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Kondratieff Waves, Warfare and World Security

Edited by
Tessaleno C. Devezas

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To Vanda
Our Love May Not Be Eternal,
But Be It Infinite While Endures.

A ubiquitous bad habit of thought is supposing that whatever is determined is inevitable… Further, it has been suggested that the universe itself is a space-time granular and that the future although completely deterministic is unpredictable, being its own fastest simulation

Daniel Dennet, 2003

To My Progeny,
João Paulo, Thiago, João Pedro,
Gabriel, Mathieu, Matheus, and Théo,
Coevals of the Next K-Wave Peak Generation,
With the Hope That the Future
Will be What it Not Used to Be.

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PROLOGUE

Long Waves and Warfare: An Enduring Controversy

In a paper published in 2001 [1] I put forth some empirical evidence, already claimed in the 1980s by Kleinknecht [2] and Vasko [3], that publishing on economic long waves (or Kondratieff waves) seems itself to move along a long wave path. Reckoning the number of publications (books and papers) on long waves since the start of the 20th century my graph suggested the existence of two clusters of publications separated by ~59 years, each following a logistic trajectory. The first cluster, presenting a ΔT (time to go from 10% to 90% of the complete growth) = 28 years, peaked in the late 1920s, coinciding with apogee and downswing of the 3rd Kondratieff wave (K-wave for short) and in my opinion it corresponded to the period of discovery and diffusion of the long wave concept, the period when the main body of Kondratieff's work was published and also the period that witnessed the uprising of publications on business cycles (not considered in my reckoning). The second cluster, presenting a $\Delta T = 25$ years, peaked in the middle 1980s, coinciding with the downswing of the 4th K-wave and, again in my opinion, it corresponded to a typical phase of proofing the existence, modeling, and theorizing on economic long waves. I concluded then that the unfolding of the second logistic signaled the ceiling of publications on long waves in the coming years, probably heading to a reasonable understanding of the phenomenon.

Now, only four years later, this conclusion seems to be incomplete. Indeed, we have observed a diminishing number of publications during the last couple of years (if compared to the huge amount of publications during the 1980s), but not the expected 'reasonable understanding'. What some chapters of this book reveal is that doubts on the very existence of K-waves increased (coming even from authors that actively published on long waves during the second cluster), or if they in fact exist (or existed), some recent developments may have perturbed their unfolding, in such a way that long waves might be but a temporary historical fact associated perhaps with the onset of the massive capitalistic means of production.

We must recognize, however, that considerable progress has been made in understanding the underlying mechanisms driving the long wave behavior of the world socioeconomic development. Despite this progress, one also recognizes that many aspects related to these underlying driving forces remain unsolved. Perhaps the most controversial of these aspects to have endured is the close relationship between K-waves and the outbreak of major wars, first suggested by Kondratieff himself.

Social scientists and politicians are well acquainted with the fact that chance events (instantaneous and unforeseeable events of human or physical nature) have been responsible not only for the outbreak of wars, but also have even changed or decided their course and outcome. Notwithstanding, since the last quarter of the 20th century the new recognition of some patterns in the study of warfare may contribute to change this perception. Two main trends in analyzing warfare are now acknowledged: the increasing recognition of the existence of some cyclical patterns of warfare involving the core of the world system, and a shift toward newly evolving patterns involving non-state actors and asymmetric warfare.

Moreover, we should add the fact that warfare analysts agree that for the coming decade the threat of a largely bi-polar, superpower-driven global war situation is practically non-existent. Instead, the near term threat for international security comes from conflicts of asymmetric nature, bringing a confusing mix of stateless actors, separatist and fringe independence movements, insurgence operations, terrorist attacks, the use of WMD (Weapons of Mass Destruction), information warfare, and other unconventional threats. There is consensus too that there are few, if any, countries that can militarily challenge the NATO countries in open combat at the present time, a scenario that, however, may change in the long term.

The prevailing view has been that warfare is a random occurrence having more or less severe or transitory effects on the economic and social system. Contemporary historians, economists, and other system scientists, who have demonstrated the existence of cyclical patterns, however, are increasingly questioning this view [4–6]. Long wave theorists have shown a clear secular pattern of recurrence of major wars with a period of 50 to 60 years [7–10], as well as a concentration of wars in the upswing phase of the K-wave. Another pattern of 25-year periodicity, probably generation-driven, also emerges from these studies [1,11]. Moreover, simple extrapolation of the secular trend points to a highly probable severe conflict by the middle of the second decade of this century (upswing of next K-wave), involving countries struggling for leadership in the Pacific Rim.

Hence, we may tentatively agree with this maturing point of view that wars are not merely the result of blind social and political forces, but patterned according to long socio-economic cycles and/or, as recently proposed [12], the result of deep and general laws underlying the coevolutionary unfolding of the world system. It is necessary to investigate the underlying causes of the observed patterns, using the modern tools of systems science and looking at social and biological human behavior at the aggregate level, in order to develop a consistent theory of warfare. Even the recently observed trend of "brush-fire" and asymmetric wars might be an adjacent new ingredient of the long wave dynamics.

The meeting that spawned this book had as scope the discussion of the above points, mainly concerned with the relationship between K-waves and warfare under the light of the new trends observed in the international political sphere. To my surprise, however, as well as to most of the participants of the NATO Advanced Workshop on Kondratieff Waves, Warfare, and World Security (held in Covilhã, Portugal, 14–18 February 2005) many of the contributions presented and the discussions developed during the meeting again stirred up the old controversy about the existence of long waves and about the possibility that K-waves might come to an end.

For this reason it was a very difficult task to sort all the 38 received contributions among the three different parts of the book. In Part I (Kondratieff Waves Revisited: New Concepts on the Interpretation of Long-Term Fluctuations in Economic Growth) the reader will find a mix of contributions dealing with new visions or revisions of the concept of long waves considered from very different perspectives related to their unfolding. A few of them also broach the subject of their relation with warfare and some also contribute with some views about future developments, but these aspects were not the main objective of the contribution. Those contributions objectively discussing the issue of K-waves and their relation with military conflicts, following old and/or new conceptualizations of the phenomenon, were selected to form Part II (Kondratieff Waves and Warfare). Finally, those contributions with strong emphasis on the analysis of future scenarios, related or not to warfare and/or world security compose the body of Part III (Looking into the Future).

However, as stressed above, the reader will observe that the authors of many of the chapters composing this book merge the three themes (revisiting K-waves, warfare, and future scenarios) in such a way that the position of their article in the respective Part may seem out of place, but I hope that this fact does not affect the main purpose of the book –

that is – *to give readers a modern overview of the still debatable long waves concept*. I think that readers will agree that this overview, the first published at the dawn of the 21st century, is very broad and rich in scope, and will contribute deep insights for further research and actions.

The 38 chapters composing this book comprise the contributions of scientists from 12 different countries (NATO countries and NATO-Partner countries). Unfortunately (mainly due to the restrictions imposed by NATO for participants from non-NATO countries in Advanced Research Workshops), we have not the participation of scientists from other cultures and continents holding many different views of the future to enrich our understanding on this ever-exciting debate. This was one of the strong points that arose during the final discussion of the workshop – we must keep in mind that the trend nowadays toward globalization and the increasing role and weight of Asian countries in the geo-political world system urges a broader expertise participation. As I pointed out in a recent paper [13], we are presently witnessing a westward trajectory toward the '*Morgenland*', and such a culturally broad discussion on long waves would undoubtedly contribute to future actions towards creating a better tomorrow.

I cannot finish this prologue without addressing some words expressing my profound gratefulness to the NATO Public Diplomacy Division – Threats and Challenges Section, represented by the Programme Director Prof. Dr. Fernando Carvalho Rodrigues, and to the University of Beira Interior, represented by the Rector, Prof. Dr. Manuel dos Santos Silva, whose strong support made it possible to bring together at least a significant elite of today's world expertise on long waves related science.

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October 2005

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Contents

PART I

Kondratieff Waves Revisited: New Concepts on the Interpretation of Long-Term Fluctuations in Economic Growth

Kondratieff Waves, Warfare and World Security
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The Kondratieff's Waves and Cyclic Dynamics of the Economy and Wars: Theory and Prospects

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Abstract. The main theses of the theory of the big cycles of conjunction (long waves of economic dynamics) are expressed at the report, their many-sided character, mutual connection with technological and social and political cycles, fluctuations of the innovations' intensity are discovered there. There is a forecast for the Kondratieff's waves at the 21st century, transition from the fifth to the sixth Kondratieff's cycle, which will promote easing of the internal and international conflicts and military collisions, international terrorism as a point form of the civilizations' clash.

Introduction

The theory of cyclic fluctuations in the economy and other spheres of the society's activity is in the center of scientific attention in Russia as well as all over the world during more than a century. Attention to this problem always amplifies during crises, especially if these crises are connected with deep transformation of the society, change of the half-century Kondratieff's and century civilization's cycles. Not only scientists but also politicians, businessmen ask themselves questions: what are the reasons for crises? Whether it is possible to avoid them or at least to foresee?

1. Nikolai Kondratieff and The School of Russian Cyclicism

Answers to these questions are given by the trend within the Russian social and economic thoughts, which I call **the school of Russian cyclicism** [1-3]. Michail Tugan-Baranovsky (1865-1919) placed the first stone in the base of this school. In 1894 at the Moscow University he defended his master's thesis on industrial crises, which then was published. The book, modified, with an exposition of the general theory of crises, was published in 1914 and republished in 1997 [4].

According to M.I.Tugan-Baranovsky, the theory of crises allows to predict crises: "The theory of crises evolved in this book explains which factors favor increasing or decreasing of an industrial cycle's duration and also the driving forces of the cycle. That is why it is not difficult, proceeding from this theory, to formulate indications of approaching industrial crisis.

Thus, the theory gets big practical value; it gives an opportunity of prediction within an extremely important economic area" [4; pp.57-58]. Confirmations of it were the author's forecasts of industrial crises at the beginning of the 20^{th} century, and also establishment in 1912 by the government of France of a standing committee for prediction of industrial crises [4; p.58].

The monograph of M.I.Tugan-Baranovsky was published abroad and was recognized by the world science. Prof. Jean Leskur (France) named the book "the most original and most significant product among economic literature of the present time" [4; p.56]. Much later E.Hansen highly estimated M.I.Tugan-Baranovsky's contribution to development of the theory of economic cycles: "He has made the way through jungle to new horizons. He has begun a new treatment of a problem » [5; p.81]. And further: "Dominate over a cycle and fluctuations of the sizes of investments operate it, thus; consumption rises and falls as a result of these fluctuations. This is the new theory which has been put forward by Tugan-Baranovsky » [5, p.90].

Nikolai D. Kondratieff (1892-1938), pupil of M.I.Tugan-Baranovsky has gone further his teacher. He grounded a new type of long-term cyclic fluctuations – **the big cycles of conjuncture** of about half-century duration – long waves of economic dynamics (Joseph Shumpeter called them the Kondratieff's cycles). Though an idea of long-term cyclic fluctuations in the economy has been proposed before Kondratieff, namely he possesses a merit of formation and statistical check of the theory of long-wave fluctuations. For the first time he has formulated basic provisions of this theory in the monograph "The World Economy and Its Conjunctures During and After the War", which the young (30-years old) scientist published in 1922 [6]; it was republished in 2002 [7] and was published for the first time in English in 2004 [8].

In this work N.D.Kondratieff marks: "Dynamics of economic conjunctures is rhythmical. The period of high conjuncture is more or less sharply replaced by the period of lower conjuncture. It is necessary to distinguish two main types of cycles of such fluctuations: big cycle, covering about fifty years, and small industrial-capitalist cycle covering usually a period of 8-11 years" [7; p.332]. These two types of cycles are interconnected: "Rises of small cycles of the coming period will lose an intensity they possess during at the raising wave of the big cycle. On the contrary, crises of the coming period are going to be sharper, while depressions of small cycles should be much longer" [7; p.339]. The deep world economic crisis of 1929-1933 and the following depression proved this prediction.

In his following published works – articles "Big cycles of conjuncture" (1925), "Concerning the big cycles of conjuncture" (1926), the report "Big cycles of economic conjuncture" (1928), big article "Dynamics of prices on industrial and agricultural goods (concerning the theory of relative dynamics and conjuncture)" (1928) – he addresses to this problem again and again, putting forward additional arguments and providing statistical proofs.

It is necessary to mention that the idea on the big cycles of conjuncture has at once caused a resonance in the country as well as abroad. Some scientists supported this idea, others challenged it. W.Mittchell, one of the prominent experts in the field of the theory of cycles, agreed with N.D.Kondratieff that "big waves", since the end of the 18^{th} century, repeated two times and a half in various economic processes, but he left a question, whether they will repeat in the future, open. He admitted that Kondratieff's research "open attracting prospects for future work" [9; p.234]. The fact that at the beginning of the 1930s the imprisoned Russian scientist is elected a member of the Econometric society – together with Schumpeter, Keynes, Leontieff and other prominent scientists of world level testifies the high estimation of the

N.D.Kondratieff's ideas. After the 1929-1933 crisis, which have convincingly confirmed the validity of the N.D.Kondratieff's doctrine, his ideas have been confirmed and developed by Joseph Schumpeter in the two-volume book "Business Cycles" [10], while after the crisis of the beginning of the 1970s – in the book of the German scientist Gerhard Mensch [11] and many other scientists.

Other bright representative of the school of Russian cyclicism is Pitirim Aleksandrovich Sorokin (1889-1968). Recognizing the Kondratieff's cycles, he goes further and investigates centuries-old cyclic fluctuations within dynamics of socio-cultural systems, including periodic change of sensual, ideational and idealistic (integrated) socio-cultural system, as well as cyclic fluctuations of forms of art, science, ethics, social and economic relations, wars and internal disorders [12].

Revival of the school of Russian cyclicism in Russia started in the middle of the 1970s. It was expressed in a number of monographs (since 1978), interdisciplinary discussions (since 1988), International Kondratieff conferences (since 1992), the Kondratieff's readings (since 1993). Each three years Russian and foreign scientists are awarded, as result of an international competition, with the N.D.Kondratieff's medals for contribution to development of social sciences. Scientific-public organizations developing ideas of N.D.Kondratieff were created: Association "Forecasts and cycles" (1990), the N.D.Kondratieff International Foundation (1992), Branch of research of cycles and forecasting of the Russian Academy of Natural Sciences (1996), Pitirim Sorokin - Nikolai Kondratieff International Institute (1999). A symbol of recognition of the importance and urgency of the Russian scientist's heritage became the international workshop "Kondratieff Waves, Warfare and World Security" held in February, 2005 in Portugal under support from NATO, with the participation of more than 40 scientists from 12 countries.

Now it is possible to reach the conclusion that the N.D.Kondratieff's ideas have considerably outstripped their time and that they are one of the corner stones of the postindustrial paradigm of social science, which will prevail in the 21st century.

2. Many-sided Character of Kondratieff's Waves

N.D.Kondratieff researched the big cycles of conjuncture as first of all a regularity of cyclic dynamics of *the economy* that is expressed in long-term fluctuations of commodity prices, rent, interest, circulation of foreign trade, coal mining, consumption of mineral fuel, manufacture of pig-iron and lead [7; pp350-360]. It deals with *trends* for it is senseless to search for unequivocally expressed regularity, precise rhythms stacked in mathematical formulas in economic and social dynamics – this dynamics is multivariate and multifactor, it is filled with considerable number of casual fluctuations. Even in the well-studied cyclic fluctuations of solar spots of indistinct rhythm, the solar cycles are subject to significant fluctuations in duration.

However the Kondratieff's waves should not be applicable only to the sphere of the economy. They practically cover all spheres of the society's life. First of all, it deals with *technological* cycles, long-term fluctuations in renewal of the fixed capital and use of inventions (innovations); using modern terminology – with the half-century rhythm in change of prevailing technological modes.

N.D.Kondratieff believed that a material basis of the big cycles of conjuncture is mass renewal of the basic capital benefits: "Material basis of the big cycles is wear process, change and expansion of the basic capital benefits demanding long time and huge expenses for their production. *Change and expansion of these benefits go not smoothly, with pushes, and the big waves of conjuncture are another expression of that...* The increasing wave of the big cycle is connected with renewal and expansion of the basic capital benefits, with radical changes and regrouping of the basic productive forces of the society" [7; pp390-391]. It demands high rates of investment and concentration of capital.

In its turn, the increasing wave bases on a wave of *innovations,* use of the saved up background of inventions: "Presence and intensity of scientific and technical discoveries and inventions are function of inquiries of the practical validity and previous development of the science and technical equipment. However the presence of scientific and technical inventions is not enough to beget the valid change of the production technology. Scientific and technical inventions can happen, but can remain void, while the necessary economic conditions for their application do not appear... The development of technical equipment is included into rhythmic development of the big cycles" [7; pp382-383]. Waves of innovations, as shown by Joseph Schumpeter and Gerhard Mensch, underlie the big cycles of conjuncture – the Kondratieff's waves.

Long-wave fluctuations occur in parallel and mutually connected in sociopolitical sphere, in dynamics of wars and revolutions, territorial expansion: "Wars as well as social upheavals are included into rhythmic process of the big cycles and appear to be not initial forces of this development, but the form of its display. But, once arisen, they, certainly, in turn, render powerful, sometimes perturbing influence on rate and direction of economic dynamics" [7; p.383].

This interference is especially visibly during the increasing wave of the big cycles: «Rough growth of new productive forces, raising activity of the classes and groups interested in it inside, creates preconditions for an aggravation of the struggle against established social and economic relations leading to internal large turnovers. That is why... really the period of long increase of conjuncture is connected with radical changes in the field of production, with a period of private wars and revolutionary upheavals" [7; pp392-393].

To confirm it N.D.Kondratieff presented historical results measuring the frequency of waves and revolutionary upheavals on different phases of the big cycle [7; pp374-376], as shown in table 1.

Table 1 – Kondratieff's table on wars and revolutionary upheavals

	Number of wars	Number of revolutionary upheavals	Total
First big cycle			
Increasing wave	11	7	18
Bearish wave	1	4	5
Second big cycle			
Increasing wave	7	11	18
Bearish wave	2	2	4
Third big cycle			
Increasing wave	11	11	22

The big cycles of conjuncture cover also a sphere of spiritual reproduction, first of all professional trainings of the qualified labor forces [7; p.390]. From that a conclusion made by N.D.Kondratieff is clear: *"Big cycles of conjuncture on which background small cycles proceed, are caused by processes of radical redistribution of the saved up and saving capitals,* *expressing externally in deep reforms of the industry, in attraction of new territories, in preparation of the new staff of skilled workers*" [7; p.211]. Therefore the Kondratieff's waves should not be considered only as one form of cyclic economic dynamics. It is one version *of the historical cycles* covering the whole structure of society.

3. The Kondratieff's Waves and Wars: Forecast for the 21st century

The process of globalization developed since the end of the 20th century and penetrating all spheres the society life, has changed the dynamics of development of the world civilization in many respects. Whether it means that the Kondratieff's waves, precisely designated rhythms of development of the economy and the whole society during the industrial epoch, will become a thing of the past together with this epoch?

There are no bases for that. The rhythm *of technological* development – change of prevailing (in the vanguard countries and in the world market) generations of technological equipment (about ten years each), technological orders (once per 40-50 years), technological mode of production (once per several centuries) will be kept. Waviness in occurrence of scientific discoveries, technical inventions, improving, basic and epochal innovations will be observed accordingly [9; Ch. 2].

Transition to the postindustrial technological and ecological ways of production will be developed during the first half of the present century. It means not only acceleration of rates of growth of productive forces after long deep crisis of two decades, but also change of their character with a stress on humanization and noospherization of technologies and ecology. Since the beginning of the century, after the world crisis of 2001-2002, the fifth technological mode and the Kondratieff's cycle, adequate to it, entered the bearish phase. Simultaneously development of the first generations of the order amplifies which, probably, will prevail in the vanguard countries in the 2020s through the 2050s, then a time for becoming of the seventh technological order will come.

The global scientific-technological revolution developed in the beginning of the 21st century will be based on achievements of the modern scientific revolution, a wave of epochal and basic innovations that will transform the image of the world. Therefore statements on "the end of a century of the science" are groundless; on the contrary, deep contradictions of the transitive epoch will generate the highest wave of discoveries and inventions, which will result in formation and prevalence of the postindustrial scientific paradigm adequate to change considerably the world.

Technological dynamics is inextricably connected with the economic one. We witness a process of becoming of the postindustrial economic mode of production which, on the one hand, will be more globalized, synchronizing rhythms of national economies, and on the other hand – will open new spaces for the enterprise and innovative initiative of small and medium business. The basic contradiction in the transitional economy is a precipice, excessively increased during the industrial epoch, between the rich and poor countries and civilizations. If in 1800 such parameter, as per capita production of the GDP, in the USA was 3 times higher than in Africa, while in 2000 is 18,8 times [10; p.267]. The per capita total internal income of the planet's rich minority (971 million persons – "golden billion") in 2003 was 59,5 times higher than that of the poor majority (2310 million persons) [11; p.259]. Rapprochement of levels of social and economic development of the different countries and civilizations is an urgent strategic task of mankind for the 21st century. This problem cannot be successfully solved on the basis of nowadays prevailing neoliberal model of globalization, which is propagandized actively by the USA and the WTO. There is other model, allowing pulling together levels of development. It is used within the framework of the European Union. It seems that the future – is behind this model.

It is to expect that the rhythm of economic cycles and crises will be kept in the 21st century. It was confirmed by the world crisis of 2001-2002. Though for two years mid-annual rates of the GDP growth have decreased insignificantly (to 1,9 %, 1,6 % in the countries with high incomes, against accordingly 3,9 and 3,5 % in 1999-2000) [11, p.16], however the direct foreign investments for two years have fallen by 53 %, and in the USA – by more than 10 times [12, p.3, p.258].

Proceeding from the theory of the big cycles of conjuncture it is possible to expect that on the bearish wave of the Kondratieff's cycle depth and duration of economic crises will grow. Their peak, quite probably, will fall in the beginning of the 2020s, and then the return tendency begins to prevail. Hence, the Kondratieff's waves in the economy will be kept, but, probably, will proceed more synchronized within scales of the globalized world economy.

What are the prospects of the long-wave fluctuations in *socio-political sphere*? Will the regularities and tendencies proved by N.D.Kondratieff be kept?

The geopolitical situation of the world has been cardinally changed. By the end of the 20th century an absurdity of calculation on a victory in a new world war became obvious, there was a tendency to disarmament. For the first time during the post-war period there was a relative reduction of military costs. According to the forecast of the UN commission of experts led by W.W.Leontieff, Nobel Prize winner, the world military charges for 1951-1970 have grown twice (3,5 % of a mid-annual growth), and by 2000 they increased 3,2 times (3,9 % mid-annual; 13; p.240). In reality however there was a return tendency prevailing during the 1990s – military charges decreased from 3,2 times up to 23 %, including in the countries with high incomes – from 3,1 times up to 2,3 % (in the USA from 4,6 times up to 3 %); in the countries with low incomes – from 2,6 times up to 2,5 %, in Russia – from 8 times up to 5,6 % [11; pp.304-306]. However after the terrorist attack of September, 11, 2001 the share of military charges in the GDP of some countries began to grow again.

In the 1980s-1990s – during the increasing stage of the V Kondratieff's cycle – the high wave of confrontations and internal revolutions was observed changing considerably the world political map. From interstate collisions it is possible to name war in Afghanistan, Iraq, invasion of Iraq into Kuwait followed by "the Desert Storm", the NATO war against Yugoslavia. However the most serious changes took place as a result of the disintegration of the USSR and Yugoslavia – military collisions in the Balkans, in Tajikistan, Karabach, Pridnestrovie, the Chechen Republic, the Georgian-Abkhazian collision, change of political systems in the USSR and East-European countries. This phase has been finished by military overthrow of talibans in Afghanistan and the Hussein regime in Iraq.

Entering of the V Kondratieff's cycle into the bearish stage should be accompanied by falling of military conflicts and internal political upheavals intensity. During the last years some reduction of the military conflicts intensity was really observed. But in a number of countries of the post Soviet territory (in Georgia, Kirghizia, Ukraine) there were rather peace coup d'etat, but with participation of "non-parliament" forces. There is no confidence that this list is closed. There is a change of generation of the political leaders who have come to authority as a result of revolutions of the beginning of the 1990s.

Would it is possible to expect a reduction of the military-political activity during the next decade, on the bearish stage of the V Kondratieff's cycle? There are bases for that. At the same time the conflicts get other form: instead of open collisions of armed forces – asymmetric wars and international terrorism became the dot form of collision between civilizations.

However further, in the 2020s-2050s, on increasing wave of the 6th Kondratieff's cycle, the situation may change. By then economic power and military-technical power of China and India, as well as the Muslim civilization will essentially be raised. The integrated efforts of the Western Europe, absorbing the East-European civilization, will bring fruits. The technological level, the external economic and geopolitical positions of Russia will essentially be weaken in connection with obsolescence of the rocket component of our armed forces and backlog in modernization of industrial potential. Struggle for the inheritance of formerly powerful Eurasian civilization will amplify. Serious problems accrue in connection with population growth of the African civilization (south of Sahara), the poorest nowadays, which by an average variant of the UN forecast by 2050 will increase in comparison with 2000 by 2,4 times – from 653,5 up to 1557,5 million persons [14; p.50]. At the same time the burden of external obligations on maintenance the world order incurred by the USA, corresponding to their concerns can essentially undermine the power of the unique superstate.

By virtue of the mentioned circumstances it is impossible to exclude that on the increasing wave of the VI Kondratieff's cycle due to significant change of the forces ratio in geopolitical and geo-economics space, danger of military collisions will again increase. Anyway, such opportunity needs to be taken into account, developing super-long-term global forecasts.

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Toward New Conceptual Models of the Kondratiev Phenomenon

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Abstract. Accepted features of the Kondratiev Cycle/Structure (KCS) or Kondratiev Phenomenon are summarized. Saturation and exhaustion characterizing the end of the stage of depression of the fourth Kondratiev are briefly discussed. Features that may delimit the emergence of a fifth Kondratiev are discussed. Assumptions and requirements for new conceptual models are presented. Multidimensionality in time and space in building these models is emphasized. Several relevant models in the physical, biological, and social sciences are reviewed. A new model is developed, and sources of possibly substantiating data are identified. Because historically the likelihood of insurrections and wars has increased as nations recover from depression into recovery and prosperity, features imminent to war are discussed. A number of policy recommendations relevant to improving societal and environmental conditions and avoiding war are made.

Introduction

The main purpose of this paper is to generate new ideas that can be tested in more fully developed models. Scientific theories and models themselves experience life histories characterized by innovation, maturity, old age, and replacement or incorporation into edifices of greater scope. Theories and models of the Kondratiev/Kondratieff Cycle or economic long wave, which I have renamed the Kondratiev Cycle/Structure (KCS) to emphasize the structural basis of cyclicity, cannot be excepted from these dynamics of change. In the title of this paper, to suggest even broader flexibility, l again refer to the KCS as the Kondratiev Phenomenon.

1. Summary of Accepted Features of the Kondratiev Phenomenon

Mainstream economists do not accept the KCS; and, indeed, they may reject it with considerable hostility because it can pose a threat to policymaking, both in the so-called free world and in the remaining Communist world. Resurrecting discussion of these differences is mostly beyond the scope of this article, but certain studies that are directed at, say, the "Schumpeterian long wave" may warrant a further look. For example, one study [1] analyzed temporal clusters of basic innovations and concluded that authors who have argued that the long wave is <u>driven</u> (my emphasis) by such clusters have stretched the statistical evidence too far. However, statistical analysis may be inappropriate in a mutually causal force field.

A number of features of the KCS, which can be fitted into broader theory, have been identified. It is not the purpose of this paper to re-review this literature. See [2], [3] for discussion and citations to the original sources. Relevant features of the KCS follow:

- There have been four KCS starting about 1785, and we are at or near the end of KCS4.

- The KCS are not simple periodicities; they differ in length.
- The KCS differ as to dominant technologies and industries.
- The KCS differ as to dominant forms of energy.
- Successive KCS show the emergence of newly prominent nations.
- The KCS can be characterized by four qualitatively and quantitatively distinguishable stages: recovery, prosperity, recession, and depression.
- The KCS must be fitted into a larger framework of shorter cycles (e.g.,, the traditional business cycle) and longer cycles and histories (e.g., the hegemonic cycle and the life history of our civilization)
- The four stages of the KCS can be depicted by logistic functions with diminishing returns.
- The stages of the KCS differ macropsychologically, with the stages of recovery and prosperity being more exciting (open to new ideas and practices) and more dangerous (greater tendency to wars, rebellions, etc.); the stages of recession and depression show increasing conservatism in thought and behavior.
- The interfaces between successive KCS show mounting instability and chaotic behavior.

Not so evident from the KCS literature is recognition of the growing complexity of successive KCSs. This complexity obtains especially at the present time because of globalization, the emergence of the United States as the sole hegemon, and the increasing evidence of environmental insult and limitation. U.S. hegemony has led to an increased number of international military and economic organizations, a matter of special interest in this paper. Previous indicators of KCS may have lost their diagnostic value because, among other reasons, data are distorted or masked by the authorities and even by some scholars.

Indeed, we are witnessing what a symmetry break. Several new sub-structures or sub-KCSs, emerge as the older homogeneity breaks down. Some recognition of such changing structure is evidenced in the economic literature by terms like "stagflation" and "jobless recovery." However, the underlying macropsychology or order parameter maintains its transcendent processes of evolution and restructuring.

2. Macropsychological Exhaustion at the End of the Depression Stage of the Fourth Kondratiev

The stage of depression of a KCS is a time of saturation of both ideas and of goods and services. It is a time of reconfirming the status quo. It is a time of cloning. Novelty and chance are discouraged as dangerous. In short, it is a time of exhaustion. Its theme is a weary don't rock the boat! Let us discuss a few examples, keeping our focus on the main secular trends rather than on fluctuations that may suggest reversals or recoveries.

Financialization can cause dangerous and irreversible structural change in the world economy [4], [5]. An examination of economic history reveals a cyclic recurrence of bad economic developments. Recurrent structural decline can be seen within and among the histories of nations like Great Britain, The Netherlands, and the United States. In the stages of recession and depression of this fourth or latest Kondratiev, financialization accelerated during the 1980s and 1990s. Financialization preeminently involves the finance, insurance, and real estate sectors. The acquisition, massaging, and retention of money (and the power derived from money) dominate the world economy today, just as agriculture, manufacturing, and invention once did. Variety, diversity, and net information, indispensable for future beneficial change and growth, have decreased under the onslaught of wave after wave of acquisitions and mergers. Organizational corruption and the concentration of wealth and power in the hands of the very few are now an expected part of each day's news. Among other things, the touted "greatest economic expansion ever" of the 1990s is a myth, promulgated (perhaps as much out of ignorance and stupidity as out of malice) by a consortium involving business and industry, our political masters, and the media. The Dow Jones rose from 775 in summer, 1982 to 11,700 in early 2000, while the NASDAQ rose from 120 to over 5000 in the same period. Bloat, engendered by creative accounting and even more deliberate and illegal fraud, and abetted by computerization, masqueraded as growth. By late June 2002 the respective values hovered around 9100 and 1300, with subsequent oscillations around these figures and much greater losses to come if price/earnings ratios decline, debt structure collapses further, and the nation launches further foreign wars.

In the past several years, General Electric lost $281 billion in market capitalization, down from its peak value; Microsoft lost $348 billion; and Cisco Systems lost $486 billion. The Standard & Poor's top 500 companies lost over $4.6 trillion since March 2000. The blue-chip Standard & Poor's dropped 26%. Manufacturing has been hit particularly hard, with employment at its lowest level since 1950. In an oversaturated market, demand worldwide for manufactured products has declined. Decline has been particularly rapid in the past four years, but this is a manifestation of long-term influences [6]. Nor is it only manufacturing employment that has suffered. Consider the countless hundreds of thousands of clerks and telephone operators, whose jobs were eliminated by voice mail and reference to the Internet. Few of these workers have been retrained for better jobs. Clearly, the U.S. (and world economies) have suffered the structural change, characterized by overexpansion, saturation, technological obsolescence, and poverty of new ideas, that defines the stage of depression of the KCS. Of course, this structural change cannot be reversed by the simple linear policies of mainstream economists.

Collapse of the world economy and world society can stem from the fact that few if any countries today can claim healthy economies. Growth is sluggish or negative, and unemployment is increasing [7]. The underdeveloped world can be largely written off, with many countries impoverished, in societal collapse, and with starving populations. Even once promising nations like Argentina, Venezuela, and Brazil are in serious trouble. Japan and the East Asian 'tigers' have not recovered from the declines of the 1990s. Here ere are some figures for the decline of stock values in Europe in 2002: Sweden 46%, Germany 44%, France 39%, and Spain and Italy 35%. There were also declines in 2001. Significantly, the worst declines have been in technology--What ever happened to the Information Age! As usual, mainstream economists have few insights, with a typical recommendation being to cut social programs (what would this do to unemployment?)

Economic growth during President Bill Clinton's terms was dependent on grossly inflated stock prices, and of course, this was unsustainable and the bubble burst [8]. During this era, most income was spent, minuscule amounts were saved, and individuals, businesses and corporations, and governments went heavily into debt. Corporate borrowing led to the accumulation of excess capacity in plant and equipment. Excess capacity and related cost cutting, downsizing, and outsourcing have led to the elimination of millions of American jobs, jobs that are unlikely to be replaced. Stocks are still overpriced as expressed by earnings/stock price ratios. It is likely that the economy will continue to sputter along until we enter an even more vulnerable period. It is unlikely that anything the George Bush administration can do to ameliorate this situation. Tax cuts for the rich and the Federal Reserve's fiddling around with interest rates are exacerbating the situation.

Looking at some finer detail [47], there is a glut in goods and services worldwide--in everything from coffee to commercial airliners and airlines to computers to convenience stores to fast-food restaurants to telecommunications. Perhaps most ominously this glut is affecting those industries widely touted as leading us into a Brave New Future. We recognize here the vicissitudes of information systems, but concern is with gene firms. In spite of billions of dollars invested in biotechnology firms through 2001, the stocks of leading companies plunged some 90% between August 2000 and August 2002. Apparently, these businesses hope to salvage themselves by proceeding directly to drug production--as if the world needs more of something priced beyond the means of the world's needy!

Increased productivity from new technology, fewer employees, and longer hours exacts a price in worker stress and probable decreased morale in the longer term [9]. Kondratiev cyclicity in societal systems is here again strikingly evident. After improvements in worker quality of life in the 1970s, we are returning to an even more egregious Taylorism ("scientific management" like time-and-motion study and top-down decisionmaking.) Employees are forced to work long hours including overtime without proper compensation. They are demeaned with provisions of fancy titles that sound like management titles, thus making them exempt from overtime pay, while corporations are lobbying to overturn overtime laws. They are demeaned with puerile "motivational" tools like play money and balloons, provided for good behavior like meeting imposed quotas of sales. Computers monitor performance. The factory mentality has permeated the service industries. Productivity gains (output per person-hour) of 4.9% in 2002 and 4.2% in 2003, the largest back-to-back gains in 50 years, have been translated into large corporate profits and bloated stock values. But costs to companies include mounting employee resentment to a prison-like atmosphere (e.g., special permission needed to leave the office and forced "lunch-ins") and increased numbers of lawsuits.

Because of globalization and the Walmartization (paying low wages in non-union shops) of America, jobs continue to be lost, the working person continues to lose wealth and power, and unions continue to deteriorate [10]. In spite of the "prosperity" of the 1990s, real wages declined about 25%, and households could maintain themselves only because more and more women entered the workforce. Because of NAFTA and other versions of "free trade," the U.S. has lost nearly ten million factory jobs since 1973. Myriad service jobs have also been lost. Typically, corporations try to cut both wages and benefits, putting people into grim and precarious situations. Labor is not always the sole loser, however, as attested to by the fall 2003-winter 2004 supermarket strike in Southern and Central California. Among other things, the grocery stores lost at least hundreds of millions of dollars, and customer and market share loss is probably partially irreversible. The negotiated settlement appears to be lose-lose. Unless labor and the unions overcome their complacency and become more militant, the plight of industrial, service, and professional workers is likely to worsen.

All systems age, and no system can be stabilized forever. In the fourth KCS, a number of international economic and military organizations were established. Examples include the World Bank, the International Monetary Fund (IMF), the North American Free Trade Agreement (NAFTA), the United Nations, the European Union, the North Atlantic Treaty Organization (NATO), and the Warsaw Pact (now defunct). All have been criticized, and all show evidence of loss of fit to the present emerging era.

3. Emergent Features Delimiting a Fifth Kondratiev

Three major factors can limit the emergence of a fifth KCS. Most important are humankind's impacts on the natural environment. These are myriad and interrelated and include global warming, irreversible destruction of natural resources, degradation of ecosystems, and new and resurgent diseases. Stress the socioeconomic system can trigger massive reconfigurational change and an entirely new set of dynamics. The second major factor is the continued elimination of jobs in the technologically advanced countries, and the inability to create relevant new jobs. Now, job structure is hemorrhaging in the so-called developed countries because of automation, downsizing, and outsourcing. Myriad "good" jobs in industry, the services, and the professions are lost to countries in southern and East Asia and Latin American. When transferred and newly created jobs are compared with population growth there, the picture that emerges is dire indeed, and of course, this will have a direct bearing on the likelihood of war discussed below.

A third major factor is the lack of resilience and adaptability of large organizations. Louçã [11] looked at pendula as bases for business cycles, and Louçã and Mendonça [12] looked at corporate evolution, turbulence, technological competence, and structural change "in the context of the neo-Schumpeterian long-wave hypotheses." Their analysis showed that the giants, among the 200 largest U.S. manufacturing firms, of the early 20th Century were not the same as the giants at the end of that century. Turbulence (chaos?) occurred in pulses that affected specific industries, and turbulence has increased over time. Information and communications technologies played a role in the emergence of the most recent large industries. New firms are less likely to arise in industries that occupy crowded regions of the market, however [13]. Organizational policies, moreover, that attempt to maximize efficiency and business competition may lead to industries' becoming highly vulnerable to exogenous forces of change [14]. Decline and possible resurgence in mature industries seems especially to be related to the inertia of the population of organizations [15].

4. Assumptions and Basic Requirements for New Models

My own contributions to the theory of the KCS, within systems theory, are these:

1. Emphasizing that structure underlies function, and coining the term Kondratiev Cycle/Structure.
2. Expanding the concept of macropsychology and relating this, within field theory, to the concept of order parameter [2], [16], [17].
3. Further use of systems constructs or basic systems-theoretic building blocks in explanation. I have collected and summarized these constructs elsewhere [3].

Extending these ideas, the KCS can be considered an evolving, four-dimensional, macropsychological, spatiotemporal order-parameter structure. The KCS can fit into a framework of alternating expansion and contraction that appears to be characteristic of all complex systems. Consider these examples. Our present expanding universe following the Big Bang was presumably preceded by a big contraction, in turn preceded by an earlier big bang. Late in the Paleozoic, the continents came together to form the supercontinent, Pangaea. By the mid-Mesozoic, Pangaea had broken up into Gondwana and Laurasia, which in turn broke up into our present seven continents. Geologists believe that in pre-Cambrian time there was an earlier supercontinent called Rodenia. At various times in Earth's history, glacial states have alternated with interglacial states. Concentrations of atmospheric gases like CO_2 have risen and fallen. In biology, plant and animal populations, because of climatic and other stressors, may expand, contract, and expand again. Plant and animal physiology shows the waxing and waning of hormone and other biochemical levels. Implicit in our modeling attempt is the need to show a continuous evolution between alternating system states, rather than treating them as different steady states, and the identification of factors that amplify the variability between the two states.

There are limits to predictability in the use of models. It is unlikely that any model of a complex system can produce anything approaching absolute predictability. Predictability can be limited by deterministic chaos and by our inability to pinpoint critical bifurcation points, beyond which the system may flip into an alternative structure. This situation is quite evident in weather and climate models [18] and is especially true of ecological and societal systems. In the case of any of the historical sciences, modelers must not assume that, after running a historical sequence backwards to a given point, running it forwards will reproduce any structure observed at present. There are just too many fluctuations, random events, and bifurcation points in any evolutionary sequence. Thus, it is often noted that humanity's evolution was not inevitable; and it has been observed that economic time series represent only one of a great number of behaviors that could have occurred if random effects had been different [19]. Models can and must, however, provide an early-warning capability that tells us--and policymakers and decisionmakers--not to push the boundaries of stability. This lesson is especially applicable to conservative thinkers who appear to demand absolute proof as to the dangers of climate warming, species extinction, political instability, and war, and other dire consequences of our actions. Policymaking and decisionmaking must be satisfied with only probabilistic forecasts. Simplistic rational approaches like risk analysis and benefit/cost analysis, relics of post-World War II military systems analysis that have been resurrected by conservative thinkers, must be eschewed. Because of the many limitations just considered, forecasts like those discussed in [20] should be viewed as fairy tales.

5. Multidimensional Models in the Physical, Biological, and Social Sciences

For over 50 years, systems theorists have stressed a commonality of principles applicable to the three classes of sciences. The literatures in general systems theory, living systems theory, cybernetic theory, system dynamics, catastrophe theory, dissipative-structure theory, and synergetics are illustrative of this research. Catastrophe theory (e.g., [21, [22]) and dissipative-structure theory (e.g., [23]) have been formalized in multidimensional models applicable to living systems. Many of these approaches, however, have not lived up to their early promise and may now be well past their heyday. Most disappointing is their failure to have much impact on education and policymaking. Among other reasons, so-called interdisciplinary programs have been only multidisciplinary because participants have remained rooted in their disciplines and have been unable, and often unwilling, to communicate with one another. Putting physicists and economists together in an institute, for example, has yielded little of value (but see [24] for some interesting applications of self-organized complexity to physical, biological, and social science). It seems preferable that the individual researcher(s) have some knowledge of all the relevant fields; they must be polymaths. In this section, emphasis is placed on the evolutionary sciences that deal with large-scale phenomena that can occur naturally in Nature and society.

A distinction can be made between learning from a given modeling theory and methodology and actually using that approach. For example, we are trying to develop four-dimensional landscape or box kinds of models. We are interested in the interactions of basic system elements that generate the emergence of something qualitatively different. Atoms and molecules interact to generate a multidimensional potential energy surface or landscape. The geometry of the surface that depicts hills, valleys, basins, and passes changes with parameters in the potential function. Local minima of the function can be expressed as basins and transition states as passes [22]. In borrowing these ideas from catastrophe theory, however, we need not assume a potential function, and the atoms and molecules can be people, plants, animals, ideas, technologies, economic transactions, etc.

Two further qualifications are made here. First, we make no attempt at exhaustive searches of the literature. A review of climate models, for example, might require volumes. Rather, we are searching for constructs that may aid our own model building. Second, we are dealing with interactions, not only among elements of the system but also between these elements and the encompassing structure. Thus, the model box, for example, is not a passive "cage" but is an active field in the sense of field theory. We can consider, therefore, that a "force" is generated by these dynamics.

5.1 Phase Transitions in Particle Physics and Beyond

The most familiar physical examples of phase transitions are the solid-liquid-vapor transition and the magnetization of iron, but similar interpretations have been applied to social and biological phenomena [25]. Lattice models, based on very simple states in the individual cells, can depict the emergence of increasing order (order parameter to other authors). A model of percolation of fluid through a porous medium has applications to the spread of infectious disease and to the spread of racial prejudice. Links between the cells of the lattice can be viewed as either open or closed. The choice is random, with the probability p that the passage will be open. As p increases, the areas or volumes of "order" grow; and beyond some critical threshold, analogous to the Curie temperature in the magnetization of iron, a single huge cluster encompasses most of the lattice.

5.2 Cosmology

Consider the origin and evolution of large-scale structure in the universe [26]. As is characteristic of most systems, minuscule fluctuations (or perturbations), self-amplified and amplified by external forces, played a major role in evolution. In the case of the "cosmic web," the driving force on initially small density fluctuations was that of gravity. Simple basic phenomena over time yielded complex structures like galaxies and stars. Using computer numerical simulations melded with observations provides successive three-dimensional frames, in which the dimensions are spatial and expressed as light-years. Successive frames represent different times and greater dimensional distances as the universe expands. As the universe evolved, it moved from essentially no structure to a gauzy structure to the clumpy structure of today. New structures in turn began to influence one another and the intergalactic medium, and new forms of feedback arose.

5.3 Climatology

Models of climate are by no means faultless; but, considering the amount of effort put into developing them, they can be of considerable value in extrapolating ideas to ecosystems and societal systems. Global climate results from myriad and complex interactions among the atmosphere, hydrosphere, ice cover, lithosphere, and biosphere, driven by solar radiation. Numerous positive feedbacks are present. Climate change occurs in cycles, with periods ranging from a few years to hundreds of millions of years, and climate can change dramatically and precipitously because of natural forces and human perturbations. Although prototypically chaotic, climate systems show certain substructures that are less dependent on initial conditions and hence generate more predictable behavior [27]. New and improved spatiotemporal models have recently been developed ([28], [29], [30]).

Of special concern, theoretically and practically, are the dynamics of the abruptness of climate change, whereby by passing some critical threshold the system can flip into a different structure within a few years. The new configuration, rather than the original perturbing force, then governs further changes. Bistable systems may show a hysteresis effect (cf. catastrophe theory). Models divide the atmosphere (or hydrosphere, etc.) into cells or boxes [28]. The local dynamics of occurrences within one cell are calculated for a given time frame. Then various flows are communicated to neighboring cells, and the process is repeated for all the cells over an arbitrarily selected long period. Model precision can be improved by making the cells and original time frames smaller, but the required computer power may not be available. In addition, whereas the behavior of the small region for a short time may be straightforward, the behavior of the complex system as a whole will probably be chaotic. Ecosystems and human societies may be incapable of adapting to realworld changes, and providing early warning may be quite difficult [28].

5.4 Ecology

Interactions among individuals and individual species, and interactions between organisms and their external environments, operate in a multidimensional space wherein biodiversity arises and is maintained [31].

5.5 Bacteriology

In systems science, a mutation may be a genetic mutation, an innovative idea, or a new technology. One study [32], [33] discusses the adaptive opportunities and limits resulting from mutations in the genotype of the bacterium *Pseudomonas fluorescens.* A three-dimensional landscape model is used to depict niche generalists and specialists. Fitness in one kind of environment decreases fitness in alternative environments. Increased fitness in a given environment decreases the ability to diversify into other environments. Specialists are best adapted to constant conditions, and generalists are better fitted to varying conditions. Tradeoffs are necessary. In the landscape model, peaks represent optimal genotypes for each ecological niche. Different mutations bring individuals in a population near different peaks, thus allowing for greater diversity. As individuals begin to climb a given peak, however, only beneficial mutations allow it to continue the climb, and other mutations are eliminated through selection. Once individuals are atop a peak, only stabilizing conditions obtain, and any mutations are deleterious and are eliminated.

6. Characteristics of the New Model and Possibly Substantiating Data

The required dynamic, evolutionary, multidimensional structure of the model can be captured by depicting time in successive frames and the other axes by (1) human cognition ranging from convergent thinking to divergent thinking; (2) the socioeconomic capability to adapt, accept, and benefit from innovation and change; and (3) the tendency to generate environmental externalities. Modeling would have to start with the present stage of depression that is ending the fourth KCS. Initial structure would be dense or clumpy with much specialization and low capability to diversify. Apparently, we are in the puzzle-solving stage of a Scientific Revolution--for example, the double-helix interpretation of DNA structure, plate tectonics, big-bang theory, string theory, and space exploration and travel are decades old. Improvements take place within already defined frameworks. Our challenge will be to determine ways to break out of such constraints. The model should depict evolution to a more gauzy, more generalist structure. The model should also be able to depict abrupt reconfiguration. Lattice modeling could provide fine-grained structure.

Unfortunately, substantiating data may not be readily available. Two reasons can be mentioned. First, as indicated above, data provide a basis for power to the organizations that collect the data, and the data may be selectively collected, filtered, suppressed, presented, and otherwise corrupted. A perusal of *Science* shows an alarming increase in the number of cases of data fabrication and other scientific dishonesty and forced retraction of published results; and cheating seems a way of life in our schools and universities as pressures to compete and succeed increase. In less extreme situations, many data may "validate" the dominant economic paradigm, but data critical to this paradigm may be available only indirectly. Consider, for example, the validity of data on employment and unemployment. The U.S. Bureau of Labor Statistics (BLB) collects data such that "jobs" include full-time, part-time, multiple, rewarding and dead-end employment. On the other hand, people who have been out of work for a number of months and have given up looking for work are not counted among the unemployed! Further, BLB data themselves, collected from different sources, like corporations and households, may present major contradictions [34]. Data from other countries are equally suspect. For example, because of widespread corruption, fisheries, forestry, and mining data from the Russian Far East are essentially meaningless [35]. Of the data that are available, we can perhaps place the most confidence in those that characterize the environmental-perturbation dimension (e.g., those on climate change). Second, although various economic, social, and environmental indicators have been collected in recent decades, emergent systems-level data are largely lacking [36]. For example, are the untoward effects of the NAFTA [37] to be classified as social (destruction of local farms and economies in Mexico and increased migration to the United States), economic (effects of U.S. subsidies to agriculture and falling prices of corn in Mexico), or environmental (noncompetitive and desperate Mexican farmers forced onto marginal and wild lands, increased pollution from high-intensity crops, and loss of genetic diversity as only highly selected strains of corn are grown), when it is the complex interactions among all these factors that we must probe?

Consider further the dimension of human cognition. Convergent thinking means that a person, organization, or society homes in on the correct answer or explanation. The status quo is confirmed and reconfirmed. Novelty is discouraged and even suppressed. History provides myriad tragic examples of this situation. Divergent thinking means that the living entity seeks varied answers or explanations. This entity can live with ambiguity, and it may actively seek novelty. What sorts of data might substantiate evolution along this axis? Possibilities are numbers of new programs started in schools, books published on new topics, and patents made. But using such proxy data has not been particularly enlightening, and a great deal of subjectivity is required. Consider here this example. As critics have pointed out, in evaluating basic innovations, does the transistor fit this category but not the zipper?

N. D. Kondratiev himself, and most of his successors, have relied on time-series data; but for the reasons just discussed as well as statistical difficulties associated with analyzing these data, time-series data may play a minor role in the present effort.

7. The Kondratiev Phenomenon In War and Peace

Chestnut [38] pioneered work on applying the methods of systems engineering, used in the development of weapons systems, to the improvement of international stability and the furtherance of peace. Chestnut called his approach Supplemental Ways For Increasing International Stability (SWIIS). Chestnut himself worked with communications and control theory and methods, but participants from many countries used other approaches within the framework of SWIIS.

Instability, for both better and worse, seems immanent in the KCS from the terminal part of the stage of depression to the middle of the stage of prosperity. Now, as humankind's impact on Earth penetrates all aspects of Nature, "international stability" assumes an even more global and ominous meaning. Throughout history, wars have been fought over land, water, minerals, and so forth. Preventing imminent major wars may be beyond human capability without radical and revolutionary new thinking.

It seems unlikely that the technologically advanced nations will go to war against one another in the near future. Patterns leading to such major war must be seen in the absence of the clutter or noise caused by continuing guerrilla wars, wars for ethnic liberation, and the so-called war on terrorism. However, intervention by the technologically advanced countries in these smaller wars may lead to the passing of some critical threshold and explosion into World War III. The United States is presently the major intervening nation, but it seems likely that Russia, China, India, and perhaps Brazil will also play such roles in the near future as their internal situations improve. All nations must realize that war cannot be won, only prevented. Note the analogy with virus diseases that can be prevented through inoculation but not cured. Unfortunately, there are aspects of humanity that suggest that humanity is not a learning system [3], [39].[40], [41], [42], and we can ask why the United States insists on pursuing military actions on six continents, actions that accrue to a worsening of social and environmental conditions and perhaps the foundering of democracy itself [41, [43]. The U.S. is the world's most powerful country--indeed, the most powerful in history. She faces no major military threats. Increasing militarization of American society during the Cold War generated a momentum that should have been reigned in but was not. Instead, as fits Kondratiev theory, the macropsychological order parameter of national thought became increasingly conservative, and power-driven, even fanatical, leaders harnessed the momentum. As Lord Acton's warned: Power corrupts and absolute power corrupts absolutely. Part of these dynamics of course stems from the limitations immanent in all bureaucracies. Bureaucrats will not use information that challenges the way they are used to doing business. Organizations try to solve "known problems "while ignoring problems they do not understand [44].

What should be the policy of NATO, and of the American policy that largely drives NATO policy? Beware pushing too close to the boundary of stability. Building and manning the huge number of bases in parts of the foundered USSR and in the Near, Middle, and Far East are deliberately designed to rub the faces of the Russians, Muslims, and Chinese in the manure pile. The result is likely to be dire indeed as America's overwhelming contribution to military spending, to the use of natural resources, and to environmental degradation intensifies both national and international instability. Beware of linear, unicausal thinking and of policies that perturb the system so that its behavior passes a critical threshold and triggers a structural change that develops its own internal, unpredictable dynamics! U.S./"Coalition" policy in Iraq seems to show this deficiency. In realtime, not just because of retrospective analysis, this appears to be indeed what is happening [41, [42]. Present U.S. actions strongly resemble those of Imperial Britain in 1920, and "the lessors of empire are having to be learned all over again" [41]. Ignoring history, the U.S. intends to stay in Iraq indefinitely [42]. It is likely that irreversible structural change has already been induced, narrowing immensely our possible policy options. Observers contend that, among other untoward consequences, poorly thought-out, blundering policy has accelerated civil war in Iraq and created "killing fields" that many extend from Afghanistan to Palestine [45] and has led to a contesting of Western values more vigorous than any of the past 500 years [46]. The latter point is consistent with the idea of the termination of our stage of world civilization.

8. Summary and Conclusions and Recommendations

The conceptualization of the KCS as an evolving macropsychological order parameter has been advanced further. Alternating expansion and contraction is seen as a basic aspect of the dynamics of physical, biological, and social systems. A number of multidimensional models in several sciences have been reviewed and new constructs derived or developed further. Steps toward the design of a new model of the KCS have been taken and possible sources of substantiating data identified.

Two categories of recommendations are provided. First, and most straightforward, other authors should try to add to the model skeleton presented herein. Mathematical, computer, and data-gathering support will be needed. Second, conceptually less formidable, but psychologically and policy-wise much more difficult, NATO must redefine its *raison d' être* and its fundamental mission. Radical and revolutionary new and deeper thinking will be required. NATO policymakers must not expect lip-service endorsements from the present authors. Obfuscation, Orwellian double-speak, and the actual degradation of freedom and democracy of the kinds now widely prevalent [41], [42], [43] must be eliminated. The possibility of abolishing NATO, as a bureaucratic remnant of Cold War countering the Warsaw Pact, must be considered. Alternative replacement organization designs must be identified.

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Recurrent Instabilities in K-Wave Macrohistory

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Abstract. Over the last two centuries in the US, macroeconomic rhythms and political processes have been closely cointegrated. Each K-wave has been composed of three Kuznets cycles, each Kuznets cycle has been marked by a particular type of growth, and each transition between Kuznets cycles has been marked by both political and economic instability. One type of instability coincides with K-troughs and a second type with K-peaks, and these in turn with warfare. Exactly on time, we are currently in a K-trough, with all of its economic and political instabilities, and are engaged in a new trough war, the War on Terror.

1. Present State of Knowledge

I recently completed a twenty-year program of analysis of the long-wave phenomenon, based primarily upon U.S. evidence.[1] What has resulted is a set of conclusions concerning K-wave dynamics and their embedded periodic instabilities that I will review in highly capsulated form because I am sure that participants in this conference will be familiar with them. I will then speculate about the quarter-century to come.

Of particular importance to the conference theme are the following:

- Long wave signals are embedded in a very noisy macroeconomic history. Slightly more than one third of the variance of the U.S. inflation rate for the last 200 years is attributable to four rhythms, the 9-10 year Juglar business cycle, the 18-19 year Kuznets building cycle, the 27-28 year cycle of alternating generations, and the 55-56 year Kondratiev innovation wave. Somewhat less than one third of the variance of the rate of growth of real per capita GDP is attributable to the Juglar and Kuznets cycles and to higher-frequency periodicities.[2]
- Although the share of variance attributable to the 55-56 year K-wave is relatively small, the four rhythms are mode-locked and inflation and economic growth are cointegrated via the Kuznets cycle, so that the macroeconomic rhythms therefore are mutually reinforcing.
- Low signal-to-noise ratios are frequently markers of chaotic systems in which distinct phase states are separated by episodic instabilities, as nonlinear processes approach threshold levels and increased volatility prompts phase shifts.[3] Such is the case with long-wave macrohistory, where each Kuznets cycle displays a particular type of growth and domestic politics, and manifestations of the instabilities separating them have included critical elections, domestic conflict, and war.

- It is possible that the regularity of the rhythms over centuries of time has been maintained because there is an exogenous 18.6-year pacemaker that the serves to synchronize the economic downturns that separate Kuznets cycles: the stagflation crises that lead to K-peaks; the primary troughs that terminate flurries of innovation; and the deflationary/disinflationary depressions that mark K-troughs.
- Between periodic instabilities there are distinctive economic/political phases, each spanning one Kuznets building cycle and its two constituent Juglars:
  - The eras of deflationary growth that follow a K-peak are marked by clusters of innovation and by supportive conservative governance.
  - The eras of secondary recovery that follow primary troughs are periods when liberal leaders shift focus from economic transformation to social reform to address the inequalities that arose during the period of economic transformation.
  - The eras of reflationary growth that follow deflationary depressions (K-troughs) are time spans in which progressive leaders push a combination of economic transformations and social reforms towards market saturation, followed by stagflationary overreach and the inflationary spiral that precedes a shift back to conservative governance and to the next innovatory transformation.

2. K-Wave Phasing in U.S. Macrohistory

Table 1 summarizes this economic/political macrohistory of the U.S. There are three Kuznets cycles embedded in each long wave. Each spans two business cycles and is associated with a distinctive phase of growth. The first, the deflationary growth Kuznets, begins with a cluster of innovations that restructures the economy under the guidance of conservative administrations, in an era marked by rapid deflation from a K-peak. There is also rising inequality as some, but not all, benefit from the new economy. This first surge of innovation-driven growth slows in a primary trough, and at this time liberals who seek to restructure the polity to redress the problem of inequality oust the conservatives. The liberals dominate political life during the second Kuznets, when the innovations introduced in the preceding two decades become routinized and widely diffused, shoring up employment even while competition drives prices down towards the deflationary depression of a K-trough. The highly polarized politics that characterize such K-troughs ultimately lead to the election of progressives who seek a middle ground by combining the economic policies of the first Kuznets and the social policies of the second into an expansionary growth agenda embedded within a redefinition of the role of the nation. Ultimately, however, saturated markets, anticompetitive behavior and profligate spending contribute to rising inflation, culminating in a stagflation crisis during which key industries and infrastructures reach limits to growth and investors turn to more speculative instruments, propelling a disastrous inflationary spiral. Conditions are set for yet another critical election in which conservatives are elected and, as the inflationary bubble bursts and the cost of money falls, venture capitalists seek out the next cluster of innovations that will drive another K-wave.

Table 1 - K-Wave Phasing of US Macrohistory

DEFLATIONARY GROWTH KUZNETS **Technological revolution. Economy is restructured.**	PRIMARY TROUGH Liberals elected.	**SECONDARY RECOVERY KUZNETS** **Polity is restructured.**	LONG-WAVE TROUGH Competitive party politics. Third party challenges.	**REFLATIONARY GROWTH KUZNETS** **Progressives complete economic and social restructuring.** **Role of nation redefined.**	STAGFLATION CRISIS → Technology stalemate. Saturation and overshoot. Third party challenges.	LONG-WAVE PEAK Inflationary spipral. Conservatives elected.
POST-INDEPENDENCE ENTHUSIASM Market integration in northern states.		WASHINGTON PRESIDENCY Bill of Rights	**1793-99** **Turbulence of Adams presidency.** **Naval warfare**	JEFFERSONIAN VISION Territorial expansion. Louisiana purchase.	**1812-16** **War of 1812**	**1815-16**
THE ERA OF GOOD FEELINGS Canal Era Wind & water power Monroe presidency Urban/rural inequality grows.	**1825-28**	JACKSONIAN DEMOCRACY Rise of Mass Political Parties and the Second Party System: Distributive State evolves. Spoils system.	**1836-48** **Mexican War**	CONTINENTAL EXPANSION Manifest Destiny. Slavery debate.	**1857-66** **Civil War**	**1865-66**
THE GILDED YEARS Railroad Era Coal & steam power Grant presidency Regional inequality grows.	**1873-78**	EARLY REFORM Third Party System: Regulatory initiatives at state and national levels.	**1884-96** **Spanish-American War**	IMPERIAL EXTENSION White Man's Burden. Regulatory State evolves. Trade union and suffrage movements.	**1907-20** **World War I**	**1919-20**
THE ROARING TWENTIES Highway & Airway Era Oil power Harding/Coolidge presidencies Metropolitan/nonmetropolitan inequality grows.	**1929-32**	ROOSEVELT'S NEW DEAL Fourth Party System: Redistributive State born. Keynesian macroeconomic policies. Bureaucratic management and control.	**1940-52** **World War II** **Korean War**	GLOBAL REACH Free World Leadership. Great Society programs. Civil rights movement.	**1973-81** **Cold War**	**1980-81**
THE REAGAN YEARS Telecommunications Era Knowledge power Reagan presidency Skilled/unskilled inequality grows.	**1987-91**	CLINTON PRESIDENCY Resurgence of Congressional power. Reform of welfare state. Debate on equal opportunity and affirmative action.				

3. Instability and Conflict

The instabilities that precipitate the phase shifts from one Kuznets cycle to the next also are of distinctively different types, associated with K-peaks, primary troughs and K-troughs. In U.S. political history, a particular type of critical election has marked each type: K-peaks by conservative landslides, primary troughs by conservative-liberal transitions, and K-troughs by the emergence of centrist progressives. K-troughs and K-peaks also have been marked by warfare:

Table 2: Nature of Critical Elections in Troughs and Peaks

	Critical elections	Warfare
Primary troughs	Conservative → Liberal	–
K-troughs	Progressives emerge	Mexican War Spanish-American War World War II/Korea
K-peaks	Conservatives take over	War of 1812 Civil War World War I Cold War

Importantly K-trough conflicts have precipitated rethinking and reshaping of the nation's self-image and its role in the world. K-peak conflicts have served to sharpen the new image, to assert the role, and to resolve issues that may have arisen as a consequence of the change:

Mexican War → Manifest destiny/slavery → Civil War
Spanish-American War → Imperialism → World War I
World War II → Free World Leadership → Cold War

4. The Present and Beyond

Where does this leave us? What might we say about the next quarter-century? Half of the last row of Table 1 is blank. What is likely to go into the empty boxes?

Only three full business (Juglar) cycles have passed since the stagflation crisis of the late 1970s. Following the critical election that accompanied the 1980-81 K-peak, the first two of these cycles propelled the Reagan-Bush era of deflationary growth, during which the IT Revolution began to reshape the national economy and to put into place a new and radically different kind of infrastructure network. The third business cycle, following the right-left political shift of 1992, drove the Clinton phase of secondary recovery that spanned the interval between the 1987-91 and the 2000-2003 recession. A fourth Juglar now is unfolding, even as there are all the signs of us living within a disinflationary K-trough. Internally, there are increasingly bitter and divided politics, while externally yet another trough war, the War on Terror, is promoting rethinking of the nation's self-image and global role.

That the US was approaching trough conditions was signaled on 6 November 2002 when the Federal Reserve, responding to deflationary tendencies in the economy, slashed its overnight bank lending rate to a level not seen since the Eisenhower presidency. This move followed the government's quarterly growth report that revealed a third-quarter decline in prices for personal consumption expenditures at an annual rate of 0.4 percent. The previous time that such a decline had been recorded was in 1954. The same report revealed that the GDP price index, a broad measure of inflation, fell to its lowest level since 1950, a product of a sharp deflationary shock in the prices of tradable goods and rapid disinflation in the prices of services.

Continuing disinflationary pressures appear likely, despite temporary increases forced by rising oil prices and the initial acceleration of the current business cycle. There is significant excess capacity in many industries and the negative output gap – the excess of potential over actual GDP – remains high, increasing competitive pressures. Reflecting expectations of further deflation, the yield curve – the interest rate spread between long-term and short-term bonds – has narrowed. Falling prices encourage consumers to defer spending and make it difficult for companies to achieve earnings targets. As the prices of assets linked to debt decline, the real debt burden increases, leading to further declines in demand and hence to business cutbacks, rising unemployment, and the possibility that slowing growth and disappointing profits will turn into a vicious downward spiral. Similar trough conditions occurred in the 1790s, the 1840s, the 1890s, and the early 1950s. Each of these earlier troughs followed by a quarter-century a major surge of innovation that reshaped the economy, and each was marked by deflation, collapsing asset prices, rising unemployment, depression, and a general sense of malaise. Each also displayed distinctively competitive politics and tightly-fought elections before external events – trough wars – helped loosen party identification and destroy the existing balance of power in the economic and political system and push the nation into a new phase, the upswing. The Mexican War brought both territorial expansion and the concept of Manifest Destiny to the succeeding upwave. The Spanish-American War brought both an overseas empire and the acknowledgement that the United States had to share in the 'White Man's Burden'. Following on the heels of World War II and Korea, the rising East-West tensions that culminated in the construction of the Berlin wall reaffirmed the United States' leadership role in the western alliance during the Cold War, and ultimately led to the triumph of US-style market-based democracies across many parts of the globe. In each case, the upswings that followed were impelled by a very different domestic politics, one characterized by 'the progressive impulse.'

The U.S. now faces the same bitterly competitive domestic politics amidst a new trough war, the War on Terror. Already there is intense debate about the future role of the nation, since the grand strategy of the Cold War is no more. The majority domestic opinion favors the assertion of U.S. hegemony through the exercise of strong leadership in the pursuit of free trade, global markets, democratic institutions, and preemptive action, as evidenced by the electoral support for George W. Bush. Domestic opposition comes from the extremes of both right and left – from those who fear loss of sovereignty, who seek protected markets, and are pathologically opposed to the rising volume of migration that accompanies the international mobility of labor. Domestic opposition may be less important than international challenges to U.S. leadership, however. The countervailing forces are of three kinds. The first involves the "clash of civilizations," at its extreme the conflict between the spread of the individual rights that are central to Western market-based democracy and the religious dictatorships and terrorist groups that seek to expand the reach and control of Jihadist Islam. The second is that of the former major players such as France and Russia who are unable to reconcile themselves to American power, seeking new forms of Russo-European collaboration to counter U.S. leadership and exercising their veto when international organizations are called on to act multilaterally. The third is that represented by the rising economic power of Asia.

One possibility, as a reflationary Kuznets cycle takes hold after c.2010, is that market-based democracy will become truly global and the U.S. will become firmly established as the undisputed world leader. Supporting this view is the belief that Islam is likely to fragment, that the Russo-European alliance will be weakened by aging and declining populations, and that China's rise will be threatened by the fundamental contradictions between the needs of a free-market economy and the communist party's monopoly on power. The second possibility is that the multilateral experiment that emerged after World War II will not follow the path of the League of Nations, but will be shaken free of its current malaise and, reshaped and strengthened, will find new ways to withstand instabilities and reduce international conflict. Failing either of the first two, the third possibility is that the external opposition, however weakened, will be sufficiently aggressive, and the costs of global leadership sufficiently burdensome as reflationary growth resumes, that domestic critics will force the U.S. to disengage and turn inward. In such a case the world will surely enter a dangerous power vacuum at the very time that rogue states are busy securing nuclear and biological weaponry, setting the stage for a new peak conflict that will be even more terrifying than those of the twentieth century.

5. Conclusions

What are we to conclude? K-wave macrohistory provides a rich and deep understanding of cointegrated macroeconomic rhythms and political processes. We can be sure that a reflationary Kuznets cycle will follow the present trough. The future role of the U.S. remains unclear, however, with options that range from successful leadership to promote global freedom and security to disengagement that will lead to catastrophic peak-war confrontation. The first requires leadership, vision and a consensus that is at present missing in trough-driven conflict. The latter will surely be the result of self-interested factionalism at home and the combination of old-style power politics and Islamic medievalism overseas. A pessimistic view is that a peak war bred of the latter may be a necessary precursor to achievement of the former.

Notes

1. The list of publications is as follows:

B.J.L. Berry, *Long-wave Rhythms in Economic Development and Political Behavior*, Johns Hopkins University Press, Baltimore, MD, 1991.

B.J.L. Berry, Long waves in American urban evolution, in J.F. Hart, ed. *Our Changing Cities*, Johns Hopkins University Press, Baltimore, MD (1991) 31-50.

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B.J.L. Berry, H. Kim, H-M Kim, Are long waves driven by techno-economic transformations? *Technological Forecasting and Social Change* 44 (1993) 111-135.

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B.J.L. Berry, E.J. Harpham, E. Elliott, Riding the long wave: macroeconomics, the presidency, and Clinton's dilemma, *Business and the Contemporary World* 6 (1994) 122-140.

B.J.L. Berry, H. Kim, Leadership generations: A long-wave macrohistory, *Technological Forecasting and Social Change* 46 (1994) 1-9.

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B.J.L. Berry, A pacemaker for the long wave, *Technological Forecasting and Social Change* 63 (2000) 1-23.
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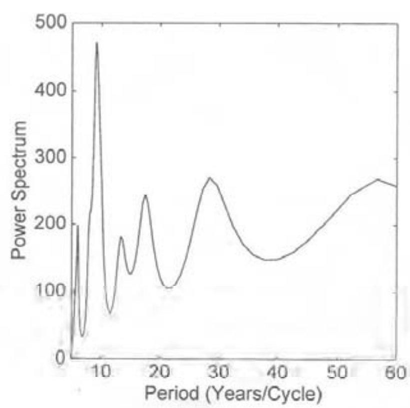
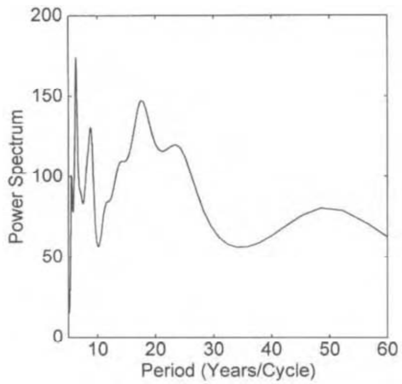
2. The power spectral density (PSD) function for inflation, with frequencies converted to years per cycle, show all four rhythms to be present:

(Inflation)



The PSD for the growth rate of real per capita GDP is, however, dominated by rhythms up to the Kuznets cycle, with no half-Kondratiev peak and a relatively weaker long-wave rhythm:

(Real per capita GDP)



3. Since WWII short-term interventions by the Federal Reserve have served to suppress some of the noise. Growth rates now oscillate as a limit cycle in a narrower range around stable long-run objectives, while the Fed's monetary transmission mechanisms appear to have reduced inflationary fluctuations to the rhythms of the long wave. See Berry and Kim (2000), and J.H. Stock and M.W. Watson, "Has the business cycle changed? Evidence and explanations," in Federal Reserve Bank of Kansas City, *Monetary Policy and Uncertainty: Adapting to a Changing Economy*, by the Bank, Kansas City, MO, 2003, 9-56.

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A Marxian Model of the U.S. Long Waves with Endogenous Growth of Labor Force

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Abstract. This paper defines a hypothetical Law of capital accumulation that includes a growth rate of supply of labor force as a non-linear function of capital intensity. The main state variables are the labor productivity, unit value of labor force, employment ratio, and capital-output ratio. An application of an extended Kalman filtering to the U.S. macroeconomic data 1969–2002 and computer simulation runs demonstrate that long wave has been a viable pattern of capital accumulation.

The characteristic of the inertia scenario is a strengthening of the secular tendency of the general profit rate to fall. This is not accepted by the U.S. state and business leadership. The terrorist attack of the September 11, 2001 has served as a new powerful catalyst for a mobilizing policy that aims at a fast overcoming of the structural crisis and safeguarding the global dominance based on technological leadership.

The mobilizing policy enables, probably, overcoming the structural crisis, accelerating productivity growth, raising the general profit rate, reducing unemployment ratio in 2001–2010. The main leverage is freezing real wage under the conditions of the present war. This paper touches briefly the question whether the USA tend to participate in wars late in long boom and beginning of structural crisis.

1. The Hypothetic Law (HL) of Capital Accumulation

The HL upgrades models developed in [8] and [9]. The advanced capital does not include variable capital since workers advance capitalists. The HL abstracts from capital of circulation. Natural capital is not taken into explicit account in this paper.

1.1 An Extensive Deterministic Form of the HL

A deterministic model is formulated in continuous time. Time derivatives are denoted by a dot, while growth rates indicated by a hat. It consists of the following equations:

$$P = K/s; \qquad (1.1)$$

$$L = P/a; \qquad (1.2)$$

$$u = w/a; \qquad (1.3)$$

$$\hat{a} = m_1 + m_2(K\hat{/}L) + m_3\,\psi(\hat{v}), \qquad (1.4)$$

$$\psi(\hat{v}) = sign(\hat{v})|\hat{v}|^j, \; m_1 > 0, \; 1 > m_2 > 0, \; m_3 > 0, 1 > j > 0;$$

$$K\hat{/}L = n_1 + n_2 u + n_3(v - v_c), \tag{1.5}$$

$$n_2 > 0, n_3 > 0, \; 1 > v_c > 0;$$

$$v = L/N; \tag{1.6}$$

$$n = p_1 e_1^{-M_1|K/L - K_c/L_c|^{i_1}} \text{ for } 0 < K/L < K_c/L_c, M_1 = 1; \tag{1.7a}$$

$$n = p_1 e_2^{-M_2(K/L - K_c/L_c)^{i_2}} \text{ for } K/L \geq K_c/L_c, \; M_2 = 1, \; p_1 > 0; \tag{1.7b}$$

$$\hat{w} = -g + rv + b(K\hat{/}L), \; g > 0, r > 0; \tag{1.8}$$

$$P = Q + \dot{K} = wL + (1 - k)M + \dot{K}; \tag{1.9}$$

$$\dot{K} = k[(1 - u)P], 0 < k < 1. \tag{1.10}$$

Equation (1.1) postulates a technical-economic relation between the advanced constant capital (K), net output (P) and capital–output ratio (s). Equation (1.2) relates labor productivity (a), net output (P) and labor input, or employment (L). Equation (1.3) describes the relative wage, or unit value of labor power (u), as a ratio of real wage (w) to labor productivity. Equation (1.4) is an extended technical progress function. It includes: the rate of change of capital intensity, K/L and direct scale effect, $m_3\psi(\hat{v})$; $|x| \geq 0$ is an absolute value of x; $sign(x) = -1$ for $x < 0$, $sign(x) = 1$ for $x \geq 0$. The non-linear continuous function $\psi(\hat{v})$ is analytical except at a singular point $\hat{v} = 0$ where its positive first derivative becomes infinite.

Equation (1.6) outlines the rate of employment (v) as a result of the buying and selling of labor–power. In the equation (1.8), the rate of change of the real wage rate (w) depends on the employment rate (v), as in the usual Phillips relation, and on the rate of change of capital intensity (K/L) additionally. The capital intensity (K/L) is a proxy for qualification.

Mechanization (automation) manifests itself in a growing capital intensity. The rate of change of capital intensity (K/L) in the equation (1.5) is a function of the relative wage (u), difference between the real employment ratio (v) and some base magnitude (v_c) that is lower than quasi-stationary employment ratio (v_a) defined below. A high relative wage and high employment ratio promote mechanization (automation) that shapes the labor supply.

Before reaching a critical magnitude, mechanization (automation) pushes new demographic groups (children, women, aged, immigrants from less developed countries) into a laboring population (as far as qualification really or potentially satisfies technological requirements) thus chiefly accelerating the growth of supply of labor force. Afterwards mechanization (automation) becomes mainly a decelerating factor for the growth of supply of labor force because a substantial part of working-age population does not possess adequate qualification for being hired or self-employed. Accordingly, the equations (1.7a) and (1.7b) determine the growth rate of labor force (N) as a non-linear continuous function of capital intensity. The growth rate of labor force is monotonically increasing for $K/L \leq K_c/L_c$, reaching an absolute maximum $n_{\max} = p_1$ at the point $K/L = K_c/L_c$; this rate is monotonically decreasing for $K/L \geq K_c/L_c$.

In the equations (1.9) and (1.10), the net formation of constant capital is $\dot{K}$, Q sums net export, final private and public consumption, $M = (1 - u)P$ is a total profit in real terms.

1.2 An Intensive Deterministic Form of the HL

The deterministic model in an intensive form, derived from the equations (1.1) – (1.10), consists of four non-linear ordinary differential equations (1.11) – (1.14):

$$\dot{a} = (m_1 + m_2(n_1 + n_2u + n_3(v - v_c)) + m_3\psi(\hat{v}))a, \tag{1.11}$$

$$\dot{s} = (-m_1 + (1 - m_2)(n_1 + n_2u + n_3(v - v_c)) - m_3\psi(\hat{v}))s, \tag{1.12}$$

$$\dot{v} = (k\frac{1-u}{s} - (n_1 + n_2u + n_3(v - v_c)) - n(sa))v, \tag{1.13}$$

$$\dot{u} = (-g + rv - m_1 + (b - m_2)(n_1 + n_2u + n_3(v - v_c)) - m_3\psi(\hat{v}))u. \tag{1.14}$$

It has a quasi-stationary state

$$E_a = (a_a, s_a, v_a, u_a), \text{ where} \tag{1.15}$$

$$a_a = a_0e^{i(t-t_0)},\ s_a = k\frac{1-u_a}{i},\ v_a = \frac{g+(1-b)i}{r},\ u_a = \frac{i - n_1 - n_3(v_a - v_c)}{n_2},\ i = \frac{m_1}{1-m_2}.$$

A quasi-stationary growth rate of constant capital, net output, real wage, labour productivity and capital intensities is the same: $\hat{K}_a = \hat{P}_a = \hat{w} = \hat{a} = \widehat{K/L} = i$. At this quasi-stationary state, the value of constant capital, employment and labour force are fixed, i.e., $\widehat{K_a/a_a} = \hat{L}_a = n_a = 0$. The quasi-stationary general profit rate is $(1 - u_a)/s_a = i/k$.

This quasi-stationary state E_a is dynamically unstable because $\psi'(\hat{v}) = j|\hat{v}|^{j-1}$ goes to positive infinity at $\hat{v} \to 0$. This substantial singularity explains also why the growth rate of labor productivity changes stepwise at local extremes of the employment ratio. Abruptness of economic crises follows from this essential singularity too.

1.3 A Probabilistic Form of the HL

For taking into account measurement errors and an impact of factors neglected in the model assumptions, the deterministic model (1.11) – (1.14) has been transformed in a stochastic model. This makes implicit allowances for short-term and middle-term economic fluctuations by specification of the random components. The latter model includes state equations and measurement equations for discrete moments of time

$$\mathbf{x}(n) = \mathbf{f}[\mathbf{x}(n-1)] + \mathbf{w}(n), \tag{1.16}$$

$$\mathbf{z}(n) = \mathbf{H}\mathbf{x}(n) + \mathbf{v}(n), \tag{1.17}$$

where $n = 1, 2,\ldots, N$ is an index of data samples, $\mathbf{x}(0)$ – a vector of an initial state of the system, $\mathbf{w}(n)$ – a vector of equations errors (driving noise), $\mathbf{v}(n)$ – a vector of measurement errors. The deterministic part $\mathbf{x}(n) = \mathbf{f}[\mathbf{x}(n-1)]$ corresponds to the system (1.11) – (1.14). The symbol **H** is for a rectangular matrix. The residuals are not due entirely, or largely, to pure random influences. On the contrary, these residuals contain highly systematic, non-random components.

This paper applies a simplified version of an extended Kalman filtering (EKF), realized in the Vensim software developed by Ventana Systems, Inc. This software has enabled to estimate the unobservable components of the compact model (1.11) – (1.14) by a procedure of maximum likelihood.

2. An Inertia Scenario for the U.S. Economy Based on the HL

An application of the EKF to the U.S. macroeconomic data for the basal period 1969–2002 has identified unobservable components of the above stochastic model: $b \approx 0.540$, $e_1 \approx 2.5$, $e_2 \approx 100$, $i_1 \approx 0.2$, $i_2 \approx 0.4$, $g \approx 0.046$, $j \approx 0.342$, $k \approx 0.203$, $K_c / L_c \approx 0.098$, $m_1 \approx 0.0067$, $m_2 \approx 0.2357$, $m_3 \approx 0.015$, $n_1 \approx -0.246$, $n_2 \approx 0.347$, $n_3 \approx 0.6$, $p_1 \approx 0.03$, $r \approx 0.053$, $i \approx 0.009$. The simulation, started at the magnitudes of the phase variables observed in 1969 ($a_0 \approx 0.0422$, $s_0 \approx 1.826$, $v_0 \approx 0.965$, $u_0 \approx 0.710$), has calculated the most probable (still sub-optimal) magnitudes of these four and other variables in the subsequent years.

The main variables have the following units of measurement: a [millions of chained 1996 dollars per worker per year], u, v [dimensionless], s [years]. Calculations of u and s are done with the nominators and denominators measured in current prices. The employment ratio v is for the civil labor force (without accounting hidden unemployment). Private and governmental produced non-residential fixed assets present the constant capital.

2.1 A Historical Fit of the HL in the Basal Period 1969–2002

The HL has passed behavior reproduction tests. In particular, estimating its historical fit (Table 1), the Theil inequality statistics have been used [10].

Table 1: Decomposition of errors of the retrospective forecast for 1969–2002

Variable	RMSPE (%)	U^M	U^S	U^C
a	0.81	0.049	0.076	0.875
s	3.31	0.002	0.315	0.683
v	0.92	0.000	0.080	0.920
u	1.56	0.088	0.000	0.912
$(1 - u)/s$	4.36	0.076	0.087	0.838

The rather small root-mean-square percent errors (RMSPE) and prevailing non-systematic errors of incomplete co-variation (U^C) prove that this probabilistic model tracks the major variables observed in the basal period agreeably. Fig. 1 and Fig. 2 support this conclusion by demonstrating a certain likeness of simulated and realized trajectories.

A long wave has been a viable pattern of the U.S. capital accumulation in the basal period with local maximum (minimum) of the employment ratio, v, in 2001 (1982) and local maximum (minimum) of the general profit rate, $(1 - u_a)/s$, in 1998 (1982). The maximal magnitudes of the both variables are lower than their magnitudes in 1969. Moreover, the previous local maximum of the profit rate (higher than that in 1969) was observed in 1965–1966 before the basal period [9: 90–96]. The uncovered tendency of the profit rate to fall is unfavorable for the employment ratio in the long-term. A shortage of labor supply is detrimental for capital accumulation.

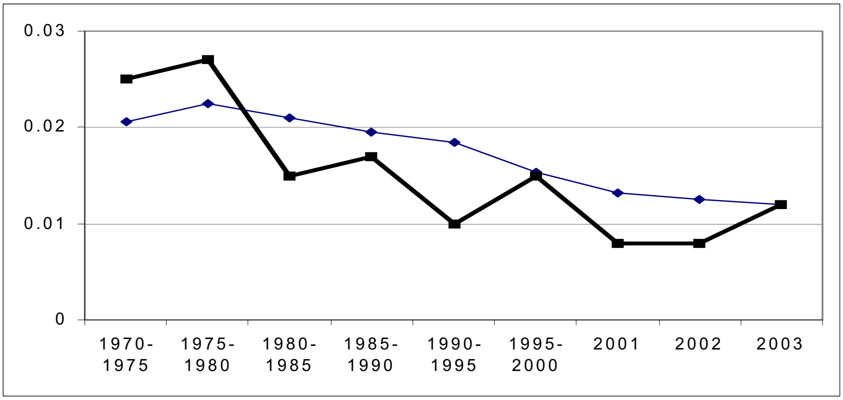

Figure 1: The Realized (solid broken line) [3: Table V.B2)] and Simulated (thin line) Growth Rates of Labor Force (n) in the USA, 1970–2003

2.2 A Long-term Extrapolation of the Tendency of General Profit Rate to Fall

An extrapolation of the retrospective forecast, based on the deterministic model (1.1) – (1.10) with the parameters values given above, is called the inertia scenario.

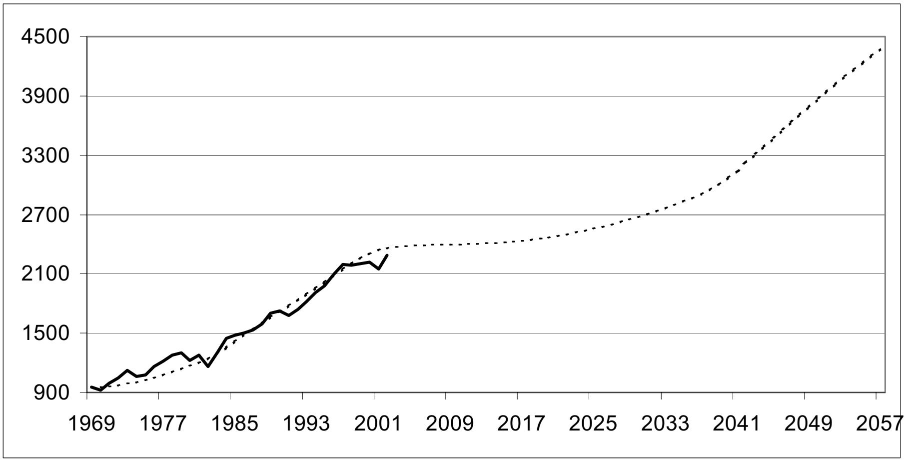

Figure2: The Profit M (milliards 1996 dollar a year): Realized (solid curve), 1969–2002, and Simulated (dotted curve) in the Inertia Scenario, 1969–2057.

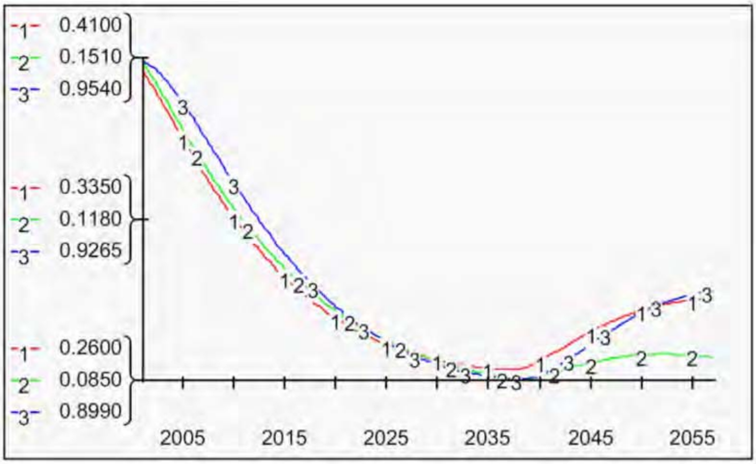

Figure3: The Rate of Surplus Value $(1 - u)/u$ (1), Rate of Profit $(1 - u)/s$ (2) and Employment Ratio v (3), 2001–2057, in the Inertia Scenario

The tendency of the employment ratio, rate of profit and rate of surplus value to fall during the first quasi-cycle of the 21st century lasts until the end of 2030's mainly because the growth rate of the real wage exceeds the growth rate of labour productivity. Only when the latter surpasses the former the long wave starts to move upwards.

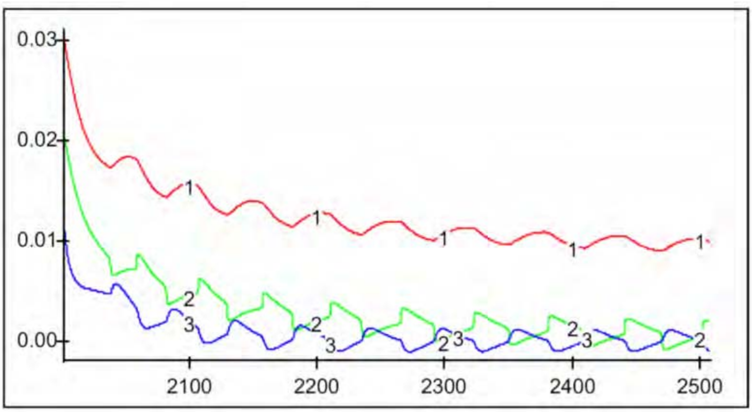

Figure4: The Growth Rates of the Constant Capital $\hat{K}$ (1), of its Labor Value $K\hat{/}a$ (2) and of Labor Input $\hat{L}$ (3) in the Inertia Scenario, 2001–2507

Profit in real terms grows uninterruptedly in spite of the fall in the profit rate in 2001–2038 (Fig. 2 and Fig. 3). Still this variable almost comes to a standstill when the profit rate declines.

Computer simulations reveal that phase variables (s, v, u), gross profit rate, growth rates of labor productivity and real wage as well as some other variables fluctuate. The duration of fluctuations is 58–63 years. The periods of fluctuations are shorter at the beginning. For example, the first complete quasi-cycle of the employment ratio (v) in the 21st century encompasses 2001–2058. More than four hundred years later, this variable starts to oscillate about the quasi-stationary value (v_a) with a period 62–63 years.

The growth rate of the material substance of the constant capital (K) and growth rate of its labor value ($\widehat{Ka}$) as well as growth rate of the labor input ($\hat{L}$) experiences the long-term anharmonic fluctuations. These growth rates, together with the general profit rate, tend to decline at the transient to the quasi-stationary values (Fig. 4).

3. Explaining a Contemporary Development of the U.S. Economy by a Modified HL

3.1. A Dialectical Negation of the Inertia Scenario

The inertia scenario above may lead to a wrong fatalistic conclusion that the general profit rate has inevitably to decline uninterruptedly in 1999–2038 and that the total profit is to be nearly constant in 2000–2010. The official middle-term macroeconomic projection in January 2001, based on information as of November 2000, carried traits of this pessimistic vision: the full amount of corporate profits (before taxes) in the year 2010 deflated by CPI was projected only 4 per cent higher than that in 2000 [7: Table II-1]. The same official middle-term projection envisioned that the ratio of the full amount of nominal corporate profits (before taxes) to wages and salaries would have to decline from 0.196 in 2000 to 0.153 in 2010 (ibid.). The analogous rate of surplus value declines (Fig. 3) during these years in the inertia scenario too.

U.S. capital and leading circles have rejected the policy of a passive adaptation to the long-term decline. They have been carrying out a mobilizing policy at least since the beginning of 2001. The terrorist attack of September 11, 2001 has served as a new powerful catalyst for this policy that aims at a fast overcoming of the structural crisis and safeguarding the global dominance based on technological leadership.

For the second time after the World War II the USA have started or become involved in the wars in the former Yugoslavia, Afghanistan and Iraq (1999 – nowadays) late in the boom of the previous big cycle and during the unfinished structural crisis of the current one. Recall that the U.S. wars in Indochina extended over 1965–1973 when the similar transition from the boom of one big cycle to the crisis of the other took place.

The wars, aimed at strengthening geo-political positions, serve capital to restore profitability. In particular, it is much easier for captains of finance and industry to explain workers a necessity to fasten their belts during a war than in peaceful time. Rephrasing saying from the J. Stainbeck ‘Grapes of Wrath’, *got enough wars and profit will hit the ceiling*. Cheapening elements of constant capital, foreign trade and outsourcing belong to additional counteracting factors beyond the scope of the present analysis.

An official middle-term projection based on information available in November 2001 has aimed at substantially higher growth of corporate profits in real terms and considerably higher ratio of nominal corporate profits to wages and salaries than those in the previous official projection: in 2010 the first indicator would have to stand higher by 23.1 per cent than in 2000, while the second would be 0.169 in 2010 [4: Table 2-1].

Output per hour worked grew since the fourth quarter of 2000 up to the beginning of 2004 at an exceptional annual rate of more than 4 per cent per year [6: 46]. Yet workers’ compensation has consistently lagged productivity growth over this period. Total labor compensation has experienced the slowest growth in any recovery since World War II [2]. As a result, the profit share (ratio of property and entrepreneurial income to GDP) has recently reached its previous peak of 1997 – 7 per cent above its average for 1981–2003 [1: 15, 24]. This is the fastest rate of profit growth in a recovery since World War II.

3.2 A Synthesis of the HL and Historical Contingency

The inertia scenario above and facts from the previous section contradict each other like thesis and antithesis. Synthesis necessitates breaking the closeness of the initial causal system by saving its essence and allowing for the mobilizing policy. A working assumption is that the rate of growth of real wage is not higher in the middle-term 2001–2010 than the quasi-stationary magnitude, defined by the equation (1.15): $\hat{w} \le \hat{w}_i \le i$. The deliberately chosen magnitude $\hat{w}_i = 0.007$ is plausible. The modified equation for the rate of growth of real wage takes the form

$$\hat{w} = \min[\hat{w}_i, -g + rv + b(\widehat{K/L})],\ 0 \le \hat{w}_i \le i \approx 0.009,\ g \ge 0,\ r > 0. \qquad (1.8')$$

All other equations, the starting point for 2001, and parameters values remain the same.

Table 2 reports on results of the simulation run based on the modified model. The outcomes of the mobilizing policy do not contradict qualitatively the above latest data on growth and distribution. They are compared with outcomes of the inertia scenario. For capital, the mobilising scenario is superior to inertia scenario. In particular, the total profit in the mobilising scenario will be 42.9 per cent higher in 2010 than in 2001 (in the inertia scenario only 2.6 per cent higher). A recent official projection expects the 68.9 per cent increment of corporate profits (before taxes) deflated by CPI in 2001–2010 [5: Table C-1].

Table 2: Increments (per cent) in the two scenarios of the U.S. economic development, 2001–2010 (2001 = 100)

Variable	Scenario	
	Inertia	Mobilizing
Labor productivity (a)	8.8	12.2
Real wage (w)	14.4	6.5
Rate of surplus value ($(1 - u)/u$)	–16.9	18.5
Profit rate ($(1 - u)/s$)	–19.8	7.5
Employment (L)	7.9	13.2
Labor force (N)	10.2	10.4
Surplus value ($(1 - u)L$)	–5.7	27.4
Constant capital (K)	27.9	32.9
Value of constant capital (K/a)	17.5	18.5
Net output (P)	17.4	27.0
Profit (M)	2.6	42.9

According to the simulation run, the American economy will crash into the upper limit of full employment ($v \approx 0.978$) at the end of the projection period or even before 2010 in the mobilizing scenario. This creates the necessary conditions for a new crisis.

4. Conclusion

The HL of capital accumulation and computer simulations based on the U.S. official statistics have put in a nutshell how under conditions of the current war American workers have got to take freezing real wage to restore profitability and secure higher employment in coming years. The mobilizing policy facilitates the U.S. technological, economic and military power while the labor distributive share shrinks. Still with all its benefits, especially for capital, the mobilizing scenario contains seeds of its own negation since capital itself remains the real barrier of capitalist production.

The presented HL could be useful in controlling severity of structural crises and helpful for avoiding wars as profitability instruments.

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Economic Cycles under Test: A Spectral Analysis

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Abstract. Spectral analysis is a particularly valuable method for seeking dependences expressed as lags between different magnitudes. Its use in this article was first determined by the search for maximum objectivity in the observation of time series. The possibility of applying it to a large number of series was then examined. This twin requirement resulted from a desire to avoid the criticism generally levelled at statistical studies concerning cyclical movements of the economy. Spectral analysis is based on the theory of stochastic processes. It starts with the core hypothesis that a given time series consists of a large number of sinusoidal components with different frequencies (univariate spectral analysis). It makes it possible to divide a particular category of records into a set of oscillations of different frequencies and then to show the links between the components with the same frequency in the various series examined (cross-spectral or bivariate spectral analysis). It has had limited applications in cliometrics to date. It is used here to determine the frequency of GDP series of several OECD countries. A reminder of the method (I) is followed by successive examination of the various series chosen, the treatment of these series and the results of spectral analysis (II). It is then possible as a conclusion to show the prospects of this type of approach and to synthesise a completely new major result for understanding economic dynamics in the nineteenth and twentieth centuries, that is to say the existence of a single intermediate cycle with 15 to 20-year frequency that calls into question or even partially contradicts previous work on economic cycles.

Introduction

Spectral analysis is a particularly valuable method for seeking dependences expressed as lags between different magnitudes. Its use in this article was first determined by the search for maximum objectivity in the observation of time series. The possibility of applying it to a large number of series was then examined. This twin requirement resulted from a desire to avoid the criticism generally levelled at statistical studies concerning cyclical movements of the economy. Spectral analysis is based on the theory of stochastic processes. It starts with the core hypothesis that a given time series consists of a large number of sinusoidal components with different frequencies (univariate spectral analysis). It makes it possible to divide a particular category of records into a set of oscillations of different frequencies and then to show the links between the components with the same frequency in the various series examined (cross-spectral or bivariate spectral analysis). It has had limited applications in cliometrics to date[1]. It is used here to determine the frequency of GDP series of several OECD countries. A reminder of the method (I) is followed by successive examination of the various series chosen, the treatment of these series and the results of spectral analysis (II). It is then possible as a conclusion to show the prospects of this type of approach and to synthesise a completely new major result for understanding economic dynamics in the nineteenth and twentieth centuries, that is to say the existence of a single intermediate cycle with 15 to 20-year frequency that calls into question or even partially contradicts previous work on economic cycles.

1. Methodology

Spectral analysis, which is applied essentially to determinable[2] stationary[3] series, makes it possible to divide a particular categories of long-term data sets into a set of oscillations with different periods (breaking down any time series into a sum of periodic functions) and then to show the links between the components with the same frequency in the various data sets examined (Priestley [5]). Each of these stages has obvious cliometric interest. The first, by showing all the frequency components of a data set and by isolating—if it exists—the most important frequency component (and its harmonics) reveals the cyclical behaviour of a time series and shows the frequency and amplitude characteristics of this cyclical movement. The second stage makes it possible to compare the periodic movements of two series and to establish a correlation between them. The latter stage therefore seems particularly suited to the aim of this article.

1.1 Estimation of Spectra

The amplitudes of the different oscillations (from the breakdown of stationary series) are random variables that can be defined by the scale of the values that they might have. A variance corresponds to each given period oscillation and this defines what is called the spectrum of the process envisaged. The differences between the various sinusoids are insignificant.

More precisely, the spectrum of a stochastic process $[X_t]$ is the function $f(\omega)$ defining to within a multiplicative constant the expected value of the square of the amplitude of frequency ω in the Fourier decomposition of the relations of the process. The spectrum thus describes the importance of the various frequencies in the process in question.

The calculations are as follows. For stationary processes, a bias-free estimator can be calculated from a single realisation of the process, that is to say from a particular time series X_t in which ($t = 1, 2, \ldots, T$). This estimator is the periodogram and can be defined as:

$$I(\omega) = \frac{1}{2\pi} \sum_{\theta=-T+1}^{T-1} \upsilon_\theta \cos \omega\theta$$

υ_θ being approximately the empirical autocovariance, and more precisely with $\bar{x}$ the empirical mean of the series:

$$\upsilon_\theta = \frac{1}{T} \sum_{t=1}^{T-\theta} (x_t - \bar{x})(x_{t+\theta} - \bar{x})$$

Although it has no bias, the periodogram is not a good estimator of the spectrum because it is not convergent. This is why the erratic function $I(\omega)$ is replaced by a more regular function representing the mean trend of variations of $I(\omega)$ with ω. This is referred to as the smoothing of the periodogram.

The smoothed function is then:

$$f'(\omega) = \frac{1}{2\pi} \sum_{\theta=-m}^{m} \left(1 + \cos \frac{\theta\pi}{m}\right) \upsilon_\theta \cos \omega\theta$$

This formula is Tuckey–Hanning's estimation function (or spectral window). There are other estimation formulas, especially Parzen's, that causes less leakage in non-adjacent frequency bands but leads to higher correlation between the successive estimated values of the spectrum.

Finally, to improve spectrum estimation, the X_t series is generally filtered beforehand by subjecting it to a transformation in such a way that it is possible a priori to consider that the spectrum of the filtered series is more representative. In many of these practices, filtering thus eliminates the trend of the series in such a way that the hypothesis of the stationarity of the generating process seems less coarsely imprecise (especially for economic data series). The filter chosen here is that proposed by Hodrick and Prescott [6], for several reasons. Firstly, it is easy to apply. Secondly, abundant literature shows that its statistical properties are satisfactory. Finally, it is commonly used in the literature and in the empirical analyses performed by national bodies and international organisations (Bouthevillain [7]).

1.2 Estimation of Cross-Spectra

Cross-spectra examine the existing relations between the spectral components taken in pairs for two given time series. Generalising the case to a single variable, (X_t, Y_t) are stationary if their first and second moments are both independent of time. In this case, one of the results of the theory of stationary processes is that the component centred at ω_j is independent not only of the other components of the variable, but also of the components of any other variable whether or not it is centred on ω_j. A full description of the system of relation between two stationary processes just requires knowledge of the extent to which the frequency component ω of the process [X_t] is correlated with the frequency component ω of the process [Y_t] and knowledge of their phase difference.

This correlation between two frequency components in two processes is given by:

$$C^2(\omega) = \frac{c^2(\omega) + q^2(\omega)}{f_x(\omega) f_y(\omega)}$$

$0 \leq C^2(\omega) \leq 1$, $c(\omega)$ is called the cospectrum and $q(\omega)$ is the quadrature. $C^2(\omega)$ is the square of coherence at ω (equal to the square of the coefficient of correlation). The measurement of the phase difference between the frequency components of the two processes is given by:

$$\Phi^{(\omega)} = \arctan\left(\frac{q(\omega)}{c(\omega)}\right)$$

It can therefore be said that the amplitude cross-spectrum of two processes [X_t] and [Y_t] defines the expected values of the product of the amplitudes with which each frequency ω affects [X_t] and [Y_t] and that the phase cross-spectrum defines the expected phase difference with which each frequency is involved in the two processes.

Spectral analysis, whose theoretical basis has thus been described briefly, is a logical extension of our work on outliers and that on long memory time series[4]. It is a particularly suitable mathematical tool for the development of our research programme and should give good results on condition that the statistical data series used are suitable for it. These series are now examined.

2. Cliometric Results

The aim of our research is the comparison of the behaviour of the per capita GDP (log transformed) in 15 OECD countries, with on the one hand a study of the national cyclical features of the 15 OECD countries and on the other a search for common factors in these cycles. For this we use the now well-known database drawn up by Maddison [8], expressed in 1990 US dollars for the period 1870-1994, and extended (until 2000) by EUROSTAT indicators.

2.1 Analysis of Spectra

The characteristics of the national cycles are first analysed individually. The aim is to find out whether all the countries display the same propensity for cyclical fluctuations and the same regularity in these fluctuations. It must be possible to determine whether a country typology can be shown according to the cyclical properties as the impetus and propagation of fluctuations at the international scale can only be fully understood if this national heterogeneity is taken into account (Fayolle and Micolet [11]).

Graphic analysis of the fluctuations establishes in a general manner that the different countries are characterised by relative cyclical regularity but that the features of this cyclicity are unevenly distributed at the international level. However, these results should viewed in relative terms and subjected to spectral analysis as the cycle typology shows that duration and amplitude characteristics vary from one cycle to another and above all that cycles are similar to sets of Russian dolls and their influences can strengthen or oppose each other depending on whether the swings coincide or not or are in phase or not. Whence the advantage of spectral analysis for separating and analysing the different cycles integrated by per capita GDP and then putting forward a more perspicacious country typology in the relations of impetus and propagation of fluctuations at the international scale.

Application of the spectral density methodology described above showed an interaction between two types of cycle in each of the 15 countries analysed. Indeed, the spectral density functions (Figure 1) show that the cyclical movement can be decomposed into two distinct cyclical components. One is short and of the Kitchin type with a frequency of 3-5 years (Kitchin [12]) and relatively moderate amplitude and the other an intermediate phenomenon between the Juglar business cycle (Juglar [13]) and a long Kondratieff type of cycle (Kondratieff [14]). The latter, a Kuznets type cycle (Kuznets [15]) with a frequency of 15-20 years and comparatively large amplitude, underlies GDP conjuncture. *More widely accepted in recent years is the 15- to 25-year swing in economic growth rates uncovered by Nobel laureate S. Kuznets. The cycle is more evident in the United States than elsewhere. M. Abramovitz recognises the Kuznets cycle as associated with population growth and immigration. Most economists hold that this cycle was material only for the period from 1840 to 1914* (Diebolt [16], see also Abramovitz [17], Goldstein [18], Schumpeter [19] and Solomou [20]). It should be noted that although the swing of short cycle is smaller than that of the intermediate cycle, it nevertheless has sufficient amplitude and volatility to inflect the overall movement of the cycle that may account for the differences observed in the graphic analyses at cycle aggregate level and thus invalidate the statistical characteristics generally used in the analysis of cycles. This justifies the use of spectral analysis and hence the analysis of cyclical international relations between fluctuations in the same categories.

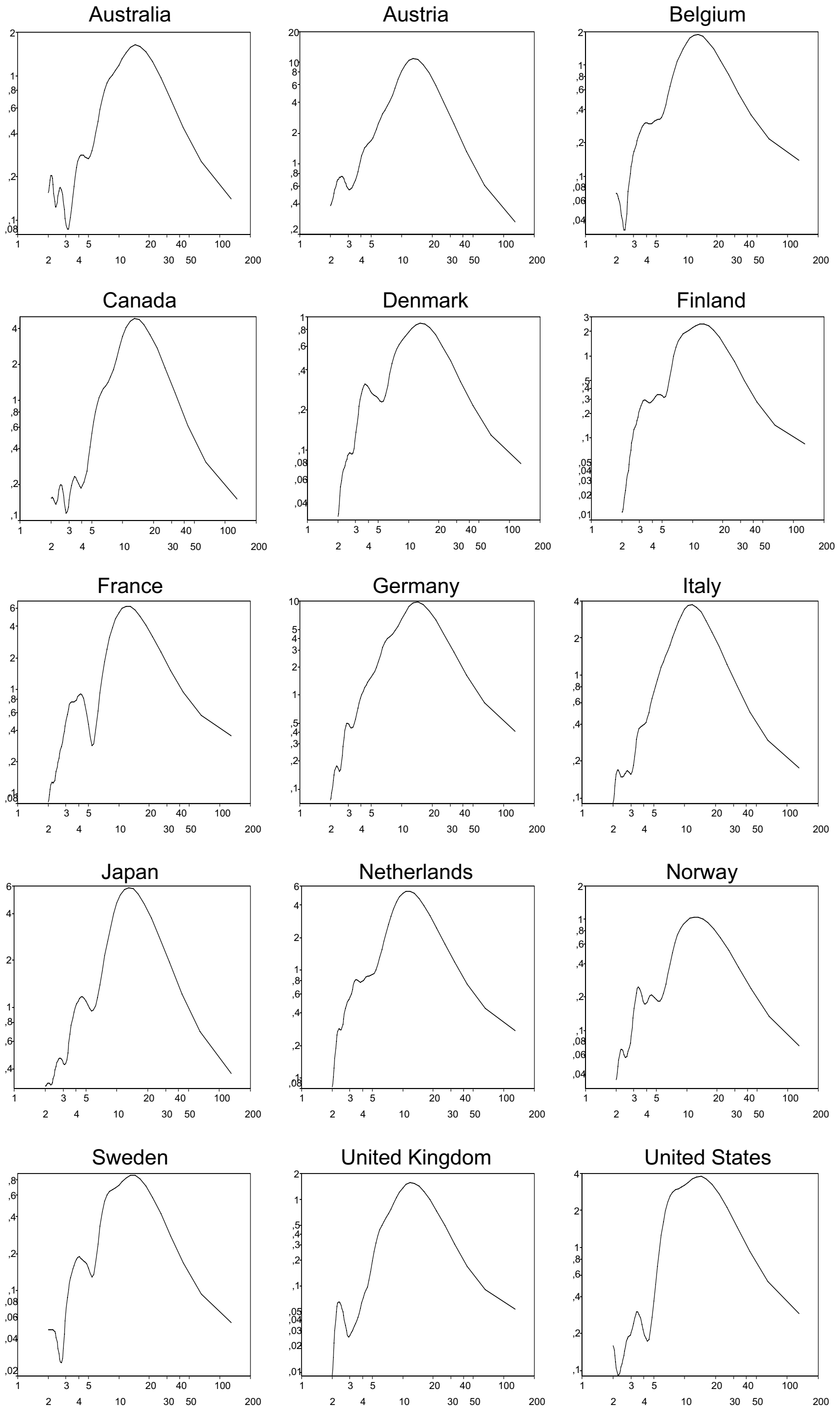

Figure 1 - Spectral Density of Per Capita GDP

With this double cyclical movement of per capita GDP combining short oscillations and slow intermediate movements, we consider that national economic fluctuations are first of all governed by storage behaviour. Here, the minor cycles reflect essentially storage and release phenomena by businesses and above all large investments involving large amounts of capital such as those for the construction industry or for transport and seen as a response to population factors as Kuznets type intermediate cycles basically govern conjuncture. The economic situation is therefore governed essentially by a 15-20-year frequency and not by short cycles of the Kitchin or Juglar type or by long movements of the Kondratieff type. We consider that the driving force underlying this frequency can be compared to the mechanisms proposed by Kuznets, that is to say an economic reaction to demographic mechanisms, for example via the movement of large investments or the labour market. Indeed, the links between the functioning of the labour market and demographic movements may be an explanation, in particular through three essential mechanisms linked to demographic factors. These are first of all a cycle linking work and employment (the productivity cycle), then an effect linking unemployment and wages (the Phillips effect) and finally a link between demand and income (the consumption function). These three mechanisms also play greater or lesser roles according to the period and the country; they can increase or reduce the cycles and hence account for the international disparities observed.

This preliminary study of the characteristics of national cycles that shows agreement between the cycles characterising the different countries is followed by a study of the impetus and propagation relations at the international scale through cross-spectral analysis.

2.2 Analysis of Cross-Spectra

The search for international relations between the main economic cycles is the other fundamental component of this analysis. We therefore incorporate the cycle approach in addressing the entire international economy through the multivariate spectral approach (i.e. cross-spectral analysis). This makes it possible to examine the similarities and synchronisation of the different national cycles. Here, we first analyse the coherence[5] between the different cycles using coherence of 0.7 or more as the criterion of significance. This is followed by study of the phases[6] of the cyclical processes whose coherence is significant. The results of the two methods can be represented schematically to make it easier to examine and interpret the results.

Coherence is represented by lines (dotted, unbroken or double unbroken) indicating their degree of importance (0.7, 0.8 and 0.9 respectively), while the phases are shown by the direction of the coherence relation with the beginning of an arrow showing the process that is ahead with regard to the process at its extremity (a double arrow means that there is no lag between the processes—they are synchronous). Thus, it is seen in a general manner that the impetus and forces governing national intermediate cycles are not independent between countries and there is thus strong interconnection between national cyclicity. This can be shown in more detail by a grouping in three geographic zones and linked to notions of similar, common cycles[7].

Using this (Figure 2), a first parallel can be made between the English-speaking countries (United States, Canada and the United Kingdom) that are linked in a joint cycle through their common historical, political and geographic context. A second, much wider parallel can be set between the European countries in the broad sense (the countries of continental Europe and Scandinavia) where the characteristic of the cycle is that it is largely similar in all the countries of this zone and sometimes common with certain neighbouring countries (e.g. Belgium and the Netherlands and Germany and Austria), explained in particular by a flexibility of the labour market and geographic mobility of labour are made easier by geographical proximity. However, the cycle in the United Kingdom displays greater similarity with that of the United States and Canada than with the European countries. Finally, Japan seems to form a zone all by itself with a cycle similar to that of all the European countries but more advanced.

In a general manner, a regime of growth and international fluctuations is defined by a combination of properties characterising the international area. The cyclicity of the economy at the international level is not independent of the hinging and compatibility of growth trends, which, as has been seen above, indicates a phenomenon of catching up over a long period. This catching up is only possible through the efficiency and profitability of productive resources, whence conditioning with regard to constraints of external equilibrium and the cyclical interdependence found in all the countries studied (Fayolle and Micolet [11]).

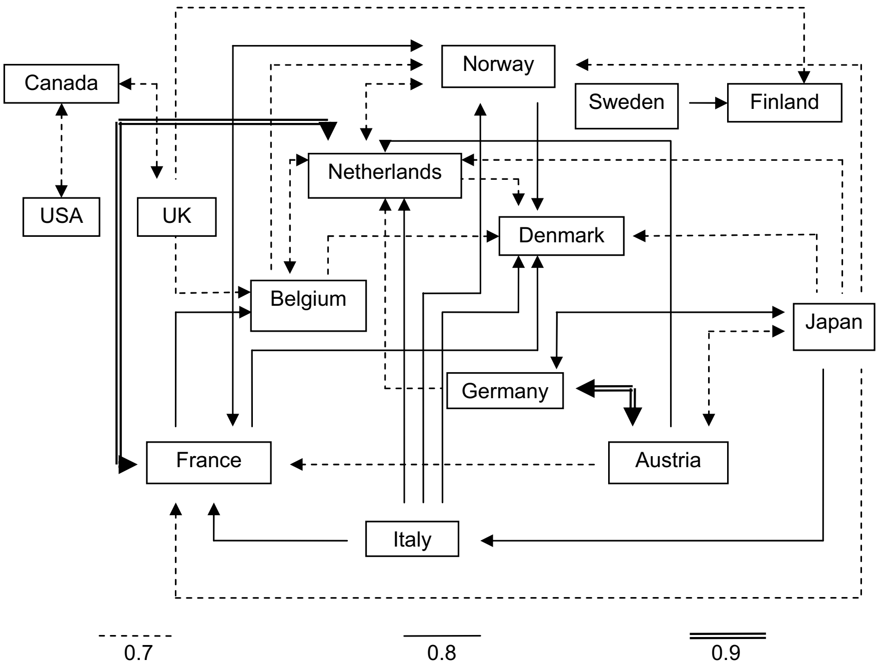

Figure 2 - Relation between Intermediate Cycles of the Kuznets Type

Conclusion

This analysis of national fluctuations and cyclical interconnections makes it possible to enrich our understanding of the cyclical mechanisms between nations. It gives a major, entirely new result for the understanding of economic dynamics in the nineteenth and twentieth centuries, that is to say the existence of a single intermediate cycle with a frequency of 15 to 20 years that calls into question or even contradicts (at least partially) previous work on economic cycles.

This understanding of cyclical mechanisms is all the more essential today as it will make it possible to put forward more concerted and more cooperative economic policies aimed at parallel development of activities. Indeed, although growth cycles leave real but comparatively small room for manœuvre for intervention by the authorities on the determinants of growth, macroeconomic policies can nevertheless slow, shift, accelerate or dampen cyclical phenomena, whence the advantages of better understanding national cyclical features and their interaction at the international level.

Endnotes

[1]Interested readers should see, in particular, Ewijk [1], Gerster [2], Reijnders [3] and Metz [4].
[2]An important theorem developed by Cramer ensures that stationary series can be broken down into a set of separate sinusoidal oscillations whose characteristics, amplitudes and relative differences are random. There will generally be a very large number or even an infinity of such oscillations, each of which is very small and the process is then said to be indeterminable. This contrasts with determinable processes consisting of a finite number of sinusoidal oscillations, each of which will have a finite non null amplitude.
[3]A very important class of series is that given by processes whose first moments are not functions of time. Such series are referred to as being stationary of the second order.
[4]See especially Darné and Diebolt [9] and Diebolt and Guiraud [10].
[5]Coherence makes it possible to measure the degree of linear correlation between components of the same frequency in two processes. The closer it is to 1 for a given frequency, the more the two processes move in a similar manner for this frequency or periodicity.
[6]The phase makes it possible to measure the time shift of a process in relation to another. A positive phase shows that the second series is ahead of the first and the opposite if it is negative. Interpretation of the phase is then strongly linked with coherence as the analysis of a lag between two processes is only meaningful if the processes are related, that is to say if their coherence is high.
[7]Indeed, a distinction should be drawn between a similar cycle and a common cycle. A cycle is referred to as being similar when the cyclical component that drives the movement of each series is founded on the same propagation mechanism but engendered by a specific impulse series so that the cyclical components can be markedly different and desynchronised. This similar cycle can be called common when the impulse series applied to it are perfectly correlated, that is to say the cyclical components are perfectly synchronised and differ only in their amplitude (Bentoglio, Fayolle and Lemoine [21]).

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Are there Long-Term Cycles in the Evolution of the Oil Price? A Research Using the Hodrick-Prescott Filter

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Abstract. This paper studies the long-term economic cycles of the international price of the oil barrel written in the supply contracts signed after January 1972. The approach begins by the estimation of the long-term trend using the Hodrick-Prescott filter, and continues with the isolation of the long-term cycles that can be identified from the data series. In a second step it dissects each one of the long-term cycles in the different expansion and contraction periods of the price cycles. In the last step it appreciates the existence of an association among these cycles and their phases, the armed conflicts that occurred during these 30 years, the main political leaders of the countries that played the main role in the international scene (some countries of the EU, the USA and Russia) and other important explicative factors of the long-term evolution of the international crude oil price.

Introduction

The paper discusses the existence of the long-term economic cycles in the international crude oil price using the prices written on the supply contracts signed from January 1972.

The approach used begins by the estimation of the long-term trend using several methods from the polynomial curve, to the ARIMA models and to the Hodrick-Prescott filter, among others; after selecting the best trend using one of several optimisation criteria it computes the cyclic movements present in the data series of the crude oil price.

After this it dissects each one of the computed cycles, namely their phases, shapes, expansion, contraction and duration periods. The text ends with an attempt to investigate if there are associations among the crude oil price's cycles and their phases with the main political leaders of the occidental countries (some of the EU, the USA) and Russia, and also with the wars that occurred during these 30 years, and other important explicative factors that help to understand the evolution of the long-term cycles contained in the price of the oil barrel.

1. Research Methodology

The approach we are going to use has several steps: 1st) as there are no seasonal movements in the crude oil price, the first step is to identify the best long-term trend, (that we note here by x_t), using several mathematical curves or expressions – like the linear one, the polynomial one, the Hodrick-Prescott one, etc.; 2nd) after selecting this trend curve using a selection criteria – the determination coefficient (R^2), the Akaike Information Criteria (AIC), or the Schwarz Information Criteria (SIC) – we eliminate it from the actual values (y_t) under the multiplicative hypothesis ($y_t=s_t.x_t.c_t.a_t$ where y_t is the actual oil price in USA dollars, s_t is the seasonal movement or effect, c_t is the cyclical movement that we want to identify and a_t is the irregular or random effect), we divide the actual values (y_t) by the estimated trend values (x_t) in order to obtain $y'_t=y_t/x_t$; 3rd) in the third step we estimate the cyclical component, the cycles, c_t, using a moving average process of 3 or 5 terms; 4th) we can also estimate the random movement computing first the ratio $y''_t=y'_t/c_t$ and then the difference $a_t=y'_t-y''_t$.

The Hodrick-Prescott Filter that proved to give the best trend is a smoothing method that is widely used, especially by macroeconomists, to obtain a smooth estimate of the long-term trend component of a data series. It's interesting to note that this method was first used in a working paper that circulated in the early 1980's and was published only in 1997 by Hodrick and Prescott, the two authors, to analyse the post-war business cycles.

The Hodrick-Prescott (HP) filter is a two-sided linear filter that computes the smoothed series s of y by minimizing the variance of y around s, subject to a penalty that constrains the second difference of s. That is, the HP filter is obtained from the minimization of the expression

$$\sum_{t=1}^{n}(y_t - s_t)^2 + \lambda\sum_{t=2}^{n-1}[(s_{t+1} - s_t) - (s_t - s_{t-1})]^2 .$$

where the penalty parameter, λ, controls the smoothness of the series. The larger the λ is the smoother the series. As $\lambda \to \infty$, s approaches a linear trend. The value of the smoothing parameter λ takes an integer that can be computed using the Ravn and Uhlig (2002) rule – the number of period per year dived by 4, raised to a power, and multiplied by 1600. The default is to use a power rule of 2, yielding the original Hodrick and Prescott values for λ equal to 100 for annual data, equal to 1600 for quarterly data, and equal to 14400 for monthly data. Ravan and Uhlig recommend using a power of 4.

In order to study the association or correlation among the cycles of the crude oil price, particularly their expansion and contraction periods, the main political contemporaneous leaders, the wars and other factors we are going to use a qualitative approach that consists of finding contemporaneous associations among some or all these factors.

2. Empirical Research

2.1 Data Values and Sources

The data values that are the base of our analysis refer to the monthly price of the barrel of Saudi light oil expressed in USA dollars. The prices are in nominal terms, i. e., in "dollars-of-the-day", and have not been adjusted for inflation. Its evolution can be seen in the figure n. 1.

The data used was extracted from the reference Department of Energy's Office of the Strategic Petroleum Reserve, Analysis Division (2004). "World Oil Market and Oil Price Chronologies (1970–2003)". Updates for 1995-2002 were extracted from the Energy Information Administration[i].

2.2 Estimation of the Long-Term Trend

As we said before now we are going to estimate the long-term trend contained in the actual values (the prices of the crude oil barrel, figure 1). To estimate the best long-term trend we tried several mathematical functions or curves: the linear, the polynomial – with order polynomials from 2 to 13 -, the ARIMA, and the Hodrick-Prescott filter.

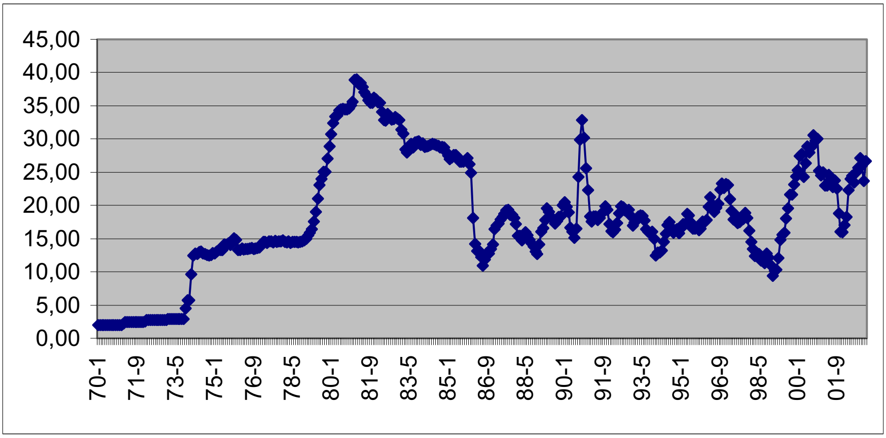

Figure 1 – Evolution of the Crude Oil Price (1970-2002)

The three last functions conducted to good results but the one that showed to be the best for our aims was the Hodrick-Prescott approach. The values found using this methodology are those underlying the following line graph (figure 2):

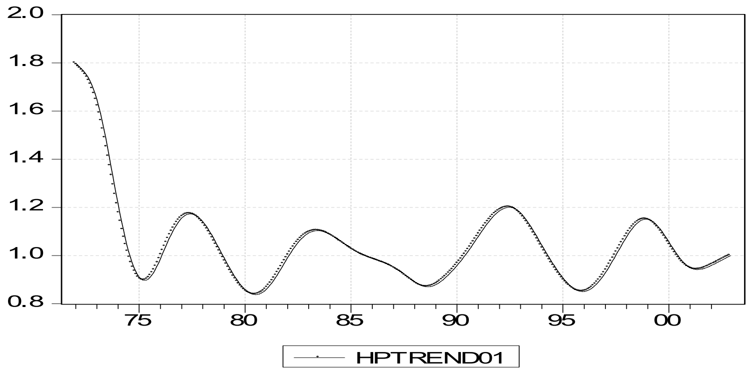

Figure 2 – Long-term Trend using the Hodrick-Prescott Approach

2.3 Brief Description of the Cycles Identified from the Crude Oil Prices

Using the Hodrick-Prescott filter (Hodrick, R.J. and E.C. Prescott, 1970, 1997) we computed the trend present in the data values. After eliminating it from the original data values we identified 11 cycles in the crude oil price evolution, 2 of them incomplete – the first and the last one, explained by the absence of data before 1972 and after 2002 – and 9 complete with an average duration of about 3 years. All the cycles can be seen on the graph shown in figure 3. The fist complete oil price cycle began on December 1975 and ended on October 1981, with a period of almost 74 months, the longest of the period under study. The second cycle began on October 1981 and ended on April 1986 with a period of 35 months. The third cycle began on April 1986 and ended on March 1989 with a period of 35 months. The fourth cycle began on March 1989 and ended on February 1991 with a period of 21 months. The fifth cycle began on February 1991 and ended on July 1992 with a period of 17 months. The sixth cycle began on July 1992 and ended on May 1994 with a period of 22 months; this is the quickest cycle of the 30 years in analysis. The seventh cycle began on May 1994 and ended on December 1996 with a period of 33 months. The eighth cycle began on February 1997 and ended on January 1998 with a period of 23 months. The ninth cycle began on January 1998 and ended on September 2001 with a period of 44 months.

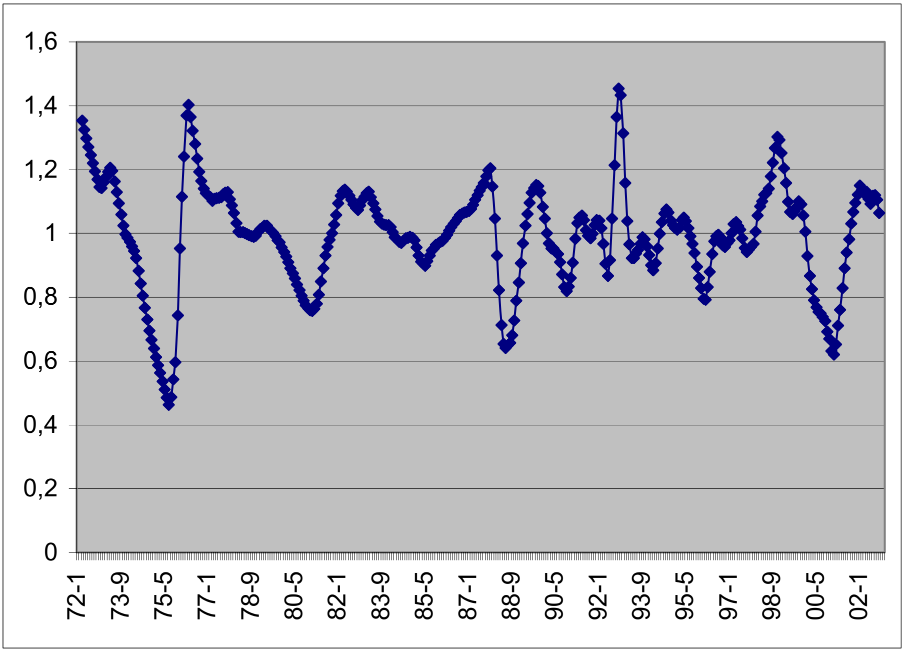

Figure 3 – Long-term Cycles

Note: the number in front of the year in the abscissa line corresponds to the month of that year (for instance 78-9 means September of 1978, and 97-1 means January of 1997).

Defining the expansion phase of the crude oil price cycle as the number of months between the trough of one cycle and the peak of the following, and the contraction or decreasing phase of the oil price cycle as the one that goes from the peak of one cycle to the trough of the same cycle, we can appreciate the expansion and the contraction periods of the referred cycles and fill the table 1. A quick look at the table shows that the average duration of the expansion period is 14.0 months, against the average duration of the contraction period that is 19.9 months, so greater than the first one. The average duration of the full cycles is 35.5 months, almost 3 years.

Table 1 – Long-Term Oil Price Cycles

Dates of				Period (in months)		
n.	Begin. date	Peak	Trough	Expansion	Contraction	Full cycle
1	?	?	1975-7	?	?	?
2	75-12	1976-4	1981-1	9	57	71
3	81-10	1982-4	1985-6	16	36	54
4	86-4	1987-11	1988-7	30	7	35
5	89-3	1989-9	1990-11	15	14	21
6	91-2	1991-5	1992-5	7	12	17
7	92-7	1992-10	1994-2	5	7	22
8	94-5	1994-9	1996-2	16	17	33
9	97-2	1997-4	1997-10	15	4	23
10	98-1	1998-11	2001-1	15	25	44
11	01-9	2002-1	?	12	?	?
		Average duration		14.0	19.9	35.5

2.4 Main Political Leaders, Wars and Other Explicative Factors of the Crude Oil Price Cycles

Putting side by side the expansion and contraction periods of the different oil price cycles and the contemporaneous conflicts/wars, the political leaders of the United States of America (USA), of the United Kingdom (UK), of France (F), of Germany (G) and of URSS/Russia (R) and other elements we can find interesting contemporaneous correlations among some of these items; of course there are conflicts that we don't put side by side because they are almost permanent as is the case of the Israeli-Palestinian war and the Angolan civil war (this one finished very recently). The contemporarily of these elements can be seen in the following paragraphs.

1st cycle – contraction period (unknown date to 1975/12): with our data beginning in 1972-Jan we can't identify the beginning of this cycle; the only thing we can see is that it ends in December, 1975. *The contemporaneous armed conflicts and other factors are the following*: the 6 days Israeli-Palestinian war, the assertion of power by OPEC, the raise of tax rates, the posted prices and royalties, the nationalization of firms, the raise of oil prices in response to falling USA dollar; the beginning of negotiations for gradual transfer of ownership of western assets; the beginning of the oil embargo (1973); the freeze of OPEC prices; the mandatory oil allocation by USA; the end of the oil embargo (1974); the beginning of the USA crude oil entitlements program; the OPEC increase of the revenue (10/1975), the Kissinger hint at military action against oil producers in case of "strangulation", the negotiation collapse between oil producers and consumers. *The contemporaneous Political Leaders* of this contraction period were the following: USA: Nixon, France: G. Pompidou, UK: Wilson and Heath, G: Willy Brandt, R: L. Brezhnev.

2nd cycle (12/75 to 1/81): **Expansion period (7/75 to 4/76):** *wars and other explicative factors of this expansion period*: nationalisations in Kuwait and Iraq, Ford signs the energy policy conservation Act to establish a Strategic Petroleum Reserve (SPR), EPCA 3-tier price regulation begins, Lebanese civil war causes drop in Iraq oil exports through trans-Lebanon pipelines to Mediterranean Sea. *Political Leaders*: USA - Ford, UK - Wilson, G - Schmidt, F - G. d'Estaing and R – Brezhnev. **Contraction Period (4/76 to 1/81):** *wars and other explicative factors of this contraction period*: OPEC reacts against protective measures adopted by several countries, pipeline fire drops Iraqi production, Iran oil production starts dropping, OPEC oil production raises, 1st emergency crude oil buy-sell program allocations, Iranian revolution, Saudi Arabia cuts oil production, Iran resumes petroleum exports, USA phased oil price decontrol begins, Canada stops oil exports to USA refiners, Iran takes hostages, Carter halts imports from Iran; Iran cancels USA contracts, Iraq breaks 1975 treaty with and invades Iran (Iran-Iraq war), mutual bombing of installations, Windfall Profits Tax enacted, collapse of OPEC pricing structure, Iraq repels Iranian offensive. *Political Leaders*: USA – Ford and Carter, GB – Wilson, Callaghan and Thatcher, G - Schmidt, F – D'Estaing, R – Brezhnev.

3rd Cycle (1/81 to 4/86): Expansion Period (1/81 to 5/82): *wars and other explicative factors of this expansion period*: Iran-Iraq War, Reagan abolishes remaining price and allocation controls, mediation Iran-Iraq attempts fail, Damascus (Syria) closes trans-Syrian oil export pipeline to show support on Iran, Spot prices dominate official OPEC prices, USA boycotts Libyan crude. *Political Leaders*: USA – Carter and Reagan, UK - Thatcher, G - Schmidt, F - D'Estaing and Mitterrand, R – Brezhnev. **Contraction Period (05/82 to 05/85):** *wars and other explicative factors of this contraction period*: Iraq cease-fire declaration, Iran launches 1st attack into Iraq, oil demand falls as a result of conservation and rational use of other fuels; economic recession, Iraq attacks Iran with missiles, USA threatens action to preserve navigation in Persian Gulf, heavy Iran-Iraq fighting, beginning of the tanker war (due to Iran-Iraq war 44 ships were attacked), Reagan rules out US military intervention, Libya initiates discounts; OPEC, Norway, UK, and Nigeria cut prices, Saudi cuts Light price. *Political Leaders*: USA – Reagan, UK – Thatcher, G - Kohl, F - Mitterrand, URSS – Brezhnev and Andropov.

4th Cycle (04/86 to 03/89): Expansion Period (05/85 to 11/87): *wars and other explicative factors of this expansion period*: Gulf war escalade: battle of the cities in Iran-Iraq war, Iraq raid air against Iran main oil export terminal (Kargan Island), Iraq attacks Teheran refinery, Iran attacks refinery near Baghdad, Iraq attacks Iranian Sirri Island to interrupt Iran exports, Saudis link to spot price and begin to raise output. *Political Leaders*: USA - Reagan, UK - Thatcher, G - Kohl, F - Mitterrand, R – Andropov, Chernenko and Gorbachev. **Contraction Period (11/87 to 6/88):** *wars and other explicative factors of this contraction period*: PEC meeting fails, wide use of formula pricing, Iran accepts cease-fire, Exxon-Valdez tanker runs around, producers meeting failure. *Political Leaders*: USA - Reagan, UK - Thatcher, G - Kohl, F - Mitterrand, RUSSIA – Gorbachev.

5th Cycle (3/89 to 2/91): Expansion Period (6/88 to 9/89): *wars and other explicative factors of this expansion period*: Fulmar/Brent production outages in the North Sea, refinery fires, OPEC raises production, Exxon's Valdez tanker spills crude oil. *Political Leaders*: USA – Reagan + Bush, GB - Thatcher, G - Kohl, F - Mitterrand, R – Gorbachev. **Contraction Period (9/89 to 11/90):** *wars and other explicative factors of this contraction period*: OPEC raises production ceiling, Iraq invades Kuwait (beginning of the Persian Gulf War), the Israeli-Palestinian war. *Political Leaders*: USA - Bush, UK – Thatcher + Major, G – Kohl, F – Mitterrand, RUSSIA – Gorbachev.

6th Cycle (2/91 to 7/92): Expansion Period (11/90 to 5/91): *wars and other explicative factors of this expansion period*: Bush orders troops to Saudi Arabia, operation Desert Storm begins; shortfall due to invasion, fear of war and long-term supply disruptions as Hussein threatens Israel, Libyan Kadhafi speaks against the Israeli, British secretary says force can be used if Iraq doesn't leave Kuwait, report says that Iraq will bolster its forces in Kuwait, Mitterrand accepts military use in Kuwait, Persian Gulf war ends. *Political Leaders*: USA - Bush, GB - Major, G - Kohl, F - Mitterrand, R – Gorbachev. **Contraction Period (5/91 to 5/92):** *wars and other explicative factors of this contraction period*: US begin attacks against Iraq, Bush directs drawdown of the SPR; oil prices fall, allied success on the Gulf War, Iraqi Scud missiles land in Israel and Saudi Arabia, Persian Gulf war ends, Iraqi soldiers ignite Kuwait oil fields, URSS cuts partially its oil exports, Nigerian begins oil production, end of the Soviet Union; creation of the Commonwealth of Independent States (CIS); last Kuwaiti oil fire extinguished. *Political Leaders*: USA - Bush, GB - Major, G - Kohl, F - Mitterrand, RUSSIA – Gorbachev and Yeltsin.

7th Cycle (7/92 To 5/94): Expansion Period (5/92 to 10/92): *wars and other explicative factors of this expansion period:* nothing to refer. *Political Leaders*: USA - Bush, GB - Major, G - Kohl, F - Mitterrand, R - Yeltsin; *wars and other factors*: OPEC increases production. **Contraction Period (10/92 to 5/93):** *wars and other explicative factors of this contraction period*: nothing to refer[ii]. *Political Leaders*: USA - Bush, GB - Major, G - Kohl, F - Mitterrand, RUSSIA – Yeltsin.

8th Cycle (5/94 to 2/97): Expansion Period (5/93 to 9/94): *wars and other explicative factors of this expansion period*: oil plunge on speculation that Iraq will accept UN missile test site inspections and receive approval to resume oil production, OPEC overproduction; North Sea output; weak demand, oil prices firm on strength of institutional shifting of US investment funds from equity and bond markets to cash and commodities, Nigerian overall strike. *Political Leaders*: USA – Bush + Clinton, GB - Major, G - Kohl, F - Mitterrand, R – Yeltsin. **Contraction Period (9/94 to 2/96):** *wars and other explicative factors of this contraction period*: Europe acquires Norwegian NG, OPEC leaders ask Norway foreign minister to lower production in order to stabilize world oil prices, Exxon signs an agreement to buy soviet NG, demand contraction of Iranian oil, Kuwait and Angolan increase oil production, Iran test a new anti-ship missile near the Strait of Ormuz. *Political Leaders*: USA - Clinton, GB - Major, G - Kohl, F - Mitterrand, R – Yeltsin.

9th Cycle (2/97 to 1/98): Expansion (2/96 to 5/97): *wars and other explicative factors of this expansion period*: Clinton authorises the sale of crude oil from the Strategic Petroleum Reserve to lower prices, Exxon signs an agreement to explore oil and NG in Russia. *Political Leaders*: USA - Clinton, GB – Major, G - Kohl, F - Chirac, RUSSIA – Yeltsin. **Contraction Period (5/97 to 9/97):** *wars and other explicative factors of this contraction period*: Venezuela authorises foreign companies to explore and produce oil, Gabon leaves OPEC, USA imposes sanctions to firms that sign energy agreements with Iran and Libya, and launches cruise missile attacks into Iraq following an Iraqi-supported invasion of Kurdish safe haven areas in northern Iraq, Iraq begins exporting oil under UN Security Council Resolution 986, prices rise as Iraq's refusal to allow UN weapons inspectors into "sensitive" sites raises tensions in the oil-rich Middle East, OPEC raises its production, Exxon and a Qatar Corporation intend to convert gas in oil products, Iran threatens to close the Strait of Ormuz if it is threatened, Iraq authorised to sell some oil. *Political Leaders*: USA - Clinton, GB – Major and Blair, G - Kohl, F - Chirac, RUSSIA - Yeltsin;

10th Cycle (11/97 to 1/01): Expansion Period (9/97 to 12/98): *wars and other explicative factors of this expansion period*: Kyoto conference, OPEC cuts production, India tests nuclear weapons. *Political Leaders*: USA - Clinton, GB - Blair, G - Kohl, F - Chirac, RUSSIA – Yeltsin. **Contraction Period (12/98 to 1/01):** *wars and other explicative factors of this contraction period*: Iraq increases production coincides; no growth in Asian oil demand and economic crisis; world oil inventories increase following 2 warm winters, OPEC pledges additional production, strong world oil demand, OPEC oil production cutbacks, and other factors, including weather and low oil stock levels, Clinton authorizes the release of oil from the SPR to bolster oil supplies, particularly heating oil in the Northeast, world demand and economic recession; OPEC overproduction. *Political Leaders*: USA - Clinton, GB - Blair, G – Kohl + Schroeder, F - Chirac, RUSSIA – Yeltsin + Putin.

11th Cycle (1/01 to unknown date): Expansion Period (1/01 to 1/02): *wars and other explicative factors of this expansion period*: Sept, 11 terrorist attacks on the US, increased fears of a sharper worldwide economic downturn, sharply lower oil demand, prices then increase on oil production cuts by OPEC and non-OPEC at the beginning of 2002, possible renewed conflict with Iraq, OPEC oil production cuts, unrest in Venezuela, rising tension in the Middle East. *Political Leaders*: USA - Bush, GB - Blair, G - Schroeder, F - Chirac, RUSSIA – Putin. **Contraction Period (1/02 to unknown date):** *wars and other explicative factors of this contraction period*: strike in Venezuela, military conflict in Iraq, cold winter weather; U.S. oil inventories decline; continued unrest in Venezuela and oil traders' anticipation of imminent military action in Iraq causes prices to rise (2003), military action commences in Iraq on March 19, 2003, Iraqi oil fields are not destroyed. *Political Leaders*: USA - Bush, GB - Blair, G - Schroeder, F - Chirac, RUSSIA – Putin.

As *a synthesis* we may say that the qualitative analysis done to study the contemporaneous association or correlation between the long-term cycles of the oil price and the armed conflicts permit us to conclude the following: 1st the armed conflicts favour the raise of the barrel crude oil price and this helps the development of the expansion phase of the oil price cycle; 2nd that the absence of armed conflicts or the peace time helps the descending of oil prices and this favours the contraction phase of the oil price cycle; 3rd that there are no clear association or correlation between the oil price cycle and the political leaders of the main industrial and developed countries (USA, UK, F, G, Russia), because some of these leaders are contemporaneous of several expansions and contraction phases of the oil price cycles; 4th that there are other explicative factors of the oil price cycles apart from the political leaders and the armed conflicts, like, for instance, the phase of the contemporaneous economic cycle and 5th that there are long-term oil price cycles, what is not a unanimous conclusion.

Conclusions

This paper questions the existence of long-term economic cycles in the international barrel oil price and their explicative factors. To do this it uses monthly non-constant data of the period 1972-2002. The approach used – whose main step is the Hodrick-Prescott filter that is used to estimate the long term trend – isolates the cyclic movements or effects present in the data series after eliminating this trend from the data and after smoothing these values. Later it dissects each one of the long-term crude oil cycles in the different phases that compose each one of the cycles. At the end there is an attempt to prove the association between the crude oil price cycles (with their phases), the armed conflicts and the main political leaders of the some occidental countries (France, England, Germany, USA) and Russia that are contemporaneous to the phases of these cycles.

The analysis done confirms either the existence of long-term oil price cycles, or a surprising conclusion, that the armed conflicts favour the expansion phase of the oil price cycle, or that the absence of armed conflicts (peace time) favours the contraction phase of the oil price cycle, or that there are no clear association between the oil price cycle and some of the main political leaders of the world (USA, UK, F, G, Russia) and that there are other explicative factors of the oil price cycles apart from the political leaders and the armed conflicts.

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[i] One can use the web site www.eia.doe.gov/emeu/cabs/chron.html to confirm and obtain more information concerning the data used.

[ii] USA, Mexico and Canada sign a multilateral free trade agreement.

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Did the Fifth K-Wave Begin in 1990-92? Has it Been Aborted by Globalization?

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Abstract. Of the many theories that have been offered to 'explain' K-cycles, the most plausible by far is their close correlation with clusters of radical innovations associated with changes in major primary energy sources, starting with the "age" of coal and iron, followed by the "age"of steam power, railways, steel, and town gas, followed by the age of electrification, internal combustion engines and automobiles. Schumpeter (writing in 1939) suggested that the third wave would end around 1950. He expected the A-period of a fourth K-wave to begin then, with a B-period starting in the 1970s and ending around 1990. The postwar boom and the advent of nuclear power and natural gas seemed to fit that prescription. The slowdown beginning in the 1970s also fits the pattern. US oil production peaked in 1969-70. The energy crisis of 1973-74 was followed by the deepest recession since the 1930s. Nuclear power suffered a setback in the 1980s, and the on-going de-industrialization of the US accelerated. In effect, it can be argued that the fourth K-wave occurred on schedule and ended around 1990-1992, also with a deep recession. The A-period of the fifth wave presumably began then, driven by the 'digital revolution' ICT and the internet. But recent events, especially since 2000, also suggest that the pattern may have broken. This paper reviews the evidence for such a view. The relevance to US National Security is spelled out clearly in Michael Klare's book "Resource Wars" (2001) which virtually predicted 9/11 and the US attack on Iraq.

1. Introduction

The Kondratieff-cycle or K-wave was first identified, as such, by the Russian economist N.D. Kondratieff in 1926 [1] based on long price time series, and price changes, as shown in Figure 1 redrawn from [2] Figure 2. Schumpeter's well-known schematic for the K-wave identifies price 'upswings'(A-periods) of about 25 years, followed by 'downswings' (B-periods) of similar length [3]. His A-periods (for the US) were 1787-1813, 1843-1869, and 1898-1924. He postulated a B-period starting in 1925, presumably to end around 1950. A straightforward extrapolation (as suggested by Kleinknecht) suggests a peak around 1950 and another downswing in the 70s and 80s, followed by an upswing in the 90s [4].

Joseph Schumpeter theorized that each of the long waves (A-period plus B-period) reflects a cluster of radical innovations. The first period did correspond to the substitution of coal for wood and charcoal and steam power for waterpower. The second period was characterized by the substitution of steel for iron, steamships replacing sailing ships and railroads replacing canals. It also saw the substitution of gaslight and kerosene lamps for candles. The third period saw the rise of the electrical industry, the substitution of electric light for gaslight and kerosene lamps, the replacement of steam power in factories by electric motors, the internal combustion engine, and the substitution of automobiles for horse-drawn vehicles. The fourth period might be characterized by the advent of nuclear power and natural gas (by pipeline), substitution of plastics for many other materials, truck transport replacing rail transport, and so on. The fifth, starting around 1990-92 would seem to have been driven – for the first time – by non-energy-related innovations, notably the mass production of PCs and cellular telephones, and the Internet.

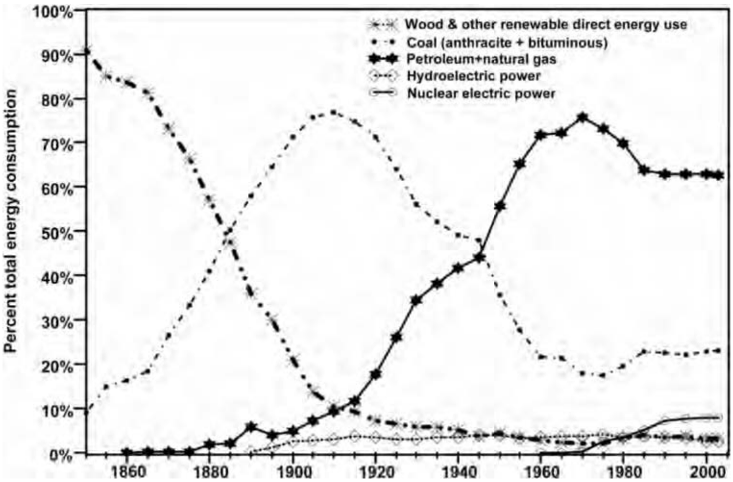

Figure 1 – Apparent Energy Consumption USA 1850 – 2003: % by source

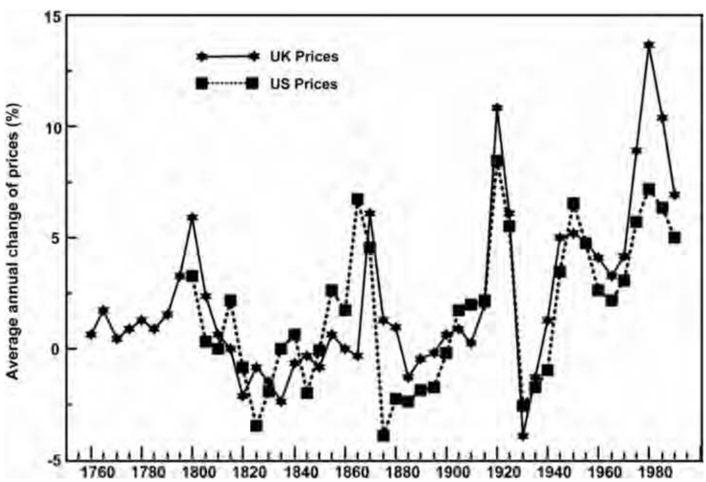

Figure 2 – Long Waves of Prices 1760 – 1990 for the US and UK, % annual change

The Schumpeter scheme, as modified and extended by Kleinknecht [4] and Ayres , is shown in Table 1 (Ayres modifications indicated by italics).

Table 1: The Schumpeter-Kleinknecht scheme

K-wave	Upswing (A-period)	Downswing (B-period)	Innovation
1st long wave: Industrial Kondratieff	1787-1813	1814-1842	Substitution of steam power for water power, substitution of coal and iron for wood, emergence of the textile industry
2nd long wave: Bourgeois Kondratieff	1843-1869	1870-1897	*Petroleum industry*; railroadization, steamships, substitution of steel for iron; *gaslight*
3rd long wave: neomercantilist Kondratieff	1898-1924	1925- *1950*	Electrical and chemical innovations, internal combustion engines; *automobile industry*
4th long wave:	1951-1974	1975-1991	*Natural gas, nuclear power (aborted), plastics, aluminum, substitution of truck transport for rail transport; air transport*
Fifth long wave:	1992-2020 (?)	?	*Digital revolution*

While the above-mentioned technological innovations and substitutions did obviously occur, Simon Kuznets immediately criticized Schumpeter harshly for failing to show that the apparent regularities were reflected in other economic data, or to justify or explain the alleged bunching of major innovations [5]. However, the search for economic indicators other than prices has continued, with some success [6-9, 10-12]. Similarly, the phenomenon of innovation bunching has been investigated by a number of authors since then (including the present one), and several tentative explanations for it have been offered [13-18]. Mensch's basic hypothesis was that a depression releases capital and other under-utilized resources that tend to encourage radical innovations, whereas boom periods tend to discourage radical innovations by tying up resources for purposes of satisfying current demand.[1]

The fact that there have been no major energy-power-work-related innovations driving the conjectural 5th K-wave is cause for some concern, as discussed subsequently. First, however, it is important to consider a question that is fundamental to the issue, but that has been neglected.

2. On the Meaning of 'Radical Innovation'

Looking back on the literature from the perspective of the present year (2005), however, a certain general criticism can be applied to most, if not all, of the 1980s literature cited above. None of the studies I am aware of have classified technological innovations in terms of their 'spillover potential' or their fundamental potential for generating new products and services *in sectors other than the one where the innovation took place*. The point is straightforward: most technological innovations affect only a single sector, or subsector, or even a single product or service. By contrast, only a very few innovations reach across sectors. The steam engine did that. It began as a coal-mining innovation, but it soon found applications in other (copper-tin) mines, in the metallurgical industry (driving boring

1.Unfortunately Mensch's hypothesis was not supported by an extensive independent database on innovation. He borrowed his list largely from another source that was created for very different reasons, and which covered far too brief a period [19].

machines and air pumps for blast furnaces), as a supplement for water power in cotton mills and grain mills, and finally as the enabler of a completely new type of land transport (the railroad) and a new type of ocean-going vessel independent of wind, tides and currents. Cast iron and later wrought iron began to replace wood for all types of structural purposes, starting with wheels and axles, then rails, and finally structural shapes enabling buildings to rise higher and bridges to span wider streams. Steel, being stronger than iron, enabled still more products and structures.

Electric power, beginning in the 1880s, was even more potent in creating new opportunities and stimulating growth. The first application by Edison was for incandescent lights, but that was followed almost immediately by applications to trams, elevators, electrified railways and the replacement of steam power plants in factories that formerly utilized long shafts and belts to drive machine tools. Electric power permitted high temperature electric furnaces that were used to manufacture synthetic materials like calcium carbide (for acetylene) and silicon carbide ('Carborundum') for drills and grinders. Electric furnaces were also essential for melting refractory metals, including nickel and chromium (for stainless steel), cobalt, molybdenum and tungsten. Electricity in quantity permitted large scale electrolysis, which enabled aluminum to become a major structural material – essential for aircraft – rather than a curiosity. Chlorine, another product of electrolysis, is now a mainstay of the chemical industry. Finally, without electricity there would be no telephones, telegraphs, radios, TVs, radar, microwave ovens or computers. While other radical innovations were needed in some cases, the key innovations were Edison's efficient generator and Tesla's inductive motor and his 3-phase AC distribution system, developed by Westinghouse.

In case the point is not yet obvious, one can contrast the above examples with most of the 'major' innovations on the list of case studies that has inspired many subsequent analyses of clustering, viz." The Sources of Invention"[19]. To take a few examples of innovations from their list that had *no* spillover impact whatsoever, consider the ball point pen, 'cinerama', continuous hot strip rolling (of steel), continuous casting (of steel), the cotton picker, crease-resistant fabrics, diesel-electric railway traction, DDT, gyro-compass, hardening of liquid fats, insulin, Kodachrome, long-playing records, penicillin, power steering, safety razor, zip fasteners, etc. Others in the Jewkes list, mostly new plastics, may have had applications to a number of different products, especially packaging materials, but few if any created whole new industries. Evidently the great majority of innovations, even though they may have been termed 'radical', have contributed little or nothing to the creation of opportunities outside the industry (or firm) where the innovation occurred, hence to economic growth. It is true that plastics and synthetic fibers, taken all together, can be said to have created a new industry based on the availability of petrochemicals derived originally from coal (via coke ovens) and later from natural gas. But the single truly radical innovation on the Jewkes list was the transistor.

Bearing in mind the spillover issue, noted above, an interesting pattern within Schumpeter's proposed scheme of substitutions (Table 1) can be discerned. The historical long waves correspond fairly well to major shifts in the dominant energy and energy-conversion systems as shown in Figure 1. The cluster of radical innovations associated with a given source of primary energy is *not* independent of each other and the clustering itself is never accidental. On the contrary, the innovations linked to an energy-power or work system are closely related, and in some sense inevitable. For instance, applications of electric power, such as electric furnaces, electrolysis and electric motors followed after the availability of electric power on a large scale because, prior to that time, there was no incentive to develop such applications. Applications of acetylene, aluminum, chlorine and so on, followed later still.

In short, there is a plausible, if qualitative, explanation for clustering: namely that a number of important innovations stem from the exploitation of a new source of primary energy or a new technology for energy-conversion. This also leads to a plausible explanation for why a few well-defined clusters – as noted above – have contributed so much to past economic growth. Finally, there is also a plausible argument – which cannot be developed further in this paper – to the effect that the 25 year length of the B-period (or half-cycle) corresponds roughly to the useful design life, and thus the depreciation rate, of factories, mines, power plants and comparable productive investments. Clearly, a major energy-work-power system that is in place cannot be depreciated and replaced in less than this time (although the replacement may easily take longer). Of course the capital for the replacement system is largely obtained from the very same depreciation process.

In short, I think the K-wave phenomenon is basically a capital-replacement cycle, for capital associated with dominant energy-power-work systems, each of which was preceded by a period of radical innovation during the B-period (downswing) of the preceding K-wave.

3. Supporting Evidence

Some interesting quantitative evidence of the fourth K-wave, in particular, can be derived from historical data on energy use and energy conversion efficiency for the US, starting in 1900. Figures 3 and 4 below graph the aggregate exergy inputs to the US economy since 1900, taking into account all sources of exergy, including biomass from agriculture and forestry.[2] Details of the sources and aggregation and the exergy data series cannot be reproduced here, but can be found in the appendix to Ayres [20].

Figure 5 shows the long-term trend in energy (exergy)/GDP, in three forms. When only commercial (mainly fossil) fuels are taken into account (top curve) there is a clearly marked peak in the early 1920s, corresponding roughly to the peak of Schumpeter's third Kondratieff cycle. But when contributions from biomass and other renewables are included (bottom curve), there is no peak, but rather a more or less monotonic long term declining trend. The obvious explanation for the difference between the two curves is that fossil fuels of all kinds were substituting for biomass – particularly fuelwood – as a source of exergy for the economy.

Figure 6 shows the allocation of total exergy inputs to different types of work. The most noteworthy shift over the past century is the sharply reduced share of exergy inputs used for producing space heating, water heating and cooking. These uses were heavily based on biomass (fuel wood) during the 19th century and – in rural areas – well into the 20th. The share of exergy used to generate electricity has risen almost as sharply. Meanwhile, the share allocated to transportation and other prime movers (such as construction and agricultural machinery) has increased but only mildly.

Figure 7, which follows, graphs the increasing exergy-work conversion efficiency for the US economy, during the 20th century, again showing two versions. The upper curve is for conversion of fossil fuels to work (which means that muscle work by humans and animals is not taken into account). The lower curve does take into account all forms of exergy inputs, including the biomass consumed by working animals. It is noteworthy that overall conversion efficiency (lower curve) has increased about 5-fold during the 20th century. Details of the underlying efficiency analysis obviously cannot be presented here,

2.The term 'energy' is more commonly used, but is technically incorrect for purposes of this discussion. Energy is a conserved quantity, meaning that it is not 'used up' in conversion processes, but simply becomes less available. Hence what we really mean, when we use the term energy in the sense of an input to a process, is *available energy*, or *exergy*.

but they can be found in another publication [20].

Figure 8 shows aggregate useful work – as characterized above – done by the US economy from 1900 to 1998, including muscle work. It also shows the ratio of useful work done to GDP, analogous to Figure 5. In this case there is a well defined peak in the early 1970s. It may be significant that this peak occurs approximately 50 years – or a complete K-cycle – after the 1920s peak in the exergy/GDP curve for fossil fuels and commercial energy. As mentioned earlier, the earlier peak seems to reflect the substitution of fossil fuels for biomass, especially fuel-wood., especially for space heating, water heating and other domestic uses. The more recent peak seems to coincide with peak US production of petroleum and, perhaps, the increasing importance of nuclear power and/or the increasing dependence on imports.

Having said this, however, I think that the A-period of Schumpeter's 'fourth wave' actually did start on schedule around 1950 and ended more or less on schedule in 1973-74, although the K-wave theory could not have predicted the peaking of US domestic petroleum production in 1969-70 or the Arab-Israeli conflict that erupted in the Yom Kippur war. Still, the peak in the work/GDP curve hardly seems accidental. Perhaps the war and the attendant crisis merely accelerated the coming change. Moreover, just as a crash and the Great Depression of the early 1930s followed the boom of the late 1920s, the energy crisis of 1973-74 was actually accompanied by a deep, albeit shorter recession coincident (1974-75). The following price-induced inflation was not associated with an economic recovery: it was called 'stagflation' at the time.

In fact, the widely expected shift to nuclear power had already begun in the 1960s. But the coming of the age of nuclear power was delayed significantly by doubts about the technology itself (including its linkage to proliferation of nuclear weapons) and events at Three Mile Island and later Chernobyl. Given the energy crisis, and the setback to nuclear power, the B-period should have been characterized by significant *non-fossil*, *non-nuclear* energy-related innovations that could stimulate a new 'takeoff' in the 1990s. It did not happen that way. The subsequent B-period decline simply ended with another recession in 1990-92.

Backup alternatives, such as Solar Power Satellite (SPS), wind turbines, photo-voltaics (PV) and fuel cells did emerge, and – except for SPS, began to find small potential market niches in the energy scene. But they all appeared on the scene too late and are still far from being ready for instant large-scale application.

In consequence, it seems that the 'age of oil' has been unduly and indefinitely extended. The violence in the Middle East is almost certainly about competition for access to dwindling reserves of cheap petroleum, more than democratization or any of the other excuses that have been offered [21]. On the other hand, it can also be argued – as I do in another paper – that the period after 1970, and especially after 1990, was characterized by the long-expected economic impact of computers and the digital revolution. Despite the collapse of the 'dot.com' bubble that exploded in the late 1990s and collapsed in 2001, it is plausible that information and computer technology (ICT) have finally taken over the role of primary driver of economic growth into the 21st century.

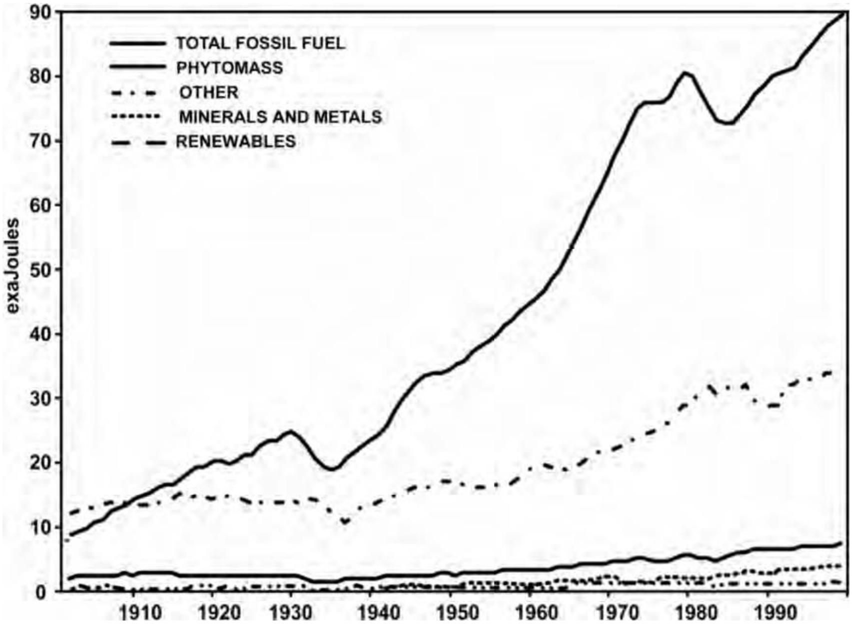

Figure 3 – Exergy Inputs by Source, USA 1900 - 1998

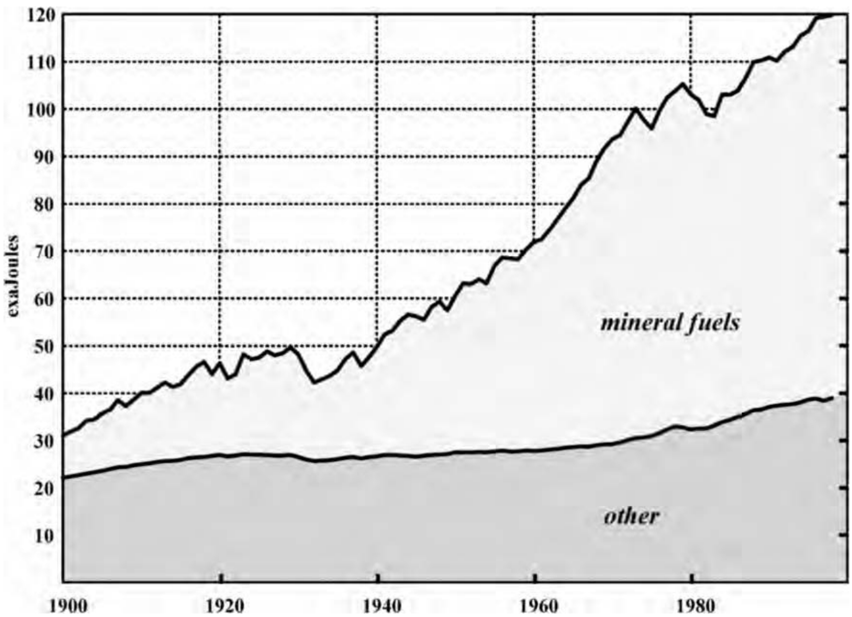

Figure 4 – Cumulative Exergy Inputs, USA 1900 – 1998 (mineral and non-mineral fuels)

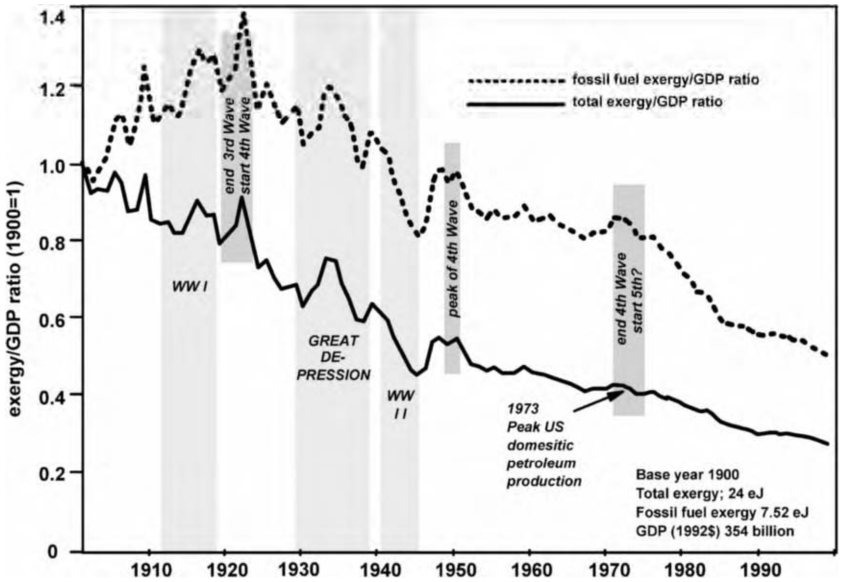

Figure 5 – Ratio of Exergy Inputs to GDP, USA 1900 - 1998

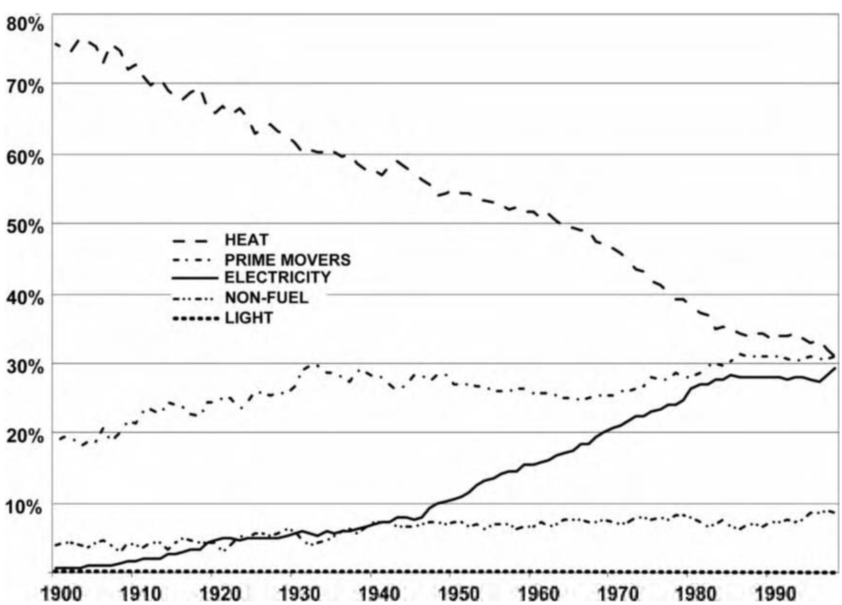

Figure 6 - % of Fossil Fuel Exergy Consumed by Type of End-use, USA 1900 - 1998

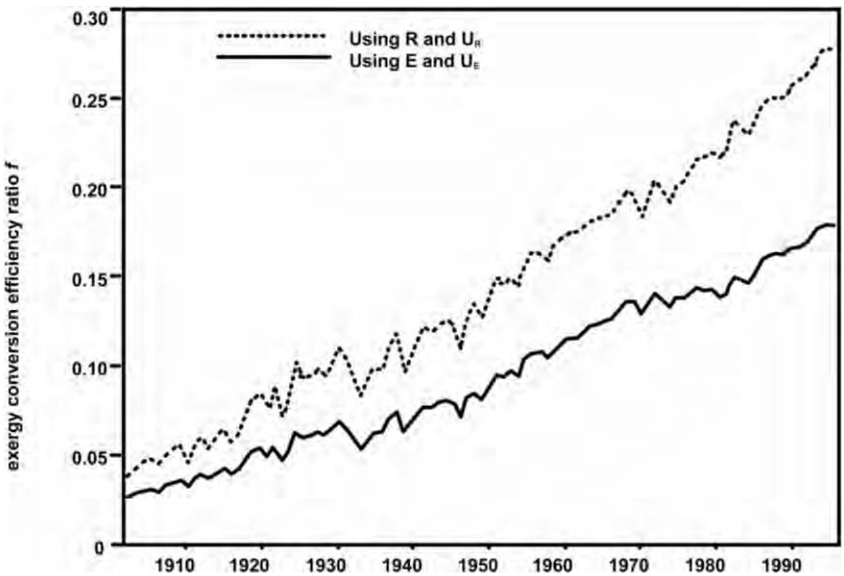

Figure 7 – Exergy Conversion Efficiencies for 2 Definitions of Work & Exergy, USA 1900 - 1998

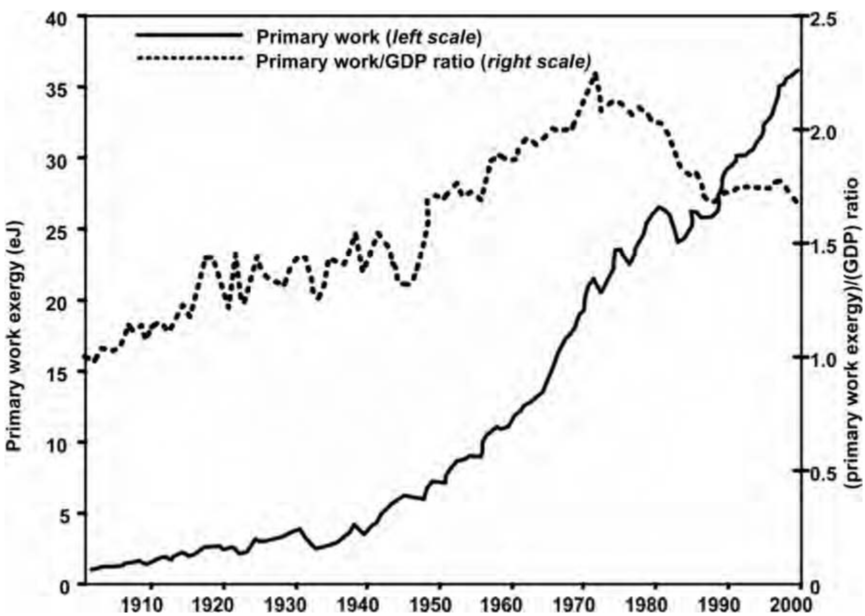

Figure 8 – Primary Work and Primary Work/GDP ratio, USA 1900 - 1998

4. Sources of 'Noise'

It has always been hard to 'see' K-waves amidst the 'noise' of irrelevant and distracting events and irreversible changes that are occurring simultaneously. In the coming decades it will be still harder, and quite probably the noise will drown out the signal entirely. Major visible changes in the world economy have certainly occurred since the end of the 1960s. Many of them began in the US and some have only recently begun to spread across the globe. Some of these changes may have contributed to slower economic growth in the US and the OECD area; others may be a consequence of slower growth. Still others may have accelerated economic growth in some areas, compensating for slowdowns elsewhere. Or some altogether deeper cause may have been responsible for both slower growth and other observed changes.

Here is a short list of the major changes that began or accelerated during the early 1970s, most of which *cannot* plausibly be related to any business cycle.

(1) US domestic petroleum production peaked in 1969-70. Since then the US has become the world's greatest importer, partly due to political unwillingness to restrain consumption (by taxation). The early peaking can be attributed to the fact that the oil industry began in the US and US territory was the first to be comprehensively explored for petroleum resources. By the same token, high consumption resulting from the low prices accelerated early exhaustion.

(2) The long decline in petroleum prices ended with the Yom Kippur War of 1973, the Arab oil boycott of 1973-74, and the price spikes of 1973-74 and 1980. OPEC controlled prices after that, and the Saudi Arabia became the enforcer of OPEC. OPEC policy since the 1970s has been to keep exports high enough and prices low enough to encourage continued consumptive uses and discourage the development of viable technological alternatives. Geopolitics and resource scarcity drove these changes.

(3) De-industrialization of the US accelerated after 1970 thanks to US preoccupation with military technology and the Cold War. Meanwhile a successful export-oriented economic development policy had been initiated by Japan in the late 1950s, with US connivance (to ensure Japanese support during the Korean conflict) and imitated by other countries of East Asia. Japan, became the world's most efficient manufacturer of steel, ships, radios, TVs, cameras, watches, random access memory (RAM) chips, robots and many engineered products – including automobiles – especially in the field of 'mechatronics'[22,23].

(4) The US trade deficit began to grow rapidly after 1960 and has continued to grow ever since. It was financed at first by Japanese purchases of US government bonds. More recently S. Korea and China and other Asian countries have also become major creditors. Loss of manufacturing jobs in the US was (and is) justified by many economists and politicians on the basis of Ricardian trade theory, viz. benefits to consumers outweigh job losses. The US savings rate has fallen to zero, and the US now (2004) absorbs three quarters of the world's annual savings to finance its twin deficits.

(5) Information and computer technology (ICT) have made extraordinarily rapid progress since the invention of the transistor in 1946 and, especially, since the invention of the microprocessor by Intel in 1970. (This single event saved the US computer industry). Personal computers, mobile telephones and the Internet are the most obvious outgrowths.

(6) The European Union began in the 1950s as the European Economic Community (EEC) a customs union of six countries, but is now much more. It already includes 25

countries, with several more (including Turkey) eager to join. A dozen of the 25 members have implemented a common currency. The European Union is economically as powerful as the US, albeit politically and militarily weaker.

(7) The Soviet Union collapsed in 1989-90, the "iron curtain" has rusted away, and the bipolar world of two superpowers is a thing of the past. NATO is undergoing a major renovation. The world still may not be experiencing the universal triumph of democracy and capitalism, as some have argued [24], but geopolitics has changed radically and irreversibly since 1972.

(8) The global environment (climate, tropical forests and oceans) has deteriorated significantly. This is so, even though the Thames, the Rhine and the Hudson rivers are now cleaner, and the air in big cities of the OECD countries is now cleaner and more breathable than it was in the 1960s. The modern environmental movement began with Earth Day in 1970 and the Stockholm Conference in 1972 (which resulted in the creation of the UN Environmental Program, or UNEP).

In short, the period around 1973-74 was a major turning point in US and world affairs, and, as such, any underlying business cycle K-wave is going to be hard to see. Many of the above trends add up to one 'megatrend': it goes under the name of *globalization*. Many, if not most, of the conflicts evident in the world today can be interpreted in terms of forces promoting globalization versus forces resisting it. One of the most powerful forces promoting globalization is trade and economic growth. Information and computer technology (ICT) is an important driver of both.

5. US Innovations that Stalled after 1970

The crucial geo-political event of the early 1970s was the fourth Arab-Israeli (Yom Kippur) War of 1973, followed by the Arab oil boycott of the US, UK and Netherlands. Behind the headlines, it is less well-known that US domestic oil production had peaked in 1969-1970 and output had started to decline. Thanks to the war and the Arab boycott, the price of petroleum (followed by other hydrocarbons) rose rapidly in 1973-74 to an historic high.

What *should* have happened, according to the conventional economic wisdom, was that new sources of energy (such as nuclear power) and new hydrocarbon energy conversion technologies (such as coal gasification, the fuel cell and the combined cycle) and more energy efficient products (such as automobiles) would quickly emerge from the laboratories and workshops of the world, to compensate for any shortage and keep the resources flowing and the engine of growth turning [25-27].

In fact, the US technological response to the 'energy crisis' was slow and comparatively feeble. (Japan did better). At first there was a flurry of interest on the part of the oil industry, in developing oil shale and tar sands. The shale projects were stopped after a decade, though Canadian tar sands are still regarded as a viable future resource. The US government embarked on a major program of coal gasification. The energy industry did not invest, and most of these projects have subsequently been terminated. There was another brief flurry of interest on the part of the US government in solar power satellites, an outgrowth of the NASA space programs of the 1960s.

The oil price spike of 1973-74 (repeated in 1980-81) resulted in some very modest public enthusiasm for smaller and more fuel-efficient cars, but the first US entries into the small car market were uninspired, to put it mildly. The major beneficiaries were the Japanese manufacturers, especially Toyota and Honda. (Honda vaulted into the automotive major leagues on the strength of the success of its 'Civic' model and the CFCC engine that met EPA emissions standards without the need for a catalytic converter on the tailpipe). To induce the US manufacturers to get serious about conserving energy, congress imposed the corporate average fuel economy (CAFÉ) standards toward the end of the 70s. Thereafter, automotive fuel economy improved until the late '80s[3]

What about the technologies that were widely expected in the early '70s but that did not develop? The setback to fission-based nuclear power resulting from the accidents at Three Mile Island and Chernobyl put an end to investment in new nuclear power plants and, incidentally, to any near-term innovations in nuclear plant design. The so-called 'breeder reactor', which had been expected to supplant the early reactor designs (adapted from the US navy's nuclear submarine program), was terminated. Government R&D in nuclear technologies continued, but much or most of it was really weapons related. The expected long-term follow-on, controlled fusion, is a continuing object of substantial research expenditures in the US, Japan, the European Union, and Russia.. But progress has been very slow due to plasma instability and containment problems. Ultimate success is still not even yet assured, and the earliest time that fusion plants could possibly contribute significantly to the Earth's electricity supply would be c. 2050.

Another technology that many people expected, as an accompaniment to very cheap nuclear power, was the electrification of ground transportation, including an electric car. Europe and Japan progressed much faster in the electrification of public transportation, but the US (led by General Motors) went the other way during the 1930s when thousands of tram-lines already in existence were torn up and replaced by diesel buses. As regards the electric car, one cannot really blame the automobile companies, though they were strongly opposed to the idea. The fundamental problem was the lack of a suitable rechargeable but lightweight storage battery. Most people are unaware of the extent of research that went into the search, during the late sixties. A number of possible electrochemical combinations, including improved lead acid, zinc-air, sodium-sulfur, lithium-chlorine, nickel cadmium and many others received attention at that time.[4] However all had serious drawbacks, including weight, lifetime, and cost. However the surprisingly successful Toyota and Honda hybrid vehicles introduced in 2002 utilize nickel-metal hydride (NiMH) batteries that have been developed by Matsushita Electric Co. in 1989.

No major new US technology initiatives followed the successful end of the Apollo program with the 1969 moonwalks. New applications of space technology, such as the orbiting solar power satellite system (proposed by NASA scientist Peter Glaser in 1968), the creation of orbiting colonies at the so-called L5 (Lagrange) point, as proposed by Gerard O'Neill in 1974), or the industrialization of the moon itself for purposes of providing solar power for the earth (proposed c. 1980 by Criswell [29]) were underfunded or ignored. Only the very limited follow-on programs (space shuttle and orbiting space station) were retained – as NASA monopolies with no significant incentives for private sector participation.

At the same time the US withdrew public support from several other promising non-military areas of energy-related technology, including the supersonic passenger aircraft (SST), high-speed railroad trains, and the magnetic levitation ('mag-lev') train. Other nations stepped in to fill the gap. The supersonic 'Concorde' was launched by a British-French consortium, and operated successfully from 1972 to 2002. High petroleum prices precluded an immediate supersonic follow-on. But the consortium, expanded to included German and Spanish partners, has become Airbus Ltd, and it has recently overtaken Boeing as the leading global manufacturer of airliners. The Japanese pioneered high-speed

3.The law has not been renewed and the gradual return of low prices and talk of gluts was accompanied by the invasion of the so-called sports-utility vehicles (SUVs) in the 1990s.

4.For a survey of these technologies in the late 1960s see Ayres [28].

'Shinkansen' trains in the Tokyo-Osaka corridor. The French went further with the TGV ('très grande vitesse') system that is now linking France with Brussels, soon to reach Amsterdam and Cologne, in the north, and Barcelona, then Madrid and Seville in the south. China has announced plans to build 3000 miles of ultra high-speed routes, probably using French technology.

Meanwhile the Japanese and the Germans have both developed mag-lev technology for ultra high speed alternatives to airlines. The first commercial mag-lev system is in operation, connecting Shanghai's airport with the center of the city. But the most promising of the original mag-lev concepts, by Henry Kolm et al of the MIT Magnetics Laboratory, was funded by the Department of Transportation only to the extent of a working laboratory prototype, then abandoned by the Reagan administration.

Two other technologies that were thought to be very promising in the early 80s were artificial intelligence (AI) and robotics [30]. If a serious program to colonize space or industrialize the moon had been undertaken then, both of these technologies would have been developed much faster than they have been, possibly to the point where they would have significant spillover potential. However, for whatever reason, both have been largely neglected, since the early 80s, except to the extent that specialized assembly robots have been further improved and fairly widely adopted in mass production industries.

Why were these apparent opportunities neglected? In the early 1970s the US was preoccupied by the Viet Nam war, the 'cold war' and the so-called 'energy crisis'. US efforts have been limited largely to the military sphere. US military technology is now by far the most advanced in the world. But the civilian spinoffs are hard to find. Symbolic of changed priorities, the US government actually promoted the breakup of AT&T, which spelled the inevitable decline of the Bell Telephone Laboratories, once the outstanding industrial research establishment in the entire world. And the Bush administration recently cut the 2005 budget for the National Science Foundation, to help pay for increases in military spending and spending on "homeland security".

6. Implications for National Security

National security has dominated public policy in the US since the Korean war and, especially, the Cuban missile crisis. The US response to the Soviet challenge and the Cold War has been to build up an enormous and costly military establishment, focusing on high tech weapons. However the weapons developments have had very little spillover into civilian sectors, with the result that US international competitiveness has lagged. Whereas the US enjoyed export surpluses in many areas in the early postwar years, the tables have turned. The remaining areas of favorable trade balances for the US are now very limited indeed: weapons technology is one of the few, along with large airliners (Boeing, now under challenge by Airbus), microprocessors (Intel), computer software (Microsoft) and movies. Even the old standbys, grain and soya beans, are losing out to Brazil.

An addition to the trade imbalance, the US also has an enormous budgetary imbalance, thanks to the anti-tax ideology of the Bush administration. The twin imbalances have driven the national debt to new and dangerous levels. Meanwhile, economic growth – which the Bush administration confidently predicts will eventually convert the debt into a surplus – shows no signs of doing so. The so-called 'recovery' since the latest recession of 2001 has generated far too few new jobs, despite the tax cuts, high levels of military spending, and ultra-low interest rates[5]. Why?

5.In Dec. 2004 the US Federal Reserve Board increased the Federal Funds interest rate for the fifth straight time, to 2.25%. A year ago the rate was only 1%. Mortgage rates are still extraordinarily low. Income taxes

The reasons are complex and cannot be summarized in a few paragraphs. Globalization is one of them. In practice, it means that capital is free to move from country to country, while successive cuts in tariffs and non-tariff barriers to trade have made it easier for manufactured products to move. But, except within the European Union, labor is not free to move. It follows that jobs, not just in manufacturing, are being exported from the US (and Europe) to Asia and with the manufacturing jobs the engineering and design capabilities will follow, leaving nothing but marketing and distribution (and top management) behind.

This trend is obviously unsustainable. It has continued as long as it has because of the US dominance of international finance, and the fact that the US dollar has been the major reserve currency of the world since it replaced the pound sterling in that role during the first World War. Countries exporting to the US, especially Japan (and now China), have invested their surplus dollars in US government securities, which are regarded as being extremely safe. These foreign investments then finance the twin deficits. But for Japan or China to cease investing or, worse, to sell bonds they already own, would cause the value of the dollar, *vis a vis* other currencies, to collapse. This would cause US prices to rise, triggering inflation and having a devastating impact on the Japanese and Chinese exporters. To prevent this collapse scenario, the US Federal Reserve Board will be forced to continue to raise interest rates in the US, to attract foreign investors, but with a depressing effect on US consumers and producers, both.

Meanwhile, the US is far too dependent on imports of petroleum and other natural resources. Today, these resources are priced in dollars. But it could happen that, as the dollar declines, they will be priced increasingly in “baskets” of currencies, or even in Euros or Yen. That would further increase the US trade deficit and the inflationary impact.

The US led war in the Middle East was originally promoted by the Bush administration on the basis of false intelligence about weapons of mass destruction. Since WMDs were not found, this rationale has been followed by a sudden change in emphasis toward creating a stable democratic regime that would stimulate democratic reforms throughout the Arab world, thus removing the perceived threats to Israel. While the latter story is clearly believed by some of the people in the Bush administration, I think the real underlying reason for the attack on Iraq was the hope and expectation of establishing long term US bases – and influence – in the country with the second largest petroleum reserves in the world (after Saudi Arabia). Given Bush’s past personal connections with the oil industry, the historical connections of the Bush family with the oil industry in general and Saudi Arabia in particular, as well as Cheney’s background at Halliburton and Condoleeza Rice’s links to Chevron (she was a director) – not to mention others – I think the war was really about access to oil.

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for the high-income earners are lower than they have been since the 1930s. The US savings rate is essentially zero. Yet the ‘recovery’ is anemic.

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The Cyclic Dynamics of the Venture Capital

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Abstract. Venture capital (VC) provides financial and managerial support for new innovative ideas at the initial stages of commercialization. It has helped to find the market for many radical innovations of 20th century, including personal computer, Internet and genetic engineering.

As a part of market economy venture business was not stable from the very beginning. The periods of rapid growth alternated with deep recessions. However each time VC revived anew as the Phoenix due to its very important function in modern knowledge-based economy.

This report presents an analysis of statistical data that prove the existence of several cycles in VC dynamics in the USA and the Great Britain. The main factors of these cycles formation are discussed. The author proposes two possible scenarios of development of VC market for the first 30 years of the new 21st century. A hypothesis is put forward about the relation between VC cycle's amplitude and a phase of Kondratieff's cycle.

Introduction

Many cycles of various periodicities are revealed in a market economy. The most known among them are the Kondratieff cycles (approximately 50-70 years), the Kuznets cycles (15-18 years), the Juglar cycles (8-9 years) and the Kitchen cycles (3-4 years) [1]. This report discusses the cyclic phenomena in the VC markets and their relations to other economic cycles.

The basic ideas that underlie VC investments have been successfully introduced for the first time in the USA at the beginning of 1950s. Later an interest to VC business grew due to several reasons. <u>First</u>, in some cases investors received the real income surpassing many times the possible income from more traditional businesses. <u>Second</u>, the new wave of basic technological innovations has begun in computer hardware, software and services, Internet, telecommunications, biotechnologies, industrial technologies. <u>Third,</u> VC mechanism has provided a practical way for investing in the new innovative projects at their riskiest initial stages.

For last years VC became the important part of national innovation systems in many industrial countries. It has played an appreciable role in the growth of such leaders of modern high tech business as "Amazon.com", "Apples", "Digital Equipment Corp.", "eBay", "Genentech", "Google", "The Home Depot", "Intel", "Microsoft", "Yahoo!", etc. The governments stimulate venture business, understanding well its significance for competitiveness of national industries in the global economy. The support measures can become more efficient if the regulators will take into account some cyclic factors of VC development.

1. Cyclic Dynamics of Venture Capital.

The author collects and studies evidences of VC cyclic dynamics since 1986 [2]. Today such cyclic processes are observed in many countries. However it is the most convenient to demonstrate the wave effects by an example of US VC market which is the biggest in the world and has the longest history and the most detailed statistics besides.

VC development was not stable in the USA from the very beginning. The periods of the big interest to high technology firms alternated periodically with deep failures. However each time this market revived anew and rose to a new absolute level.

Venture business as a special form of investments in the entrepreneurial start-ups has appeared in the USA right after the Second World War. The initial phase of development has occupied about 20 years and continued approximately till 1969. The main emphasis was done at this time to support of new innovative projects and firms in chemical and petroleum industries, electronics, computers and other branches which have appeared and formed during the previous fourth Kondratieff cycle [3].

However it became clearly fast enough, that a growth of new firms quantity in a portfolio of VC fund leads to increase in costs of their maintenance. The tendency of VC concentration at the later stages of investments (directly before an *exit* of VC from business) began to prevail. This tendency has amplified even more during the next (second) phase of VC market development in the USA (1969-1977, see Figure 1a). Two economic crises fall to that time period: contractions of 1969-1970 and 1973-1975 [4]. The columns corresponding to crisis years are marked dark in the histograms. The tax reform in the USA was carried out in this period that was extremely adverse for development of VC business. For example, capital gains tax has increased in some case up to 49,1 %. Growth of taxes has led to decrease of investor's interest to this kind of business.

The immediate intervention of the US government has helped to save VC market: the pension funds were allowed to invest small part of their money in VC funds since 1979 and the capital gains tax for individual investors was reduced to 20 % in 1981. These measures promoted transition of the VC market to the third phase of development that lasted from 1978 to 1987 (Figure 1b). It is important that these regulation measures were so favorable for VC in USA that this market has ignored two new economic contractions of 1979-1981. Let us note that the disbursements of VC in peak points have increased during this phase ten times and more in comparison with the previous one.

In 1985 a short recession of investments was marked which has been caused probably by technological factors (see below). After this a growth of investments continued again till 1987. The next year a new recession of investment activity has begun (fourth phase). This recession has reached a bottom point during the contractions of 1990-1991.

A new unprecedented growth of VC investments began in 1995 (fifth phase) and continued almost up to the end of 2000 (Figure 1c) In 2000 these investments have increased about 25 times in comparison with 1987.

This phase has been caused in many respects by the long general revival of economy in 1990s and by occurrence of new promising directions of the innovative activity related to commercialization of information technologies, Internet and electronic trade (see next section). It is important too that these two growth factors have coincided in time.

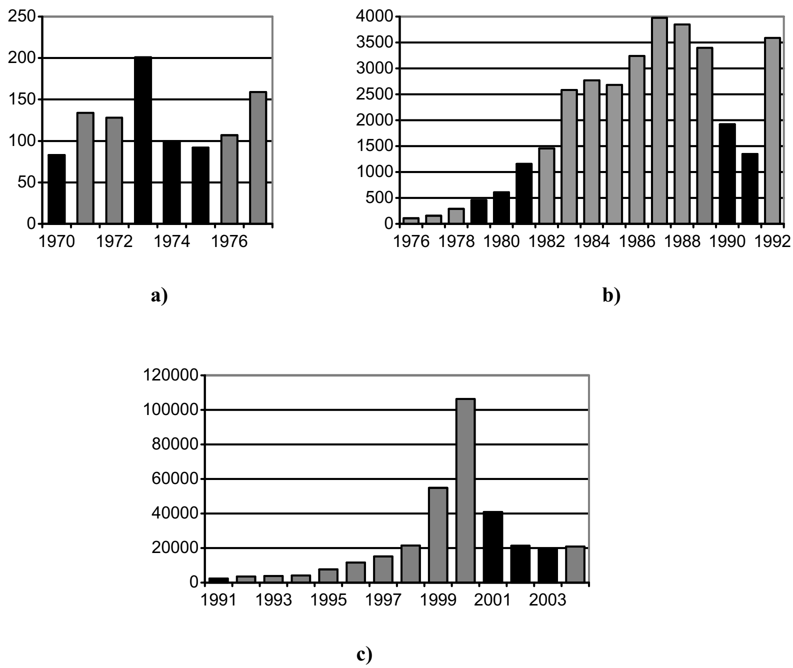


Figure 1 - Venture Capital Disbursements in the USA ($ mln).
Source of Data: before 1991-[5]; after 1991 – [6]; 2003-2004 - [7].

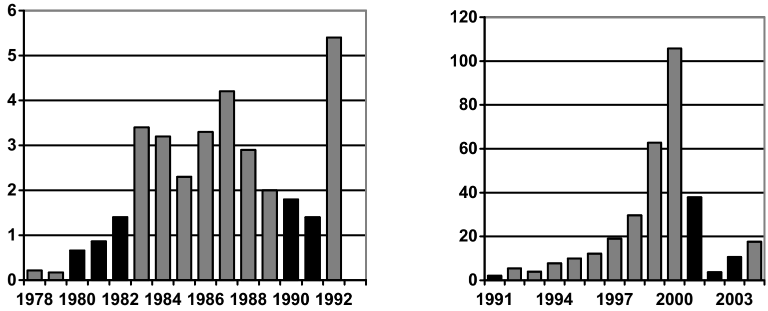
A sharp increase of VC profitability was observed in the second half of 1990s. An average annual rate of return of VC funds has made 48 % in 1995, 40 % in 1996 and about 37 % in 1997 according to the data of " Venture Economics " [8]. This increase stimulated interest to VC business of more cautious investors.

A demand for shares of new firms during initial public offering (IPO) has increased simultaneously. Thus the favorable conditions for an exit of VC investors from the projects have appeared. As a result, the average rate of return of VC funds in a sample of 271 IPO (approximately 50 % of all US IPO) has reached a record 146,2 % in 1999 [9].

The situation in VC market at the end of 1990s could be described by the model of "venture accelerator": *high rates of return of VC investments ⇒ inflow of new money to VC funds and to IPO market ⇒ increase of liquidity for the invested projects ⇒ high rates of return of VC investments.*

It is obvious that this "venture accelerator" includes not only some rational economic elements, but also some attributes of "financial bubble". This inflated bubble has bursted in the autumn of 2000. Though 2000 year appeared record in the history of VC business not only in the USA but also in other countries, the symptoms of crisis were marked since the 3-d quarter of 2000. NASDAQ index has decreased practically twice to spring of 2001. During 2001 - 2002 a continuous decrease of new commitments to VC funds was marked in the USA. The amount of new VC investments was decreased too. There has come the new crisis of VC in the USA (<u>a sixth phase</u>) that has proceeded at least during 2001-2003.

The dynamics of new VC commitments is practically similar to dynamics of VC investments (Figure 2a, b). It testifies to general mechanisms of this market development.



a) b)

Figure 2 - New Capital Committed to U.S. Venture Capital Funds (in US$ bln)
Source of Data: before 1992- [5], after 1991 – [6], the data for 2002-2004 were taken from [10].

Thus it is possible to outline six phases of the US VC market development for the last years which could be aggregated in ***four principal periods***: *initial period* (about 1950 – 1968), *a period of VC integration into the US innovation system* (1969 – 1977) and two obviously expressed *cycles of VC market development* with duration of 14 years (1978-1991) and at least 12 years (1992-2003), accordingly (it is difficult now to classify correctly the data for 2004 year; a preliminary evaluation testifies for a beginning of a new investment cycle).

It is necessary to note that the second (last) cycle has the boundaries that coincide completely with a traditional business cycle (the Juglar cycle). Thus, it is possible to assume that formation of this VC cycle was influenced appreciably by general *exogenous* economic factors. The bigger duration of the first cycle is probably a result of government support measures.

The tendency of cyclic dynamics in VC markets was observed too in many other countries which have adopted this mechanism later. Thus, it is possible to believe that a cyclic development of the VC is *the universal economic phenomenon* linked to Juglar cycles and sharpened sometimes by “venture bubble” formation.

Another observed tendency of increase in ten times and more of VC cycle's amplitude (expressed in volumes of VC commitments and disbursements) during three consecutive historical periods of VC development in the USA would be hardly explained only by these reasons. It is possible to propose that this phenomenon has a technological origin.

2. A Technological Input to VC Cycles

VC investors consider attentively not only macroeconomic situation, but also those changes that occur continuously in the science and technology. They adjust the distributions of VC volumes and streams of investments following these changes. Investment decisions at early (and consequently more risky) stages of innovations development (seed, start-up, early expansion) are especially sensitive to these changes.

Figure 3 shows the dynamics of US early-stages VC disbursements expressed in the number of disbursements. Use of numerical characteristics allows to reduce in part great differences in VC volumes and to present the data in a comparable manner, excluding thus influence of inflation and rise of projects costs.

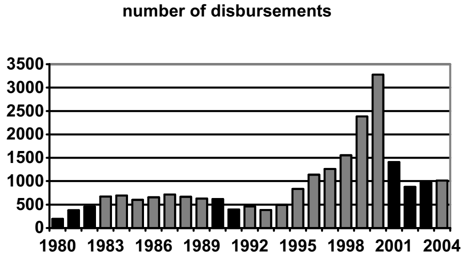


Figure 3 - Dynamics of Early-Stages VC Disbursements (number of disbursements) in the USA. Source of Data: [6], the data for 2003-2004 were taken from [7].

Two investment waves with identical periods of 12-13 years could be distinguished in this figure (left wave may be longer from the left tail and right wave - from the right, really). Both waves have the natural borders conterminous with the periods of economic contractions but differ in amplitude.

The wave amplitude represents the sum of projects in various directions (computer science, biotechnology, etc.), maintained at early stages of projects development within each year. The author has no data representing a quantitative ratio of these projects. However the basic financial characteristics (investments volumes distribution by technological directions and their share in total volume of investments at early stages in the current year) are published. These histograms are shown in figure 4.

Apparently from the figure, the share of projects in the field of energy and industrial technologies was steadily reduced during the considered period. The fact could be probably explained by the relatively low prices for energy resources in this period. The share of projects in the field of communications remained approximately constant in time intervals of 1980-1991 (12%-13 %) and 1992-2002 (15%-17 %).

Dynamics of project's shares in the fields of biotechnology and medicine / public health services are especially interesting. First, these histograms are almost synchronous though they differ by amplitude. It allows speaking about close relation of these fields among themselves from the point of view of investors. Second, it is possible to notice, that these curves are in an antiphase to a curve representing dynamics of total VC investments at early stages of innovative projects development (Figure 3). Growth of investment's shares in biotechnology and medicine / public health services projects occur when general activity of VC investors decreases and vice versa.

Finally it is necessary to note steady decrease in share of VC projects in the field of computer hardware after 1983, which could be explained in part by capital intensity of this industry, relatively stable interest of VC investors to projects in the field of computer software after 1990 and explosive character of growth of the Internet projects share in 1995-2000 (about 45 % of all VC disbursements in 1999-2000).

From the comparison of the curves shown on figures 3 and 4 it is possible to make a conclusion that a difference in the amplitudes of the first and the second waves of VC is determined, mainly, by the growth of interest to Internet related projects.

Appeared in 1970s as a narrow military innovation (ARPANET), the comprehensive information network (WWW) has become to the middle of 1990s a radical innovation with the predicted huge market potential. The period of numerous improving innovations has come which needed VC investments for new applications.

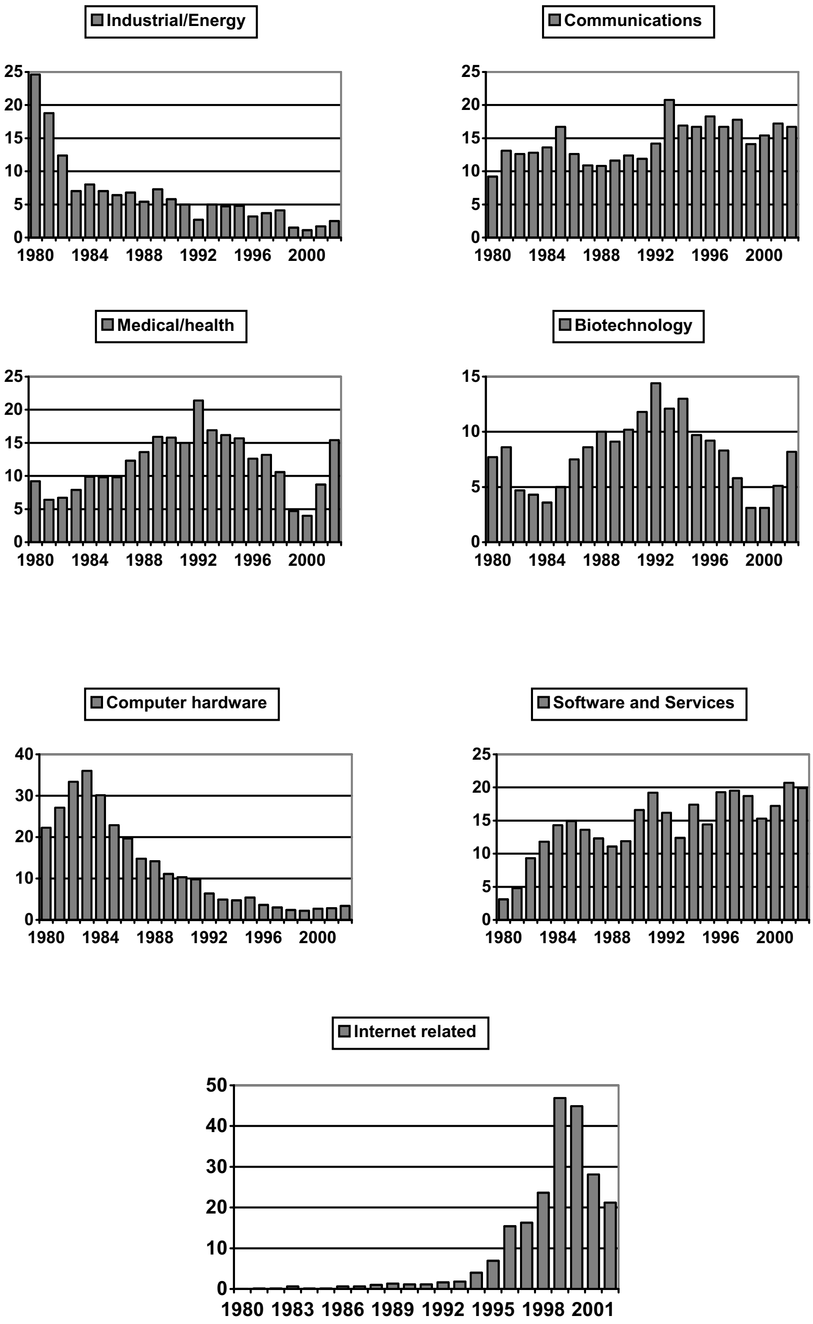
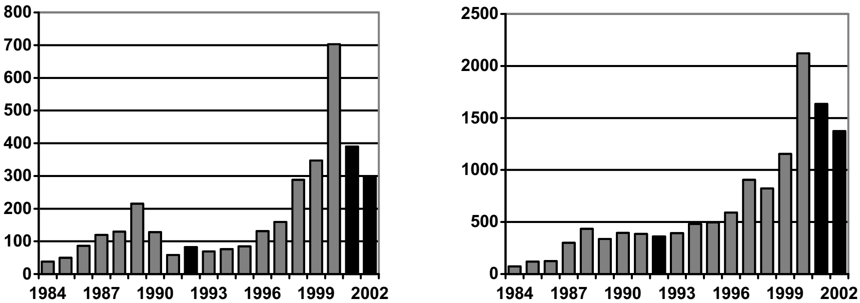


Figure 4 - Venture Capital Disbursement by Industries (percent distributions).
Source of Data: [6].

The cycles of VC development was observed not only in the USA. Figure 5 shows the dynamics of VC investments in the Great Britain at early and later stages (without MBO and MBI). As we can see from the left histogram, cyclic dynamics is expressed more obviously at early (most risky and technology sensitive) stages (Figure 5a).

It is possible to speak about two cycles of investor's activity in Great Britain. The first wave began, probably, before 1984 and lasted until the economic crisis of 1992 [11]. The second cycle has started in 1992, and existed, probably, till 2003 at least. Thus it has the duration not less than 12 years. A cyclic dynamics at later stages of VC investments in the Great Britain is appreciable too, but is expressed less obviously (Figure 5b).



a) b)

Figure 5 - UK Venture Investments by Stage (in £ mln.):
a) Investments at Early Stages, b) Investments at Expansion Stages
Source of Data: [12].

A certain type of cyclic development could be noted in Russia too. However it is related not to VC market, but to *attempts* to promote this mechanism. Special points on this time scale are: 1988 - when the USSR government has allowed innovative banks development; 1994 - when the EBRD supported in Russia first 11 regional VC funds with a main goal to participate in privatization of the state enterprises; and 2000 - when the Russian government has proclaimed a decision to allocate some money for the formation of several regional and branch venture funds in cooperation with private capital.

3. Two Future Scenarios of VC Growth

The analysis of VC dynamics for the last 50 years allows to make the following conclusions, which may be useful for decision making in government innovation policy development.

Future VC market will survive new regular cyclic fluctuations. Their periodicity will be equal to about 12-14 years. It is predetermined by combination of several factors such as the future business cycles, "venture accelerator", “bubble” formation and technological changes affecting VC priorities.

Bottom points of VC cycles will generally coincide with the future cyclic economic crises. At the same time there is a real opportunity to avoid negative influence of weak cyclic economic crises in VC markets with a help of adequate government interventions such as tax breaks, fundraising regulations, etc.

Besides it is possible to propose two hypotheses about possible amplitudes of VC cycles in the peak points.

The linear hypothesis is based on a simple linear extrapolation of earlier observed dynamics of VC market. Within the framework of this hypothesis each new rise of the VC will be accompanied by more than 10-fold increase in volume of investments and 2-5 multiple increase in number of supported entrepreneurial projects.

The cyclic hypothesis recognizes that each new K-wave will have several waves of innovations supported by VC. In particular, for the present fifth K-wave that would enter recession after 2000 [3], it is possible to expect next two new peaks of VC investment activity in the USA in 2011-2013 (third VC cycle) and in 2023-2027 (forth VC cycle).

In peak points of new VC investment cycles *a decrease* in the total number of new projects supported at early stages is quite probable in comparison with the same parameter in year 2000 because of the recession of the fifth K-wave. This is the most unexpected conclusion from the analysis of cyclic dynamics of the VC market, which take into account an interaction of VC cycles with a longer Kondratieff cycle.

Conclusions

The development of the VC has cyclic dynamics with the period of about 12-14 years. Bottom lines of VC cycles coincide generally with the cyclic economic crises. The directed measures of government regulation allow avoiding negative influence of relatively weak exogenous business cycles on VC market development. The amplitudes of VC cycles measured by the number of new VC projects depend on technological factors. From here the opportunity of Kondratieff cycle's influence on dynamics of the VC follows. It is possible to expect two next peaks of VC investment activity in 2011-2013 (a third VC cycle) and in 2023-2027 (a forth VC cycle). The number of entrepreneurial projects supported at early stages by VC in peak points of these cycles could be less in the same matured markets compared with year 2000 because of the K-wave recession.

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If this Long Wave Steeps-Up and Breaks: What then?

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Abstract. The title captures the gist of the Neo-Kondratieff Agenda: Can long waves break? This question looms large in EU countries. The Lisbon 2010 Mission depends on the breakability of the low, slow long trends considered stiff in many EU countries. The point is that some of these slow trends may change fast, indicating fast renewal.

Schumpeter attributed to Kondratieff the regular, slow moving Long Wave Concept (K-Model). Had Kondratieff not been imprisoned for his contrary economic theory, and shot upon order of Stalin, Kondratieff himself may have objected to his name being attached to such a stiff macro-wave mechanism in socio-economic life. He knew better. Kuznets ("Secular movements in production and prices") started the Neo-Kondratieff Agenda with the notion of irregular movements (Kuznets: "atypical Kondratieff"). And I followed suit, in 1975, with the Metamorphosis (M-Model) as an alternative to Schumpeter´s K-Model, proposing overlapping S-curves, implying the possibility that the economic system may shift fast from the stagnant branch of an old S-Curve towards the fast growing branch of the new S-Curve: A growth spurt. That is what goes on when a "long wave" breaks.

In this paper, I analyze Structural Instability (alias: breakability) by means of a potential function, apply it to the Roaring Twenties (and the crash 1929/31), and to the New Deal thereafter. The approach is robust and transferable to today: To the Roaring Nineties, the crash 1999-01 and a Neo-New Deal 2005 ff. this is "synthetic" Economic Evolution.

These contingencies vary from country to country (place dependencies), and depend on speed of better understanding, and learning (pace dependencies). Key impact area of this type of social learning is the financial service area. There will be much shake-out associated with the new take-off, as banks and governments prefer supporting big firms in old industries. The Neo-New Deal will favour European Small and Mid-Sized Firms´ Innovations that open up new avenues.

1. Overview

My country, Germany, suffers zero growth and unemployment. Towards the end of 2004, the unemployment rate has jumped to five times the "natural rate" (which leading economists assess as one million unemployed). Thus, I think, something there will break, soon.

This possibility urges me to publish some results from Structural Instability Analyses applied to times of rapid changes. It tests my Metamorphosis Model (lead hypothesis H_2), employs a Potential Function approach, applies it to American and German time series, and proves the point (H_2).

The point is: *Structural instability* in some parts of an economic system goes hand in hand with *structural readiness for breakthroughs* of something "new" (good or bad).

My vision is that the European economy is structurally unstable (breakable), and that a breakthrough of a "renewal" is on its way. The renewal is a push (cluster) of basic innovations that will establish some new branches of industry. It is accompanied by radical improvement innovations in certain stale branches of established industry that underperform. In view of this, financial services appear information inefficient, and hinder the process of investing in innovation. The cluster of innovations will renew sectors and regions, and rejuvenate the entire economic system in the enlarged European Union. The Metamorphosis Model H_2 provides a scientific basis for fighting unemployment and relaunching Lisbon 2010. What´s more, the flagship of this convoy of innovations in the goods and services industries is radical financial innovations in financing this renewal.

This is my Neo-Kondratieff Message. "Neo-Kondratieff" stands for flexible instead of stiff and sticky. Today, when knowledge is the (immaterial) factor of production, change may occur much faster than in industrial times, when "Secular Movements in Production and Prices" (Kuznets) where observed in basic goods, such as corn, iron and coal. Basic goods industries are inert. Today, it is more appropriate to discuss Neo-Kondratieff Effects (fast swings, breaks, breakdowns, breakthroughs), and to illustrate such switching with data on financial productions (share data) and prices (stock market quotations). This is being done in the following plot, taken from Brealey and Myers [1] (the "bible" of finance in US College texts).

Two observations are in place. They are grounded in the data and supported by the subsequent causal analyses:

1. Small and Medium Enterprises (SMEs) perform better, in the long run than large firms. Especially so in some time windows. Then, on log-scale, the smaller firms outperform the larger firms by five to ten times.
2. Based on Structural Instability Analysis on data for previous windows, the next window just opened up, in 2005. We can expect a) that small firms will outperform large firms, as the smaller ones are more agile in innovating, and b) the innovations brought to market by the more creative innovators will capture greater dividends. Because their market targeting and their market timing is superior.

Therefore, these contingencies will induce investment fonds to diversify, worldwide. This, finally, establishes the bottom line hypothesis: While EU member countries hasten to support their endogenous SMEs innovations, with public funds (place dependent), the international investment industry will co-finance, selectively, those SMEs that appear superior in terms of Market Targeting and Market Timing (pace dependent). As I said before: Now, the race is on in Europe as it is elsewhere. In the Life Sciences, Non-Darwinian Evolution Theory makes inroads into the Darwinian Mainstream, alias Gradualism. Now, this inroad reaches Economics.

2. The Long-Term Trend Breaks

Among economists, the "gradualist" view dominates, at least since the time when *Alfred Marshall*[2] insisted that "Economic evolution is gradual" (in the 1892 Preface to his *Principles of Economics*). Upon this premise he grounded his doctrine ("Principle of Continuity"), against which J.A. *Schumpeter* objected (suggesting the alternative "Discontinuity Principle"). Marshall even pontificated "*natura non facit saltum*" (nature doesn't jump). And even if it jumps, he concluded, such events may safely be "provisionally neglected as abnormal". A wonderful excuse for doing nothing.

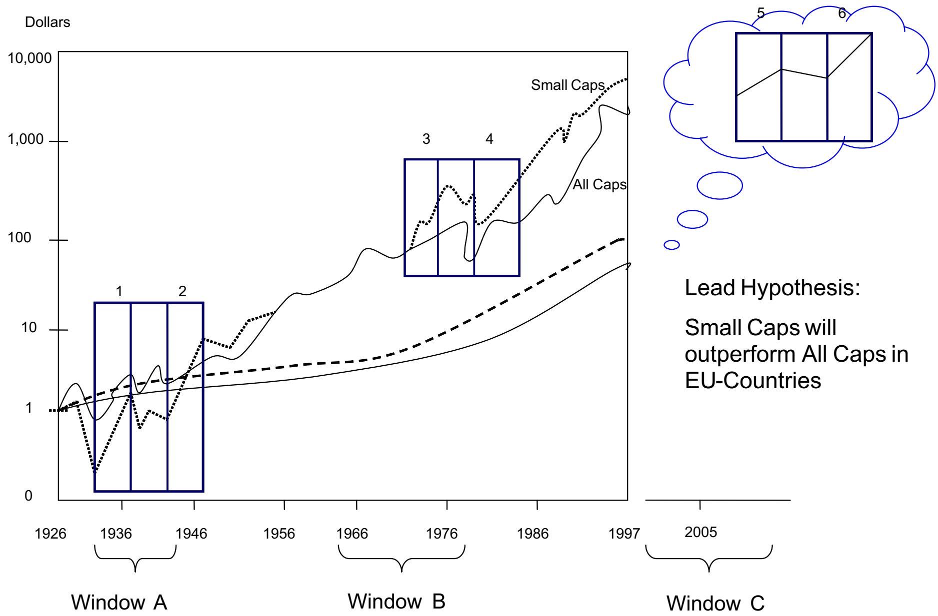

Figure 1 - Market Targeting and Market Timing by the M-Model: A Neo-New Deal?

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Sources:- Stock Market Data 1926-97: Brealey & Myers 2003; Time Windows The Thirties and Seventies: Mensch 1980,81; The Time Window 2005 ff.: Mensch 2005

This tells us what the Lisbon 2010 Mission is up against: Gradualists are sceptical when something non-gradual (a discontinuous change) is being seriously considered, such as a leap-frog spurt of growth in the EU. Gradualists rather have it not considered at all. They resist, thus throwing out the baby with the bath water.

Today, many mainstream economists regard the Long Wave Model (K-Model, named after *Kondratieff*, and possibly *Kuznets*) as the mental fall-back position of moderate "gradualism". Our experience is that indeed, sometimes, *natura facit saltum*. Every economist is aware of the fact that economic subsystems sometimes shift fast or even break down. But for the gradualists, there exists no solid scientific basis for getting prepared, other than by wait and see. For these economists, active policies are out. Therefore, even moderate gradualists are equally opposed to Lisbon 2010.

This "moderate gradualism" defines the Null-Hypothesis (H_o), or counter-position, to the particular "structuralist" view expressed here as the lead hypothesis H_2. The H_2 is my Metamorphosis Model (M-Model). I developed the M-Model during the mid 1970s, when unemployment was low. However, in 1974, before handing the manuscript to my publisher, I included the prediction that from now on, full employment is vanishing, and unemployment will increase and increase and increase [3]. At that time, discontinuity theory (H_2) was considered a heresy. Today, let's try again, as time is ripe now.

In the 1970s, the M-Model faced the same criticism from gradualists as the K-Model. But now, 2005 ff, we have a different (breakable) situation.

The key issue is: How can a system behave, at the same time, according to both the Principle of Continuity (Marshall) and the Principle of Discontinuity (Schumpeter)? To clarify this contradiction in terms, we distinguish three hypotheses H_o, H_1 and H_2. That distinction helps us to see what's coming: Trend Breaks in EU-economies.

Schumpeter recognized that economic evolution sometimes takes quantum jumps (H_1 = saltism, supply shocks, etc.). For proponents of General Equilibrium Theory (GET), this historical combination of fundamental "gradualism", and occasional "saltism" (alias: "punctuated equilibrium") is "measurement without theory" and, they feel, can still be "provisionally neglected as abnormal" (Marshall, 1892).

The M-Model is an alternative (H_2) to the punctuated equilibrium notion (H_1). Metamorphosis is non-equilibrum change. Metamorphosis occurs, if and when it occurs, not in equilibrium. The structuralist Metamorphosis Model is free of certain limitations imposed by the axioms of GET. The M-Model is a Special Evolution Theory (SET) that is incorporating "structuralism" as the lead hypothesis H_2.

In short, H_2 rivals with H_1 just as New Evolution Theory (say, Non-Darwinian, "synthetic" theory of evolution) rivals with Old Equilibrium Theory and with Old Evolution Theory (say, Darwinian). The key to understanding why I consider the EU-Trend as coming up for a quantum jump is the notice of "Structural Instability" (H_2: in this state, "potential Discontinuity" characterizes the perceived state of reality). Because in some meso-economic subsystems of the economy, Schumpeter's "gale of creative destruction" looms large. The econometric test tool used for detecting Structural Instability is Structural Instability Analyses. I am using a Potential Profit and Penalty Function as mathematical model of Metamorphosis (Mensch [4-5]). The M-Model is "synthetic" evolutionary economics and finance.

In the following, this test tool is being applied to American industry data from 1900 to 1934. It shows that structural instability evolved during the Roaring Twenties, setting the stage for the crash 1929-1930, and for structural readiness for basic innovations during the subsequent New Deal years. And the test tool is being applied to German industry data from 1950 to 1978, showing that structural instability evolved during the years 1971 to 1974, setting the stage for the enormous increase in unemployment. And last, but not least, the structuralist view is being projected into the Roaring Nineties which led to the crash 1999-2002. Again, the Potential Profit and Penalty Function serves to hypothesize that structural readiness for basic innovations is present during 2004 to 2010 (Mensch [6]).

The main advantage of the synthetic Evolution Theory, H_2, is the structuralist perspective: Some EU member states will enjoy the potential benefits of fast learning, others will suffer the penalties for slow learning. C´est la vie. Let's learn fast. If structural instability becomes so obvious as in Germany in 2004, it may come to pass that the political elite will resort to any kind of activism, good or bad, to do something about unemployment. Than Structural Instability Analysis may help to shift the balance from too much bad towards more good. That's my objective.

For example, as the actual rate (5 Mio. unemployed) surpasses five times the "natural rate" (1 Mio. unemployed), the German government compensates for the loss in taxes income with a record increase in public debt, bringing the gross investment rate down to 8% in 2004, and the measure of GNP underperformance up to 120 bio. Euros per year. The opportunity cost of unemployment is staggering. But the outlook suggested by the gradualists is more of the same in Germany. That must be changed.

As another example, in USA, the Bush government is proposing a budget that aims at reducing the deficit by cutting social expenditures, increasing defence spending by 5% in 2005 to create jobs. Again, continuously more of the same.

So we see that economic policy priorities are different: America is creating new jobs at the expense of tolerating more poverty, and Germany is damping poverty at the expense of tolerating more unemployment, and underperformance. Both policy stances are non-sustaining. Something is going to give. What will break through?

To sum up what the structural lead hypothesis H_2 suggests as M-Model-Forecast: some highly developed national economies have become structurally instable, while some mesoeconomical subsystems of these nations (regions, sectors) have become structurally ready for breakthroughs of disruptive innovations. Scientifically speaking, the potential is phase dependent, place dependent, and pace dependent. The task ahead for Lisbon 2020 is learning fast how to do the right things, and how to do these things right.

3. Theoretical Framework: Meso-Foundation of Economic Potential

Objective of this section is to ground the Economic Potential Function Approach, which is being used to define "structural instability" of some sectors of the economy, and to test this property econometrically. On the one hand, this is "macro-to-meso", namely a top-down approach that disaggregates as much as necessary to reach an intermediate level (for example, branch, region) that is testable using branch data, or regional data. On the other hand, this is "micro-to-meso", namely, a bottom-up approach that aggregates the data sufficiently to serve as a measurement of the mesoeconomic subsystem (to be tested for stability).

So let us begin with Keynes' macroeconomic Principle of Effective Demand, which is expressed as production P_t that has cleared the market for consumption goods C_t and investment goods I_t, such that $P = C + I$. The standard neoclassical foundation of this market clearing production process is the production function, where output is a productive combination of labor inputs and capital inputs (see Hicks, [7]).

To get to the potential function, which is an evolutionary re-combination of the neo-classical production function and Kaldor-type progress functions, we are approaching a disaggregate level where progress takes place because autonomous investors plan investments that change the production and reproduction process within the economic subsystem under consideration. We are introducing the Principle of Expected Demand. Here, expected production $X(P_t)$ is a function of expected labor hour input $X(A_t)$ and expected investment expenditures $X(I_t)$. The crucial point is that in the production potential function with an emphasis upon progress made through investing in innovation, we do not incorporate accumulated capital (as in the production function), but latest vintage capital I_t. The Principle of Expected Demand for investment goods maintains that autonomous investors plan $X(I_t) = X(E_t) + X(R_t)$, where E = expansionary investment ("sales-induced") and R = rationalizing investment ("cost-induced"). Of course, the determinants of these investment plans E_t and R_t are the cash flows (sales-costs) expected to be caused by $X(P_t)$, $X(A_t)$ and $X(I_t)$.

The Metamorphosis Model is grounded upon the discovery by Mensch [3] that the community of industrial investors forms dynamical expectations on P,A,I,E and R such that $X(A_t,I_t) \Leftrightarrow X(E_t,R_t)$ if the expected potential $X(P,A,I,E,R,t)$ over time t is non-linear, and a Taylor expansion of a form that allows for one root only if the subsystem under observation is structurally stable, and three roots if structurally instable (Mensch [4,5]). This Rule of Roots gives us the test criterion employed below.

Under these Taylor requirements, the production potential function $X[P(A,I)]$ can be inferred from a reduced bi-quadratic function of expected values (E,R):

$$X(E,R) = \tfrac{1}{4} X_t^4 - \tfrac{1}{2} R_t X_t^2 - E_t X_t$$

which has roots (one or three) at values E,R where $X^3 = RX + E$. In the empirical section below, this Rule of Roots is applied to American industry data 1900 to 1934, in order to illustrate how structural instability evolved during the "Roaring Twenties".

The Structural Instability Analysis reveals: Not long before the crash of 1929, the US Industry switched from a stable One-Root-Regime to an instable Three-Root-Regime. Gerhard Mensch´s Innovations-Research Team at the Science Center Berlin, using German industry data for the period 1950 to 1978, invented the Structural Instability Analysis in

1980. Incidentally, this was the first application of chaos theory (in the form of catastrophe theory) to evolutionary economics. Needless to say, the above Rule of Roots is a special case (cusp catastrophe) from a larger family of potential functions. In 1979/80, this special case sufficed for the purpose at hand (checking for stability).

The challenge at that time was to make sense of the labor market trend reversal in the seventies in Germany and other industrial countries. In the full version of this paper, I show data plots on Germany, Holland, England and Japan on the evolution of factor inputs (A_t,I_t) over time t. In 1975, Mensch discovered the investment-innovation-linkage $X(A_t,I_t) <-> X(E_t,R_t)$. Then, the deeper analysis revealed, there was a trend reversal in the composition of vintage capital I_t, such that while $I = E + R$, the composition E:R shifted from an expansionary bias $(E > R)$ to a rationalization bias $(E < R)$. This discovery was then widely popularized by Abernathy and Utterback [8].

This brings us back to the theoretical relationship between expected demand for labor hour inputs and latest vintage capital inputs, (A,I), on the one hand, and the evolutionary composition of the latest vintage capital inputs, (E,R), in years t. This insight I owe to John Hicks (Capital and Time, 1973, [7]).

The Principle of Expected Demand suggests that, if the expected potential function X(P,A,I,E,R,t) is robust, the evolutionary relationship $X(A,I) \Leftrightarrow X(E,R)$ is robust. The full paper includes graphs showing this robustness: Q-Square = .79. Here I am showing the goodness of fit between model-based numbers of theoretical potential X(E,R,t) and materialized potential P(A,I,t) as indicated by the official statistics of the German Federal Statistical Office. The fit is highly significant.

Also, there is the Table 1 that shows how the theoretical potential X(E,R,t) did evolve during t = 1950 to 1978, calculated from inputs E(A,I) and R(A,I):

$$E(A,I)_t = c_{11} A_t + c_{12} I_t$$
$$R(A,I)_t = c_{21} A_t + c_{22} I_t.$$

In the full paper there are also two double-graphs showing that the cross-calculation of data is robust, namely, calculating E(A,I) and R(A,I) from official statistics on A and I, and calculating A(E,R) and I(E,R) from separately available data in E and R, which in Germany at the time was available due to investment surveys by the Munich Ifo Institute. The two double-graphs show the goodness of fit of the model-based calculated data A(E,R), I(E,R) and E(A,I), R(A,I) with data from official statistics in Germany.

This concludes the delineation of the evolutionary mezzo-foundation of the method (Structural Instability Analysis based on the Expected Potential Function), and of the model (Metamorphosis Model). We have the following proven results with German data:

1. Potential Function Approach, and Measurement Technique, are robust
2. The Rule of Roots shows: There was structural instability in 1971 to 1974.

4. How the Evolution in the Demand for Labor Input is Shaped by the Latest Capital Investment Input

During the mid-seventies, Mensch's Innovations-Research-Team at SC Berlin made the discovery that in various industrial countries, industrial firms changed the factor input allocation pattern. The surprise was, they all changed at about the same time. Industries, on the whole, become capital expanding and labor rationalizing while product-adding and productivity-advancing. This switch became known as the Abernathy-Utterback Model [8].

4.1. Goodness of Fit of Observed and Inferred Production

The observed industrial production P(A,I,t), reported by the FRG's Statistical Office, is being compared with the computational results inferred from the evolutionary production potential function X[E(A,I),R(A,I)] conjectured from the Metamorphosis Model on E = expansionary investments and R = rationalizing investments. The E,R are the driving variables of the resources allocation process over time t (1950 to 78).

The solid line indicates P(A,I,t), while the doted line indicates computed X(E,R,t) in these years. For easier comparison, dividing the two time series by the greatest number in the respective time series has scaled the numbers.

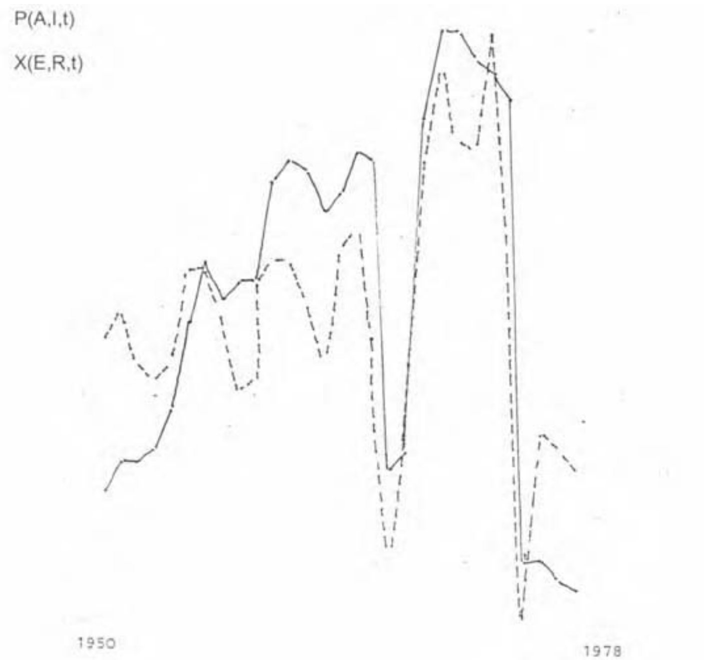

Figure 2 - Industry Sector, Federal Republic of Germany, 1950 to 1978.

The key point is that structural instability developed in the years 1971 to 1974, when the observed production potential P(A,I,t) was at a record high ("overshooting"). Furthermore, after structural instability developed, causing the cyclical downturn 1975 and 1976 to be deeper than usual, production remained depressed for some time.

4.2. The Parameters of the Potential Function

The potential V(P,A,I) of planned production output P(t) is considered a function of the planned inputs (labor, capital) at the time t; namely the planned labour hours A(t) and the newly invested (fresh) capital I(t), not the capital stock from the past. These investments are considered as either aiming at expanding the production capacity (E = expansionary investments) or aiming at rationalizing factor inputs (R = Rationalizing investments).

This potential as an assembly of production and investment plans cannot be directly observed. In can be inferred, and calculated from the theoretical potential function X(P,A,I), considering that the investment plans E(t) and R(t) reflect desired A(t) and I(t).

Once these (A,I) are observable, the E and R can be estimated as E(A,I) and R(A,I). These estimates E(A,I) and R(A,I) have been listed in the Table 1.

Table 1 - Statistical Data, and Calculated Data Using the Potential Function Approach

t	x_{1t}	x_{2t}	x_{3t}	x_t	E(A,I)	R(A,I)
1950	-.527			-.527	-.353	-.391
1951	-.449			-.449	-.259	-.374
1952	-.431			-.431	-.242	-.375
1953	-.396			-.396	-.205	-.361
1954	-.279			-.279	-.113	-.325
1955	-.022			-.022	-.006	-.254
1956	.158			.158	.041	-.237
1957	.051			.051	.012	-.238
1958	.088			.088	.021	-.232
1959	.085			.085	.018	-.199
1960	.386			.386	.088	-.080
1961	.470			.470	.109	-.012
1962	.423			.423	.077	-.004
1963	.311			.311	.037	-.022
1964	.375			.375	.049	.010
1965	.491			.491	.075	.087
1966	.453			.453	.045	.106
1967	-.462			-.462	-.077	.048
1968	-.399			-.399	-.059	.013
1969	.581			.581	.059	.235
1970	.836			.836	.164	.504
1971	.858	-.574	-.285	.858	.140	.573
1972	.757	-.605	-.152	.757	.069	.481
1973	.711	-.591	-.120	.711	.050	.434
1974	.635	-.664	.029	.635	-.012	.422
1975	-.745			-.745	-.110	.408
1976	-.750			-.750	-.107	.419
1977	.526	-.796	.271	-.796	-.114	.492
1978	.598	-.818	.220	-.818	-.108	.538

Using the bi-quadratic potential function X[E(A,I),R(A,I)], the (cubic) first order derivative gives the roots of the theoretical potential function X(E,R). We find that during the 1950s and 1960s, there exists but one root x_{1t} in each and every year (uniqueness).
In 1971 t0 74, there co-existed three roots x_{1t}, x_{2t} and x_{3t}, indicating structural instability, foreshadowing the deep slump in production and employment in 1975 and 1976.

5. Empirical Test of Structural Instability of US-Industry in the "Roaring Twenties", before the Crash of 1929

It has been said quite often: the weakness of the Kondratieff Wave Model is the difficulty of specifying where the cycle actually stands at a specific point in time. Therefore, the K-Model hasn't even been asked to give an explanation of the timing of the critical developments preceding the crash in 1929-1930, and the ups and downs during the 1930s. In contrast, the M-Model shows: the K-Wave broke. Here comes the evidence.

In this empirical section, we are using the M-Model to analyse the US Industry data from 1900 up to 1934. Employing the Structural Instability Analysis as delineated in section 2, we venture a structuralist explanation: 1 - of the vulnerability that resulted in the crash, and subsequent depression in the stagnant and instable industries, and 2 - of the structural readiness for breakthroughs of basic innovations in the New Deal.

To repeat: The purpose that motivates me to analyse the "Roaring Twenties" is my judgement that the "Roaring Nineties" generated a similar pattern of (1) structural instability in one subset of branches of the economy, going hand in hand with (2) the emergence of structural readiness for breakthroughs of basic innovations in 2005 ff. In fact, the following Table and Picture come from my Working Paper No. 53 entitled "A Bi-Equilibrum Model of Bi-Valued Technical Progress embodied in innovative industrial investments in U.S. Industry between 1900 and 1934" (Mensch [5]), which I only now care to publish, because only now I feel the time ripe for it.

The following Table 2 presents the time series 1900 to 1934 production, labor hours input, and fixed capital investment (first three columns), and the data on the level and composition of that investment [$I_t = E_t + R_t$] in columns 4 and 5. Inspecting the data E_t : R_t, we realize that during the first decade 1900 to 1910, the E:R-Ratio was growth driving (expansionary bias: E > R). During the second decade, 1910 to 1920, the E:R-Ratio was balanced (E = R). And in the third decade, 1920 to 1930, the E:R-Ratio went off balance (rationaliziation bias: R > E); R >> E means strong R-bias. This imbalance of sales-driven investments versus cost-induced investments made the U.S. industry structurally instable. It shifted to the Three-Root-Regime. Contrarian investors felt it coming: The next cyclical down-turn becomes a breakdown; a crash.

The subsequent plot illustrates the path of events during the 1920s and into the 30s. The graph shows how the ups and downs in actual (officially measured) production are well anticipated by the theoretical value of the production potential function itself. The goodness of fit as measured by correlation coefficients is impressive (validity). The topology of the potential function appears to be especially useful, indicating that the Rule of Roots is robust (reliability).

To sum up, it appears that the M-Model has performed well in terms of "parameter accuracy and predictive relevance" (Herman Wold). So why not projecting these proven structuralist concepts into the future? Given the "Roaring Nineties" and the subsequent crash 2000-2001, wouldn't it be reasonable to at least consider 2005-10 as "structurally ready" for a trend reversal in the E:R-Ratio? Why not expecting a growth spurt that is driven by a cluster of basic and radical improvement innovations? The time is ripe.

Table 2 – Statistical Data and Calculated Data Using the Potential Function Approach

Time Series Data spanning Belle Epoque, Roaring Twenties, Crash, and Depression in USA 1900-1934

Year	PT	LABHS	FCINV	ET	RT	VRT	X1T	X2T	X3T	XT	X Trend	P Trend	X DEVT	P DEVT
1900	50.600	56.000	1.220	-0,322	-0,676	-0,608	-0,414			-0,414	-0,337	59.360	-0,077	-8,760
1901	56.700	59.500	1.300	-0,280	-0,654	-0,588	-0,381			-0,381	-0,305	62.333	-0,077	-5,633
1902	63.200	63.000	1.490	-0,234	-0,578	-0,520	-0,360			-0,360	-0,273	65.305	-0,087	-2,105
1903	65.400	65.500	1.440	-0,207	-0,615	-0,553	-0,317			-0,317	-0,241	68.277	-0,076	-2,877
1904	62.300	63.900	1.390	-0,227	-0,631	-0,568	-0,331			-0,334	-0,208	71.249	-0,126	-8,949
1905	73.600	68.200	1.570	-0,172	-0,564	-0,508	-0,290			-0,290	-0,176	74.221	-0,114	-0,621
1906	78.900	71.800	1.910	-0,119	-0,416	-0,375	-0,267			-0,267	-0,144	77.193	-0,122	1,707
1907	80.600	73.800	2.110	-0,089	-0,329	-0,296	-0,249			-0,249	-0,112	80.165	-0,137	0,435
1908	68.000	69.300	1.820	-0,151	-0,448	-0,403	-0,301			-0,304	-0,080	83.137	-0,223	-15,137
1909	80.200	74.400	1.990	-0,087	-0,390	-0,351	-0,218			-0,218	-0,048	86.109	-0,169	-5,909
1910	85.300	76.900	2.040	-0,057	-0,378	-0,340	-0,156			-0,156	-0,016	89.081	-0,139	-3,781
1911	82.200	78.400	1.940	-0,043	-0,433	-0,390	-0,103			-0,108	0,016	92.053	-0,123	-9,853
1912	93.700	81.400	2.150	-0,002	-0,346	-0,311	-0,006			-0,006	0,048	95.025	-0,053	-1,325
1913	100.000	82.500	2.380	0,019	-0,239	-0,215	0,085			0,085	0,080	97.997	0,005	2,003
1914	94.100	79.600	2.040	-0,026	-0,391	-0,352	-0,073			-0,073	0,112	100.969	-0,185	-6,869
1915	109.300	79.200	2.010	-0,032	-0,430	-0,363	-0,085			-0,085	0,144	103.942	-0,229	5,358
1916	129.600	87.200	2.620	0,081	-0,145	-0,131	0,333			0,333	0,176	106.914	0,157	22,868
1917	129.700	88.800	3.050	0,114	0,056	0,050	0,520			0,520	0,208	109.886	0,312	19,814
1918	128.800	87.500	3.210	0,105	0,140	0,126	0,560			0,560	0,240	112.858	0,320	15,942
1919	113.200	84.300	3.700	0,086	0,393	0,354	0,692			0,692	0,272	115.830	0,420	-2,630
1920	124.000	85300	4.770	0,136	0,909	0,818	0,978	-0,806	-0,171	0,978	0,304	118.802	0,674	5,198
1921	100.000	76.200	2.950	-0,032	0,068	0,061	-0,381			-0,381	0,336	121.774	-0,717	-21,774
1922	125.900	83.000	3.560	0,067	0,332	0,298	0,635			0,635	0,368	124.746	0,267	1,154
1923	144.400	91.600	4.640	0,202	0,815	0,734	0,971	-0,650	-0,320	0,971	0,400	127.718	0,570	16,682
1924	137.700	88.500	4.460	0,161	0,743	0,668	0,918	-0,649	-0,269	0,981	0,432	130.690	0,486	7,010
1925	153.000	92.100	4.950	0,219	0,963	0,867	1,038	-0,792	-0,276	1,038	0,464	133.662	0,574	19,338
1926	163.100	96.300	5.110	0,272	1,021	0,919	1,082	-0,744	-0,337	1,082	0,496	136.634	0,586	26,466
1927	164.500	96.700	4.840	0,267	0,888	0,799	1,029	-0,585	-0,443	1,029	0,528	139.606	0,501	24,894
1928	171.800	97.300	4.790	0,272	0,861	0,775	1,021			1,021	0,560	142.579	0,460	29,221
1929	181.300	100.000	5.600	0,332	1,241	1,117	1,182	-0,851	-0,327	1,182	0,593	145.551	0,590	35,749
1930	155.600	91.500	4.370	0,192	0,684	0,616	0,909			0,909	0,625	148.523	0,285	7,077
1931	129.700	80.900	2.750	0,014	-0,052	-0,047	0,178			0,178	0,657	151.495	-0,478	-21,795
1932	100.000	69.400	1.560	-0,159	-0,575	-0,517	-0,269			-0,269	0,689	154.467	-0,958	-54,467
1933	119.900	68.500	1.530	-0,170	-0,585	-0,527	-0,281			-0,281	0,721	157.439	-1,001	-37,539
1934	129.700	69.700	2.200	-0,132	-0,265	-0,239	-0,360			-0,360	0,753	160.411	-1,112	-30,711

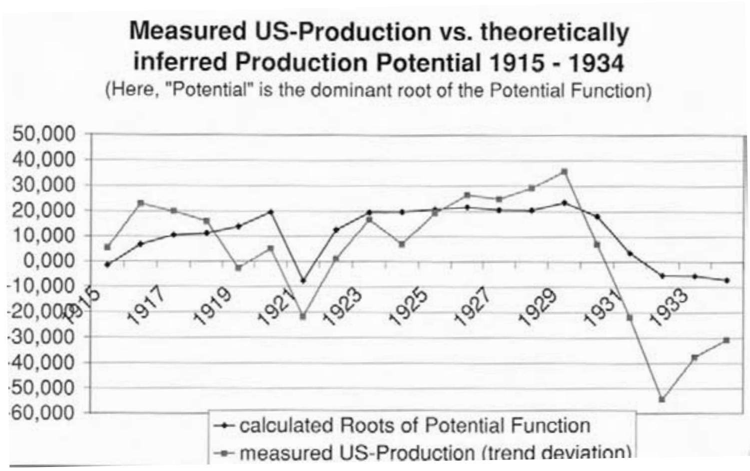

Figure 3 – US Production 1915 – 1934. The goodness of fit as measured by correlation coefficients is impressive (validity). The topology of the potential function appears to be especially useful, indicating that the Rule of Roots is robust (reliability).

6. Conclusions and Discussion: A Neo-New Deal?

This concludes my presentation of the Crash-New Deal breakdown-breakthrough as a case of "Nondarwinean Evolution" in the Lead-Economy of the 20th century.

So let us return to the title question "Can Long Waves Break? What then?" From the structuralist point of view, the Metamorphosis Model (M-Model) allows us to pose different questions than the gradualist K-Model, and to develop different answers. As one answer, I thus emphasize that long waves can break, that trends are breaking in EU-countries, with a Neo-New Deal likely to emerge as concept of Lisbon 2010.

In short, I have established that the expected potential function model, and the Structural Instability Analysis method, open up vistas about the short-term future that combine, at the mesoeconomic level, the principle of continuity (in Walrasian sectors) with the principle of discontinuity (in Schumpeterian sectors). In particular, I see the financial service sector, typically Walrasian in the past, as turning somewhat Schumpeterian, with a swarm of path-breaking financial innovations upsetting the apple-card. In a number of subsectors information inefficiencies and institutional asymmetries frustrate the community of autonomous investors. In all EU member countries, and the US, autonomous investors are turning contrarian, looking for innovation to invest in.

In my book with H. Freudenberger [9] on the coming about of the Industrial Revolution, we argued that one sufficient condition for structural readiness of breakthrough innovations was that at the time, capital had become concentrated in some places where contrarian investors, that fickle subgroup in the community of autonomous investors, formed a network of daring spirits that invested in radical innovations. Capital concentration was the flip side of out-migration of unemployed capital that was quitting declining businesses. The evolutionary pattern is very obvious; in the First Industrial Revolution, and presently, it is as follows.

As the standard Keynesian inducement mechanism in stagnant industries fails to keep the working capital there, it flows to where the action might be, namely, where structural readiness for breakthrough innovations manifests itself in a network of contrarian investors within the larger community of autonomous investors, say in EU regions, China, or elsewhere. There they trigger the take-off; at home, the shakeout.

In other words, within the capital markets worldwide and the financial service providers that operate institutions, the evolutionary shift in the expected potential function is taking place, when and where structural readiness pulls a Neo-New Deal. My reading of the observable facts is that this mental metamorphosis is already taking place. Now, in this phase, participation in the exploitation of these potentials is place dependent, and pace dependent. Now, the race is on for the best chances, notably within the EU-countries that strive to overcome Eurosclerosis.

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Empirical Evidence and Causation of Kondratieff Cycles

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Abstract: The empirical evidence of Kondratieff cycles is highly controversial. In this paper, the question is analysed how far World War I and II are responsible for this situation. It is shown that after estimating the effects of the Wars and other exogenous shocks the long-term economic development is characterized not by Kondratieff - but rather by Kuznets cycles. The long-term growth rate for the US economy seems constant, for the European economies there are significant changes in speed of the growth process. These growth phases seem to be in significant inverse correlation with the innovation process.

Introduction

In [10] it is argued that there is evidence of Kondratieff waves in many national production series during the 19th and 20th century. Kondratieff waves are defined as cycles with duration of twenty to sixty years oscillating around a non-cyclical trend. In [11] this conclusion is revised at least for Germany. The long-wave cycle for the German GDP found in [10] was mainly due to exogenous shocks, namely the two world wars and the great depression. When handling these shocks in a proper statistical way only a cycle of about 20 years duration remains.

In this paper I will first explain how these contradicting results, which have raised a lot of confusion in literature, can be explained. In a next step I will analyse the significance of such shocks for the dating of "long waves" in other countries, confining myself to the GDP per capita in France (1820-2001), Great Britain (1830-2001), Italy (1861-2001) and the USA (1891-2001).[1] After estimating the cyclical component and the long-term growth rate of GDP per capita a new indicator for innovation activity and its influence on growth dynamics is presented. Summarising the results and putting some questions for future research will complete this paper.

1. Explaining Contradicting Results

In [10] the question "*Is there any evidence of Kondratieff „long waves" in important indicators of general economic activity?*" is answered with an unrestrained YES. The methodological background for the analysis behind this answer was the theory of linear filters. This theory allows the construction of filters that exactly transform a predefined signal from filter input to filter output. "Long waves" are defined as cycles with duration of about twenty to sixty years. Correspondingly the trend was defined as oscillations with duration longer than sixty years. The used Stier filter allows filtering the predefined

[1] Figures are taken from [8].

components in an exact way without a phase shift and without changing the amplitude. However, when this analysis was conducted it was not clear how the filtered components are affected by extreme values and how these values should be handled within filter analysis: Although the problem was recognised it could not solved.

Since that time the statistical time series analyses has made great progress. Nowadays reliable tools for handling exogenous shocks within the framework of stochastic processes exist. Stochastic processes are the basis for modern univariate and multivariate time series and are driven by stochastic shocks. There are normal or regular shocks, which are due to the regular process mechanism, and big or irregular shocks, which are due to specific historical events outside this mechanism. In the historical shape of time series the effects of these two kinds of shocks are interwoven. If a time series is affected by big shocks or outliers every kind of trend and cycle estimation leads to an overestimation of the cycle and an underestimation of the trend. This fact explains the results in [10] to a great part. Therefore it is evident that estimating or filtering trend and cycles requires the identification of big shocks in advance.

2. Identification and Modelling of Outliers

Statistically there are several possibilities to model irregular shocks. One is the analysis of outliers in the framework of the ARIMA approach. In this case, outliers are treated as interventional effects and are modelled within the bounds of the transfer function model. Interventions are historically singular, exogenously caused events outside of the actual process mechanism, which cause a temporary or lasting, abrupt or gradual shift on the permanent level of the time series. Identifying and modelling outliers is a complicated and time consuming task. Because of the scarce of time and space neither the statistical models nor the calculations done can be presented here[2].

Our analysis reveals significant outliers in all GDP series mainly due to the two World Wars and the Great Depression. For France, Germany and Italy also the decade after World War II is identified as an irregular growth phase. The outlier effect on the growth rate can be demonstrated by subtracting the adjusted series from the unadjusted series. Figures 1 and 2 show the outliers for the growth rates of the GDP series from 1820 to 2001. Without going into detail it is obvious that the war and interwar period is characterised by strong irregularities compared to the forgoing and following period.

3. The Impact of Outliers on the Trend and Cycle Component

Once the outliers are identified their influence on the trend and cycle component can be examined. Two questions are in the centre of the analysis. First: Are "long waves" of economic development the result of outliers that have not been considered adequately in empirical analysis? Second: What does economic growth undisturbed by historical "accidents" look like? Does it really show a constant rate, as the neoclassic growth theory claims?

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[2] The interested reader is referred to [12, 13] for a comprehensive presentation and discussion of the statistical procedures and problems.

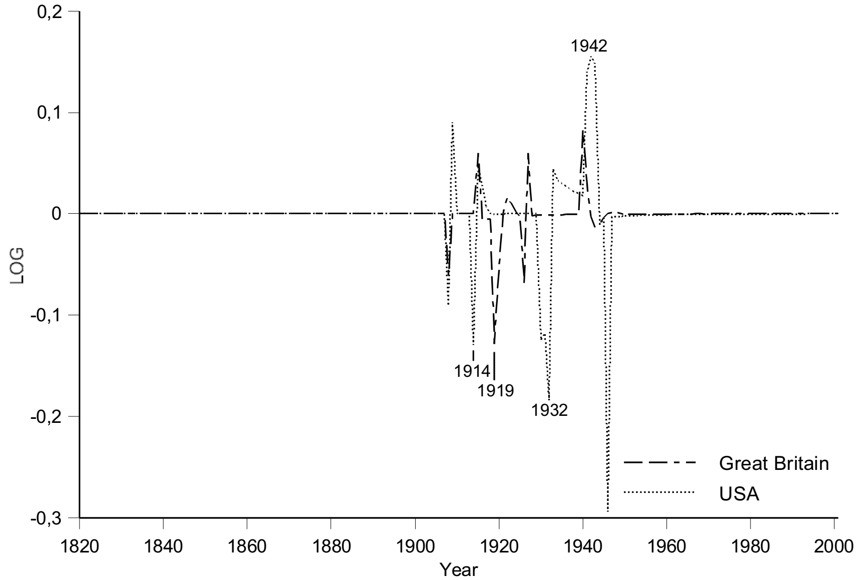

Figure 1 - Outliers in the growth rates of GDP

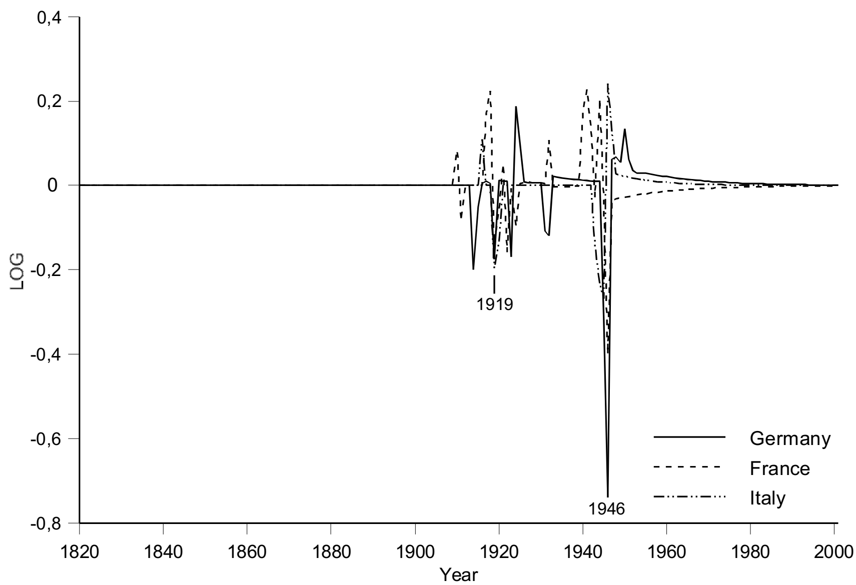

Figure 2 - Outliers in the growth rates of GDP

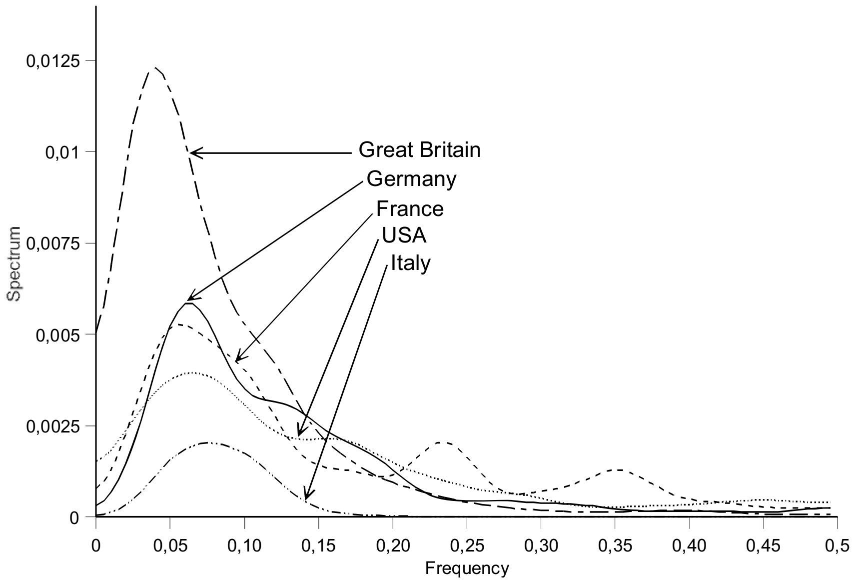

Figure 3 - Estimated spectra of the cycles in five countries according to the „Trend-plus-Cycle" model

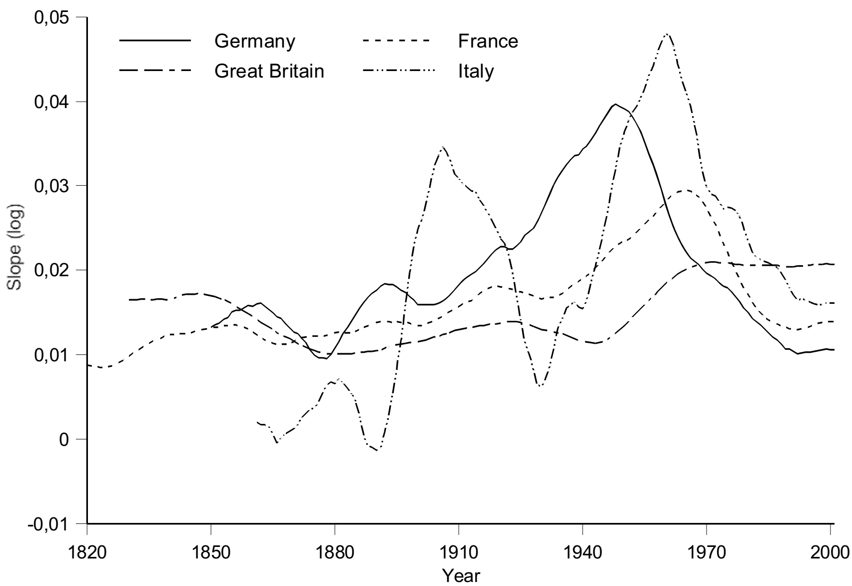

Figure 4 - Slope of the stochastic trend in four European countries

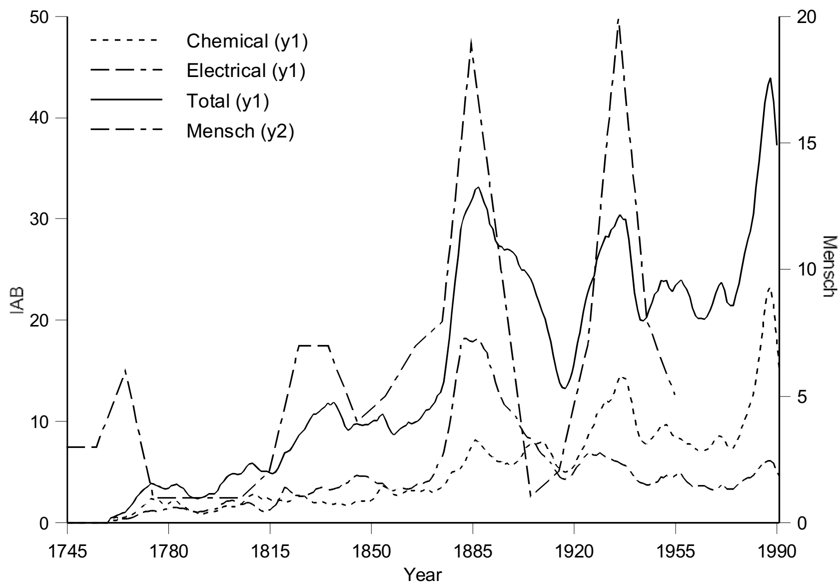

Figure 5 - Number of innovations according to IAB [14] and Mensch [9]

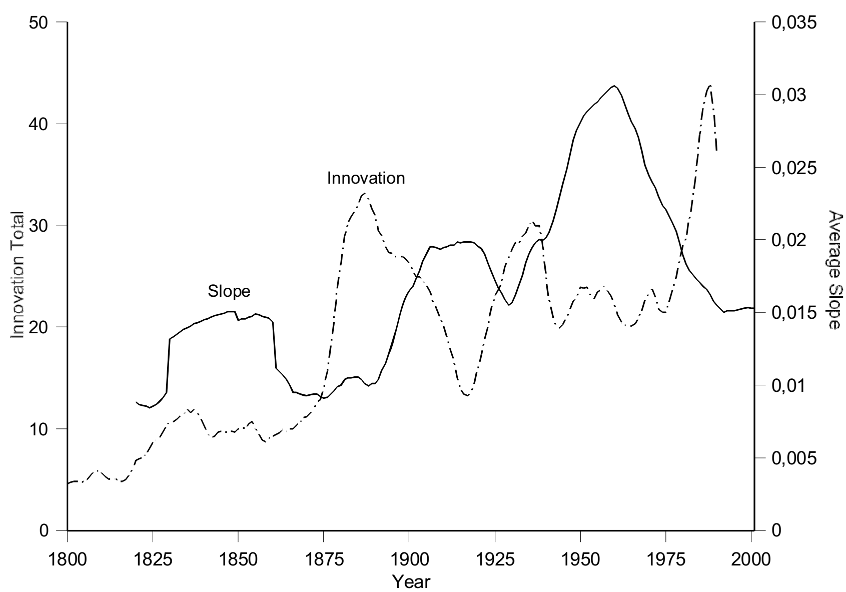

Figure 6 - Average slope of the growth trends and innovation intensity

To answer these questions we proceed in two steps. First we filter the adjusted GDP series with the Stier filter in the same way as in [10]. This gives answer to the question to what extent the „long waves“ identified in [10] are due to outliers. Applying the Stier filter to the adjusted GDP series yields to trend-free series that, with one exception, do not contain Kondratieff but shorter cycles ranging from 20 to 25 years.[3] The only country whose trend-free series shows a long cycle with duration of about 50 years also for adjusted GDP is Italy. But this may be due to the fact that filtering is not the appropriate way of component estimation.

As already mentioned historical time series are conceived as realisations of stochastic processes. The components of a time series should therefore be modelled according to the specific structure of the data generating processes. If one ignores the series-specific process one runs the risk of producing statistical artefacts. Long cycles are a very prominent example for such an effect in econometric literature.

For estimating stochastic trends and cycles the structural time series model developed in [5] is very suitable. The "Trend-plus-Cycle" model can be expressed as follows:

$$Y_t = T_t + C_t + \varepsilon_t,\ t = 1,...,T \tag{1}$$

where Y_t is the logarithmic time series (with or without outliers), T_t the trend C_t the cycle and ε_t the irregular component. The trend component T_t is modelled as a local linear trend:

$$T_t = T_{t-1} + \mu_{t-1} + \eta_t,\ \eta_t \sim NID(0, \sigma_\eta^2) \tag{2}$$

$$\mu_t = \mu_{t-1} + \zeta_t,\ \zeta_t \sim NID(0, \sigma_\zeta^2)$$

Here μ_t is the growth rate ("slope"), which is usually called "drift", η_t and ζ_t are uncorrelated white noise processes, and NID stands for normally independently disturbed.

The following analysis with this "Trend-plus-Cycle" model is based on the adjusted GDP series of the five countries. The duration of the estimated cycle component varies between twenty-two years for Great Britain and twelve years for Italy. Figure 3 shows the estimated spectra of the cycle components, which clearly demonstrate that a long-wave cycle is not present in either of the series.[4] The long cycle found for Italy with the Stier filter is obviously the result of false trend estimation.[5]

Do these results mean that in all the countries the GDP follows a constant rate of growth surrounded by Kunzets cycles? Surely not. The long-term growth dynamics of the series are imbedded in the slope of the stochastic trend (compare equation 2). The slope can be interpreted as the long-term growth rate (= growth rate of the trend). According to neoclassical growth theory this rate is constant. According to long-wave theory this rate shows a regularity of why it is necessary to statistically isolate it from all non-cyclical oscillations. According to the structural break hypothesis[6] this rate changes due to historical exogenous events but is constant within specific growth regimes. Figure 4 shows the slopes

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[3] Peak of the spectrum at 20 years for the USA, 25 years for France, 22 years for Great Britain and 20 years for Germany.

[4] The finding in [3] that the long cycle play a dominant role may be due to the fact that the author does not isolate the irregular shocks before he estimates the components with the structural model.

[5] It is interesting to note, that the cycle in Great Britain has the highest and that in Italy the lowest spectral density. This means that in Britain a relatively higher proportion of the yearly growth rates are due to the business cycle phenomenon than for example in Italy. In France, Germany and the US the cyclical variance is nearly identical.

[6] Angus Maddison is a proponent of this hypothesis, compare e.g.[7].

of the estimated trends for the four European countries. There are significant variations in the long-term growth rate. In the USA however the long-term growth rate is constant and amounts to about 2 %. Obviously the economic growth process in the USA is in complete accordance with the neoclassical growth theory where long run growth is assumed to be constant.

The empirical evidence shown in Figure 4 is not easy to interpret. But it seems clear that long-term growth is not steady and there are successing phases of accelerating and decelerating growth. In general the second half of the twentieth century is marked by a slowdown in growth rates which starts first in Germany (1950) and last in Great Britain (1970), whose growth speed is very similar to US since then. At the end of the 20th century the growth speed in Germany, Italy and France is similar to that in 19th century. But in the 19th century overall growth speed is not dominated by accelerating or decelerating phases but rather by stationary oscillations. The first half of the 20th century is mostly a phase of accelerating growth. Only Italy shows a wave like pattern. The slopes for Germany, France and partly also for Great Britain fit very well to a picture, which Robert Gordon [4] has drawn for the US economy. He called it "One Big Wave". This wave starts with slow multi-factor productivity growth in the late 19th century, then an accelerating peaking in 1928-50, and then a deceleration to a slow rate after 1972 that returns to the poor performance of 1870-1891.

4. Long-Term Growth Variations and Innovations

What are the causes for these long-term growth variations? One surely has to consider a lot of country specific factors. But are there common factors behind these? In opposite to the hitherto discussed „long waves", for which a tendency to international synchronisation is assumed and therefore the question for common causes can be discussed in a theoretical framework it is questionable whether it makes sense to ask for general causes for such a heterogeneous growth picture. Even if one succeeds in explaining European growth dynamics the question remains why the growth rate of the US economy is constant.

The assumption that innovations play an important role for economic growth and productivity is not confined to the proponents of the long wave theory. Also in mainstream economics innovations play a dominant role in analysing the factors of long-term growth. In the following we will have a closer look to the innovation process as possible explanation for the growth dynamics shown up in the slopes in Figure 4.

For measuring the innovation activity many indicators have been constructed so for example in [1], [9], [2], [6] and recently in [15]. We do not use any of these indicators but an indicator that is based on 15.000 innovations for the period from 1750 to 1991, which have been collected by researchers of the Institute of Employment Research (IAB) in Nuremberg.[7] The idea behind this collection was not to focus on single basic innovations, whose dating will never be possible on sure grounds but to collect as much as possible "important" innovations. The collection has different advantages. For example it allows selecting all innovations belonging to specific technological systems (e.g. railway or electrical engineering) and to analyse the dating and intensity of the innovations of this system.

For our analysis we have chosen the following five systems: textile and steam (424), railways (568), electrical engineering (1128), chemistry (1270) and automobile (297).[8] Figure 5 shows the distribution of all these five innovations together with the innovations

[7] The collection is available at the Centre for Historical Social Research at the University of Cologne. For a more detailed description compare [14].

[8] The figures in brackets indicate the number of innovations belonging to this system.

selected for electrical engineering and chemistry as examples.[9] A comparison of the peaks of the different distributions shows that the cluster around 1890 is mainly due to innovations in electrical engineering whereas the cluster around 1936 is mirrored by innovations in chemistry. Around 1916 electrical engineering as well as chemistry is characterised by a poor innovation activity. The distribution of the innovations for the five technological systems fits very well to the distribution of basic innovations according to [9], which is also included in Figure 5. This seems at the one hand to confirm the clustering of innovation activity and on the other hand the high quality of the innovation indicator derived here.

After measuring the intensity of innovation the question arises on how to measure the interdependencies between innovation activity and growth dynamics. For such an approach one normally would have to formulate a multivariate econometric model according to a specific theory. This would go far beyond the scope of this paper and should be in the centre of future research. We confine ourselves here to a simple graphical inspection of growth curves and innovation indicators. As indicator for the overall growth speed in the four European countries we use the arithmetic average of slopes shown in Figure 4. Figure 6 shows this average slope together with the indicator of innovation intensity. Both curves show a somehow inverse movement. If one shifts the growth curve 18 years back both curves move highly parallel. It seems that every acceleration of innovation activity was followed by an upswing in growth with a lag of about 18 years. Whether this is the proof of the depression trigger hypotheses formulated by Mensch and Kleinknecht may also be a question for future research.

Conclusions

If one accepts the capitalist growth process of the 19th and 20th century as the outcome of an unique process significant exogenous shocks can be identified mainly in the first half of the 20th century. The „long waves“ of economic development identified in [10] are mainly due to these outliers. If one adjusts the GDP series for these outliers the estimation of trend and cycle with a structural model reveals cycles within the Kuznets range. The estimated slope of the trend shows significant phases of accelerating and decelerating growth in the four European countries and a constant growth for the US economy. These growth phases seem to be highly inverse correlated with innovation activity calculated from innovations belonging to five technological systems.

There are several questions open for future research: Why does the US economy follow a constant rate, despite the obvious clustering of innovations? How can the impact of outliers on innovation activity be assessed? Is it possible to find a model, which de-scribes the interrelation between innovation activity and growth dynamics systematically? And last but not least, can the identified Kuznets cycles be integrated into such a model?

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Principles of Self-Organization and Sustainable Development of the World Economy: From Local Conflicts to Global Security

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Abstract. The phenomenon of states changes of the world economy during the last 200 years shows that there is a certain 70-year regularity in its development, which is expressed in increased structural complexity of the global economic system every 70 years. The development happens after certain periods of bifurcation (up to 50 years) accompanied by the lower rates of economic development, and periods of adaptation (up to 20 years) with the higher rates.

The theoretical reasoning of this process shows that complication in the structure of the global socium is the external demonstration of the self-organization process in a large complex system we call the "world economy". This process of development is based on two fundamental laws of nature: the principle of minimum dissipation of energy (or resources), and the law of conservation of accumulated energy (economic efficiency); and is realized via two types of development mechanisms – bifurcation and adaptation.

Formation of the world-security system should rest on applying the natural laws of development, and lead towards the creation of a complex, two-level (regional and global) structure with the institution of geopolitical pluralism, based on implementing the "principle of minimum dissipation". This will contribute to the development of the global system on a conflict-free base.

Introduction

The objective of the work is to reveal and define phenomena, which are characteristic for the behavior of complex systems in the process of their development on the basis of factual material of the world economy development during the period of 1825-2000. Some elements of the work were presented at scientific forums that took place in the USA, Spain, Italy, and Russia. Theoretical issues are explained in monograph "Self-Organization of the World Economy: Euro-Asian Context" [1].

Social system – "the world economy" – is considered as a complex system consisting of two global subsystems: economic and political. Common agents for both subsystems are national economies, which interact in economic and political spheres and form connections and structure of social system of the world economy.

Here we could use the term "the world system" (or global system), which could include both economic and political subsystems. But we believe that the term "social system – world economy" is more suitable because we assume that political system being an object of non-economic scientific disciplines should be included into economic scientific domain.

Such approach allows us to view political system as an object of economy through the understanding that a certain type of political system can influence economic result of the functioning of the world socium. Thus, hereinafter the term "world economy" will mean complex, combined social system. Economic system of the world can be regarded as combinations of the subjects of the world economy – national economies and economic relations between them. These relations arise in the process of exchanging international resources on the basis of international division of labor. The economic system "the world economy" can be represented as a system of international economic relations: geographical and production structure of international trade and services movements; geographical and social structure of international migration of labor resources; international capital movements. International economic relations function on the grounds of already formed system of international monetary relations. Political system of the world economy is the combination of direct and indirect diplomatic relations among countries that participate in international labor division. (The indirect relations are represented as taking joint decisions in supranational institutions). This division provides legal aspect in functioning international economic relations.

Functioning of a social system "the world economy" means implementation of economic and political relations in the process of international exchange of resources basing on international labor division. This process is aimed at allocating resources more effectively for production in the circumstances of their scarcity. One more purpose is to distribute manufactured products in the circumstances of unlimited growth of consumption. The main functional purpose of a social system "the world economy" is to implement self-regulation among agents of an economic system via political system (since national economies are ordinary agents). This process leads to the state of maximum dynamic equilibrium in an economic system "the world economy and consequently, to economic growth of the world economy.

It is a well-known fact that at the present time the main problems of the world economy are as follows: the threat of ecological disaster, two thirds of the population live in poverty, mass famine, illiteracy and many others. At the same time the population is increasing and the global resources are decreasing. Therefore, to solve these urgent problems we should have a mechanism which will effectively help us to reallocate the limited resources in the context of growing the world economy.

Development of a social system means a process of increasing its stability under the influence of environment (maintaining stability within the given limits – homeostasis) by accumulating structural information which changes the quantity of organization (efficiency) of the system and makes its structure more complicated. Increase in stability is expressed in accumulating economic efficiency and forming more complicated structure of a society.

Development of the world economy means a co-evolution of development of economic and political subsystems resulted in further gradual complication towards environment effect, pressure of population growth and limited resources.

Development means a change of equilibrium states with different macroeconomic characteristics. Each state is expressed in structural and quantitative characteristics. For the world economy the international monetary system (IMS) will be considered as a structural characteristic. The growth rate of the gross national product of countries participating in international economic relations will be regarded as a quantitative characteristic.

We consider that our task is to form the verbal model of development and self-organization of the world economy as a social system. Having basic regulations of the theory on social development [1], we should define and formulate system regularities. The world economy develops on the basis of these regularities and, correspondingly, a new structure and organization of the world economy will be formed according to them. There follows an assumption that basing on these regularities we can formulate a forecasting version as to development of the world economy in the nearest future.

1. Idea and Description of the Model of the World Economy Development

In order to explain the process of self-organization of the social system “world economy” more properly and to demonstrate correlation between these processes as well as interaction between economic, political subsystems and evolutional development of a social system we decided to use a theoretical space-time, three-dimensional model of self-organization.

As a basis we used R.F. Abdeev’s model [2] by introducing structural and quantitative characteristics – criteria. According to him different states of the system “world economy” are defined in the process of its development. The idea of the model consists in the simple assumption: “the phenomena of development can generally be viewed as the struggle between two opposite tendencies – organization and disorganization. At the same time the process of development that begins with the maximum disorganization can be described as a process of gathering structural information. The information is estimated as the difference between true and maximum value of entropy. Consequently, phenomena of development should be examined in coordinates that are connected with such category as entropy (information) and with the opportunity to measure the level of organization or disorganization of a system at all stages of its development. Therefore, the theoretical model obtains its (polar-potential) system of coordinates and the hypothetical three-dimensional space where disorganization is decreasing from periphery towards the center (to the axis of the model) as information becomes available. It means increase in the level of organization of the given object as this object is developing…”. [2] The model of self-organization of the “world economy” system is represented in the form of vertical convergent spiral around the axis. The axis reflects economic efficiency as quantitative expression of its development. The spiral itself is a trajectory that shows development of the world economy within a certain period of time. Coils of development demonstrate recurring cycles of development but at a qualitatively high-organized level. The projection of coils on a plane along with the radius of moving away from the axis of efficiency shows a quantity of organization in the world economy system for every state under study. Gradual decrease in radius from coil to coil illustrates the process of diminishing the quantity of disorganization (entropy) and increasing the quantity of organization of an economic system. This process reveals the essence and dynamics of the development.

2. Structural and Quantitative Characteristics as to the States of the World Economy System.

Development of the world economy as a large complex system represents the change of its states. Each state has structural and quantitative characteristics. Thus, we should determine the states of a social system “the world economy” during development so that we could better describe and model the process of its development. We also need to define structural and quantitative characteristics for every particular state. Taking into account the fact outlined before, we can state that many scientists that conduct researches into development of the world economy consider relations among countries of Western Europe, the USA, Canada and Japan as major relations in the sphere of development of international economic relations between 1875 and 2000.

Trade, migration of population and capital flow among the countries of Western Europe, the USA, Canada and Japan make up international economic relations for the period under study. International monetary system is a base for all abovementioned elements of international economic relations. This system enables all these relations to be implemented. *Therefore, we regard the structure of the international monetary system as the structural characteristic of organization of both the international economic relations and the world economy system.* It is a well-known fact that international monetary system has the following structural characteristics: type of international money (gold, USD, SDRs); type of world reserves (gold, USD, SDRs); type of currency exchange (the system of exchange rates); availability or absence of supranational institutions that regulate international monetary relations. The basic changes of at least one of these characteristics lead to changes in the system structure, in its transformation as well as to changes in the way the world economy system is organized. That is how the system state is changing during its development. According to the way these characteristics are combined the international monetary system is classified into three types: the gold standard system; the Bretton Woods system, the Jamaican currency system. Basing on these types we can determine three states of the world economy system.

The period when one state of the world economy system exists throughout its development is the period during which the main structural elements of international monetary system are being formed and maintained. One state corresponds to a single cycle of development. One cycle of development of the world economy system includes two different periods which are determined by the type of development mechanism and by the quantitative characteristic for making a description of a model: the period that is characterized by bifurcation mechanism of development; the period that is characterized by adaptation mechanism of development. Accordingly, every type of international monetary system during its development and functioning goes through two periods. The system is being formed at the stage of bifurcation mechanism whereas at the stage of adaptation mechanism the system is functioning.

Different rates of the world economy growth are connected with these periods: there is a decrease in the rates of the world economy growth during the period when the bifurcation mechanism of development actions; there is a spasmodic increase in the rates of the world economy growth during the period when the adaptation mechanism of development actions. *The synergetic effect is then implemented.* We also take into consideration this supposition in order to simplify calculation of quantitative parameters introduced into the model. *Thus, we calculate the quantitative characteristic of the states of the world economy system for the period from 1875 to 2000 as an average value of gross national product growth for abovementioned countries for every period under research (in %). For the period up to 1875 we determine the value of the growth rate of the world economy as 1, 5%.*

3. Development and Self-Organization of the World Economy System.

According to the already defined criteria, the historical period being studied concerns the development of the world economy system for the period from 1825 till 2035. Basing both on the periods when indicated systems of international monetary relations are functioning and on the quantitative characteristics we define the time limits when three states of the world economy system exist in the process of its development. In other words we determine the time periods as to three cycles and six periods of development of the world economy system. These time periods are represented as follows:

The first state. The first cycle of the world economy system development corresponds to the time span when the gold standard system functions; 1825 – 1875 – 1895, and can be divided in two periods.

The first period in the first cycle of the world economy system development: the period from 1825 till 1875; transformational period; the period of forming the gold standard system; the period when the bifurcation mechanism of development actions; rate of the world economy growth corresponds to 1.5%.

The second period in the first cycle of the world economy system development: the period from 1875 to 1895; the period of active functioning of the gold standard system; the period when the adaptation mechanism of development actions; rate of the world economy growth corresponds to 2.6%. In the sphere of policy: countries participating in international economic relations came to mutual agreement about substituting their currencies for gold; this agreement was reached on bilateral basis; the principle of implementation of social and joint agreement in international economic relations was carried out in the sphere of monetary relations. Therefore, the world political system was formed on the basis of direct diplomatic relations and took shape of military alliances, coalitions, etc.

The second state. The second cycle of the world economy system development is the time span when the Bretton Woods system functions – 1895–1945–1965, and can also be divided in two periods.

The third period in the second cycle of the world economy system development: the period from 1895 till 1945; transformational period of forming the Bretton Woods system; the period when the bifurcation mechanism of development actions; rate of the world economy growth corresponds to 1.8%. The main result of the third period in the second cycle of the world economy development was the forming of supranational institution. The institution included the system for regulating international financial and trade relations. The institution also performed the principle of social, joint agreement between countries participating in the process of establishing and developing international economic relations. Such relations suggested mutual regulating of exchange rates, crediting balance of payments of participating countries, mutual reducing tariff restrictions in international trade, etc.

The fourth period in the second cycle of the world economy system development: 1945 – 1965. In the sphere of economy: during this period; rate of the world economy growth development was high and with great advance it increased up to 5-6 % comparing to the similar indices of the previous period. The mechanism of development was of adaptation type. By the end of 60-s - the beginning of 70-s (1972 – 1973) the system of international economic relations reached its maximum efficiency for the current state and began its transformation into the next stage. The change of the principles of monetary relations approved at Jamaican conference became a logical conclusion as to the fourth period of the world economy system development. The formations of conditions for international monetary relations were not finished yet. Jamaican conference just initiated these changes.
In the sphere of policy: regional and international supranational institutions began their formation and development. However, they received further development in the next fifth period of the third cycle of development .On the whole, a bipolar political system and an ideological opposition supported the global political and economic stability. The world political system obtained an instrument of solving conflict situation by mutual agreement – the United Nations. The UN includes not only institutions that regulate the world economy but also the Security Council in order to regulate war and conflict situations.

The third state. The third cycle of the world economy system development is the time span corresponding to the Jamaican system – 1965 – 2015 – 2035. Again can be divided in two periods.

The fifth period in the third cycle of the world economy system development is the period of transforming the system of international monetary relations and forming its new structure; the period from 1965 till 2015; the action of the bifurcation mechanism of development; the rate of the world economy growth corresponds to 3.4%.

During this period two phenomena of the global development were formed. One of them was the phenomenon of regionalization: 23 international organizations of integrative character with regional location had already been created by the 90-s of the 20^{th} century (EU, NAFTA, MERCOCUR, ASEAN etc.). They have more than 60 % of the world gross domestic product and the major part of international trade - about 8 trillion dollars. Furthermore, 85 regional trade and economic agreements were concluded in 90-s. The second phenomenon is globalization. There exist thousands of transnational corporations in the world. 50 % of the world production and 63 % of the world trade are concentrated in these corporations. This flow of capital and resource is uncontrolled by the state. Moreover, these resources are allocated in an efficient way. *A national state as a form of organizing people activity is connected with resources allocation and distribution of goods within the limited territory and the limited number of people. Hence, we can state that the national state became less effective compared to a regional version of forming a number of countries and with global resources movement.*

The political situation suggests two conclusions. The first one lies in forming new political structure on multipolar and two-level basis: regional and global. (It is connected with appearance of new leading countries that have economic and military potential: the EU, China, India and Japan). The second conclusion corresponds to the fact that the structure of the political system should stipulate the implementation of principles of joint agreement between developed, developing and undeveloped countries.

The sixth period in the third cycle of the world economy system development is the period which can be forecast, the period of active functioning of a new system of the international monetary relations, predicted to last from 2015 till 2035 under the action of the adaptation mechanism of development; the rate of the world economy growth may correspond to 8-9% (predicted).

According to already defined structural and quantitative characteristics as to organizing the world economy system we point out its three states. Every state corresponds to one of three types of the system of international monetary relations and three cycles of development. Six periods of the world economy system development correspond to these cycles. The first five periods are real and the sixth one is theoretical or predicted.

Based on the system states outlined above we form a model of self-organization and development of the world economy presented in figure 1.

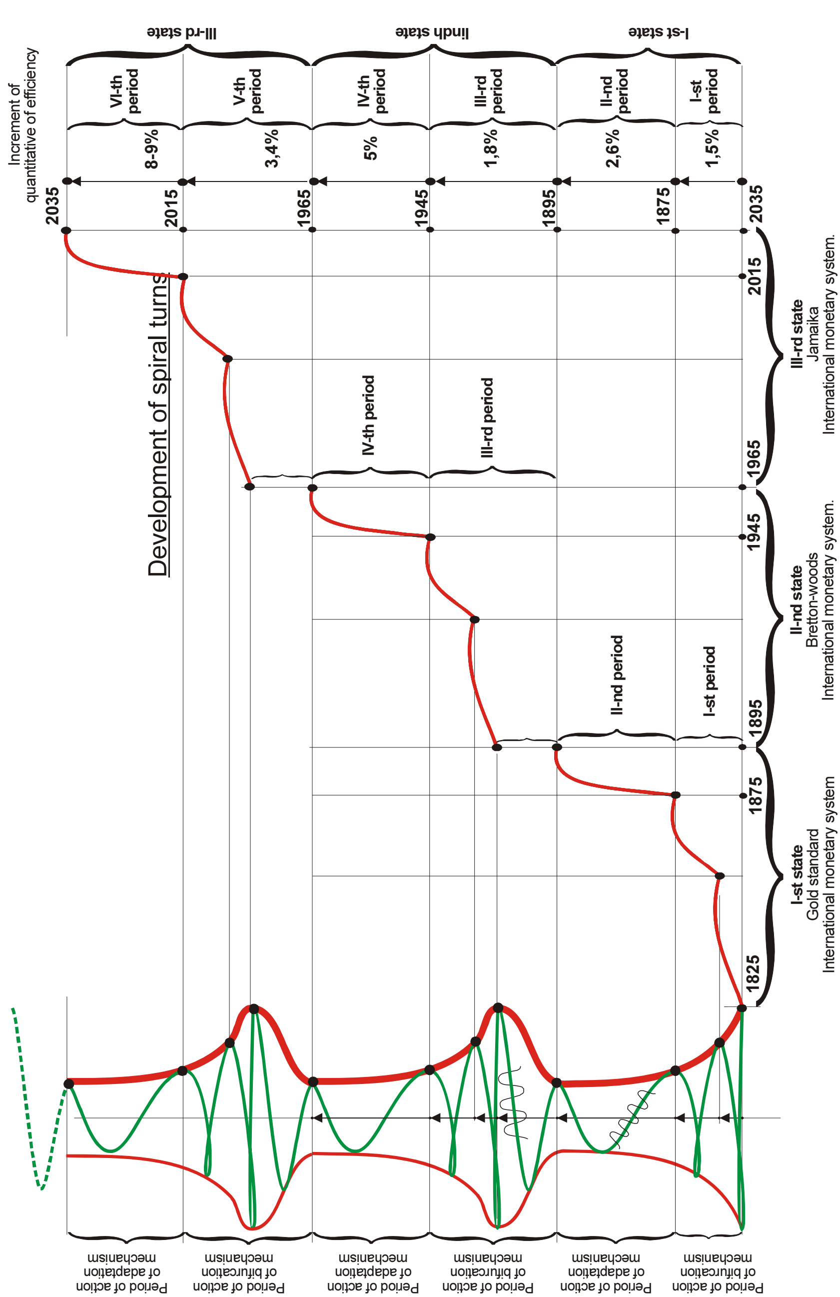

Fig.1 The model of development and self-organization of the World Economy for interval of time 1825-2035 years

Conclusions

Each subsequent (out of distinguished) state of the world economy has more complex organization of political and international monetary system. And this fact demonstrates the tendency towards complication of the structure of the world community.

Each subsequent state is more effective from economic point of view and has the higher rate of economic growth. This allows the world economy to develop steadily in conditions of swollen population on the planet along with limited resources. A tendency towards increase in economic efficiency of the whole system is observed during a long period of time.

The process of forming subsequent structures of both political and economic organization of the world economy took place in conditions of non-equilibrium environment. It was expressed by numerous military and civil conflicts as well as economic crises.

All facts outlined above lead to the following conclusions: the world economy system has the feature of an authentic complex system, i.e. self-organization. The Oksanger-Prigogin's principle of minimum energy dissipation is implemented in the process of development. Each subsequent organization of the world economy produces less entropy than the previous one. The category of energy in physical system corresponds to the category of resources in social system. Thus, the principle of minimum dissipation of limited resources functions in social systems. The model reflects the implementation of this phenomenon in the process of development and self-organization of the world economy. The conservation law of accumulated efficiency defines direction of the world economy system development and it means that the model has the predicted potential for making prognosis of future organization of the world economy.

The global socium security assumes its self-preservation under the impact of various destructive processes: increasing risk of ecological disaster, mass dissemination of the epidemic diseases that cannot be cured yet, growing death-rate due to the ubiquitous poverty and famine, increasing deficit of finite energy resources because of their non-renewable (the world oil and gas reserves are available for the next 30-35 years of the civilization existence). According to experts, the global warming (greenhouse effect) could happen within the nearest 50 years. In addition, there still exists a threat of nuclear catastrophe and war conflicts.

The possible ways of solving the above problems are complicated by multi-religious and multi-cultural environment, peculiarities of mentality of the population in the whole world, differences in natural resources availability in various regions of our planet.

Thus, guaranteeing the worldwide security means the necessity to create institutions of the global socium which would support its stability in above circumstances. The worldwide security is impossible without joint interests of different geographical, cultural, ethnic and other groups of population being implemented.

The population joint interests could be pursued via establishing the institutions of geopolitical pluralism on the basis of the principle of public harmony at regional and global levels. The institution of the public harmony is a mechanism for optimal solving the existing problems. This institution rests on the functioning of natural laws: the principle of minimum energy (recourses) dissipation and the law of conservation, which forms the trajectory of the civilization development. As it could be seen from the aforementioned facts, such laws underlie a large and complex system of the world economy. The worldwide security implies establishment of the institutions which can embody and support these laws of Nature. Such institutions will provide stable development of the global socium without any conflict for the long-term period of time.

For the time being we could speak about reforming the Organization of the United Nations into a system that could pursue both joint regional and national interests of developed, developing, backward countries, countries with transitional economy and others in the context of solving all-planetary problems. This assumes the necessity of creating the institutions able to conduct the worldwide controlling over the scarce resources (energy resources) being in terms of crisis and over the process of preserving the ecosystem. At the same time there has to be a clear understanding of the fact that the planet is one and for everybody – both for the USA, Iraq and for a primitive tribe somewhere in Africa. Within the system, effective mechanisms should be created to restrict the activity of those countries or group of countries whose military potential incite them towards the actions that do not take into consideration interests of some nations or the whole planet. The system should rest on the adoption of All-Planetary Constitution – the Fundamental Law, which all existing forms of the people organization shall observe. Within the Fundamental Laws, the wide spectrum of problems as to preservation of the global socium, starting from local conflicts and ending with preservation of the ecosystem and life on the Planet as a whole can be and must be solved.

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Waves of Socio-Economic Development: An Evolutionary Perspective

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Abstract. The main aim of that paper is to outline an alternative view on a wavelike development of human systems. The hypothesis is based on evolutionary interpretation of human knowledge development. There are some evidences that individual knowledge of each human being consists of paragons (understood as an ideal pattern of human behaviour) – of perception, cognition, behaviour, understanding, and so on. Paragons play a role analogous to genes in biology and determine, in some way, the behaviour of an individual in well-defined life situations. On the basis of biological analogy a hierarchical structure of human knowledge (a so-called archetype) is partitioned into six levels (taxa), namely: (1) epigenetic paragons, (2) the image of the world, (3) the image of the society, (4) the image of the economic system, (5) the epistechne, and (6) the paradigm.

Introduction

Fluctuations and cyclical behaviour are observed in majority of socioeconomic processes; the literature on this subject is enormous and has its own long tradition in history of civilisations, politics, economics, and other social sciences. In the beginning of the 20th century, economics J. Kitchin has identified short, roughly 3 years, inventory cycles; a few decades earlier Clément Juglar discovered 8-10 year business cycles; Simon Kuznetz in 1930s noticed 15-25 years length cycles and associated them with fluctuations in rates of population growth and immigration, but also with investment delays in building, construction, transport infrastructure, etc. In the beginning of the 20th century Nikolay Dmitriyevich Kondrateff has postulated an existence of so called Long Waves (K-waves) of 50-60 years longevity. The K-wave idea can be considered as a link between economics and political science. In the recent review of the world system evolution Devezas and Modelski [1] distinguish, beside K-waves, the 120-year long cycle of global politics (known also as the rise and decline of world powers), 240-year cycle of democratization, 480-year cycle of opinion making, 960-year cycle of world economy.

1. Human Knowledge – Evolutionary Interpretation

Evolution is the specific process of a search for better solutions (types, ideas) by means of trial and error. A special, and distinguishing, feature of this process is the existence of two mechanisms – the generation of new types (ideas) and the selection of types. Knowledge is the basis for any human action and the evolution of ideas may be considered as the essence of human development. A great part of the knowledge of an individual consists of *paragons*[1] – of perception, cognition, behaviour, understanding, and so on. Paragons play a role analogous to genes in biology and determine the behaviour of an individual in some well-defined life situations. Examples of paragons are: ritual action (conditioned by genes or culture), systems of law, technological standards, statements and theorems of scientific theories, successive steps of algorithms applied in solving standard (normal) scientific and technical problems and everyday duties to be fulfilled during the working day. The set of paragons of an individual is called his *individuality*, in contrast to *personality* that, in our understanding, is the social image of the individual described in terms of his comportment, roles, and mettle.

Two main areas of an individual's subjective knowledge ought to be distinguished:

1. Paragons of individuality (the so-called *active* paragons), and *latent* (redundant) paragons which are stored by an individual but do not belong to the individuality, that is, these latent paragons do not affect personality, but at any time they may be incorporated into the set of paragons' individuality.
2. Knowledge of the environments in which an individual lives; this knowledge consists of facts, events, human activities and their evaluation, and so on. This area of knowledge enables an internal, subjective evaluation of others' personalities, as well as self-personality evaluation.

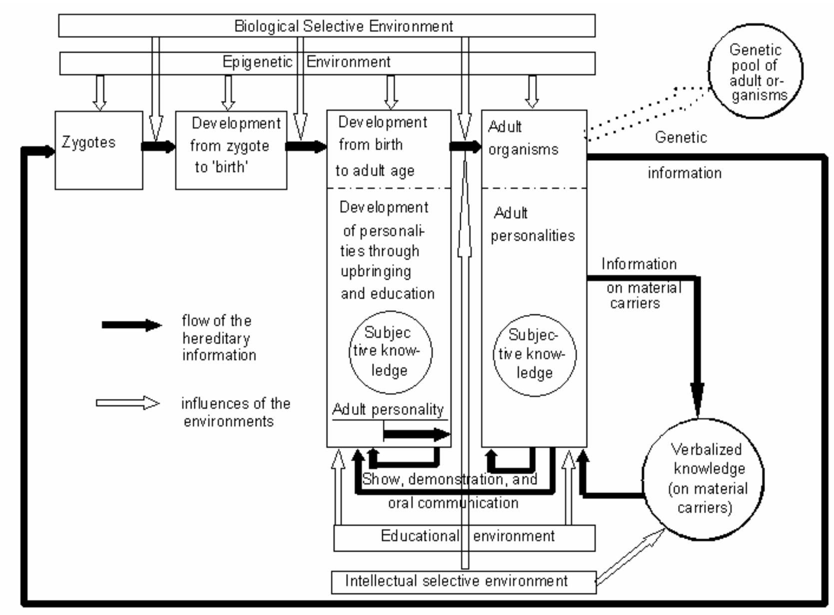

Figure 1 - Knowledge development coupled with biological evolution

Most of the human paragons, either active or latent, are unconscious to each of us and exist in our minds in a nonverbal form. Michael Polanyi calls this kind of knowledge 'tacit', that is, knowledge that cannot be articulated. As Polanyi [3] writes: 'We know more than we can tell'. The quintessence of tacit knowledge is that it can be used almost freely

[1] I use the term *paragon* to underline the ideal type of patterns of behavior. A paragon in this context means a pattern of excellence or perfection. There are some similarities of *paragons* to the well-known concept of *memes*, proposed by Richard Dawkins.

by its holder (although in most cases unconsciously), but cannot be directly communicated to someone else. Individual skills, competence and talents are based mainly on tacit knowledge. Such organization of our knowledge is probably the outcome of the evolutionary forces (selective mechanisms) acting during the long phylogeny evolution of the human species. It is much more efficient for an individual to focus attention on a small part of individual activity and leave the other activities to unconscious processes.

The development of personal knowledge is strongly connected with the biological evolution of man. An essential role in knowledge development is played by extra-genetic transmission of paragons (cultural and social learning). From the biological point of view there exist two environments, namely epigenetic and selective. Human beings also live in a cultural environment and from the cultural and social points of view we may distinguish also two environments, namely the educational environment and the intellectual selective environment (Fig. 1). The educational environment on the basis of written knowledge as well as on the basis of verbal communication shapes personality. A very important role in social and personal learning is played by tacit ways of paragon transmission such as show, instruction, training, demonstration, exemplification, and so on. The emergence of adult personality frequently occurs before the maturation of the biological adult organism – the shaded arrow indicates it at the bottom of the third stage of the different phases of development. Some paragons are transmitted through the social and personal education process on the basis of written knowledge. Contents of this written knowledge (the knowledge pool of the human species) are also affected by the intellectual selective environment – some pieces of information may be considered important and the carriers containing the written information are much less likely to be destroyed; some others are considered less important and carriers containing such information are frequently destroyed or disappear in the historical process.

2. Structure of the Hereditary Information

We can expect that there exist a hierarchical order of an individual's hereditary information, that is, a hierarchy of paragons. This hierarchy stems from: (1) the successive incorporation of some types of paragon during the development of individuality and personality, and (2) the consequences of the adaptation of a new paragon's shape to the cohesion of individuality; even a small variation in a high-ranking paragon implies a disintegration of individuality, and personality, followed by the reconstruction and adjustment of many correlated paragons.

It is said that an entity in which a small change of some of its details results in a drastic diminishing of the quality of work is a fine-tuned object. I postulate that individualities, as well as genotypes, are such fine-tuned objects. Paragons of individuality are divided into two categories: *archetype* and *adornment*. Archetype paragons remain unchanged during a relatively long period of personality development, while adornment paragons change frequently according to local and temporal changes in the environment in which an individual lives. The adornment paragons allow incremental adaptation of the personality to local, highly diversified, environments. Diversity of paragons may be used as a criterion for partitioning the paragons into these two categories. The smaller the diversity of the given category of paragons within a society, the higher the rank of a paragon is.

I suggest that there exist six taxa of archetype paragons, namely: (1) genetically determined paragons (epigenetic paragons), (2) the image of the world, (3) the image of the society, (4) the image of the economic system, (5) the *epistechne*, and (6) the paradigm. A more detailed description of the main categories of paragons of the above six taxa is presented in [2].

In my understanding, a long-range development of evolutionary processes (among them of knowledge development at personal and social levels) is cyclical with two phases in each cycle, namely, the *substitution phase* and the *quasi-equilibrium phase*. The transition from a quasi-equilibrium phase to the ensuing, substitution phase is connected with a fulguration of a new and better archetype. The duration of the quasi-equilibrium phase is much longer than the duration of the substitution phase. In the quasi-equilibrium phase the evolutionary system is in a near stasis state and individuals adjust to a varying environment through changes of adornment paragons. The new archetype delimits the scope of possible changes in the adornment domain, that is, a new archetype demarcates in the adornment domain a new canalized pathway of change – a *chreod*, to use Waddington's terms:

The stabilization of a progressive system acts to ensure that the system goes on altering in the same sort of way that it has been altering in the past. Whereas the process of keeping something at a stable, or stationary, value is called homeostasis, ensuring the continuation of a given type of change is called homeorhesis, a word which means preserving a flow. A phrase used to describe such systems, is to say that the pathway of change is canalized. For the pathway itself one can use the name chreod, a word derived from Greek, which means 'necessary path' [6].

Probably a new form of higher taxon demarcates analogous chreods in all lower taxa of the archetype paragons. The personal development of man and the resulting social development of human societies are bounded by our biological constitution. The same may be said about all other taxa: the accepted worldview (the image of the world) delimits, more or less broadly, the spectrum of our acceptable views on forms of organized society, or ways of economic order; the accepted social view delimits the spectrum of acceptable economic orders, and so on, down to the lowest taxa of human knowledge (paradigm, and adornment). It is not possible to describe each taxon in terms of its paragons, but we can point out some categories of paragons. The situation is similar to that in biology. Biologists describe each taxon by giving examples of organisms of a specific taxon and describe each taxon in terms of phenotypes (morphological traits) of the organism.

Probably there is no possibility to make a formal proof of the existence of proposed taxa but it is possible to find some corroboration of that taxonomy. One of the possible ways to search for such corroboration is by showing similarities between successive stages of the development of individual knowledge and the parallel stages of the historical development of knowledge in a given cultural realm. Study of the personal intellectual development of man may be used also to search for evidence of our proposition of taxonomy of knowledge. If we look closely at the personal development of human beings, we can notice that the forms of paragons of the higher taxa are modified less frequently than those of the lower taxa. A researcher is much more eager to change his (her) methods of research (for example, of making scientific experiments) through the adoption of more efficient methods than through a change his (her) beliefs, or moral attitudes, shaped during his (her) first, 'youthful' phases of development.

It seems that the strong evidence of the proposed taxonomy of knowledge and ensuing mode of development flows from a time span of the domination of given categories of paragons within large societies. Let us assume that it is possible to describe at any moment of historical time and within a relatively large society dominant categories of description of the reality. In the long-term development of the society we can observe significantly longer periods of the domination of paragons belonging to higher taxa than of those belonging to lower taxa. Within a relatively large society, an evolution of a given taxon is an 'outcome' of all paragons of that taxon as observed in all members of the society; and, for example, the 'outcome' of paragons of the image of the world determines what is called civilization (or culture in the narrow sense); the outcome of the image of society's paragons settles the political and social order of the society; the paragons of the methods of management determine the economic system; and the *epistechne*'s paragons determine the epistemological and technological systems of scientists and engineers in the given society.

It ought to be underlined that at any stage of human development different categories of paragon coexist and at any time we observe great diversity of paragons. It is possible to find a wide spectrum of opinions, a wide spectrum of thought categories within the chosen society; but it seems that at any time it is possible to distinguish the dominant categories of thought. Estimations of the duration of the substitution phase and the quasi-equilibrium phase for the five taxa are presented in Table 1. These are subjective evaluations, made mainly to illustrate a hypothetical dynamics of evolution of different taxa. Apart from the image of the world, the estimations are made on the basis of observed historical changes in Europe and North America in the last 500 years.

Table 1 - Long waves of development (Western Civilization)

Taxon	Substitution phase (years)	Quasi-Eq. phase (years)	Total longevity (years)
Image of the world/civilization	100– 300	300–700	400–1000
Image of the society/political order	50–100	150–200	200–300
Image of the economic system/economy	30–60	70–90	100–150
Epistechne/epistemological and technological systems	10–30	30–90	40–120
Paradigm (scientific and technological)	5–10	25–50	30–60

The period around the 6th century BC is a singular period in the history of humankind. It is marked by the activities of the great Greek philosophers, the prophet Isaiah (concluding the work of the Jewish prophets), Confucius and Lao-tsy in China, Gautama Buddha in India, Zarathustra in Persia and King Numa – Numa Pompilius – in Rome. It is reasonable to claim that in that period the main evolutionary lines (chreods) of cultural development in the history of humankind were initiated.

2.1 Epigenetic paragons

The results of research in psychology, physiology, ethnology and other social sciences suggest the existence of many categories of cognition and perception in man which depend strongly on our biological nature. The idea of the existence of some *a priori* categories of our brain and *a priori* forms of human cognition comes from Immanuel Kant. The examples of categories in this taxon are: some *a priori* categories of space and time (Immanuel Kant); inborn categories of language structures (Noam Chomsky), disjunctive thinking, that is, thinking in categories of opposition (Konrad Lorenz); some expressive forms like inviting, leave-taking, quarrelling, consternation, fearing, delighting, courting (Irenäus Eibl-Eibesfeldt), thinking in terms of analogy and the search for similarities; classification abilities and recognition of common traits in different objects; and anticipation of impending events and building mental models of our action.

2.2 Image of the world

The main categories of paragons associated with the image of the world are the following:

- *existential categories* – paragons of these categories enable us to find answers to secular questions concerning: the sense and aim of human existence; the meaning of human suffering, torment, pain and death; the role of evil and the attitude of human beings to evil; the meaning of community spirit; understanding of the mind-body problem; the attitude of man towards nature; the place and role of man in the Universe.

- *aesthetic categories* – paragons of these categories enable us to evaluate the beauty of ideas and the beauty of physical objects; they define general categories of beauty.
- *cosmogonic* and *cosmological categories* – paragons concerning origin, evolution, structure and the essence of the Universe, its end and the goal of its evolution.
- *perception categories* – paragons of these categories refer to: general apprehension and knowledge of the world; ways of noticing phenomena, events and processes in the world; categories allowing the acceptance of some explanations of real phenomena (theories, hypotheses, ideas, and so on) as sufficient, adequate and satisfactory; attitudes of man to the incomprehensible, mysterious, inscrutable and transcendental phenomena; perception of man's surrounding spaces such as life space, social space, geographical space, and so on; nature of spaces – physical and theoretical; nature of time, awareness and experience of time; relation between space and time.

The three last shifts of the image of the world in the Western hemisphere (European Civilization) were observed in the periods from the 6th to the 4th centuries BC in Ancient Greece, between the 2nd and the 4th centuries AD in Western Europe and in the 16th and the 17th centuries. Probably since the end of the 19th and the beginning of the 20th century an emergence of the next wave of the image of the world is observed.

2.3 Image of the society

The image of society consists of paragons concerning the arrangement of social activity and the institutional organization of society, which make community life harmonious and amiable. The main categories of paragons forming the image of society are as follows:

- *subjective categories* – paragons of these categories enable us to expound on the roles and duties of the basic units of societies such as the individual, family, lobby (group of interest), social class, and so on, and their relative influence on the course and tempo of development of the whole society;
- *notional categories* – paragons of these categories give meaning to such notions as equality, justice, law-abidance, responsibility and liability, sense of duty, freedom of the individual, sovereignty of social groups and nations, and so on;
- *governing categories* – paragons of these categories denominate ways of judging the conflicts between basic units of the society; ways and scope of using force, constraint and violence; ways of assuring the security of every individual within the society and the security of the society in relation to other organized societies.

A predominant model of organized society in the Western hemisphere is the model based on the idea of the state as a social contract. The idea of such an organized society was the direct result and crowning moment of protracted efforts made by philosophers of the English and French Enlightenment – Locke (1632-1704), Montesquieu (1689–1755) and Rousseau (1712-1778), creators of political democracy based on such principles as individual freedom, democratic representation and the separation of powers. The system of checks and balances of such government agencies as the legislature, the executive and the judiciary provided the restriction of government to the exercise of its proper function. In the successive stages of development of this system an important role was played by political parties as the representatives of main social groups (classes).

Current efforts to rebuild the social order within contemporary capitalist society are clearly visible. Probably now we are in the substitution phase of emergence of the next wave of image of the society.

2.4 Image of the economy

Paragons of this taxon relate to ways of the fulfilling material needs of members of the society. The main categories of paragons in this taxon are as follows:

- *categories of needs* – paragons of these categories refer to the material human needs possible to be fulfilled at the current stage of socio-economic development;
- *management* (*organizational*) *categories* – paragons of these categories concern (1) economic criteria (objectives) to be applied during the manufacturing process, (2) manufacturing structure and manner of manufacture of material goods, and (3) ways of distribution of material goods and services;
- *relational categories* – these paragons determine (1) the role of political power in the economic process, that is, intensity of connections or separation of political power (e.g. of the state), and economic 'power' (for example, of economic agents), and (2) the role and 'weight' of organized labour (for example, guilds, trade unions) in the economic process.

The 'classical' image of the economy, which lasted over 100 years from the middle of the 18th century until the end of the 19th century, was based on the liberal ideas of David Hume, Adam Smith and Jeremy Bentham. The 20th-century image of the economy was shaped in the last 30 years of the 19th century. During that period the image of the economy, which had prevailed in Western societies since the end of the 18th century, was significantly modified.

2.5 Epistechne

The name of this taxon comes from the Greek *episteme* (i.e. knowledge, acquisition, understanding), and *techne* (i.e. art, craft, proficiency, wiliness). An intention was to include in this term both cognition research, which extends man's knowledge about the world, and practical knowledge, which decides on a degree of suppression of nature by man. So, *epistechne* includes both types of research activity of man, or what is now called science and technology. Paragons of the *episteme* describe:

- research domains recognized by a researcher as important, interesting and suitable to undertake;
- ways of carrying out research activity and its organization; forms of interchanges and protection of knowledge and research achievements;
- type, place and meaning of experiment (observation) in a research activity; type of instruments, devices, plants, installations, and so on, applied in experiments (observations);
- types and forms of mathematics (for example, computation methods, formal methods) applied to describe and explain results of experiments (observations).

Until the 17th century the fields of research of *episteme* and *techne* were almost fully separated. *Techne* was mainly connected with craftwork, and, since the 15th century, also with manufactures, and was developed through the transmission of practical skills from generation to generation. Making prototypes and testing their performance on material objects, not by using any systematic methods of research, made innovations within techne mainly through trial-and-error processes. Development of the *techne* is widely documented and described by different authors as so-called long waves or Kondratieff cycles. The last Kondratieff cycle has probably started in the 1990s and most likely will be identified with the revolutionary development of computer, information and telecommunication technologies.

More detailed analysis of episteme is presented in [2], the analysis suggests the following periodization: (1) from 1620 to 1677, (2) from 1677 to 1787, (3) from 1787 to 1859, (4) from 1859 to 1912, (5) from 1912 to the 1980s, (6) current wave, the substitution phase, *circa* 1980s.

2.6 Paradigm

Paragons of this taxon relate to forms, patterns and designs of conducting scientific and technological research in some well-defined research domains. The term 'paradigm' is adopted from Kuhn. After publication of his *The Structure of Scientific Revolutions* in 1962, the concept of paradigm was very popular and readily accepted, even by the opponents of his concept, but as Kuhn himself emphasized, also differently understood. Our intention is to use the concept of paradigm as a pattern of research or as a disciplinary matrix.

In technology, an analogous concept was proposed by Sahal [5], who used the term 'technological guidepost', but its meaning is very similar to the meaning of paradigm in the Kuhnian sense. Examples of paradigms are numerous, so only a few will be given here:

- in physics, successive paradigms are: Galileo's mechanics (1609), Descartes' physics (1644), Newton's mechanics (1687), the modification of Newton's mechanics made by Hamilton (1853), the special theory of relativity of Einstein (1905), quantum mechanics (1920s);
- in biology, theories of the development of living organisms: Lamarckism (1809), Cuvier's catastrophism (1825), the theory of evolution based on the principle of natural selection (Darwin and Wallace, 1859), Weisman's neo-darwinism (1892), the synthetic theory of evolution (1946);
- in technology: in aeronautical engineering – the design of the famous DC-3 aeroplane in 1935 (followed by the Lockheed Electra in 1936), which was a pattern for numerous airplanes designs in the next 30–40 years; the design of digital computers as proposed by J. von Neumann (1947) – probably neuro-computers or so-called fifth generation of computers (for example, field computers, transputers) may be considered as an attempt to design digital computers on the basis of a new paradigm.

Summary

We have only outlined an evolutionary concept of long waves existence in human development. The presented concept was developed in 1990s [2] independently to the work of Modelski, Thompson and others [1]. Because of limited length of the paper any comparative study was not done here but it seems to by useful to make it in future. Identified categories of paragons affiliated to different taxa can be a good starting point to find more formal and more convinced proofs of existence of different long waves of human development.

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Who Was Right? Kuznets in 1930 or Schumpeter in 1939?

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Abstract. This paper gives a brief historical account of the discussion on innovations clustering, reviewing Kuznet's criticism on Schumpeter's cluster-of-innovation hypothesis. Thereafter engages into econometric analyses of time series of major innovations that were produced by various authors. We conclude that much is to be said in favour of a rehabilitation of Schumpeter's (1939) cluster-of-innovation hypothesis.

1. Introduction: Kuznets versus Schumpeter

In his 1930 *Secular Movements in Production and Prices*, Simon Kuznets[1] was the first to demonstrate that macro-economic growth was built up of numerous s-shaped industry life cycles. These life cycles followed breakthrough innovations that initiated new industries:

"In many industries there comes a time when the basic technical conditions are revolutionized … In all these cases we observe a revolutionary invention or discovery applied to the industrial process which becomes the chief method of production … When such a change occurs, the industry grows very rapidly. The innovation is rarely perfect at the start, and further improvements take place continually after the main invention or discovery. The use of the continually improving and cheapening commodity spreads to larger areas, overcoming obstacles that may have limited demand in the past … But with all this, after a time the vigorous expansion slackens and further development is not so rapid." ([1], p. 10)

At the time, Kuznets believed these breakthrough innovations to be *randomly* distributed in historical time. Nine years later, in his *Business Cycles*, Schumpeter [2] proposed that these life cycles are not randomly distributed on the time axes but tend to occur in clusters. This implies that, at any point in time, several of these industry life cycles tend to be in the same stage (i.e. slow start, or rapid expansion, or saturation). This would give rise to fluctuations in real economic growth at macro-level. A year later, in a famous book review of Schumpeter's *Business Cycles*, Kuznets [3] articulated severe criticism: Schumpeter had failed to give a satisfactory theory of why innovations should cluster (and why the alleged Kondratieff waves should occur), and Schumpeter had also failed to give any serious empirical underpinning of his speculative construct.

Kuznets' criticism was tough and, at the time (in 1940), it was credible. As a consequence, Schumpeter and his theory were *passé*. From that moment onwards, up to the late 1970s, little has been published on Kondratieff long waves or on Schumpeterian innovation clusters. In the wake of the Schumpeter renaissance during the 1980s and 1990s, various scholars have re-investigated Schumpeter's cluster-of-innovation hypothesis, but the discussion remained controversial. In this paper we give a brief historical sketch of this discussion, and thereafter, we address analyses of time series of major innovations that were produced by other authors. We do not undertake econometric analyses of *economic* time series, as this has been done quite thoroughly by other authors (the best contributions coming from Reijnders [4-6], Bieshaar and Kleinknecht [7]; and Metz [8]). In our final section, we conclude that there is something to be said in favour of a rehabilitation of Schumpeter's cluster-of-innovations hypothesis.

2. History: Requirements of a (Long) Cycle Theory

In discussing the realism of the Schumpeter-Kondratieff long wave hypothesis, one should first remind that any such theory would need to fulfil demands such as formulated by Kuznets:

"To establish the existence of cycles … requires first a demonstration that fluctuations of that approximate duration recur, with fair simultaneity, in the movements of various significant aspects of economic life … and second, an indication of what external factors or peculiarities of the economic system proper account for such recurrent fluctuations. Unless the former basis is laid, the cycle type distinguished cannot be accepted as affecting economic life at large … Unless the second, theoretical, basis is established there is no link that connects findings relating to empirical observations of a given type of cycles … with the broader realm of already established knowledge. Neither of these bases has ever been satisfactory laid for the Kondratieff cycles … The prevalence of such fifty-year cycles in volumes of production … in employment, in physical volume of trade, has not been demonstrated; … Nor has a satisfactory theory been advanced as to why these 50-year swings should recur …" ([3], p. 267).

It is hard to deny that the statement by Kuznets was realistic at his time (i.e. in 1940). During the Schumpeter renaissance of the 1980s, several authors have tried to meet the above-quoted demands by Kuznets. A first strand of research related to time series analyses of industrial production or National Product data of advanced countries. While some authors (among which Van Ewijk [9-10]) arrived at sceptical results, others were affirmative of Kondratieff waves. In an important but sparsely noticed *Social Science Information* article, Reijnders [4] formulated a criticism of authors like Van Ewijk [9-10] who had transformed original time series into trend-free series by using first differences. According to Reijnders, such a transformation is not as innocent as it may look at first view; transformation into first differences will increase the noise in the series and it may also favour the discovery of 'waves' that are half as long as the waves that are really in the series.

In 1990, Reijnders [5] demonstrated the existence of Kondratieff long waves in real output series. Moreover, Metz [8] applied a novel method of de-trending economics series and also judged positively about Kondratieff long waves. In our judgment, both authors have given a satisfactory answer to Kuznets' above-quoted first demand: Show that wave-like movements (corresponding to the periodization of Kondratieff) indeed occurred in important indicators of general economic performance.

This leaves us with Kuznets' second demand: What are the causal mechanisms behind such fluctuations? Without a satisfactory theory, one could argue that observed movements in economic times series have been due to historically unique or accidental factors and they can therefore not be considered as 'cycles'. In other words, if there is no evidence of an 'endogenous' cycle mechanism, there are no reasons to expect such movements to be repeated in the future.

During the Schumpeter renaissance of the 1980s, a second strand of research focused on Schumpeter's [2] hypothesis that innovations cluster in historical time. Mensch in 1979 [11] was the first to re-discover the old Schumpeterian argument that major breakthrough innovations ('basic innovations') would be introduced into the market discontinuously in time i.e. in a roughly 50 years rhythm. This implied that several industry growth cycles initiated by such 'basic innovations' would tend to pass simultaneously through the same stages: slow introduction, rapid take-off, or saturation, thus being a cause of fluctuations in macro-economic growth. Mensch also provided data on 'basic innovations' that should prove the realism of Schumpeter's clustering hypothesis. A few years later, however, Freeman, Clark and Soete [12,13] provided a tough criticism of Mensch's innovation series. Their criticism related to problems of precise timing of 'basic innovations', to Mensch's sampling procedures, and, in particular, to the inclusion or exclusion of certain doubtful cases.

Another round of discussion was initiated by Solomou's [14] *Cambridge Journal of Economics* article, arguing that there was little evidence of Schumpeterian clusters of innovations. He received a reply in the same journal. In a critical re-examination of times series of three different authors, Kleinknecht [15] concluded that, using an appropriate timing of waves (close to the original dating by Kondratieff in 1926), there was evidence of clusters of major innovations. In a quite recent contribution in the same journal, however, Silverberg and Verspagen [16] raised again doubts about the realism of Schumpeter's cluster-of-innovations hypothesis. The remainder of this paper will be dedicated to an appraisal of their criticism.

3. Breakthrough Innovations: Random Walk or Clustering?

Testing of Schumpeter's cluster-of-innovations hypothesis was essentially based on three time series of 'basic innovations'; i.e. one by Mensch [11], one by Haustein and Neuwirth [17] and one by Van Duijn [18]. Freeman, Clark and Soete [12,13] criticised the series by Mensch and made some amendments and updates to his 20th century data. Further below, we use of the amended version of the Mensch data. It should be obvious that, in collecting cases of 'basic' innovations, there remains some room for judgment about what is 'basic'. Probably everybody would agree that cases such as the first successful application of the steam engine, the first commercial bicycle or photography should be included. But what about cases such as 'Refined steel/Bessemer steel', the 'first portable camera' or 'reinforced concrete'? There clearly is room for personal judgment. Indeed, the three named databases do not show much overlap. Figure 1 shows that 44 cases of basic innovation are named in all three sources. 48 cases have been included in two out of three sources and a considerable number of cases (119) are named in only one source, being ignored by the other two data collectors.

The discrepancies in data collection decisions shown in the figure can be due to using different historical sources or due to different personal judgments by the data collectors. It should be beyond doubt that really famous historical cases of breakthrough innovations are named in numerous historical sources and therefore have a high chance of being picked up by more than one data collector. Moreover, with respect to 'classical' cases of breakthrough innovations, data collectors will hardly differ in their decision to have them included. It seems realistic to assume that the 44 cases that are named in all three data series are 'safe' cases of basic innovations, inclusion of which can hardly be debated. The 48 cases that come back in at least two out of the three sources will probably also cover fairly safe cases. However, the 119 cases that have been included in only one out of the three sources are likely to cover more doubtful cases. The latter may be cases that are named in only few technical history records and had therefore less chance of being discovered by data collectors. And if they have been discovered, the data collectors may have had doubts about whether or not to consider them as 'basic' innovations.

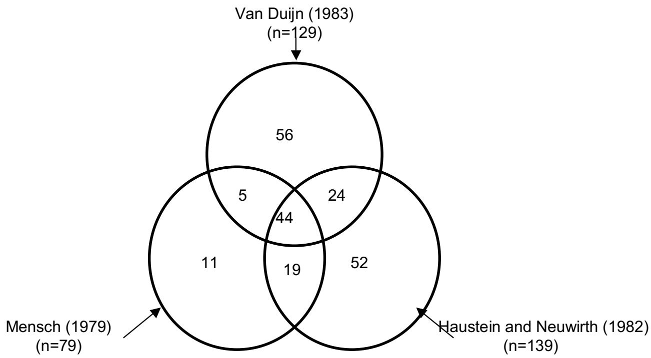

Figure 1 – Overlap between three samples of basic innovations (1861 – 1968)

In his appraisal of the evidence, Kleinknecht [15] has therefore decided to handle some weighting procedure, giving more weight to fairly safe cases (being picked up by more than one of the three data collectors) than to the less safe cases (being found in only one of the three sources). Silverberg and Verspagen [16] complain that Kleinknecht's weighting procedure "introduces an element of extreme arbitrariness" (p. 676). We disagree with them by several reasons:

First, Silverberg and Verspagen's decision not to apply any weighting is, in a sense, also arbitrary. In other words, they decide to give every case the same weight, even if some cases are safe cases, while others can be subject to debate.

Second, one can of course apply different weights or weighting procedures and check in how far the outcomes are sensitive to them. Silverberg and Verspagen apply only one procedure i.e. they count cases named in more than one source only once.

Third, they use only the Van Duijn [18] and the Haustein and Neuwirth [17] data, omitting the (amended) Mensch data.

Below, we shall see that applying some weighting procedure makes a difference. We shall apply the same statistical methodology as Silverberg and Verspagen. By the reasons just mentioned, however, we shall apply three different weighting procedures, checking in how far the outcomes are robust. Before engaging in this procedure, we appreciate that Silverberg and Verspagen are right in one point of their criticism: Solomou [14] and Kleinknecht [15] applied tests of differences in mean innovation rates for predefined periods. These tests assume that the data are normally distributed. Silverberg and Verspagen are probably right that they are not. In table 2 below we shall therefore apply a test that does not assume normal distribution: the Kruskal-Wallis test.

In the following we apply the procedure by Silverberg and Verspagen to the weighted data. We apply the following three weighting methods:

- Version 1: Adding up all cases from the three sources. This implies that cases named in all three sources (the most reliable ones) are counted three times; cases named in two of the three sources are counted twice and single cases are counted once.
- Version 2: We count only those innovation cases (once) that are named in at least two out of the three sources.
- Version 3: We count only those cases that are named in at least two out of three sources. Cases named in two sources are counted double; cases named in three sources are counted three times.

Following Silverberg and Verspagen we include a quadratic trend (a polynomial of second order) in our estimate. In a first step, we estimated for each of the three versions two models: a Poisson model and a negative binomial regression model. In general, the Poisson model turned out to have a much better fit than the negative binomial model. We therefore confine our documentation to the Poisson model. As the variance in the series is not constant, we use a Poisson model with correction for heteroscedasticity. In table 1 we document the coefficients and the z-values for the three different models. We test for autocorrelation, allowing for autocorrelation effects between 1 and 12 years. In other words, we test for each value in the series whether it can be forecasted by past values, trying out each year separately and going back twelve years.

Table 1 - Regression results (Poisson model), arrival rate function of time and lagged dependent variable

	Version 1		**Version 2**		**Version 3**	
Regressors:	Coefficient	Z-value	Coefficient	Z-value	Coefficient	Z-value
Time	0,4197	**5,05****	0,0535	**4,26****	0,0511	**4,22****
Time squared	-0,0001	**-4,96****	-0,0002	**-4,38****	-0,0002	**-4,35****
1 year lagged	-0,0008	-0,03	-0,0142	-0,12	0,0193	0,49
2 years lagged	0,0001	0,00	-0,0810	-0,72	-0,0393	-0,86
3 years lagged	0,0442	1,46	0,1260	**2,61****	0,0476	**2,35***
4 years lagged	0,0517	**2,65****	0,1674	**2,23***	0,0538	**1,99***
5 years lagged	0,0067	0,31	0,0802	1,26	0,0458	**2,12***
6 years lagged	-0,0415	-1,22	-0,0271	-0,32	-0,0173	-0,47
7 years lagged	-0,0184	-0,68	0,0137	0,19	0,0152	0,65
8 years lagged	0,0112	0,03	-0,0550	-0,60	-0,0144	-0,41
9 years lagged	-0,0159	-0,58	-0,0966	-0,81	-0,0313	-0,65
10 years lagged	0,0472	**2,38***	-0,0133	-0,17	-0,0037	-0,11
11 years lagged	-0,0218	-0,97	-0,0242	-0,23	-0,0225	-0,51
12 years lagged	0,0013	0,05	0,0119	0,13	0,0071	0,20
Constant term	-2,0774	-4,17**	-3,7376	-5,79**	-2,6854	-4,02**
R-squared: * Significant at 5% level ** Significant at 1% level		0.17		0.12		0.15

Other than Silverberg and Verspagen, we find some autocorrelation in the weighted series, notably in versions 2 and 3. However, the autocorrelation is weak. On average, a certain value in the series is related to values that were 3, 4 (and, in version 3: 5) years ahead in the series.

Clearly, the series is not completely random, but what we find in table 1 is no support of a Kondratieff-type pattern in the series. On the other hand, one may wonder whether estimation of autoregressive functions is the right technique for such highly erratic series.

While Table 1 is not supportive of Schumpeter's (1939) cluster-of-breakthrough-innovations hypothesis, Table 2 supports it. The table shows that there are differences in mean numbers of innovations across time periods that follow the classical dating of Kondratieff waves with a 12 years lag.[1] It should be noted, however, that the evidence is not clear-cut if the individual series by the three authors are tested separately. The differences in mean innovation rates in the Van Duijn series just fail to be significant at a 95% level; the Haustein & Neuwirth series even fails at a 90% level of significance. This is not surprising, given that these series cover many uncertain innovation cases that are covered only in one series and not by the others (see Figure 1). This underlines our plea for handling some weighting procedure.

Whatever weighting we apply (versions 1, 2 or 3), it turns out that the differences in mean numbers of innovations for pre-defined periods are highly significant[2] according to the Kruskal-Wallis test, which does not require the observations to be normally distributed (see e.g. Newbold, [19]). Table 2 supports the view that, compared to the classical dating by Kondratieff, there is a 12 years lagged fluctuation in the innovation series.

Table 2 - Mean numbers of breakthrough innovations per year according to various sources

	Series by individual authors:			**Merging the series of the three authors in three versions:**		
	Van Duijn (1983)	Haustein & Neuwirth (1982)	Mensch (1979)[#]	Version 1*	Version 2**	Version 3***
1861-1881	0,95	1,00	-	2,80	0,90	2,35
1881-1901	1.10	1,45	-	3,50	1,05	2,35
1901-1927	0,96	0,81	0,48	2,19	0,58	1,38
1927-1962	1,66	1,51	1,28	4,09	1,00	2,63
1962- …	0,33	1,07	0,57	1,40	0,20	0,40
CHI-square:	9,4	7,6	10,9	10,6	12,1	12,3
Levels of significance:	0.053	0.106	0.004	0,032	0,016	0,015

[#] 20th century data by Mensch as revised by Clark et al. [12]
* Version 1: Adding up all cases from the three sources. This implies that cases named in all three sources (the most reliable ones) are counted three times; cases named in two of the three sources are counted twice and single cases are counted once.
** Version 2: We count only those innovation cases (once) that are named in at least two out of the three sources.
*** Version 3: We count only those cases that are named in at least two out of three sources. Cases named in two sources are counted double; cases named in three sources are counted three times.

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[1] When counting average numbers of innovations per Kondratieff period, we made a strange discovery: the counting by Kleinknecht [15] and the counting documented here differ in a number of cells, although both countings are based on the same original sources. We have no explanation of these differences.

[2] As a control, we also tested a series that consists exclusively of less safe cases (named in only one of the three sources). As expected, this series (not documented here) turned out to show now significant differences in innovation rates across pre-defined Kondratieff periods.

4. Concluding Discussion

In his 1930 *Secular Movements in Production and Prices*, Simon Kuznets gave substantial empirical support to the idea that macro-economic growth is built up of series of individual industry life cycles. Each of these life cycles follows some breakthrough innovation. After the initial breakthrough, the basic concept will be developed via large series of subsequent improvement innovations (aiming at quality improvement as well as at cost reduction via process improvements). As David Landes [20] already noted in his classic *The Unbound Prometheus*, it is the large stream of subsequent improvements that push the new industry into a virtuous circle of productivity gains, price reductions and expansion of demand. In the course of time, however, subsequent improvements are subject to the law of diminishing returns, and therefore, at some time, expansion will slacken.

We argued above, that there is something to be said in favour of Schumpeter's hypothesis that breakthroughs may be clustered on the time axes. Schumpeter himself gave one argument for clustering in time: Various breakthrough innovations may be technically linked to each other. A breakthrough in one field will enable breakthroughs elsewhere.

Another argument may be related to the concept of opportunity costs: Once a new industry life cycle is under way, there will be high gains in terms of productivity and quality improvements, translating into high growth of demand and profits. This is likely to attract talent and capital to the new industry. As long as the bandwagon of this new industry is rolling hard, there are high opportunity costs of developing uncertain new breakthroughs elsewhere. This may explain why, once new growth industries show rapid expansion, investors will concentrate on incremental innovation within these industries and there is little interest in achieving radical breakthroughs in other areas. On the other hand, once the stream of improvement innovations is subject to diminishing returns, increasing saturation of demand and declining profits will lower the opportunity costs of switching to a completely new technological trajectory. Of course, such a switch will involve uncertainty. The history of breakthrough innovations is full of trial and error, false starts, dead ends and new departures, and all this takes real historical time. It appears plausible that the period between the (gradual) saturation of earlier technological trajectories and the take-off of new ones might well have the length of a Kondratieff period of weak growth of some 20 years.

It is tempting to interpret the recent hype around a "New Economy" in this theoretical context. The rise of ICT and an associated increase of productivity growth in the US might well be part of a new upswing of the Schumpeter-Kondratieff wave. Temporary increases in the speed of technical change due to the take-off of new industries fit into the neoclassical theory of economic growth that assumes 'technical change' to be a main driver of long run economic growth. At the same time, however, for a neoclassical economist, being trained in general equilibrium thinking, it is hard to accept the idea that the capitalist system will *endogenously* bring about long-run fluctuations in economic growth.

There is therefore enough room for further controversies. And clearly, the above quotation by Kuznets (1940) is still relevant: various propositions around the Schumpeter-Kondratieff wave clearly need further investigation. Students of Kondratieff long waves meet several problems that explain why consensus has not yet been reached. First, various historical series are of limited length and of poor quality. Second, all series are seriously disturbed by World War I and II, causing outliers. Outcomes can be sensitive to treatment of these outliers. And third we have the problem of how to develop indices of major technological breakthroughs, data collection depending on personal judgment. All this is likely to feed a continued debate between believers and non-believers of long waves.

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On Kondratieff's "Suzdal Letters" and Transformation of K-cycles approach (1932-1938)

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Abstract. In this report a new Kondratieff's book is represented and a general dynamic Kondratieff's model of economic growth, privately published in 1934, is described and analyzed. Some theoretical views of Russian economist-theorist are revised and adjusted both to his real day-by-day life in isolation (1932-1938) and immanent logic of precedent intellectual development. As a result, important Kondratieff's deviation from well-known K-cycles approach and Mitchell research program towards early econometrics combined with macroeconomic dynamics problems (building of social genetics system) is observed.

1. Kondratieff's "Suzdal Letters" Presentation

Some months ago in Moscow the complete edition of so-called Kondratieff's "Suzdal Letters" (1932-1938) was published. They were written by Kondratieff in Suzdal political isolator (territory of former Spaso-Evfimiev monastery in Suzdal) for a period 1932, February 12 – 1938, August 31 and addressed to his wife E.D. Kondratieva (1893 - 1982) and his daughter E.N. Kondratieva (1925 - 1995). They represent the unique archival materials for specialists to fill the gap.

This book summarizes Kondratieff's epistolary legacy and contains the following 4 appendices (see *Appendix 1*). The first, "Documents", includes 59 documents, which are: Kondratieff's letters to A.S. Lappo-Danilevsky 1916-1919 (5 docs); to E.D. Kondratieva 1922 (4 docs); to E.D. Kuskova and S.N. Prokopovich 1924 (1 doc); from Butyrskaya prison 1930-1931 (15 docs); letters of Soviet officials on Kondratieff's presupposed deportation in 1922 (8 docs); mutual correspondence between Stalin and Molotov, Gorkii, Menzhinsky on so-called "TKP [Labor Peasant Party] process" (16 docs); Kondratieff's cross-examination guided by examining magistrate Agranov 1930 (1 docs); documents, devoted Kondratieff's repeated condemnation in 1938, his death by shots at September 17 and his double rehabilitation following in 1963 and 1987 respectively (9 docs).

The second appendix, named "From literary Kondratieff's legacy", includes uncompleted Kondratieff's fabula «Marvellous adventures of kitten Shammi», addressed to daughter Elena and written in Suzdal political isolator in 1935-1936.

The third appendix, labelled "From intellectual Kondratieff's legacy", represents a bibliographic rarity: Kondratieff's 25-pages book «M.I. Tugan-Baranovsky. The main features of his scientific outlook» (Moscow, 1923).

The fourth appendix is a Photo archive. It contains photos and photo documents from various federal Russian archives and personal collections, chronologically placed and engaged all his life and creative biography.

Texts of both professors B.N. Kuzyk, Yu.V. Yakovets, director of RSAE (see below) E.A. Tyurina, editor-in-chief P.N. Klyukin, and academician L.I. Abalkin are added. The edition is provided with bibliography and nominal indices, detailed commentaries and archeographical notes.

As a result, this edition represents unknown and, to some extent, forgotten pages of the last years and scientific activity of the famous Russian economist Nikolai D. Kondratieff (1892 - 1938). It covers over 300 archival documents from Russian State Archive of Economy (RSAE) and other central Russian archives.

If we analyze the Suzdal Letters more closely, we observe that there are 247 documents, which are included in the body text of publication. They are stored in RSAE, personal Kondratieff's fund № 769, and are the main part of it.

There are 238 letters written by Kondratieff in Suzdal. 139 letters were addressed to his wife E.D. Kondratieva and 99 letters to his daughter Elena. As careful textual analysis shows, Kondratieff had written a bigger quantity of letters than we have now. Below see the totals of letters distributed by years and persons (*table 1*).

Table 1 - Totals of Suzdal letters distributed by years and persons

Years	Letters to wife	Letters to daughter	Sum of letters
1932	31	12	43
1933	33	28	61
1934	28	20	48
1935	11	10	21
1936	11	10	21
1937	11	5	16
1938	14	14	28
Sum	139	99	238

Under the label of "Suzdal Letters" we intend all epistolary documents written over Suzdal period of Kondratieff's life and thought and associated with Kondratieff's name. So, we have revealed and included the following 9 appropriate documents-letters as well: 1. Kondratieff to head of "NKVD" [Nation commissariat of domestic affairs] V.Menzhinsky, with copies to I. Stalin, V. Molotov and M. Kalinin (1932); 2-3. Kondratieva to Committee for personal amnesty (1932) and to Kalinin (1932); 4. stored and conserved Kondratieff's letter to his father Dmitry Gavrilovich (1933); 5. Kondratieff to Kalinin (1933); 6. Kondratieva to Kalinin (1933); 7-8**.** Kondratieva to A. Enukidze (1934); **9.** Kondratieva to Molotov (1934).

The majority of letters were written with green ink; they are small-sized, with badly recognized handwriting, varied year by year. Nevertheless, accurate decoding of documents let us refrain gaps in perusal and avoid not-obliging common formula such as «there is a capability of other perusal» or "illegibility". If such events met, the most probable version was offered. So, we have complete and update version of Kondratieff's letters, regardless the fact that some of them were dated as yearly as pre-revolutionary age.

The edition of "Suzdal Letters" is supplied with the scientific-reference apparatus including two versions of the nominal index (specially concerned the "Letters" and throughout the whole book) and bibliography of scientific monographs and articles demanded by Kondratieff. He seems to get literature from E.D. Kondratieva, L.M. Kovalskaya, A.A. Konius, E.E. Slutsky, A.L. Vainstein and had focused *par excellence* on mathematics – theory of probability and chance, statistics, differential equations; contemporary physics, biology, demography, chemistry as well.

Concerning economics, the publication of the "Suzdal Letters" makes it possible and desirable a new revision of the evolution of Kondratieff's theoretical views and subsequent reappraisal. We have concentrated our attention on logic of formation of the economist-theorist rather than features of the personal biography. Just in this field the inheritance of the scientist till now is represented to the least interpreted.

Western reader is acquainted with the main Kondratieff's works due to 4-volume edition of scientist's transactions (London, 1998), in which the most interesting articles concerning K-cycles are represented till 1928 (Vol. 1, 3); and the book «Basic problems of static and dynamics» as well (vol. 2). Kondratieff's book, named «World economy and his conjunctures during and after war» (1922), was recently published as well. It is just the time for Suzdal Letters to complete the picture.

Two presupposed points are important for setting of the "Kondratieff problem" today, before reading the Suzdal Letters: 1) in general, focus on economics rather than K-cycles hypothesis in treating Kondratieff's legacy, and 2) accurate attention to Kondratieff's personality aiming at integrity in perception of his intellectual development. These points may be submitted as follows: a) an economic theory (or the theory of value, in a broad sense), and b) language of its representation, i.e. mathematical, statistical, logical etc. Intellectual movement of economist-theorist is treated as search of organic synthesis of items a) and b). If it is reached, their organic combination is received, i.e. theory is formed just as the expression in the appropriate language is founded, and vise versa. It is necessary to take into account, that any formula of a) implies definite b), and any b) means fixed degree of a); but their initial interconditionality is not identical to their organic synthesis.

Thus, following to item 2), the root of a problem in contemporary Kondratieff research program is supposed to be the so-called «problem of 1928», where 1928 - year of the last official publication of the scientist. The problem has not been set in Russian and western papers, because it goes without saying, that he had stopped his researches and could not be the powerful scientist any longer. Nevertheless, Kondratieff had still lived for 10 years and Suzdal Letters demonstrate the logic of his thought regardless to unfavorable circumstances directly and indirectly.

As a result, the watershed of two periods of Kondratieff's activity – up to 1928 and the after - remains existing in the form of the tacit agreement and implicit knowledge. Because of this situation significance of economic merits of Kondratieff may be distorted; and the major cycles hypothesis is represented in the deviated context.

Therefore, new research stage in understanding Kondratieff as economist-theorist was initiated, in our opinion, by N.A. Makasheva's recent papers (in Russian); she essentially moves horizon of research from 1928 up to 1931-the beginnings of 1932, involving the work of «Basic problems…» (1930-1931) in her analytical focus. This paper was already written by Kondratieff in Butyrskaya prison and represented – as follows from Suzdal letters (see, for instance, letter dated 25 July, 1932) – the very beginning of construction of «complete theoretical system».

Makasheva reaches the following conclusion: «Thus, in the book «World economy…» and in other papers dedicated to cycles, Kondratieff appears to be Mitchell defender and follower, solving the problem of statistical validity of existence of major cycles' phenomenon, and besides he has offered some explaining hypothesis. And it would be possible to fulfill it, if not mentioned his uncompleted book «Basic problems of a static and dynamics. Preliminary schema» [1]. Prof. Makasheva considers, that this book is important as the methodological issue; its problem is comprised in building the fundamentals of «social economy». It would be possible on this basis and analytical framework to reconcile theoretical and empirical approaches; this reconciliation is essentially connected to "statistical" approach to society and economy. Moreover, it is possible to add a supposition, that building of the dynamic theory could be connected to the theory of the stochastic processes developed in Slutsky's famous article on random oscillations (1927; in *Econometrica* – 1937).

2. General Dynamic Kondratieff's Model of Economic Growth and K-cycles Approach: Placing a Context

We take into account the whole text of Suzdal Letters and shall move horizon of research till 1938, or, more strictly, till 1934, September 5, when Kondratieff formulated his General Dynamic Model of Economic Growth (*DM*, *see Appendix 2*). This is the way to include "Letters" in the context of precedent development of Kondratieff's thought. There were 3 important moments just before of his arrest in 1930, June 19: a) the idea of major cycles, elaborated in many ways, but remaining, nevertheless, as «an explaining hypothesis»; b) the evolution of the scientist towards theoretical method, started from papers of 1922 (on world economy and his conjunctures), 1924 (on concepts of static, dynamics and conjuncture) and 1926-1928 (Kondratieff-Oparin discussions) and parallel Konjuncture Institute research program; the events, happened in Konjuncture Institute in 1926-1928, and more concrete, "Kondratieff-Slutsky" interactions.

The text of Suzdal Letters, traced from 1932, February 12, up to the *DM* formulation, makes it possible to observe the following items: Kondratieff comes to Slutsky's article in 1927 (November, 1932); then he gives the positive recall (incidentally «he estimates Slutsky as higher, in the measure he reads more about him» - letter, dated 1933, September 29, and asks his wife, E.D. Kondratieva for all the others Slutsky's papers, in particular, article on stochastic limits and asymptotes (1925), and the book on correlation theory (1912). Finally, it is possible to say, that Kondratieff had perceived Slutsky's results in theoretical statistics.

Slutsky's article of 1927, at the same time, had become an important source of emerging econometric movement in the West and even the pattern of given research type [2]. There was an opinion's mutual exchange concerning relevant title of new science of econometrics in Frisch-Slutsky correspondence (1927). Frisch had recommended assigning Slutsky and Kondratieff as the members of Econometric Society, arisen in Cleveland on 1930, September 29 (J. Shumpeter's letter from 1932, October 7, revealed by F. Louçã, Portugal; we are grateful to him). Kondratieff was not well-known advanced mathematician in the West, but he had just been assigned as the unique Russian member of Society on strange circumstances and remained the Fellow of Society until 1960-1961.

There are some reasons of that fact: there are loyalty between the Society's President I. Fisher and Kondratieff, taking into account their indirect letters' exchange (1933-1934); Schumpeter's influence on the Society, and the fact that Schumpeter was alone in defending the major cycles hypothesis in 1930s – 1940s in the West; the well-known reception of major cycles hypothesis in United States of America, because of NBER and mutual contacts with Kondratieff as the director of Conjuncture Institute; translation of the Mitchell's book on cycles (1927) into Russian (1930); last but not least - the innovative character of Slutsky's article, which had crucially influenced on Frisch's argumentation in his "Nobel article" devoted to propagation and impulse problems (1933). Special case is mutual Kondratieff-Kuznets correspondence (1932-1936): Suzdal Letters include dozens of Kuznets' name and Kondratieff's thanks for books sent to Suzdal by Kuznets. Kuznets is supposed to be the main Western informant for Kondratieff-prisoner.

There are two well-known approaches in historiography of econometrics: the theoretical one (Slutsky, Youle, Frisch, Tinbergen, Haavelmo, Koopmans) and the empirical one (Mitchell and NBER, american institutionalism or Commons group). It follows, just from the facts above, that it would be incorrect to treat Kondratieff as belonging and strong adept of the second approach.

If we look at the text of "Suzdal Letters", we can see parallel research along both the first and the second line. The second is concerned with ideas of NBER (due to S. Kuznets's help), i.e. papers of A. Burns, F.C. Mills, J. Stamp, M. Rorty and others; the fact is that Kondratieff needs new data on time-series and the knowledge about state of affairs in North America. The first is embraced with the study of mathematical language of theoretical statistics. Then we go to 1934, when Kondratieff is strongly engaged on it. This tendency starts to prevail permanently. Kondratieff even doubts in professional choice (letter dated 1933, November 1). Finally, as soon as he starts to ask for books on pure economics (L. Walras, K. Wicksell, R. Auspitz, R. Lieben and others), it becomes apparent that the major cycles hypothesis has essentially transformed and drew not so much Kondratieff's attention.

There is an argument "contra", concerning that Kondratieff displaced accent on other problems as he wrote miscellaneous chapters of the planned book (the missing manuscript in October 1941). But it is indirect and it cannot stop a movement of theoretical idea. It is important for us to show how far from the state of affairs (1928) the scientist has got forward [3]. Here the text of Suzdal Letters itself can be considered as a hypothesis of the further Kondratieff's development. We mean the following.

Recently, the major stages of economic science development tried to realize the relevant major stages of physics development. We have scientific papers in Russian only and base on them (evidently, western authors have taken the similar way). So, we have the following logical pairs: "Smith - Newton" or the world of mechanics (V.P. Filatov), "marginalism - thermodynamics" or neoclassical world outlook (K.V. Sorvin). In "Suzdal Letters" Kondratieff refers to contemporary physics (Planck, Smoluchovsky, L. de Broglie, Soddy etc.) and mentions Bohr's quantum postulate, denial of atomism («the whole is more than the sum of his parts»).

Kondratieff's Pythagorean devise «numera regunt mundum» (November 1933) makes it possible to consider: he is engaged not in collecting of analogies from natural sciences (well-known opinion), but in the methodological and practical systematic search of new world outlook; so he realized that major cycles hypothesis could not be justified deductively, as Slutsky had pointed out in 1927. And he criticized, at the same time, both classical political economy (static theory), and a "methodological individualism" principle of neoclassical marginalism, for out-of-historical approach to the analysis of economy and society.

Kondratieff's search of a new economic theory had been inseparably connected with a problem of dynamics. *DM* shows it, but this model is now elaborated in no sense and practically forgotten, unfortunately. But it is very interesting heuristically. It does not content prices as variables, and it completely opposed the contemporary economic theory of equilibrium at that time (L.Walras). Nevertheless, *DM* is still more important: it is the key to Kondratieff's comprehension of two parts of the dynamic theory, i.e. major cycles (reversible processes) and problem of trend (irreversible processes). Kondratieff, following the pioneer works of R. Pearl, A. Lotka and R. Verhulst, used the form of logistic curves. Such an approach expresses trend, and does not exclude, quite on the contrary –even implies the idea of cyclicity; so exhaustion of an economy potential should be replaced - on the first Kondratieff' empirical regularity - by a new logistic curve. This point of view replies to some extent on Kuznets' criticism [4].

Source of economic growth or the material basis of cycles (in early Kondratieff's papers terminology) was an updating of the capital goods or Marshallian third-order-equilibrium. Formulating the model, Kondratieff keeps silence about it; instead *DM* represents strictly the factor of technical progress *m*. It lays foundation to treat *DM* as one of the first dynamic models of growth, because of evident difference, for example, from a Cobb-Douglas model of 1928: the latter "is stacked" in third equation of Kondratieff's model, which contains 10 differential equations and 10 variables. Capital goods dynamics is assumed to exist, but as time goes by, it will be replaced and the science and scientific progress become the main productive force. (here is the continuity of theoretical views in specific tradition "V.K. Dmitriev – M.I. Tugan-Baranovsky – N.D. Kondratieff", which seems to be appeared).

Its difference from neoclassical-type models of capital, developed by F. Ramsey's article (1928) and Samuelson-Solow (1956), is difficult to observe, but there is a difference. Moreover Kondratieff was familiar, although dramatically, with the first one before formulating his own model (letter dated 1934, July 11).

As conclusion, we suppose the following: *DM* was the basis of the lost one-volume manuscript, only one from planned 6 volumes (letter dated 1934, February 28); it included various empirical contents (although Kondratieff was naturally afraid of this part); the macroeconomics is organically combined with dynamics in this manuscript, so that econometric component was also representative (see the form of a *curve 2* in the text of the letter dated from 1934, September 5). So, the scope and revolutionary significance of the *opus magnum* created by Kondratieff in 1931-1935, should be taken into account, including this conference as well. The pioneer in investigating the major cycles problem (1922) could be remained himself, why not?

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Appendix 1. Contents of Kondratieff's Book

CONTENTS

Appendix 2. General Dynamic Model of Economic Growth (1934)

Variables: 1) National capital – K, 2) The sum of national labor power - A, 3) Production of capital goods - P_1, 4) Production of consumer goods - P_2, 5) Total production volume – P, 6) National income – E, 7) Wage – l, 8) Interest returned to capital – i, 9) Sum of (land) rent – R, 10) Total savings of capital - S.

Dynamics of K and L is modeled by equation of following type:

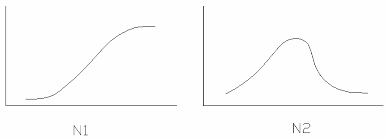
$$\frac{dy}{dt} = ky(\alpha - y),$$

where k – proportionality coefficient.

Integrating of this equation, i.e. $\int \frac{dy}{y(\alpha - y)} = \int kdt + c$, we result:

$$y = \frac{\alpha}{1 + ce^{-at}}, \qquad (1, 2)$$

where α, c и a – parameters, defined empirically. Equation (1, 2) associated graphically with pictures № 1 and № 2 (increase in curve's line speed).



Following principles of pure economic theory, we have:

$$E = \frac{\partial E}{\partial K}K + \frac{\partial E}{\partial A}A.$$

Integrating of this equation gives:

$$E = m\sqrt{AK}, \qquad (3)$$

where m – coefficient of technical progress in the economy.
Then:

$$S = \frac{dK}{dt} \qquad (4)$$

$$i = \frac{\partial E}{\partial K} \qquad (5)$$

$$l = \frac{\partial E}{\partial A} \qquad (6)$$

$$P_1 = C + S \qquad (7)$$

$$P_2 = E - S \qquad (8)$$

$$P = P_1 + P_2 \qquad (9)$$

$$r = i(K - V), \qquad (10)$$

where V – value of land.

PART II

Kondratieff Waves and Warfare

Kondratieff Waves, Warfare and World Security
T.C. Devezas (Ed.)
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The Predictive Power of Long Wave Theory, 1989-2004

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Abstract. My work in the mid-1980s on Kondratieff waves tried to explain long waves in terms of causal relationships among six main variables: war, production, prices, innovation, investment, and real wages. I emphasized war as a central element; saw production waves as leading war/price waves by roughly 10-15 years; and saw war, innovation, investment, and possibly real wages as mutually reinforcing mechanisms in the long wave. Based on analysis of historical time series, in 1989 I elaborated a four-phase dating scheme based on the lagged correlations among variables, and discussed the phase of the world system (as of 1989) in terms of that scheme.

In this paper I revisit these conclusions fifteen years later and find they had strong predictive power regarding the transition in the early 1990s from the "stagnation" quarter-phase of the K-wave to the "rebirth" quarter-phase (higher production growth and investment, low prices, high real wages, high innovation, and low great-power war). All these variables in the late 1990s fit the expectations of the K-wave scheme, especially the relative peacefulness and low military spending in contrast to the previous phase. Looking forward, changes since 9/11 may signal the onset of a new Kondratieff phase, "expansion."

Introduction

Kondratieff waves, or long waves, of roughly fifty years' duration have long interested scholars of society and economy, but have proven elusive to confirm or refute empirically. In this paper, after an absence of more than a decade from the field of long wave research, I revisit the subject to see how projections made in the late 1980s compare with outcomes in the past fifteen years. Rather than a full-scale research project to analyze the current economic and political climate in terms of the projected long-wave phases, this paper represents just a simple opening of the issues and examination of a few basic time series for the United States.

1. Dynamics of Kondratieff Waves

My work in the mid-1980s on Kondratieff waves showed that while authors disagreed completely about the causal mechanisms of such waves, they largely agreed on datings of up and down phases. This consensus was anchored in the strongest and most visible variable – prices – which showed periodic spikes across several centuries. I noted in 1985 [1] that these spikes closely correspond with large great-power wars (see Table 1, from 1989 [2]). Through analysis of dozens of historical economic time series and data on great-power wars, I adduced causality in both directions between war severity and economic variables (see Figure 1, from 1988 [3]). In particular, large wars trigger inflation short-term and drain economies long-term,

Table 1. Dating of Long War Cycles, 1495-1975

Cycle	*Starting date of war cycle*	*Peak war years*	*Length (years)*	*Ending date of corresponding long wave phase period*
1	(1495)	1521–1529	(35)	1528
2	1530	1552–1556	28	1558
3	1558	1593–1604	47	1594
4	1605	1635–1648	44	1649
5	1649	1701–1713	65	1719
6	1714	1755–1763	50	1761
7	1764	1803–1815	52	1813
8	1816	1870–1871	56	1871
9	1872	1914–1918	47	1917
10	1919	1939–1945?	(27)	(1968/80?)

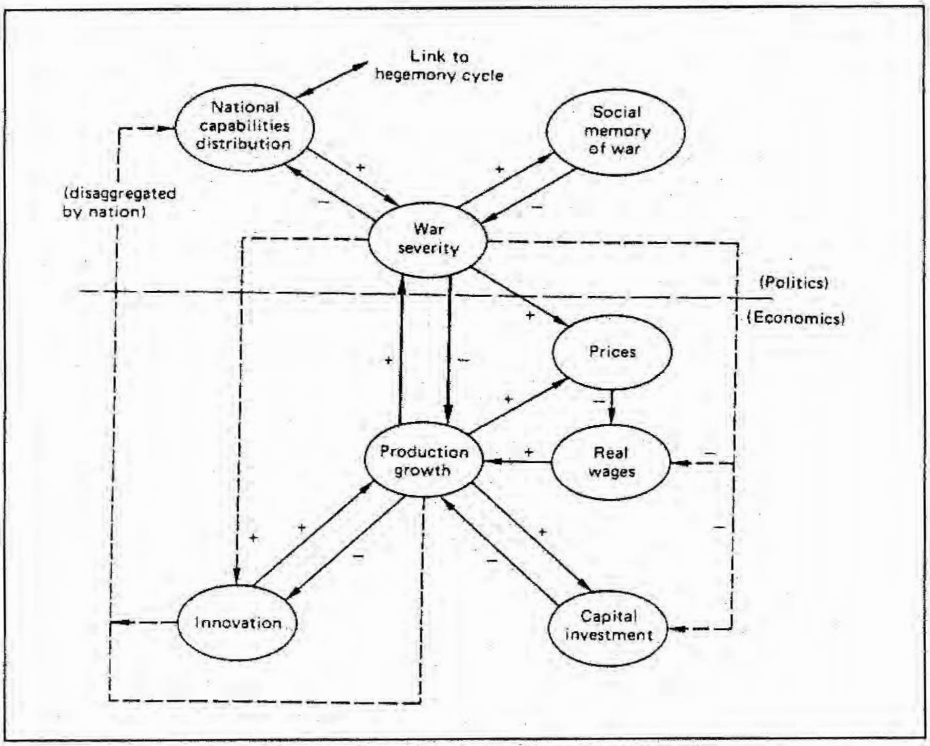

Figure 1. Theoretical Model of Long-Wave Dynamics

but economic problems in turn constrain large wars.

In 1989, at an International Economic Association conference, I elaborated a more detailed long-wave schema based on Vector Autoregression (VAR) analysis of long-term time series [2]. The VAR results generally confirmed my adduced causal relationships among six main variables: war, production, prices, innovation, investment, and real wages. I emphasized war as a central element and saw production waves as leading war/price waves by roughly 10-15 years (i.e. about a quarter-cycle). I saw war, innovation, investment, and possibly real wages as mutually reinforcing mechanisms in the long wave. Based on the lagged correlations among variables, I developed a four-phase dating scheme and discussed the phases of the world system in terms of that scheme. Table 2 (from 1989) reproduces my hypothesized historical timing scheme in terms of these four phases.

Table 2. Proposed Four-Phase Dating Scheme (1989)

Expansion	1790–1803?	1848–60?	1893–1910	1940–68
War	1803?–14	1860?–72	1910–20	1968–80
Stagnation	1814–30	1872–(?)	1920–33	1980–95?
Rebirth	1830–48	(?)–1893	1933–40	?1995–2010?

Beyond the four phases, I proposed a sequence of variables based on analysis of lagged correlations among variables. Figure 2 (from 1989) illustrates the adduced sequence and timing of these long-wave variables. The last known date in Table 2 is the price peak (at the top of Figure 2) of 1980.

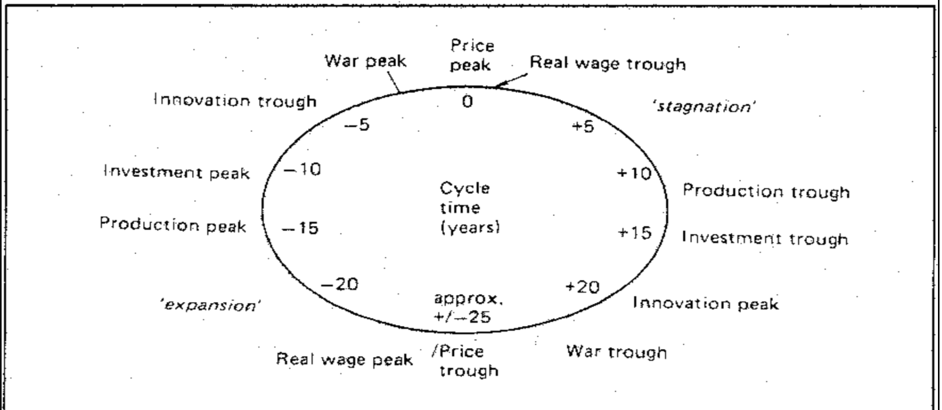

Figure 2. Sequence and Timing of Idealized Long Wave (1989)

2. Projections in 1986-89

Looking forward, moving clockwise around Figure 2, I projected that an upturn in production, marking a change from the "stagnation" quarter-cycle to the "rebirth" phase, would be the next development, perhaps starting in the mid-1990s (I would now say 1992). Specifically, the "stagnation" phase (running from 1980 to 1991) was defined as follows: "production growth is low and uneven; investment is low; war severity declines; inflation is low (or prices even decline); innovations begin rising; real wages fall." The subsequent "rebirth" phase starting by the mid-1990s was defined thus: "production growth picks up again, investment follows; prices are low; war severity is low; innovation is high; real wages are high."

During that rebirth phase, according to my theory, great-power war and military spending would continue a downward trend that I dated from the late 1970s, while inflation remained in check but production growth accelerated. *Barron's* magazine in 1988 subtitled an interview, "Joshua Goldstein Looks to the Nifty '90s." These projections of an upcoming phase of prosperity and peace ran counter to the short-term trends and conventional wisdom in the late 1980s. President Ronald Reagan had reversed the post-Vietnam trend by sharply increasing military spending, while "Cold War II" had replaced an earlier period of détente. These trends were "counter-cyclical," I wrote.

The idealized long wave scheme in Figure 2 was not intended to track long-wave phase timing exactly, but in fact it tracks quite well. Taking literally the timing of the sequence shown in Figure 2, we may set the "price peak" at the top to 1980 – the last firm point of reference at the time of writing in the late 1980s. The price peak indicates the end of a phase of higher inflation and, historically, a period of price deflation (as between the World Wars), or in recent times a period merely of lower inflation. At the same time, the real wage trough indicates a rising trend in real wages (which reflect inflation inversely).

About twelve years into the cycle, or 1992, would be the production trough, indicating a pickup in the pace of production growth after a long sluggish period. In 1995, the investment trough marks a similar upturn in investment, and around nineteen year after the price peak, or 1999, innovations peak and begin a period of either decline or slower growth in innovation.

Finally, out around 21 years into the cycle, or 2001, the war trough indicates a new upturn in military spending (historically an upturn in great-power war severity). The price trough (ending a half-cycle of low inflation) would come at "+/- 25" years, around 2005.

3. The Record since 1989

Although fifteen years is not long in the context of a cycle of roughly 50-year cycle, it is long enough to follow the cycle around at least a quarter of the way, moving from one quarter-phase to the next. Ideally one could examine a number of indicators for the variables of interest in my long-wave model, aggregated to cover the core of the world system (i.e., the industrialized countries in economic matters and the great powers in military ones). However, as a start I have simply taken three readily available indicators for the United States, for the three most important variables in my long-wave model – war, prices, and production. As the leading "core" country and dominant military power, the United States probably moves in the same direction as the core of the world system overall (though this could be debated). Given more time, and a research grant, someone could put these questions to better empirical tests. But these series should provide a useful first cut.

3.1 War

The variable for battle deaths in great-power wars may have become obsolete in the sense that since soon after the invention of nuclear weapons, great-power conflicts have not played out on the battlefield directly. Rather, for decades a "cold" war, which did not involve wars between great powers, exerted similar economic effects through the ongoing mobilization of a wartime economy. Therefore military spending seems a more useful indicator, and indeed when I used the battle-deaths measure for past centuries, it was largely as an instrumental variable to reflect military spending (data for which were unavailable). For present purposes, I graph in Figure 3 the percent of GDP devoted to U.S. national security spending as defined by the U.S. government [5].

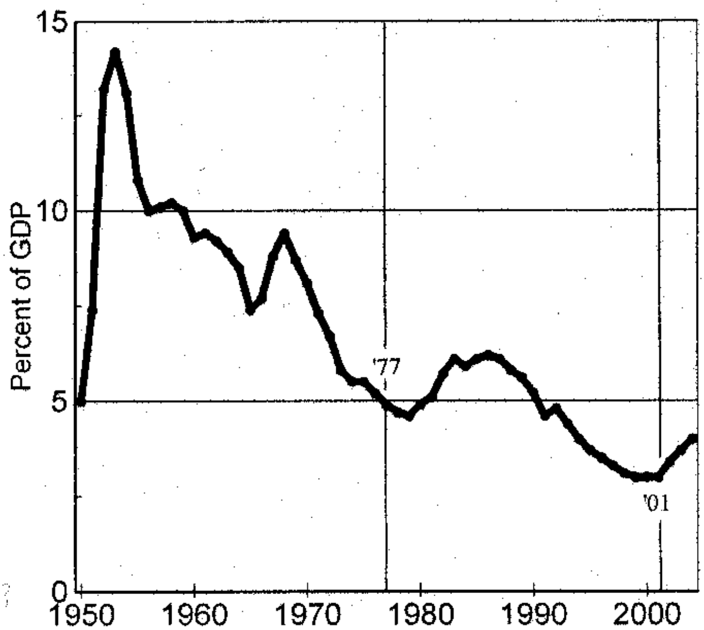

Figure 3. U.S. National Defense Outlays as a Percent of GDP

According to my long-wave sequence, sometime around 1977 should have marked the end of a war upswing period and the start of a downswing to last until roughly the turn of the century. The interesting thing about the projection in the late 1980s is that U.S. military spending had recently reversed a long trend of decline and risen somewhat (even as a percent of a rising GDP). The long-wave model projected a renewed downward trend, and that is what actually occurred (Figure 3). In terms of U.S. military spending, however, the 1977 date would seem somewhat late. (The 1940-80 war upswing has always been problematical in my scheme because of the huge war right at the start).

In terms of long-wave timing, the new upturn in U.S. military spending since 2001 (see Figure 3) is worrisome, as it could signal the starting gun for a new long-term upswing of rising military spending, an upswing that could even culminate in another ruinous great-power war in the coming decades.

3.2 Prices

Figure 4 shows the U.S. consumer price index over the past fifty years [6]. The price peak of 1980 is evident. But in the late 1980s, the period of low inflation had lasted less than a decade and had just seen a rise from 1.8 percent in 1986 to 4.5 percent in 1989. The long-wave sequence, however, projected at least a decade more of low inflation, and indeed it has remained low since then (and right up to the present). However, after 25 years of low inflation, we are now due for another long-wave price upswing.

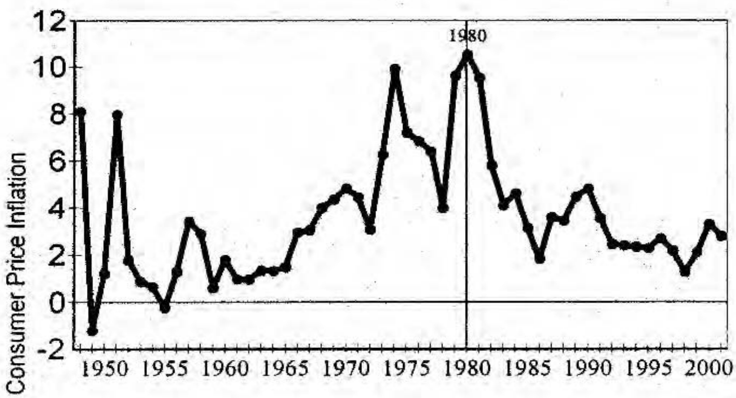

Figure 4. U.S. Inflation Rate (Change in Consumer Price Index)

3.3 Production

I am not sure how best to measure production – in my earlier research I used several scholars' long-term production indexes – but the growth of Gross Domestic Product (GDP) seems a good measure to start with. The Penn World Table [7] provides GDP data adjusted for purchasing-power parity. In Figure 5 I have graphed the growth rate in the U.S. GDP per capita, adjusted for inflation.

According the long-wave sequence, the phase from 1969 to 1991 should be characterized by slow and uneven growth, then the period since 1991 by more robust growth. What one sees in the data is not so much a slowdown and then speed-up of per capita GDP growth, but rather a greater volatility and then stability. During the nominal production "downswing" of 1969-91, ever-lower valleys and ever-higher peaks alternate rapidly). Then in the nominal production upswing from 1992 forward, we see a dramatic stabilization of growth rates – around 3 percent a year in real per capita terms – for a solid nine years. I am not sure what to make of this stable period, but it is an interesting change just at the time the long-wave sequence calls for a phase shift in production growth.

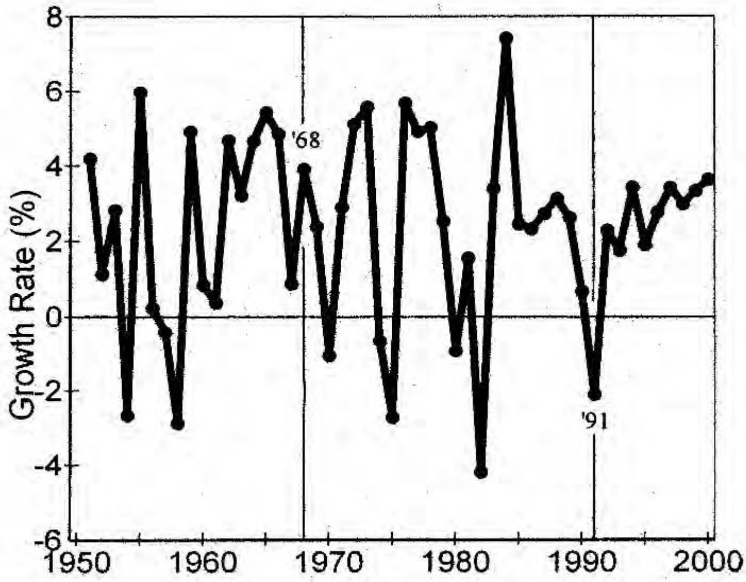

Figure 5. U.S. Real GDP per Capita Growth Rate

4. Looking Forward

Continuing around the bottom of Figure 2, if we tentatively take 2001 as the war trough, then the price trough is upon us, and we can expect inflation to begin trending upward again in the coming years. This would also mark the start of an "expansion" quarter-phase, defined thus in my 1989 paper: "production, investment, war severity, and prices all rise; innovation is stagnant; real wages flatten out." Historically analogous phases could be found in 1893-1910 or (less plausibly) 1940-68. My hunch is that both war and inflation may take quite a few years to build towards a new peak, somewhat similarly to the buildup of tensions before World War I.

If the sequence and timing hold up as exactly in the coming years as in the past fifteen years – and I have no particular reason to think they would, but it makes a good baseline projection – we could expect continued strong GDP growth despite the downturn in 2001 which broke the long period of stable growth since 1992. The production peak that would end the "expansion" quarter-phase might come around 2015. The next phase, "war," representing the dangerous second half of the long war upswing, could then occur around 2015-2030, with the war peak possibly found in the late 2020s and the price peak around 2030 (fifty years after 1980). In my 1988 book I pointed to the period around the 2020s as a potential danger zone, and it still worries me.

Historically, interest in long waves has waxed and waned, with greatest interest during bad times when the idea of a cycle suggest a brighter future. During good times, interest in cycles diminishes, since a cycle theory suggests that the good times will not last. This, sadly, is exactly the conclusion I draw regarding the good times of the 1990s. I hope I am wrong, but the long wave sequence leads to the depressing thought that the peace and prosperity of the 1990s may be the best conditions we are going to see for decades. I have elsewhere pointed to the dangers of a coming up-tick in inflation as the costs of the War on Terror begin to hit home in the coming years [8]. On the bright side, the war danger that I associate with the 2020s is still decades away, and perhaps tractable as world politics evolves. Meanwhile there could be much economic growth still to enjoy, at least for those with long-term fixed-rate mortgages who will be positioned to ride out a new round of inflation.

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Kondratieff Waves, Warfare and World Security
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Did World War II Reset the 'Rhythm' of the Kondratieff Wave?

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Abstract. In recent theories on the relation between war and the Kondratieff wave it is assumed that wars are concentrated at the end of Kondratieff upswings. They intensify the tensions of the boom, destabilise economic and social relations and usher in the ensuing downswing.

Its protagonists maintain that this co-movement of war and upswing has been with us for ages. There is, however, one notable exception. World War II, the most momentous war of all, does not fit this pattern. It is a-typical for two reasons. Firstly it occurs at the end of the Kondratieff downswing and is consequently out of step. Secondly it is followed by a sturdy upswing, which obviously does not fit the postulated 'mechanism' of the movement.

In this paper it is argued that World War II is not an integral part of the Kondratieff wave. It stands out as a separate entity. The extent of its material destruction was such that the economies of the belligerent nations were thrown off their steady state paths. They had to lift themselves, so to speak, by their own bootstraps to return to the main road. The high growth rates typical of such a 'reconstruction boom' received special impetus because new technologies were embedded in reconstructed plant and equipment.

1. Kondratieff's Endogenization of Exogenous Factors

When N.D. Kondratieff tried to establish the existence of long waves empirically, he concluded that the examination of time series alone would not be sufficient. In order not to fall victim to some defect in the statistical method it is necessary to check the findings against historical experience. Hence it is required to study the development of capitalism in its specific traits on the basis of historic-descriptive data [1, 38]. Kondratieff did not present such data but summarized his findings in four empirical properties, which he found important not only for characterizing the long waves but also for understanding them. Of these properties, two touch upon the subject of this conference:

- The first is that before the beginning of the rising phase of a long cycle, considerable changes take place in the basic conditions of economic life: i.e. profound changes in the technique of production, in the conditions of monetary circulation and in the role played by new countries in the world economy [1, 38-41].
- The second is that the rising phases of the long cycles are characterized by a concentration of social upheavals like wars and revolutions [1, 41-45].

Kondratieff lists a number of factors, which, from the point of view of the 'exogenous explanation', play a major part in the causation of long waves. Contrary to the received view, Kondratieff does not accept these factors as causes of the long waves. Their coincidence with certain phases of the long wave do not indicate the causes of but rather the existence of long waves. They are the manifestations of the operation of a mechanism that generates the long waves of which they are an integral part. Kondratieff consistently holds on to his basic point of view and 'endogenises' the factors, which others regard as exogenous causes of the cycle. He contests the belief that the long waves result from random, accidental circumstances or events such as technological change, wars and revolutions, the assimilation of new territories or fluctuations in gold production. In Kondratieff's view such a belief stems either from a reversal of cause and effect or from taking as a happenstance what is actually conformity with a law [1, 49]. Kondratieff interprets the long waves as a succession of 'states' wherein the economy is susceptible to certain types of change. In a given state the economic opportunities are present for putting scientific discoveries and inventions into practice. It is the availability of these opportunities, the presence of the right economic circumstances, corresponding to a certain phase of the long wave, which explains, for instance, the concentration of technological change in a certain interval of time. Likewise, Kondratieff rejects the idea that such factors as wars and revolutions should be acknowledged as causes of the cycle. Wars are considered to "grow out of the soil of the increasing pace and intensity of economic life, accentuating the economic fight for markets and raw materials", and revolutions "arise most readily in periods when new economic forces have an explosive impact"[1, 50]. Kondratieff perceives all these factors as attendant phenomena and associates them with the whole of the rising phase of the long cycle.

Kondratieff endeavoured to formulate an endogenous theory of the long wave. His explanation revolves around Tugan Baranowsky's loanable fund theory, the Spiethof/Cassel scissors mechanism and Marx's 'echo' theory of capital investment. It is important to realize that Kondratieff's endogenization of the 'exogenous' factors entails the establishment of a causal link between the mechanism of the cycle and the occurrence of the mentioned phenomena. It is the conditions of the downward phase of the cycle, which generate the search activities that lead to inventions, and it is the beginning of the (re)investment process of the early upward phase of the cycle, which creates the circumstances under which existing inventions can materialize into real innovations. Likewise it is the conditions of the later stages of the boom that create the circumstances under which the probability of war, revolution or other social upheaval increases considerably. Causality, however, runs from the cycle mechanism to the 'exogenous' factors and not the other way around. The 'exogenous' factors are generated by the cyclical mechanism, they may sometimes have potent perturbing effects on economic dynamics but the cyclical mechanism does not depend on them [1, 50].

2. The War-Production Nexus

Representatives of the 'modern' theory of the relation between war and long waves go one step further and assume that wars are not a by-product of the cyclical process of the capitalist economy but that they interact with the economic factors to the degree that they are part of the cyclical process itself. Goldstein for instance holds that the interaction between production and war is central to the development of the world system: "The heart of the theory [….] is the two-way causality between war and production – a dialectical movement in which economic growth generates war and is disrupted by it" [2, 260]. The interaction between production and war is essential. The increase of production supports the upturn of war. Increased war contributes to the downturn of production growth. The ensuing stagnation curtails war severity and low war severity contributes to the resumption of sustained growth.

Goldstein adduces the following theoretical arguments to support the idea that economic growth leads to an upturn in war severity:

1. Cost of wars: Big wars only occur after a sustained period of stable economic growth when countries can afford them.

2. 'Lateral pressure': Sustained economic growth leads to heightened competition for resources and markets and increases the propensity for major wars.
3. Freudian psychology articulates the political effects of prosperity and depression.

There is a certain analogy between Kondratieff's loanable funds mechanism and Goldstein's production-war mechanism. In Kondratieff's case it is the productive investment of the upswing that drains the loanable funds that have been set free during the downswing. The draining of funds stops the upward movement and pushes the economy into a downward phase during which the rate of investment again falls below the rate of accumulation. The reservoir of loanable funds is replenished and the situation is set for a new upswing.

In Goldstein's case the upswing in production generates the tensions that are a precondition for war and at the same time it generates the funds that are necessary for the waging of war. Wars in turn drain the funds generated by production during the upswing and ultimately stop the upward movement of production. After the killing of the 'goose that lays the golden eggs', the war effort must reside due to a lack of funding. The cessation of the war leads the economy into a phase of reconstruction in which production is rekindled and the preconditions for a new upswing are fulfilled.

There is, however, an important difference between Kondratieff and Goldstein in the sense that Kondratieff introduces a 'metronome' to his system in the shape of a reinvestment echo that acts as a pull factor at the lower turning point [3, 18]. This more or less determines the periodicity of the long wave. Goldstein's system doesn't have such a pull factor. It completely relies on a circular chain of causality to explain the repeating sequence.

The production-war nexus is the essential causal mechanism in Goldstein's system. Therefore it is understandable that he put great effort in establishing this link empirically. To do this he collected a number of economic time series and several war series and analysed whether or not the series alternated in the expected way: war intensity up in the upswing phases of the long waves and war intensity down in the downswing phase of the long wave. From his analysis he concludes: "The pattern of recurring war, while remaining fairly synchronous with the long wave, passes through several different eras over the course of five centuries" [2, 257]. Accordingly, Goldstein believes to have established that the co-movement of war and upswing has been with us for ages. There is, however, one notable exception, which becomes obvious when the sequence of "Great Power War Severity" (Goldstein's main war indicator) is compared with the upswing and downswing phases of the third and fourth Kondratieff. The problem occurs in the third Kondratieff. It is true that the sum of war severity (7790) is higher than that of the second Kondratieff downswing (122). It is, however, completely overwhelmed by the increase in war severity during the downward phase of the third Kondratieff (13278). Moreover, also war severity in the upswing of the fourth Kondratieff (963) is completely overshadowed by the war severity on the downswing of the third Kondratieff. It appears that World War II, the most momentous war of all, does not fit the pattern implied by Goldstein's theory. It is a-typical for two reasons:

- Firstly it occurs at the end of a Kondratieff downswing and is consequently out of sync with the war-production nexus.
- Secondly it is followed by a strong upswing, which obviously does not fit the postulated 'mechanism' of the movement (which predicts a downswing after a war).

Now the question arises whether World War II must be considered as the proverbial 'exception that proves the rule' or as the infamous 'black swan that falsifies the hypothesis that all swans are white'. Goldstein obviously has chosen for the first option. He simply considers World War II as an anomaly [2, 243]. Contrary to this, I rather tend to favour the second option. The 'anomaly' doesn't bode well for Goldstein's theory of the war-production nexus.

In the first place the wrong timing, indicates that the 'cost of wars' argument, i.e. that "The biggest wars occur only when the core countries can afford them" [2, 261] is not valid.

The biggest war of all actually occurred at the time when the core countries, at least on Goldstein's criteria, couldn't afford it at all. Moreover it appears that the preparations for the war, as a gigantic Kahn/Keynes/Kalecki pump-priming project of 'public works' generated the fiscal impulses that were necessary to overcome the great depression (compare [4]). In this sense World War II financed itself by creating an artificial boom in its preparatory phase.

In the second place, the fact that World War II was followed strong upswing does not accord with the postulated 'mechanism' of the movement. War is supposed to have a negative impact on production and to "disrupt the long-term growth of the economy", particularly "through sudden increases in national debt" [2, 268-70]. War would therefore "contribute to a downturn in production"[2, 260] and not to the kind of upturn that World War II obviously produced.

It appears that in this case the reinvestment echo, the pull factor that is central in Kondratieff's model and that is lacking in Goldstein's, is crucial here. The distinguishing feature of the Second World War was the extent of the material destruction and devastation of infrastructure and productive equipment that was the result of it. Under normal conditions the function of a downswing is to recreate the preconditions for the next upswing. An important prerequisite is that actual productive capacity falls short of required capacity in view of the existing level of output. Exactly this precondition, that is normally only met after a time consuming process of physical decay of productive capacity, was realized in one blow by the destructive effects of the Second World War.

The rapid recovery after devastation forms a fairly sturdy feature of economic history. With reference to the German *'Wirstschaftswunder'* and Japan's 'economic miracle', Milton Friedman offered the following recipe for rapid economic growth: "Destroy the greater part of a nation's fixed capital in war activity and dislocate the whole economic structure. Eventual recovery from this chaotic state of affairs will be rapid, giving a growth rate of 8-10 percent annually" (cited in [5, 291]). The principle underlying Friedman's dictum may be illustrated with reference to the Solow/Swan growth model. Under normal conditions an economy will converge to its steady state and remain there. Its pace of growth is determined by the rate of growth of the workforce and the rate of technological progress. When part of its capital stock is devastated, the economy will find itself in a situation where the rate of accumulation becomes higher than the rate of required investment (depreciation rate plus the growth rate of the workforce plus the rate of technological progress). The economy enters a traverse where its growth rate is significantly higher than steady state growth. During this traverse, catch up growth occurs that may even surpass Friedman's 8-10% mark.

Although this type of growth model could be used to explain the long upswing after World War II (see for instance [6]), it will not be suited for explaining the retardation of growth of the nineteen seventies and eighties and the subsequent reversal. A cycle model is more appropriate. The next section contains the outline of a model that is suitable for explaining the pattern of development during the fourth Kondratieff and which takes the devastations of the Second World War as its point of departure.

3. Broad Outlines of the Model

The origins of the long wave upswing can be traced to the conditions that prevailed after World War II. The largely devastated infrastructure and a productive capacity that fell short of even the bare requirements for providing the primary needs of the population together with ample reserves of labour power formed the basis upon which the impressive new economic structure was erected. The reconstruction of the European economy produced a strong impetus for employment and, concomitant with this, strong income- and expenditure impulses. From the point of view of real factors the European economy had to lift itself by its own bootstraps. It is precisely this process, which gave such a strong boost to economic growth.

Although probably not inspired by the conditions in post-war Europe, Forrester rightly calls the mechanism that is responsible for a long-lasting and vigorous expansion of production, a 'bootstrap structure' [7]. This is one of the cornerstones of his explanation for the fact that his system dynamic model displays movements, which closely conform to a long wave pattern. The bootstrap structure may be explained as follows: an increase of the output in the consumer goods sector requires an increase in its productive capacity, therefore the output of the basic capital sector must be increased. But the basic capital sector uses its own output as a factor of production. If the basic capital sector is to expand production in a balanced manner to meet the increased demand, it needs both labour and capital equipment. Yet the only way for the basic capital sector to extend its productive capacity is to divert the capital equipment from the consumer goods sector, i.e. from the source of the increased demand. So, the basic capital sector does in fact compete with its own customers and generates a tendency to supply less capital equipment in response to a demand for more of it. At the same time however, it increases the demand for consumer goods by creating extra employment and hence it again stimulates the derived demand for capital equipment.

Such a structure can create tremendous tensions, especially when the initial productive capacity is considerably lower than desired capacity. Because of the gestation period of capital equipment, time elapses before delivery actually takes place and the time lag is multiplied by the recirculation of capital equipment. As this lag is generated in every successive stage of the interdependent industrial-structure (i.e. the input-output matrix) the total time lag between the original demand impulse and the final increase in output of the commodity in question becomes considerable. During this lapse of time production continues, i.e. employment is generated and income and final demand increase. The effort to create additional productive capacity stimulates a mechanism, which generates extra demand and consequently extra-derived demand for capital equipment.

Properly speaking the 'bootstrap structure' is no more than a special case of Samuelson's mechanism of interaction between the multiplier and the accelerator [8]. However, unlike Samuelson's accelerator, Forrester's 'bootstrap accelerator' is not a single macro-economic parameter. It takes account of the input-output structure in the capital sector. In this way it introduces non-linearities, which result in a lengthening of the adjustment process.

I think that this principle can be improved by generalizing its basic idea by taking account of the fact that several basic sectors, tied by input-output relations, are participating in the building-up of productive capacity. In this case the 'bootstrap- accelerator' becomes a vector that contains several sectoral capital-output ratios, which are embedded in a more complicated lag-structure. The magnitude of the 'bootstrap accelerator' depends upon the magnitudes of the sectoral capital-output ratios, the relative weights of the sectors and the number of sectors involved (i.e. the dimension of the vector).

In my view this extension of the 'bootstrap accelerator' is important because it creates the possibility for explaining the influence of basic innovations on the process of expansion. I do agree with Kondratieff that innovations do not trigger off expansion. It is rather the process of expansion that creates the climate, which stimulates innovation. Expansion drags along innovations while the latter, when they are actually taking place, give an extra dimension to the expansion process.

As far as innovations create the necessity to construct specific installations they give a specific impetus to economic growth. The power of this specific impetus is however not to be found in the new industries themselves but in the effect new industries have on the dimension of the industrial structure of the economy (i.e. the rank of the input-output matrix). By increasing the 'roundabout of production', basic innovations increase the magnitude of the 'bootstrap accelerator' to such an extent that the interaction mechanism produces an explosive upward movement. It produces a clear-cut explosive upward sweep, or an explosive cycle whose amplitude increases with time.

At first sight the definition of the long wave as an unstable movement may look rather odd. This is because it entails the possibility that one single shock may produce oscillations that will get larger and larger, until they result in total chaos. In reality, however, the economy possesses definite physical constraints that prevent its fluctuations from overshooting certain limits. Given these limits there is nothing wrong with the assumption of an explosive movement; the system may then continue periodically breaking against these limits without running away altogether.

Given these constraints, the hypothesis of explosive movements can explain the post war long wave in a way that reasonably fits the evidence of economic history. In addition to this it may also explain why long waves have recurred during such a long period without ever damping out. This type of explanation of cycles within external bounds may be traced back to Harrod [9]. It was however Hicks [10], who developed this idea into a complete model of the business cycle. The core of Hicks' model is an accelerator/multiplier interaction-mechanism where the accelerator is assumed to have a sufficiently high magnitude to produce an explosive movement. This movement cannot develop freely, because it is restricted by external limits.

- There is a direct restraint upon the upward expansion: scarcity of employable resources. Thus it is impossible to expand output without limit. The 'full employment ceiling' is defined in the Keynesian sense as the point at which output becomes inelastic to an increase of effective demand. In a progressive economy, that ceiling will shift in the course of time i.e. will display an upward trend.
- There is no direct limit on contraction. However, the working of the accelerator on the downswing is different from its working on the upswing. This difference in mechanism provides an indirect check upon contraction, which is certain to become effective sooner or later.

On Hicks' assumption that autonomous investment increases at a regular rate, the system can grow within the limits set by the growth of the labour force and the minimum output level as determined by the minimum rate of autonomous spending. In principle the system could remain in progressive equilibrium as long as it is not diverted from its equilibrium path. However, if there is a disturbance, which takes the form of an upward displacement, the explosive mechanism is triggered off. Output will diverge from its equilibrium path. The divergence will take the form of either oscillations, which increase in amplitude, or of relentless expansion. Once started the diverging movement can take several shapes depending on whether it has hit the ceiling or whether the cycle just bounces up along the rising floor.

Having sketched the broad outlines of the model, in the next section I will try to show that this framework fits reasonably well to the post-war development of the European economy.

4. Post War Development

4.1 Reconstruction and Upswing, 1945-1965

The initial conditions that characterized the European economy in 1945 are well known. The infra-structural system was devastated and so was a considerable part of the industrial installations and equipment. An important part of the working population was unemployed, or, more precisely, redundant relative to the level of productive capacity.

Although the principal elements of the conditions, which stimulate expansion, were present, the governments gave the original push to revival. Backed up by international financial aid, they embarked upon the reconstruction of the infrastructural system. In terms of the model this means that public spending produced, in the words of Hicks, the 'hump' in autonomous spending that lifted the economy from its slump equilibrium. Subsequent to this initial impulse the recovery started. Employment slowly increased and the resulting increase in purchasing power fed the 'bootstrap' interaction-mechanism. Things accelerated very quickly. By 1952, the major part of reconstruction was completed and the economy was in full swing.

As the upswing gathered momentum, the basic industries expanded rapidly and in their wake innovations developed. The extension of the industrial network was mainly clustered around the petrochemical industry, the basic metal-industry and the electro-technical industry.

It is important to note that the notion of 'extension of the industrial structure', or in the vocabulary of the preceding section, increase of the magnitude of the 'bootstrap accelerator', implicitly assumes that in the process of economic expansion the economy builds up a dual structure. New sectors are added while old sectors remain. Substitution (Schumpeter's 'creative destruction') does not take place until the restructuring process of the downswing sets in.

4.2. The Period of Transition, 1965-1970/71

However vigorous the expansion may have been it was bound to come to an end. Ultimately it was bound to hit the ceiling and be forced into reverse. Although there are slight differences between countries, the full employment ceiling was on the whole reached in the middle of the `sixties.

The upswing did not collapse immediately. The main reason why the reversal was postponed is the relatively high degree of flexibility of the ceiling. The shock was partly absorbed by the ceiling and a transition period was created in which expansion continued though at a lesser rate. To solve the problem of the tight labour market one can either try to increase the labour supply or to decrease the rate of growth of demand for labour. During the transition period both strategies were applied:

- In order to increase the labour supply one resorted to the attraction of workers from abroad.
- An obvious way of avoiding the tensions of the labour market is to switch to less labour-intensive techniques, by the introduction of labour-saving technologies. In this manner the physical restraint on the expansion is relaxed and the full-employment ceiling is given a build-in flexibility.

Apart from the strategies employed in an effort to cope with this problem in a general way, there was also the immediate and individual reaction to the scarcity of labour: the 'natural' effect of a tense market in the short run. In order to meet their individual demand for workers, employers started competing with each other in the labour market by bidding-up wages. Besides being a symptom of the workings of the market mechanism the rise in the wage-level was, at least initially, one of the factors that kept the economy growing during the transition phase.

4.3 The Reversal and the Ensuing Downswing

The growth process is the interaction of output growth and the growth of employment. But, as under the influence of a tight labour market the growth of employment is slowing down, the growth of wage-income and consequently the growth of consumer demand - the final stimulus to the growth of output - also slow down, unless the wage-rate is increased. This is what actually happened. As far as the technical solutions failed in filling the gap in the labour market, wage-rates increased. The latter, in turn, filled the potential gap in the growth of demand. It must however be pointed out that this mechanism, although it proved to work out positively for a time, is a very weak basis for the process of growth. Especially the part played by the rising wage-level makes it very vulnerable.

- In spite of the fact that the growth process continued, the mechanism could not keep the growth-rate from slowing down. A diminution of the average growth-rate means that the stimulus of the bootstrap-accelerator fades and causes a reversal.
- Rising wages as a solution to the problem of a possibly deficient growth of demand can only have a temporary effect because of its self-contradictory nature. Rising wages help as long as the labour-saving strategy is kept in line with the rise of the wage rate. If this requirement is not met it will either lose its effect or its working will be reversed. If wages rise faster than labour productivity the rising costs will act as a profit squeeze (in which case the effect is reversed) unless the producers succeed in passing the rising costs on to the consumers of the product (in which case the positive effects are neutralized).

What actually happened is well known. The increase of labour productivity did not keep in line with the rising wage level. The consequent rise in costs was passed on to consumers through a rising price level. Within a few years time the inflationary movement resulted in double-digit figures. From the point of view of the real factors this circumstance resulted in a neutralization of the temporary positive effects of high wages on purchasing power (or even in a reversal of the effects in the case of the older and weaker industries). In this situation the reversal became only a matter of time.

Although opinions differ as to the exact dating of the turning point, one may safely assume that it took place around 1970/71. At this point employment in most countries reached its peak level. In general the fall of investment in non-residential building and in capital equipment took place in 1971/72. After this unemployment increased.

During the downswing, the interaction of the multiplier and the bootstrap accelerator does not produce the spectacular results known from the upswing. Unemployment and the concomitant decline in consumer demand result in the laying-off of workers in the consumer goods industries, while the resulting over-capacity leads to a sharp decline in investment. The decline in investment leads to overcapacity and unemployment in the investment goods industry, and so on. The problem of overcapacity spreads throughout the entire economy, reducing output and increasing unemployment in all industries. The process of economic decline keeps on feeding on itself because any increase in unemployment leads to a decline in capacity utilization. In spite of this the downswing is not as vigorous as the upswing. There is a marked lack in symmetry. This is so because disinvestment can only take place by a cessation of gross investment. The adjustment of productive capacity to a decline in the level of output can only take place by a time consuming process of physical decay [10, 101]. The downward movement has a high degree of inertia; it will hardly respond to a policy of stimulation because of the existing over-capacity. Only time can cure the 'patient'. It was not before the second half of the nineteen-eighties that the system was ready for a new spurt in (re)investment that could absorb the new information- and computer-technology that became the hallmark of the fifth Kondratieff [11, 301].

Conclusion

The fact that the Second World War was out of sync because it occurred during the downswing phase of the fourth Kondratieff makes it stand out as a separate entity. It sprang from the depths of the depression when the steep rise of unemployment created the popular support for Hitler's Nazi Party in Germany. In spite of the fact that, at least according to Goldstein's theory, the economic situation was not 'ripe' for it, war preparations started and it was this process that put an end to the depression. Once underway the World War had is own dynamics. It escalated in a war of attrition that brought the world on the verge of disaster. But, cynical as it may sound, in so doing the war performed an essential task that would otherwise have been achieved by the depression phase of the long wave itself. Because of the enormous devastations, it pushed actual productive capacity below the level that is necessary to sustain the required rate of output. Consequently the war fulfilled an essential precondition for the next Kondratieff upswing. After having interrupted the normal course of events, the war so to speak pressed the ‘reset button’. Subsequently, the economic system reverted to its original parameters and resumed its normal mode of operation without changing its basic rhythm.

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Long Waves in Global Warfare and Maritime Hegemony? A Complex Systems Perspective

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Abstract. While long waves have been seriously discussed by economists for almost one hundred years, to date there is no scientific consensus that particular frequency components are in any way privileged in the undoubtedly fluctuating history of modern economic and political development. This is disappointing for two reasons. First, the demonstration that robust, well-defined periodic components existed would present us with a plausible tool for forecasting. And second, they could (and their purported existence has variously been thought to) provide insight into underlying causal mechanisms that generate the observed patterns. The data, I argue, only provide support for a continuous spectral pattern of a power law, $1/f^{\alpha}$ type. This is borne out in the paper by the analysis of political indicators such as the newly revised Modelski/Thompson sea power index and the Levy great powers conflict data. Claims for underlying low-dimensional chaos are only partly substantiated. Individual peaks at various frequencies in the spectrum are probably only due to "random noise" factors unique to segments of the record and not robust across countries and historical episodes. While one could then play the game of finding ad hoc explanations for why the 'K-wave' did not take its expected form in this or that century, from the perspective of the theory of complex dynamics it seems more plausible to conclude that a periodic model is not appropriate. Rather, the underlying model is more likely to be of the self-organized criticality or percolation type, characterized by power-law or fractal behavior rather than well-defined periodicity. I highlight some features common to several models of innovation/ economic dynamics and war/hegemonic cycles, such as highly clustered but nonperiodic critical events and resulting long life cycles of rise and decline, that may serve as a plausible explanatory mechanism for this 'revisionist' interpretation of the empirical record on long waves.

Introduction: Long Waves as an Exercise in Pattern Recognition

Human beings seem to abhor a conceptual vacuum. They seem to be programmed by evolution to detect order in seeming chaos and recognize important configurations like previously encountered faces with uncanny accuracy. For indeed, the ability to exploit genuine order in the environment (the regularity of the seasons, the habits of prey) should impart a selective advantage to those who can properly conceptualize it. Perhaps this is the ultimate origin of the scientific enterprise. Yet this selfsame urge probably underlies such common behavioral anomalies as gamblers' delusions, superstition (religion?), technical trading and the like. Thus it behooves the scientific researcher to tread carefully in ill-defined domains, and this for two reasons. First, so as not to fall victim to imagined patterns in the data, by carefully formulating null hypotheses of agnostic disorder against which a sound methodology is brought to bear, especially if the subject appeals to personal or community investments of faith and prospects of metaphysical redemption. And second, so as not to reject too neat patterns out of hand, or overlook yet other possibilities by becoming excessively fixated on ones that have historically dominated the literature.

There seem to be three primordial patterns that have dominated human thought for most of history. The first is stasis or apotheosis, a final state in which the universe and history will come to rest, preceded possibly by a period of monotonic convergence (the Final Judgment, Fukuyama's end of history, the Solow growth model). The second is cyclical (the seasons, the orbits of the planets, acoustical harmonies, the tides), consisting of simple or more complex combinations of periodic components, often in ratios of small integers. And third is what I would term the Heracleitan pattern, or lack of pattern: a universe that is never the same, that displays no law-like regularities and is intrinsically unpredictable. This corresponds perhaps to the vision of the German Historical School, Angus Maddison's phases of capitalist development, the efficient markets hypothesis, and the Box-Jenkins approach to time-series econometrics. God simply plays dice. From the perspective of modern statistical theory, this is of course also a pattern, one whose signature can also be detected with quantitative techniques. And as Beck [1] among others has pointed out, any stationary time series will be subdividable into periods of above and below average behavior, without this being due to any underlying 'mechanism' other than the persistence of random effects. Thus the Heracleitan vision may admit the differentiation of the historical record into eras or epochs, each due to unique historical factors, but not long waves in the sense they have been used in that literature: repetitions of a basic underlying mechanism allowing a certain predictability. The long-wave debate strikes me as still largely stuck within the conceptual confines of the second pattern (after conditioning perhaps on steady-state growth, an element of the first pattern). I will argue in the following that there may be an alternative situated somewhere in between the second and third possibilities that, while not being cyclical, has a distinctive pattern, and while showing elements of persistence, is not very predictable.

Why is pattern recognition important? Take one of the first documented instances of a 'scientific' identification of a pattern with major policy implications: the biblical Joseph's dream of seven years of plenty and seven years of famine. At first glance this is a classical cyclical model that allows very accurate forecasting, probably the first aim of any pattern recognition enterprise. In fact, Hurst [2] convincingly showed that the Nile does not admit any such simple cyclical pattern. Instead, it displays remarkable *persistence*, with years of exceptionally high or low flow following each other much more frequently than pure chance would lead us to expect. This observation does not provide us with a forecasting tool like a truly cyclical model would, but does have important implications for the safe design of dams (and for the prudent stockpiling of grain). Thus other properties of a pattern such as persistence may differentiate it from pure chance without admitting much forecasting. Patterns are also important clues for the construction of models and the identification of underlying mechanisms. Thus Kepler's laws led to Newton's celestial mechanics,[1] the fit of the east coast of South America into the west coast of Africa (a coincidence many had derided as illusory) ultimately lead to the theory of plate tectonics, and the complex spectra of gases led to the quantum mechanical theory of the atom. But neither the canals of Mars nor the patterns of bumps on people's heads led to the identification of alien civilizations or a phrenological theory of the human psyche. Thus purported patterns must be treated with care, and a methodologically sound case must be established that they really exist and are not figments of our order-loving fantasy.

To this end, this paper applies some of the ideas, models and methods used by myself and my collaborators in previous papers [3-7] that focused primarily on purely economic factors, to questions of long waves in war and international relations. For purposes of illustration and clarity of exposition I concentrate in the following empirical section on a dataset on seapower [8] and one on great power conflicts [9]. In the final theoretical section I attempt to integrate these results with existing models of technoeconomic evolution into an overarching theory of innovation and paradigm lifecycles.

1. Long Waves in Global Warfare and Great Power Relations?

While most long wave research has focused on economic variables, Kondratiev [10] already suggested that wars might be more likely to occur at the end of the upswing phases of his 50-60 year economic cycles, with causality running from economic competition for scarce resources and markets to the propensity for conflict. Goldstein [11] has made the relationship between armed conflict and economics the center of his research, with a greater emphasis on the autonomous dynamics of warfare than Kondratiev and a claim that the Levy data for great power conflict show 50 year cycles and correlate with his other indicators of long wave activity. Modelski and Thompson [8,12] are particularly associated with a long wave theory of hegemonic seapower cycles of approximately 110 years in the period of European domination of the world (oceanic) economy since 1495 (subsequently extended to Sung China and the Eurasian overland economy from ca. 1000 AD onwards in [13]).

Beck [1] has convincingly argued that the question of long cycles can only be answered within the context of the well-understood methods of spectral analysis.[2] I address this question for the Modelski/Thompson (MT) seapower data by computing the Herfindahl index of seapower concentration from their original data in place of their 'leading power' and 'systemic concentration' indices.[3] Figure 1 plots the spectral density of this time series on a double-log scale. The spectral densities of the MT leading power indices are quite similar.

Two things are remarkable about this figure. First, there are no prominent individual frequencies standing out above the usual noisiness of spectral plots, in contrast to MT's claim for the existence of 110 cycles.[4] Second, the spectral density is fitted quite well by a power-law function with slope –1.8325 over almost three decades of frequency.

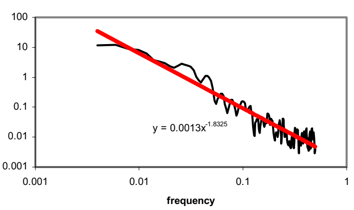

Figure 1 - Spectral density of Herfindahl index of seapower concentration, on double-log scale, with fitted power law.

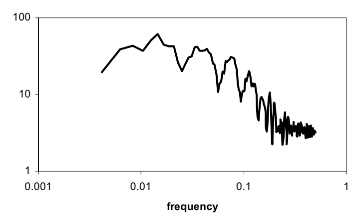

Figure 2 - Spectral density of standardized residuals of Levy/Goldstein great war fatalities data, double-log scale.

Figure 2 plots the spectral density of the standardized residuals from fitting a negative binomial model to the Levy/Goldstein time series of fatalities in wars fought between great powers in the period 1495-1975.[5] The estimated α of the negative binomial model is 10.7 and is significantly larger than zero at the 1% level on a likelihood ratio test, indicating that war fatalities are much more highly clustered than random. After conditioning on these facts, no distinct cyclical frequencies are apparent, in contrast to Goldstein's [11] conjecture of a 50-year cycle. However, something like a power-law pattern again seems to emerge, at least in the range 8-100 years. At shorter and longer time scales the spectrum resembles white noise. Quite similar results hold for the time series of all wars involving great powers in this period.

While at first sight these results may seem disappointing from a traditional long-wave perspective, they accord rather well with what is also known about many economic time series since [18]: the spectral density seems to diverge at low frequencies and follow a power law. This is in contrast to the standard view of stationary time series characterized by short memory, where $\sum_{-\infty}^{+\infty} |c_t| < \infty$, with c_t being the autocovariance of the series, implying a spectral density going to zero at low frequencies. Where this is not the case but the series is not integrated, long memory is present and correlations between distinct times persist longer than one would otherwise expect (recall the biblical case). Long memory can be characterized by a fractional differencing equation of the form $A(L)(1-L)^d x_t = B(L)\varepsilon_t$, where L is the lag operator, $A(.)$ and $B(.)$ are polynomials representing short-memory processes, and $-1<d<1$ is the long memory parameter. We can test the hypothesis that $d \neq 0$ by using Robinson's semi-parametric lpr estimator [6, 19]. For the seapower Herfindahl index this yields a value of d of 0.89, for the original MT LP series 0.88, both significant at the 1% level. For the standardized residuals of the Goldstein/Levy great war fatalities dataset d is 0.34, again significant at the 1% level.

Richards [20] also claims to have found evidence for low-dimensional chaos in the original MT LP time series, after also dismissing claims for strict periodicity. She employs the Grassberger-Procacia correlation dimension to calculate a value around 3.5 using an embedding dimension of at least 7 (see her Fig. 3, p. 62). However, her diagram fails to show if any real convergence was obtained over a range of distances in the phase-space embedding, and, as she also points out, the number of observations (507) is probably insufficient to support this claim. She also fails to employ a Theiler window to exclude pairs of points within the linear autocorrelation time of each other, something that has become standard practice since her article was published (see e.g. [21, 22]). For this reason I have repeated her calculation using the c2 algorithm from the TISEAN package [22] using a Theiler window of 42 for the Herfindahl seapower time series.

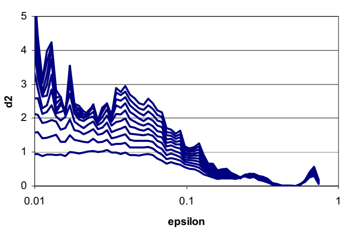

Figure 3 - Correlation dimension of the Herfindahl index for embedding dimensions 1-9 as a function of neighborhood size.

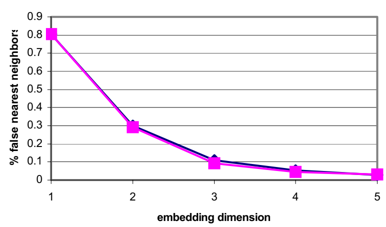

Figure 4 - Share of false nearest neighbors as a function of embedding dimension, for Theiler window size 0 (triangles) and 42 (squares).

The theory of phase space embedding states that if a time series is produced by a low-dimensional chaotic system, then by creating vectors of dimension m (the embedding dimension) using time-delay components of the original series, the topology of the strange attractor of fractional dimension d will be reconstructed for sufficiently high m. Figure 3 shows the procedure for estimating the correlation dimension. Starting at embedding dimension 5 there is in fact a small range of convergence, but at a value of the correlation dimension just above 2. That embedding dimension 5 is sufficient to recover the attractor is confirmed by Figure 4, which plots the percent of false nearest neighbors as a function of the embedding dimension for the Herfindahl index. This indeed falls off to almost zero at an embedding dimension of 5 for both zero and 42 year Theiler windows. No such convergence is apparent for the MT LP series (not shown), in contrast to the result reported by Richards. The percent of false nearest neighbors also rises from embedding dimension 4 to 5 in this case instead of falling off to zero.

A test has been proposed by Kennel and Isabelle [23] to differentiate between true low-dimensional chaos and colored or $1/f^{\alpha}$ noise, which can pass the above tests and also characterizes our datasets. It uses a one-step-ahead nonlinear predictor from the reconstructed trajectories in the phase-space embedding and compares the accuracy of forecasts with that of surrogate datasets generated randomly whose spectra resemble that of the original series. If low-dimensional chaos is present in the original series then the nonlinear forecaster should be statistically significantly more accurate in that case than for the surrogate data series. The results for the Herfindahl index are shown in Figure 5 (the test statistic is N(0,1) for the hypothesis that the original data does not allow higher nonlinear forecasting than surrogate data).[6] Thus the ensemble of our time series tests indicate that the seapower Herfindahl index displays aspects of $1/f^{\alpha}$ noise, long memory, and low-dimensional chaos simultaneously, although the evidence for chaos, because of the shortness of the time series, is probably somewhat weak.

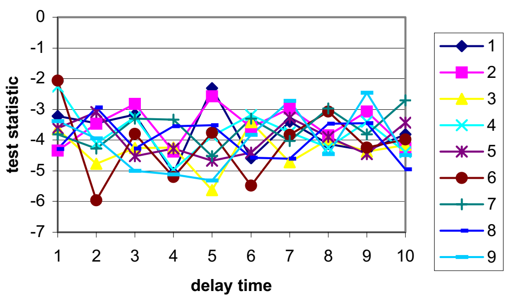

Figure 5 - Nonlinear prediction statistic for the Herfindahl index of seapower for various embedding dimensions and time delays of the phase-space embedding.

To demonstrate how variable the division of the modern period into epochs of hegemonic dominance can be, Figure 6 shows which power had the largest actual high-seas fleet when the Herfindahl concentration index exceeded a given threshold, indicating (according to a variable criterion) sufficient concentration of seapower to justify using the word hegemon.[7] For intermediate ranges of the Herfindahl index (0.25-0.35), where the world seapower system fluctuates most of the time, the pattern begins to look more fractal than cleanly cyclical, with gaps indicating periods of transition or conflict between one dominant power and another. A threshold value between 0.25 and 0.3 probably best reflects the record of periods of dominance and conflict as commonly presented by naval historians.

2. A Complex Systems Reformulation of the Long Wave Debate

Beck [1] and Goldstein [24] present two extreme positions on the long wave question. Beck adheres to a hard-nosed statistical perspective that only highly regular and distinct individual periodicities revealed by spectral analysis count as true cycles. Goldstein counters with two rather different and distinct concepts of a cycle. First, cycles in Goldstein's view need not be synchronized with calendar time. Taken to its extreme, this position would admit almost any stochastic process as cyclical, even though the 'periods' might be completely random and unpredictable. Unless the advocates of such a view can adduce a deterministic mapping from calendar time to their cyclical time, Beck's critique seems to me to be valid. Second, Goldstein maintains that if the underlying dynamic contains closed positive feedback loops, then we are also entitled to speak of cycles. This is both intriguing and prima facie wrong, since many such autocatalytic dynamical systems (starting with the simple Harrod-Domar model of economic growth) can produce very noncyclical behavior, such as steady-state exponential growth, chaos, or multistability. However, it does suggest that we need to extend our repertoire of dynamical systems and cyclical models to encompass more complex patterns.

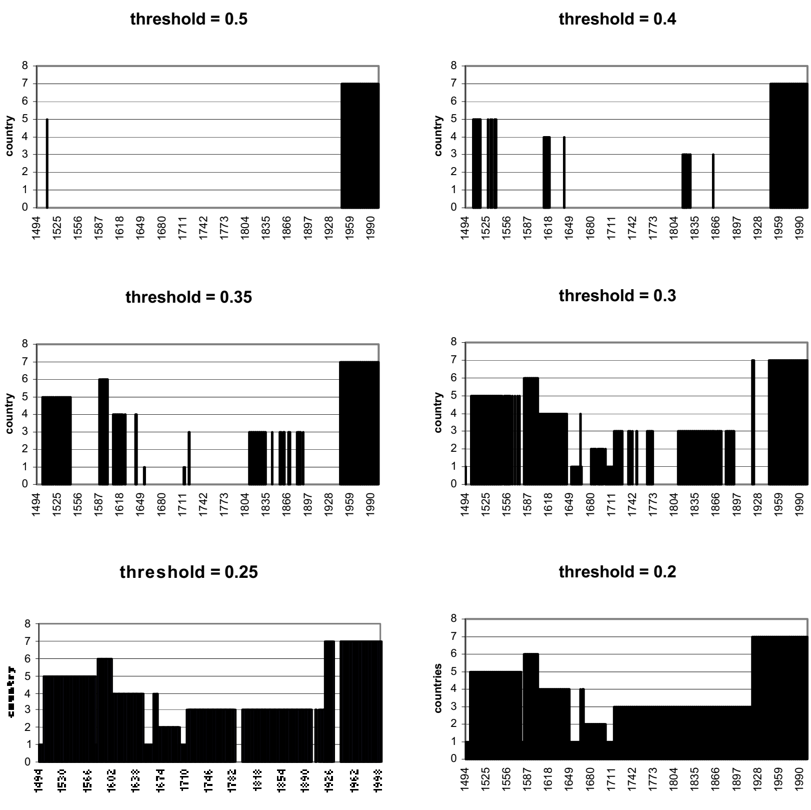

Figure 6 - Variation in the dating of hegemonic epochs according to the HI ≥ threshold criterion, using actual largest naval power in that year. The height of the bars codes for the hegemon as follows: 1=England, 2=France, 3=GB, 4=NL, 5=Portugal, 6=Spain, 7=USA.

The illustrative analysis of war fatalities and alleged seapower cycles presented in this paper, as well as previous work on innovation cycles and economic growth, offers an alternative perspective. First, we need to differentiate between 'point-process-like' phenomena like wars and technical innovations on the one hand, and system-level macro variables like power relations and aggregate output on the other, both in terms of their roles in an overarching theory and in terms of the relevant statistical methods of analysis. The former are highly unpredictable and variable, but it seems that they can be characterized as following an underlying exponential growth path in the modern era, and simultaneously as more highly clustered than a simple Poisson process. After controlling for this randomness and clustering, there does not seem to be any evidence for cycles in either realm. This is not to say that they are completely autonomous random variables simply following a complex stochastic process and unaffected by the rest of society. However, there do seem to be many reasons to favor the view that they occupy a privileged position as driving rather than driven variables, except in some long-term sense that they respond probabilitistically to changes in the configuration of macro variables and institutional frameworks.

The analysis of macro variables such as the seapower indices and aggregate economic output also fails to detect distinct periodicities. This should not be regarded as a purely negative result, however, since a pattern does seem to emerge: one of power-law spectra. While in the economic realm this has been known since at least [18], it can be regarded either as a simple statistical nuisance to be eliminated by appropriate differencing of the time series, or as a source of insight into underlying mechanisms of a quite different kind than simple cycles. In the last few years complex systems theory has come to recognize such power law relationships as possible signatures of widespread universal mechanisms in nature and society [25,35]. Instead of reacting with disappointment that the classical cyclical view has not been confirmed, we should rather embrace this insight as a clue to the directions of fruitful future research.

These findings also shed some light on the shortcomings of previous research. If a variable is really characterized by a power law spectrum, then looking at a finite segment of data of length T will always produce the largest spectral peak at period $T/2$, the limit of our resolution. Thus it is not surprising that analysis of the 100-150 years of economic statistics available in the 20th century has always led people to identify cycles of length 50-60 years, and that analysis of political data over the 500 years of the modern period even longer cycles. The existence of these continuous, as opposed to discrete, spectra, can also seduce researchers into chopping the frequency domain into all too regular pieces associated with e.g. period doubling characteristic frequencies such as the generation (30 years), the Kondratiev (60 years), the hegemonic (120 years), the democratization (250 years) and so forth, as [26] have argued. But it is precisely the *scale-free* (at least over a certain range of time scales) character of power-law spectra that sets them apart from other dynamical systems. Thus such classifications may be no more than convenient discretizations of the continuous hierarchy of time scales, unless very precise evidence is produced to the contrary.[8] If we take them too literally we run the risk of falling victim to Whitehead's fallacy of misplaced concreteness.

The relationship between the 'event' level (innovations, wars) and the macro level deserves closer analysis, and is also subject to a number of methodological caveats. [27] finds clustering of innovations corresponding (with a lag) to his macro long-wave dating. [28] already argued that the causality ran from the macro level to innovations (depressions triggering the adoption of innovations). [11] finds a somewhat similar relationship between great power wars and subsequent inflation. [1], using a bispectral method, even finds evidence for this correlation while rejecting long waves themselves. Thus cross-correlations and causalities may very well be present between two variables, but this need not be evidence of long waves in either. [3] actually demonstrate in a model in which the causalities are clear (in this case running exclusively from innovations to macro behavior) that a long wave dating resulting from the macro variables does produce a strong correlation with fluctuations in innovation activity, and in such a way that both a 'productivity paradox' and a 'depression trigger' hypothesis seem substantiated. But in fact the macro variables simply amplify the stochastic variability of the innovation process with a delay – the innovation process itself displays no long waves whatsoever. And the implications of the correlation can easily be misinterpreted in either direction. The same may apply to the interrelationship between wars, economic fluctuations and power relations: causalities are difficult to tease out, and misleading conclusions may result from the superficial reading of correlations and timings.

Nevertheless, a certain consensus about the basic elements of a canonical 'long wave' model seems to be emerging. First, there is an underlying layer of events that initiate autocatalytic growth (or decay) processes, such as technological innovations, wars, changes of political regime, new institutional arrangements, and whatever initiates the rise of nations. These events occur randomly in time (but with exponential trend for the arrival rate in the modern period), are highly clustered, and are characterized by highly skewed and possibility power law size distributions (for innovations [29], for war [16]). Second, these events induce life cycles of some entity (a technology, an infrastructure, an institutional arrangement, nations) in competition with other entities in a Darwinian-like process of growth and decline, or diffusion and obsolescence. This process of structural change also has major implications at the aggregate, macro level, and may induce feedbacks back to the micro and even 'event' level. Examples can be found for technologies in [30,31], for war and international relations in [32,33]. These life cycles need not be of constant length or exactly repetitive pattern. In fact in [3,4], both the speed of diffusion and the level of saturation have random characteristics. Nevertheless, the aggregation of this repetitive (but not periodic) pattern generates macro variables with distinctive power law properties. This seems to be a robust result even if we allow feedback from the macro to the innovation level and considerably greater micro diversity [34]. Whether we wish to classify this kind of system as displaying long waves is perhaps a matter of taste. In any event it transcends the Procrustean bed of the original long wave discourse and opens up a vaster richer domain of dynamical behaviors, some of which are probably more consistent with many long wave researchers' original intuitions (such as Schumpeter) than the primordial cyclical model ever was. It is also more consonant with the empirical 'stylized facts' that have begun to emerge from a more sophisticated statistical methodology in the last few years. Whether it will allow any sort of forecasting remains to be seen. The indicators of low-dimensional chaos for which I have found some rather tentative support might provide some ability to do short-term forecasting, although not in as straightforward a manner as the naïve cyclical model. However, I am very doubtful that we will ever be able to move very far from a firm knowledge of the pattern (in a statistical sense) to a firm ability to forecast.[9] Thus we arrive at a view of history situated somewhere in between well-defined statistical laws governing the chance and necessity process of evolution, and the Heracleitan uniqueness of traditional historiographic narrative.

Notes

[*] I would like to thank George Modelski and William Thompson for making their recently updated leading power seapower dataset available to me, as well as Jack Levy for providing me with his war casualty dataset and a number of relevant papers. I would also like to thank Bart Verspagen for implementing the Poisson regression analysis of the Levy/Goldstein data and the nvc analysis of the Modelski/Thompson data.

[1] However, Kepler was led to them by the pursuit of his specious but mathematically appealing theory of the 'harmony of the spheres': that the orbits of the then known planets were determined by the spaces between the nested natural polyhedra. Only the recognition of irreducible discrepancies between the empirical data and this Platonic pattern recognition exercise forced Kepler to propose his conceptionally quite different laws, which in turn led to Newtonian mechanics. His search for celestial analogues for acoustic harmonies is also somewhat reminiscent of the nested oscillations of both Schumpeter's three-cycle theory and recent world-system models.

[2] I will return to the issue of whether alternative definitions of cycles make sense in the last section of this paper.

[3] MT define a 'leading power' (LP) index of seapower by first identifying the leading power over stretches of history between what they identify as critical hegemonic wars, and then calculating that power's share in the sum of the forces of all seapowers whose raw shares in total world seapower is greater than 10%. This has the peculiar effect of imposing their long-wave dating on the index right from the start, since a) the leading power is not always the power with the largest naval forces in that year (this is true of Spain and Portugal vs. England and the Netherlands, in the 16th and early 17th centuries, and of England vs. the Netherlands and France for extended periods in the 17th century, and of Great Britain vs. the USA between the First and Second World Wars) and b) their choice of decisive hegemonic wars can be criticized for arbitrariness (thus [14] pp. 157-8 points out that MT leave out the Thirty Years' War (1619-48/59), the War of Austrian Succession (1739-1748), and the Seven Years' War (1755-1763), which most analysts include in any discussion of great power hegemony both for their global extent and intensity of casualties, not to mention lesser conflicts such as the wars between Charles V and France (1521-1559) and the Dutch War of Louis XIV (1672-1678), which played significant roles in establishing the European hegemon). In part this is a result of MT's exclusive emphasis on global oceanic seapower to the complete neglect of land and regional naval forces (thus promoting Portugal to hegemonic status in the 16th century, although most analysts do not even consider it a great power at any time in the entire period, and excluding the Ottoman Empire). And it may also reflect an unconscious bias on MT's part in favor of their 110 year long-wave (pre)conception.

MT's other, 'systemic concentration' (SC) index is based on a formula proposed by [15]):

$$SC = \sqrt{(\sum s_i^{\,2} - 1/N)/(1-1/N)},$$

where s_i is the share of power i in the total population of N powers. There are a number of inconsistencies in the way this index is calculated in Appendix B of [8]). First, the shares do not always sum to one (sometimes deviating by as much as 10%). Second, the number of great powers N entering the formula does not always correspond to the number of countries with nonzero shares (e.g., when a great power drops out of the population it sometimes, but not always, continues to be counted in the value of N). This is especially problematic since the Ray and Singer formula will undergo nontrivial jumps as N changes even if the sum Σs_i^2 (which is in fact the usual Herfindahl index of concentration widely used in industrial economics) is otherwise practically unchanged. Finally, a number of values of MT's SC index seem to be simply miscalculated for reasons that are not apparent. A detailed analysis of the problems of the MT indices can be obtained from the author as an Excel spreadsheet.

To correct for these problems I have recalculated a systemic concentration index by

1. renormalizing the shares taken from MT's Tables 5.6-5.9 by dividing them by the sum of shares in that year, thereby forcing them to sum to one. This is only a quick and dirty solution. A better one would be to recalculate the shares from MT's raw data, but I have not found the time to do so until now;
2. using the straight Herfindahl index Σs_i^2 instead of the Ray and Singer index. This is not sensitive to the proper specification of N and the inclusion or exclusion of marginal powers (and thus would also allow seapowers under MT's 10% threshold to be included in the calculation without significantly changing the result, something I have also not yet undertaken in the present analysis).

In the following I will rely primarily on this Herfindahl SC index, since it is not affected by ambiguities in the identification of the leading power or the number of powers, the two problems impairing the usefulness of MT's LP and SC indices. For purposes of comparison I have also calculated a consistent SC index based on the Ray and Singer formula (which is much more variable than the one in MT's Appendix B) and an alternative LP index, MaxS, reflecting the share of the naval power whose forces were actually largest in any given year. This analysis of the problems and inconsistencies of MT's LP and SC indices is not meant to detract from their immense contribution to putting the discussion of hegemonic cycles on a firm empirical and theoretical foundation. It is an unavoidable correlate of quantitative analysis that the devil is always in the details.

Since presenting the first draft of the paper at the workshop, William Thompson has made a revised seapower series available to me that corrects for these inconsistencies. I hope to incorporate an analysis of this series into a future study, as well as calculate a concentration index that more directly reflects naval hegemony based on the 'British Admiralty rule' (that the hegemon's fleet should be larger than the sum of the fleets of its next two competitors). I suspect that the data revisions do not materially change the results of the present paper using my adjusted series.

[4] Plotting on a logarithmic scale gives a better indication of the relative significance of individual peaks in the spectrum than on a linear scale. See [1], Appendix, for a discussion of how to calculate the significance levels of spectral densities.

[5] This data is taken from [11] Appendix B, variable GPWAR of War Indicators table, which in turn is based on [9]. Goldstein distributes the fatalities evenly over the years of a war, except for the first and last year, which are apportioned half as many. In contrast to [1], I do not perform a spectral analysis directly on this data, since they obviously have characteristics rather different from usual random variables, in particular the large number of years with zero values. Instead I regard them as count data in the tradition of war analysis in

[9,16,17]. The null hypothesis is that of a Poisson process with log-linear time trend. The alternative hypothesis is that of a negative binomial model representing a more clustering process than pure Poisson with a parameter α reflecting the degree of random clustering. I also introduce a dummy variable x_{1815} (=0 before 1815, 1 afterwards) to reflect the often remarked structural change in the data after 1815: great power wars become less frequent but more severe. The method of Poisson regression is then applied to each model (see [5] for details) for the Poisson arrival rate λ:

$$\ln \lambda(t) = a_1 + a_2 x_{1815} + b_1 t + b_2 x_{1815} t$$

The estimated point variances are $\lambda(t)$ for the Poisson model and $\lambda(t)(1+\alpha\lambda(t))$ for the negative binomial one. The standardized residuals are then $(x(t)-\lambda(t))/\sqrt{\lambda(t)(1+\alpha\lambda(t))}$, where $x(t)$ are the annual observations. This controls for the exponential trend and the heteroskedasticity of the data according to the relevant model. Spectral analysis is then applied to these residuals. The net result is not remarkably different than that obtained by [1], however.

[6] The 507 observations of the original series are extended by three repetitions of the first value and two of the last to obtain the power of two observations (512) needed by the nvc algorithm. Analysis of 256 'unadulterated' observations from the beginning, middle and end of the original series showed similar results, with the beginning and middle being perhaps somewhat less significant and the end distinctly more so.

[7] Recall that the MT LP index reports the share of the power MT identify as the leading power in that time interval even if that power does not currently possess the largest fleet by MT's own measures. MT define hegemony to apply when the LP index exceeds 50%, but of course their results could also be examined as a function of a variable threshold.

[8] [26] also propose a power law for their nested cascade of world system processes. Quite apart from the plausibility of their identification of specific periodic processes in the very uncertain empirical record encompassing 8000 years of human history (and even in the case of the seapower dataset it should now be clear that the claim for periodicity is highly dubious), it is evident that regressing the number of repetitions n_p of a periodic process in a time interval of length T against the period p of the process ($n_p = T/p$) will always yield a power-law exponent of -1. Thus it is not surprising that they obtain an exponent of −0.9991: they are simply estimating a mathematical/conceptual identity and not a relationship between independent observations.

[9] In this the social system may be analogous to the study of earthquakes, where the well-established Gutenberg-Richter (power) law and some knowledge about the temporal clustering properties of earthquakes still does not provide us with any lever for forecasting.

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Wars on the Borders of Europe and Socio-Economic Long Cycles

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Abstract. Europe has to face new problems. Since the WWII catastrophe, it has renounced to internal wars. And, under the American umbrella, it can provide for such an ambition. It stands for the voice of Kant's vision of international relations. However, as it is protected by USA, the European position as regard to risks of war arising may seem ambiguous. If it wants to be credible, it has to give good example at its borders. But, two cases, in Caucasia and in Africa, show that it is not so. This paper aims at recalling how the 'geographic-induced' war pressures, during the European history, above all since 1800 (the Napoleonic wars) and even more since 1914 (the first world war) were. This first enables to look at the way the situation has essentially evolved, and secondly how that very situation can modify the verdict of the Modelski-Goldstein's theory about risks of war in the world for the coming fifty years.

Introduction

Europe has to tackle with new issues. Since the WWII, it has renounced to make war. Under American umbrella, it can achieve that goal. It is the vector of Kant's vision of international relations [1].

However, as it is protected by America, the way it is placed in front of war risks may seem ambiguous. Indeed, if it wants to be trusted, it must give good examples at its borders. The cases of Caucasian and African wars show that it is not totally true.

This paper first presents the warfare long cycle theory of Goldstein (1988). Secondly, it analyses how the extension of this theory does not match the reality, as regard to the underground evolution since 1800. We recall the nature of war pushing pressures from 1800 on (the Napoleonic wars), which might be considered as "geographic", in order to wonder how the situation has fundamentally changed. The idea is that Europe has pulled war out of its genes. Thirdly, we examine how the prospect regarding war risks in the world might be changed by Europe's position, on the basis of the present war long cycle Modelski [2]-Goldstein's [3] theory.

1. The Warfare Long Cycle Theory

1.1. The Classical Framework of the Kondratieff's Cycle Theory

Kondratieff is the first author who showed a link between economic evolution and fifty years of long cycles for prices and production. Other authors demonstrate that not only the long cycle notion is relevant, but also that of long tendency. For any economy, which is not identically reproduced; many sectors replace others, bringing out a reorganization of the whole economy, through long cycles (Schumpeter). The long cycle theory has not always been unanimously welcomed. They are mainly debated during the depressive phases.

One reason to behave that way might have been the very existence of cycles, with a duplicating move, recalling some deep organic, partially unconscious effort. That is certainly why the long cycle theory has been studied by original thinkers, who tried to understand some mysteries: how economy and society were duplicated, even with partial changes, through cycles encompassing the full length of human life? Here, there is probably some questioning about regulation, through a dialogue between conscious and unconscious.

1.2.Precursors of the Theory

Few authors, because of this regressive state, introduced surprising hypothesis. Kondratieff cycles would be war and peace cycles. Ciriacy-Wantrup explains that the biggest wars take place in the second mid period of the upward phase, as a result of a depression phenomenon in agriculture, bringing about social moves. Human memory holds a record of past war events, that it will reproduce similarly, after some time, according to a hysteresis pattern, as a genuine answer to some perturbations. Beyond sectorial explanations, war is accounted for on the base of deep socio-historic facts. It arises again every two generations, the one having suffered from war horrors trying to faithfully safeguard peace; on the contrary, the following generation obeys to uninhibited bellicist feelings.

These theories, marked by an intrinsic exogenous character of war, have found echo in endogenous theories interpreting economy and society in terms of social classes. According to Kleinknecht, Mandel, Cronin and Screpanti, one can study between class relations in the framework of evolution linked to long cycles. Though, such an explanation may be ambiguous as far as war and social factors are concerned, as there is uncertainty on return points. Oparine thinks that if wars and social events of the upward phase are affected by the downward phase, interpretation of war cycles would be changed. However, according to Gatteï, Arrighi, or Sylver, war cycles do have a material base. Akerman associates long cycles with war and peace too, through a link between wars and wheat prices. Quincy Wright demonstrates that fifty years war cycles have existed in Europe since the Succession of Spain war (1701-14). Imbert considers that war can be linked to growth long cycles, as it seems related to faster innovation, like during the WWI.

1.3.The Goldstein's Theory

Several authors tried to improve that theory, even to give it more efficient empirical grounds. Modelski, Thompson, Zuck, Craig and Watt, Morgan, Goldstein are those who initiated this research program, with many far-reaching results obtained by Goldstein in his Ph. D. dissertation.

According to his theory long cycles have existed before 1800 in Europe, as cycles of war and peace, since about 1300. War cycles are themselves a component of "hegemonic cycles" (150 years since 1500, longer before), which deeply re-structure relations between nations. These 150 years cycles are relevant: with no dominating power, no "police" able to impose discipline in the nation to nation relations, and world situation is not far from chaos. Taking advantage of this lack of power, most active nations then enter competition for world leadership. And the winning one in those hegemonic wars, dominates in the military, economic and financial fields. Since Napoleonic wars (1793 – 1815) and the diplomatic verdict of the Vienna Congress, Great Britain has been hegemonic, followed by the United States since 1945 and the Yalta Conference putting an end to the WWI and the WWII.

Kondratieff cycles are strongly linked to hegemonic cycles: hegemonic or systemic wars always start in the final phase of an ascending Kondratieff. One can sum up the typical cases that Goldstein introduced about correlations between Kondratieff and hegemonic cycles in the following way (Table 1):

Table 1 - Conjunction hegemonic / Kondratieff cycles: 6 type-situations

Hegemony	Strong		Declining		Weak	
Kondratieff	Upward	Downward	Upward	Downward	Upward	Downward
Conjunction	(a)	(d)	(b)	(e)	(c)	(f)

Hegemonic wars can take place only if there is simultaneously weak hegemony - ending in world order burst - and end of upward phase Kondratieff - providing for needed resources enabling war financing: (c) combination. On the contrary, the (d) situation favours sustainable peace, combining strong hegemony - a leader imposes unquestionable world order - whereas the downward Kondratieff cannot provide the necessary resources to war financing. Conjunctions (a) and (b) enable big but non-hegemonic wars. An upward Kondratieff implies that substantial economic resources are available and strong (a) or declining (b) hegemony. Conjunctions (f) and (e) seem to be "fore-danger" transition phases: a downward Kondratieff is associated with weak (f) or declining (e) hegemony.

1.4. Goldstein and Others

Of late empirical researches (Singer and Cuzak, 1981; Small and Singer, 1982; Levy, 1983, 1985; Gochman and Maoz, 1984) strengthened his research. But, taking Europe for example, we can wonder whether world order explanation is really founded on the set of war problems.

2. Challenging Goldstein's Theory on Europe since 1945

(War pulled out of the European genes little by little. Challenging on the trend, approval about the cycle. Inducing war pressure state, coming from various horizons around Europe)

2.1. 1800-1870 Period

In 1800, during the Napoleonic wars, «war appeal» was endogenous to Europe. France decided to enter the war. So did Germany against France in 1870.

These two examples of the main European wars, between 1800 and 1870, show that, at that time, Europe was entangled in Goldstein's scheme, of inescapable big wars about every fifty years. Its development level was so low that still it did not have too much to lose in war. As a matter of fact, as soon as a country gets industrialized, it has no interest at all at war doing, because economy, strongly involved in investments with prospects, cannot go back to a kind of «natural economy»; the destructions of industrial infrastructures entailed by war are too costly to be assumed. The cultural development level, with the industrial one, impairs war arising, too: industrial revolution gives birth to a kind of "Kantian cosmopolitism» [4], the nations learn to live with, under risk and uncertainty conditions, needing not coming to grips to settle their differences.

Until 1850-1870, Europe was not, as a whole, in a state of advanced industrial revolution. War was some natural and unavoidable phenomenon, which causes were practically "endogenous", according to the war long cycle theory. In the 1870-1945 period, it was already no longer totally so.

2.2. 1870-1945 Period

2.2.1. Causes of That Period Evolution Versus the Preceding Period: the Monetarization Role; the Theory of Revolution, and The Role of Colonies

Why, within that time lapse versus the preceding period, things have so hugely changed? With industrial revolution, money plays an increasing role in economic ruling. Let us talk about the gold standard role, as of the 1860 years, and about banknotes use, which started to gain ground. Aglietta [5] has shown that money «mediates conflicts», preventing them to worsen in a physical and brutal way. Hence, «the big economic change» Polanyi [6] speaks of, faster in the nineteenth century due to the big financial markets development, acts as an antidote to military war. In the nineteenth century, Great Britain, with the gold standard, confounded with the «sterling standard», holds the first historical «key-currency» [7]. Germany, in 1873 [8], adopted the gold standard, too, and created a Central Bank. France created its Central Bank, the Bank of France, under its historical final form (covering the whole French territory), in 1848 [9].

«Socialists» thinkers then have tried to interpret social conflicts as endogenous, through their «social classes » theory. Opposite to a traditional and agrarian society, which has always known the «every fifty years big war», the industrial and progressive society, has interest in conceiving conflicts as social, not military. Internationalist ideas have outdated wars between nations, ethnic groups or religions. It became urgent to understand that economically based conflicts are internal to societies. The classes fight theory enable to think of conflicts as endogenous, social, not as military, exogenous. The war risk perception was turned into one of civil war risk. So, Marx believed that «revolution would inescapably arise in Germany»: in Europe's core [10]. The war risk has been a bit discarded, without underestimating the global risk sociological perception.

The European countries not only managed a type of «confessable» globalization from 1870 to1914, by developing trade between countries, making them more peaceful. Moreover, they went on developing that colonization, particularly in Asia and Africa. The existence of "third states" – the colonies – deported the risk, reduced it because the countries shared economic advantages.

2.2.2. Inferring from the Preceding and Induction of the Following

The above three series of grounds made that war in Europe as avoidable. As a matter of fact – in 1914-18 and 1939-45 – it was even stronger, because there were grounds pushing in the other direction too. Firstly, the gold standard system did not prevent public over-in-debtless for States depending on their relations with England. It accumulated tensions. The position of the United Kingdom between the United States and Europe was not very clear. And above all, Germany had an imperialist project, not overseas, but inside the European continent! Colonial countries also competed for colonies that made skyrocketing pressure and could induce fear of falling again into war logic. The typical case was that of Morocco, with Germany on one side, and France, backed by England, on the other. (In 1911, to protest against the absence of economic compensations about Morocco, the Prussian emperor William II forced France to bargain by casting a warship anchor in Agadir: an access to Congo in exchange of acknowledging French rights in Morocco) But, within that period, wars actually arose at the borders, not in the heart of Europe.

2.2.3. Causes Geographically Located at the Borders of Europe, not in the Core; the Balkan Wars; Russian Revolution:

The Balkan wars began in the 1880's. Before 1914, there were thirty years of uninterrupted conflicts in the Balkans. [11] Undoubtedly one cause consisted in the huge development gap between the Eastern European countries, remaining essentially agrarian, and the Western European countries, which had known the industrial revolution. The dominating powers then cleverly used the sectorial development dilemma (agriculture / industry) / (regional / national) development. These countries, in exchange of their investments, imposed tough financial conditions to South-Eastern Europe, for instance to Greece in 1882. In those countries, under financial pressure, there often were social conflicts. Conflicts grew in the Balkans, up to ending up, in 1914, when the European Western nations declared war. But the spark that triggered war came from the periphery.

Besides, far from the Balkans, the Crimea war arose (in 1853-56, a little anterior but preparatory to the cycle about to start), which might insecure European countries. There also were aggressions (in October 1914, the Turks attacked the Russian Fleet on the Black Sea. The Allied declared war to Turkey) between Turkey and Russia, both big nations at the Eastern and at the South-Eastern European borders. Already at that time, Europe, due to its starting thrive, incited its neighbours to position themselves in connection with it, possibly to compete to accede to its market.

Pushing countries to modernize, to carry out industrialization, and to socially manage that change, finally ended up in a civil war at European borders and in communist revolution: not in Germany, as Marx had foretold it, but in Russia, in 1917. Hence the European move since 1800 progressively pushed war the furthest possible from its heart. Moreover, this move is so complex that it involves the European identity: thus, there was a « come back of the repressed» that, for a last time, triggered of war at the heart of Europe: because of Germany. Because of fear of the communist revolution, Germany did "national revolution", dragging along Europe and the whole world in the WWII.

2.3. Period 1945-2000
(The causes of that period evolution compared with the preceding period: end of the colonial wars; European building up; the un (re) unifying of the European continent; a lot of work for Europe)

The European countries got rid of their «imperial complex», and of all that it brought unclear, domination spirit, coercion imposed to countries considered as «inferior». The very heart of Europe was looked after any domination spirit: Germany was not granted right of having an army of its own up to the 1990's. Europe was finally conform to its Kantian ideal, maybe somewhat schizophrenic and uneasy to manage, between « pure reason» [12] and « practical reason» [13], between values and means of putting them into action.

Through the historical mechanism of the European building up, competition does not imply war, but only economy. So, peacemaking through economy, to which many liberals were aiming at from the eighteenth century, does not proceed any longer only through trade between nations, but goes beyond, up to the production cell, enabling European economy to build up in an endogenous way.

Ambiguity between, on one hand, the between sectors gap, on the other hand the between regions or nations one, has fed attack against economic progress (living standard and production growth) which turned out to be socially tremendous in Russia, because, there, town and country were opposed, triggering true civil war. But Russia, the first, stopped arms race between both «big», pointing out that sacrifices it had imposed to its people had, paradoxically, shown it the peace way, breaking with the old European war fatality. Thus, that country has also collapsed because it was taken in, breaking with all that human history could build as «natural protections of a country»: its army. Notwithstanding itself, Russia has helped to peace on the European continent.

Thus, Europe could out pass that source of internal division: 1°) war opposing nations or outside the European nations becomes: 2°) the European civil war, «hot» war in some European countries (Russia), «cold» war in Western Europe, which, in turn becomes: 3°) taken on peace on the European continent.

3. Today's Europe Situation Regarding Wars at its Borders; and New Possible War Patterns in the Future; Implicit Europe position on the Matter

3.1. New War Forms; Risks of Evolution toward other Wars

A classical war, between two developed countries of same size, has become improbable. In the world, wars arise between little developed countries (as in Africa), - as in Europe up to 1870, a mixture of civil wars and wars in the common sense, where features of decomposition / re-composition of nation-States (in Africa) are at stake; or terrorism; at last, asymmetrical wars, like between United States and Iraq, where the world police tries to impose «its» vision of the world order.

As for the risks, all depends on terrorism development, particularly that from Islam. Should the Islamic world take fire, there would be risk of destabilizing Europe (in particular in Caucasia), Africa, and far Eastern Asia. It depends, too, on how more or less «imperialist» powers behave. Russia seems to be the last world imperialist power. Its behaviour in Caucasia, in Tchetchenia, does not favour peace. Russia's behaviour remains a big unknown, and it is the reason why Europe is not completely free from the war set of issues.

3.2.The Consequences of Europe's Position: Consequences in Connection with Deductions of the Long War Cycle of Modelski and Goldstein's Theory

There would be a «heart of Europe», which did its utmost to expel war from its ground. On the contrary, Europe periphery is not secure yet: that is why it counts on the American protection. The American world vision of safety issues, along with the European will to get rid of war, can actually help to delay war, provided it exists a dialogue. Europe position, which in the last century was torn by the ideological split between capitalism and communism as government system, might, in the twenty-first century, know a new dilemma, implying safety, not economy, involving every factor of the social link, and choosing of integrating or not categories of individuals in a protected world, depending on their behaviour. This protected world cannot admit this cancer of societies that terrorism is.

One must better understand how one comes to war on psychological grounds. Wieviorka [14, 15] distinguishes young individuals liable to violent behaviour by trying to build an «out of reach personality»: they can and must be supported to enable them to manage their personal project, in this complex world; and those for whom violent behaviour comes from the fact they are opposed to any form of society, good agreement and peace, also from their egocentrism, and perversity up to systematically want to make the others fail: they are, indeed, only a few in that category, but they may considerably damage a society; and it is why authorities should repress them. One of Europe's roles might be to systematically work as a relay for dialogue, in order to give the «unlawful States », and also the minorities or isolated contestant or claiming groups, some kind of «legitimated violence monopoly», on a real or virtual territory, and the opportunity to make their identity better known and thus get their possible rights acknowledged. Europe through its history knows how complex the situation and sociological history of States are, as influenced by interactions between economies, values, safety issues.

We showed that the theory of Goldstein is particularly well grounded, since it makes appear some continuity in the European history, in the 1300-1800 pre-industrial period, where the war genes were simply a fact, and the period since 1800, coming along with the industrial revolution. This theory enables to understand better the cycle, but not so well the tendency, this latter one accounting for elements that become more and more conscious and mastered, and that resulted in “pulling war out of the genes of Europe”. Though, on the tendency, we ought to be prudent. It might be that, if the Europe pattern can be applied there, Africa could escape the fatality of wars by entering into its industrial revolution. War risks are lessened by understanding better its essential historical factors: resources rarefaction, as a result of stagnant economy, brings about some need of fighting, at least to secure one’s “property of oneself” feeling, somewhat egoistically and aggressively. Possible wars, of terrorist nature, would arise by a psychological worsening of such a feeling from an exacerbated sensitivity, as a reaction against the world police interpreted as an imperialist power, or against a Nation State in its building process, to make sure, through absurdity, that it exists, guarantees its inhabitants their protective identity, “property of oneself”!

Europe, whose history and very identity encompasses these questions, has to serve as a relay for dialogue. This endogenous evolution of Europe about war risks can bring with it unpredictable consequences as for these risks in the world as it is getting economically and socially more developed, and politically more democratic. In line with the Goldstein-Modelski predictions, some kind of war might well arise after 2020 in Asia. Later on, endogenous evolution of Europe would have some effect to restrain wars in the world.

Conclusion, recommendations

As a conclusion, the Goldstein and Levy’s history analysis put it very clear that warfare phenomenon is regular, as big wars and hegemonic wars arise in the way displayed at the beginning of this article. Obviously, too, there have been constant Kondratieff cycles arising since 1800. Technological revolutions have brought about features, particularly in the energy exploiting technology. But, as the evolution of Europe particularly enlightens this aspect, there should have been a turning point in the Kondratieff cycles’ process, and in the extent to which we perceive them. Whether this turning point occurred in 1940 – WWII arising contradicts Goldstein’s theory according to which big wars burst at the end of an upswing phase (it was not so with WWII), unless we bring together both world wars, considering they are one unique phenomenon, or in 1990 - the present KONDRATIEFF cycle being apparently, for the first time, more information-, than energy-oriented, and, because more immaterial, also probably more peaceful – is debatable. But, the better awareness we have of the very existence of Kondratieff cycles – not only states, also individuals – should help us to better manage the link between unconscious and conscious factors of social progress, hence to better supervise the social, economical, political human evolution.

In this scope, international institutions, particularly NATO, should try and help to implement the social institutions for peace, democracy, and economic development – for instance by training security forces, where the world security is most at stake: Central Asia, Middle East, Afghanistan-Pakistan-Iran zone. Indeed, these zones might be supposed to be the areas where a coo-petitive – cooperative and competitive – contest would take place, opposing the United States and the European Union in the future. The USA are entangled in the economical, warfare and political cycles system developed by Goldstein and Modelski, but need being supported by Europe on the social side. The E.U bears more post-modernistic values, but maybe not totally adheres to at its own borders. And NATO could order more in-depth investigation about Africa: ensuring world security in the 21st century would also need starting from the last weak-link of the international chain: Africa, whose case raises the questions of: 1°) where is the political legitimacy level, the process of moving structures being so fast that it brings about terrorism: in cities, at the Home State level, in international companies, foreign States acting as intermediaries of world institutions, the African Union? 2°) what about building four or five regional zones in order to help the States to adopt common economic development goals ? Of course, in this context, NATO could propose to train some military forces in Africa. So in a sense, NATO could tend either to become an universal institution for security, or disappear. At least, two new questions must be raised: one "medium term" question, oriented toward 2020-2030 objectives, about Central Asia; one "long term" and "very long term" question about Africa.

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Is History Automatic and Are Wars a la Carte? The Perplexing Suggestions of a System Analysis of Historical Time Series

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Abstract. During the past 30 years, I have analyzed thousands of time series concerning all sorts of social and economic phenomena—from the destruction of the threshers (1 month) to the evolution of British naval power (500 years), from the rounds of artillery shot in Europe by American forces during WWI to American casualties in the Vietnam War, from the victims of the Red Brigades in Italy to those of the witch hunts in the Middle Ages, and so on. The perplexing result is that a very simple logistic model can always fit the data in a predictive format.

The usual enlightened belief that human events are the result of the fight between competing and collaborating free wills—in imprecise contexts, with unpredictable consequences—seems to be challenged by these results. History appears as the smooth de-convolution of a built-in program where free wills lock in to make it smooth. There appear to be many programs, in fact, like wheels within wheels, strictly clocked by ubiquitous Kondratiev cycles or waves, so that details are describable and predictable. This can be seen in *Figure 1*, where logistic center points of transportation infrastructures in the USA, subway starting dates for the world, and innovation waves are reported against the deviations from an exponential of energy consumption in the USA. It must be clear that I am not presenting a theory here, but rather some conclusions from numerous—that is, a few thousand—empirical analysis.

About 30 years ago, in an effort to solve the problem of the historical evolution of the energy markets, I came upon the idea that, the system being mostly "more of the same," primary energies might compete much as species in a biological niche, a subject well modeled by mathematical biologists in the 1920s. The idea proved extremely fruitful in the area of energy, so much so that I progressively tried to extend it to other areas, with the above argument that the system appears to be mostly more of the same. This worked beyond my expectations: magically, data time series in the most variegated social and economic areas could be fitted with simple logistic equations, the most elementary solutions of the Volterra–Lotka equations of competition. The following pages will show a perhaps very interesting but inevitably limited sample mainly related to war; but if it whets the curiosity of the reader, he/she can browse my Web site (www.cesaremarchetti.org/), where most of the papers can be downloaded.

Man is a territorial animal, and most wars are squabbles over territory; it may therefore be instructive to dig deeper into the mechanisms of territoriality. There is a basic territorial instinct imprinted in the limbic brain—or our "snake brain," as it is sometimes dubbed. This basic instinct is central to our daily life, and its deployment is analyzed in my 1994 paper "Anthropological Invariants in Travel Behavior." Only external constraints can limit the greedy desire to bring *more territory* under control. The main constraint in daily life is *travel time*, fixed at *one hour per day* by another basic instinct (the one hour of open-air exercise time given to prisoners). Thus there is only one way to escape this constraint and expand territory, *speed*. The daily fight to conquer more territory with higher speeds has its own blood price: according to World Bank statistics, an estimated 1 million people die and about 20 million are injured in road accidents every year. Even before starting a war, we are soaked in blood.

A human can walk about 5 kilometers in one hour, and this was the basic unit for land organization before the advent of machines built for speed. In fact, all land has been always tiled in 5-kilometer parcels, 20 square kilometers of surface, often with a village in the center. The village could grow into a capital city of 1 million people, if it stayed within the 20-square-kilometer tile. Until 1800, no city grew in size beyond that extent. Seven tiles make up a hierarchical bundle of the first level, with a more important village in the center (weekly markets); and a bundle of seven of these makes the second hierarchical level, and so on, until we find a capital. Nations are always organized in this way. Now, however, the tiles are becoming larger, because motor vehicles permit greater speeds. Since Ford, cars have had a mean speed of about 40 kilometers per hour, allowing the area of the tile to become about 50 times larger. The largest cities can then grow even larger; imperial Rome had 1 million inhabitants living within 20 square kilometers, and a "car city" like Mexico City grows according to a logistic equation, becoming saturated at 50 million people, but with the same population density as ancient Rome. The snake brain organizes space from the bottom to the top, even if our rational conscious is not much aware of it; and in spite of this, historians try rational interpretations.

The territorial instinct also operates in the heads of the rulers of a state, who visualize a nation as an extension of their limbs (*l'état c'est moi*) and try to expand it with a panoply of rationalizations. It would be interesting to make a catalogue of these rationalizations for psychoanalysis. In reality, the drive and objective are the same for a nation as for the individual: more land under one's control, thus, more power at hand. If a nation is vigorous and the boundary conditions are appropriate, the territorial expansion will produce an empire. I have analyzed a number of examples from history. They grow logistically with time constants of hundreds of years, following one single equation. Logistics saturate, so they have a limited size. I discovered that this corresponds to a couple of weeks of travel from the capital to the rim using the fastest transportation system available. Emperors build roads for a good reason. There must be an anthropological explanation. It is given in the above paper: submission to the chief must be refreshed at least once every moon cycle to make it last.

So we have anthropological machinery, basically subconscious, that organizes territory, leads to empires, and presumably inspires wars. Speed, as said before, is the key to larger territories, and the use of the airplane permits a global empire, because any place can be reached in less than two weeks. The idea has been caught by multinationals that by all means have become global. And, incidentally, once a month they have their top managers meet somewhere to refresh the hierarchy, although the formal motives are to coordinate business and exchange experiences. The political machinery is much more viscous, and we may have to wait at least a century to see a global empire, but very interesting agglomerations like the European Union are already coagulating. However, the only real way to control multinationals is to go global. One of my whimsical hunches is that the Holy Roman Empire was an invention of a fragmented political system organized to control a multinational Catholic Church. As Voltaire said, the HRE was not holy nor Roman nor an empire. (See my paper: ″From the Primeval Soup to World Government: An Essay in Comparative Evolution,″ 1976).

Incidentally, the fact that the growth of an empire follows a single logistic equation for hundreds of years suggests that the whole process is under the control of automatic mechanisms, much more than the whims of Napoleon or Genghis Khan. Some years ago, I stumbled across a very interesting set of statistics produced by George Modelski on the evolution of Britain's naval power since the end of 1400. He meticulously reconstructed, for 500 years, the number of men-o-war in operation at any time. I was able to fit their cumulative costs to a set of seven logistic equations. (See *"*Looking Forward, Looking Backward,*"* a 1996 paper I wrote to tease historians at a conference in Urbino). Modelski observed that the dates of the center points of these equations did in fact correspond to big naval battles. My cynical interpretation is that one fights a battle when there is somebody around who is sufficiently weaker—as in pubs. This is my *pub theory of history*.

In a more academic format, I could say that the anthropology of behavior leads to basic instincts as prime movers, and that individuals and organizations have the same kinds of equations pointing to the same basic mechanisms. The intuitions of Menenius Agrippa in ancient Rome and of Renaissance Hobbes in his *Leviathan* may, after all, be scientifically true. In the same spirit, biologists are discovering that most of the machinery to build a human was already inside flatworms. I tried to synthesize this evolutionary consistency in my 1996 paper *"*On the Limits to Knowledge.*"*

I also observed that the group of British Navy equations have a long-term internal logic. If one takes their center-point dates and puts on them their saturation value—that is, the total expenditures in that wave—one obtains a set of seven points sufficient to draw a logistic, if the noise is not too high. This superlogistic comes out very nicely and without noise. It saturates in the middle of 1900, in curious correspondence with the loss of naval supremacy by the British Navy. Furthermore these centers are separated, if somewhat irregularly, by a mean distance of 55 years. Kondratiev again? So, following the Modelski observation, big naval battles were spaced apart by about one Kondratiev wave. To time the K-waves, I use the deviations from the exponential of US energy growth, total and electric, as in *Figure 1*. In this frame, 1914 is the center (top) of a wave and the next center is 1969. They sound like hectic years. The end of the wave centered in 1914 was 1940, but from a study I made (not published), WWII was the second serving of WWI, a sort of Thirty Years' War with a long truce. The year 1969 did not see a war between core nations, presumably because nuclear armaments were strongly dissuasive. However, the Cold War was waged indirectly and, according to some sources, produced tens of millions of deaths, a good proxy for war. The USA ultimately won the cup. The previous K-wave centers were in 1859, when central Europe entered a period of turmoil, and 1804, the core of Napoleon's enterprises. Before that, the wave center was 1750.

I have a hunch about why wars tend to cluster around the centers of the K-waves. The first part of the cycle represents a period of boom and growth. However, nations grow at different speeds, so that after 30 years the cards are mixed in the sense that the relative powers change. In my cynical pub theory of history, this tempts the newly stronger nation to punch the newly weaker one. As with social animals, nations have a hierarchical order. America is Number One, having inherited that position from Britain. Looking at Number Ones at a glance, one sees that they tend to last one Kondratiev cycle, more or less; Britain lasted for two. Being Number One fills the nation's hearts with pride, but is extremely expensive, so Number One tends to go bankrupt. When Britain threw in the towel, its debt was about three times its gross national product. When a Number One quits, the next ones in rank fight a core war to pick up the cup. Bloodshed is immaterial. *Becoming Number One is another basic instinct* from the snake brain.

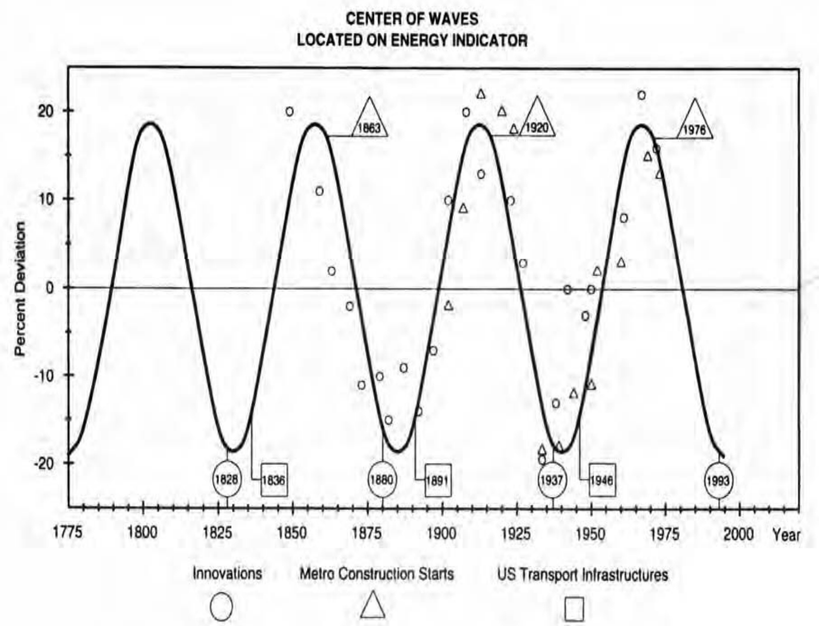
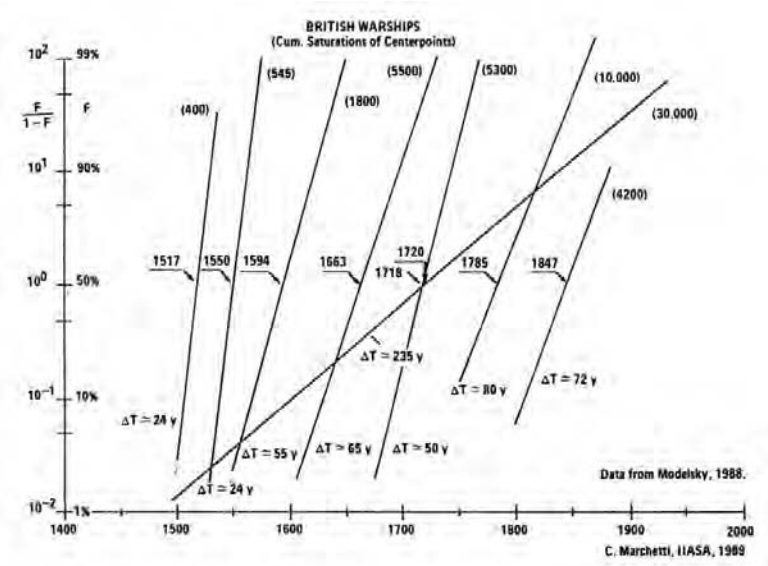


Figure 1 - This chart gives an impressive view of the power of the Kondratiev cycles to organize the system. The sinusoid comes as the residual of an exponential fit of the growth of US energy consumption, both total (circles) and electric (triangles). It is extracted from the tides of the US economy, but it holds for the world as well. Innovations come in logistic waves, as described in my 1980 paper *"*Society as a Learning System*."* The metro construction starts are again a set of three logistics that organize the dates of the opening of the first line of the Metro in world cities. US transport infrastructure takes the center points of the logistic growth in the length of canals, railways, and paved roads. All these center points have the *same phase position* on the different waves over a period of 200 years.

Real historians at this conference have certainly filled in all the gaps and innuendos of my presentation, so, the time constraints being very narrow, I had better shift to subjects they will most probably not present, but that are connected to the title of my discussion. One of the reactions I often get when I present my analysis of big events, pointing out the fact that they have an internal, long-term order that allows them to be described with simple equations, is that this is the effect of their being made of many parts and that the order is a consequence of complexity. So I analyzed the behavior of smaller and smaller systems, down to individual people (see my 2002 paper "Productivity vs. Age"), only to see that the same rules always hold. I do not plan to kill the holy cow of free will—I would hate to be lynched—but I must say it really looks like having more constraints than degrees of freedom. As historian Lynn White wryly commented, even the Church always avoided taking a definite position.

At this point I suggest that you download my 1992 paper *"*A Simple Mathematical Model of War Events,*"* where I explain the mathematical methodology and analyze time series related to WWI, WWII, and the Vietnam War: strengths of armies, casualties, rounds of artillery, and number of planes in service. All can be fitted with simple and predictive equations. Fitting the facts with simple equations means that the facts have a *precise temporal order*, in processes that war correspondents and historians consider extremely confused and naturally stochastic. I think that even a single battle—for example, between two armies with large numbers of tanks, as happened in the Battle of Kursk during WWII—can be modeled and predicted on line, so to speak, providing an early warning for the side



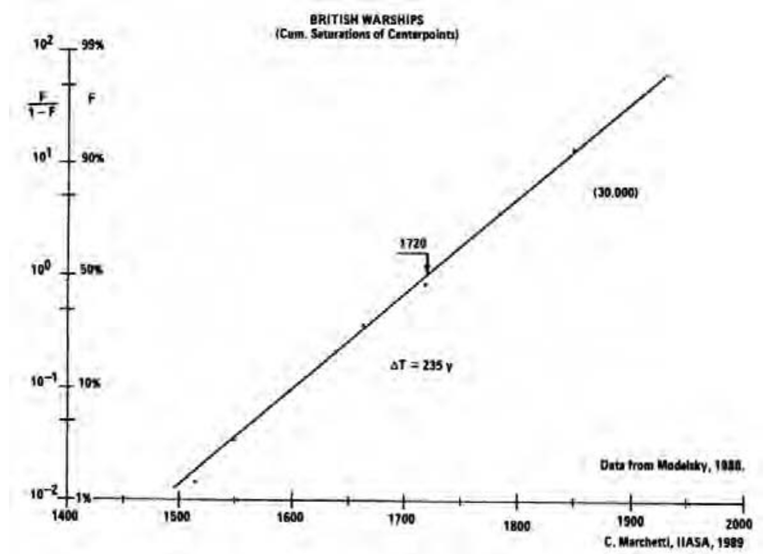
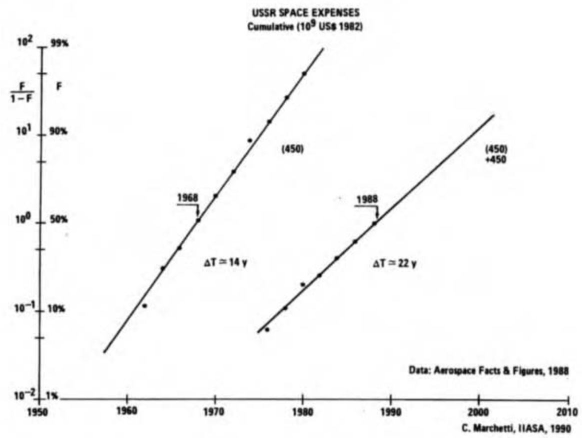


Figure 2 - British naval power. For those who enjoy a deep breath into history, this is a chart to ponder. Modelsky painstakingly collected the data on the force of the British Navy, in terms of number of operational warships since 1470. I thought the expense of maintaining this navy, measured in warship-years and *cumulated*, could give a measure of the aggressive *elan* of Britain. Actually, after much labor, I was able to splice this sum onto a set of logistics, seven of them, pretty well delineated, and with center points that Modelsky himself has found historically very significant because they correspond to big naval battles. So the big naval battles are embedded in long-range processes starting long before and fading out long after them. The distance between these action pulses is irregular, but with a mean of about 55 years, reminiscent of our Kondratiev cycles or waves. To take a breathtaking look at the secular evolution of British sea power (400 years!), I used the trick of concentrating the total intensity of a pulse (integrated warship-years) on the point of that pulse. Using the dates and the values so obtained, I constructed a superlogistic, centered in 1720 and *ending* around 1950, in tune with the loss of British naval dominance. The end in 1950 could have been predicted with fair precision 100 years before.

that will finally lose and permitting an early retreat to save lives and material. At present, this decision is left to the intuition of the commanders, always reluctant to admit defeat, and consequently it comes too late. I did not find the time series of the Battle of Kursk—that is, the number of tanks surviving at any time—but I will try the analysis should they be provided. If it works, this could be an important tactical tool to run a war at minimum cost.
I have done various analyses on more or less recent armaments, their timing, and expenditures, always finding the all-weather logistics fitting the data. One case is reported in Figure 3, dealing with space expenditures in the USA and USSR during the sensitive years of the Cold War. The central point of the K-wave, where core wars tend to cluster, is 1968. The central points of the expenditures for the first space rush are in 1966 for the USA and in 1968 for the USSR. K-waves seem to be good timers. However, I have no idea about the meaning of the second rush for both countries 20 years later!

Terrorism is a form of war escaping the definition of contraposed armies, but faithful to the principle of damaging and disrupting an enemy system. Terrorism has been very active in the past 30 years, but I suppose it has always existed in some form. I have analyzed a number of sets of terrorist attacks, for example, the Red Brigades in Italy, the set of attacks on embassies, the attacks against Israel up to 1985, the international air terrorism centered in 1985, and other cases. The result of this exploration is that terrorism, as other things, has an internal logic, so to speak, and comes in waves and denominations that can be organized through the usual logistics. Most of the cases I analyzed happened after 1968—the middle Kondratiev wave—and I have the feeling that terrorism is typical of the second part of the Kondratiev, that is, the recession years. The point is that I did not find supportive statistics ranging over 100 years or so, in which case I could have analyzed the links with the cycle. These connections almost certainly exist: an analysis of homicides and the means of committing them in the USA for the past 100 years showed a neat link with the Kondratiev cycle. Just for the record, in the case of the Red Brigades, I was collaborating with the Carabinieri predicting fairly precisely a few years ahead the number of people that would be killed. They didn't like that.



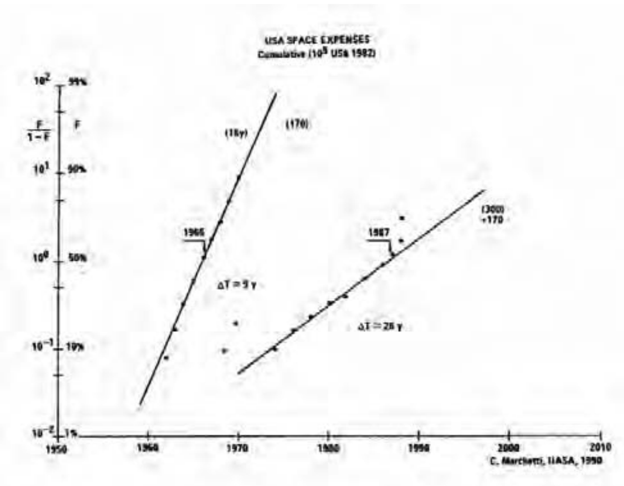


Figure 3 - Space expenditures for the USSR and USA. During the various phases of the post-WWII period and the Cold War, space expenditures were considered a sensitive indicator of the actual moods and intentions of the antagonists. My personal impression, formed for the most part from accounts in the press, was that one considered the decisions about space expenditures as something that had to be pondered *year by year* in order to match, to menace, or to impress the counterpart. If this is true, then it may come as a surprise that, for both the USSR and the USA, these programs developed according to a rigorous, *long-term*, internal logic. This might mean that real decisions were taken in the subliminal instincts of both systems, operating according to the same rules, at least in this respect. For the USA, the first wave of expenditures was centered in 1966 and a flash of activity with only 7 years of time constant. For the USSR, the center point was 1968, very near if slightly later than in the USA, and a more leisure time constant of 14 years. The total expenditures were much larger, by a factor of three, although the purchasing power of the ruble was difficult to assess. The second wave for the USA is centered in 1987, with a time constant of 26 years; that for the USSR is centered in 1988, with a time constant of 22 years. So the second pulses were very similar in shape, but the Russians again spent about 50% more. The two pulses may be justified or explained on various grounds. I obtained them in a very formal way, by discovering that the data for both the USA and the USSR could be fitted by the sum of two simple logistics. This “splicing” can be done in only one way.

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Long Cycles, Global Wars and World Energy Consumption

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Abstract. Current long wave upswing falls on the phase of deconcentration of Modelski's long cycle. Hence the danger of new world war conflict is arising. These circumstances demand for investigation of possible exact causes of probable war. It's a matter of a sharp necessity to explain the economic motivation fundamentals being the basis for global instability growth. Such kind of investigation seems to be useful for creation and implementation of the instruments intended to resist the danger of global war.
Therefore economic nature of the globalization processes should be analyzed in the first place. This kind of investigation shows that the danger of new war in globalized world is connected to resource and financial trends economic dynamics characteristics, as well as to the changes in stimulus for basic innovations formation.

Introduction

The main purpose of this paper is to show the close connection between broad money stock dynamics and long waves. The second one is to demonstrate that there is the interrelationship between resource and financial dynamics that is inside long wave mechanism. The conclusive aim is to show that financial globalization has destroyed the mechanism of innovative searching for new primary energy resources in the phase of transition from one long wave to another.

1. Economic Causes of Global Instability

Despite the recurrence of world wars in the scale of Kondratieff Waves and Modelski's Long Cycles [1] which was discovered by number of specialists the War is supposed to be caused by deep specific economic factors. At the age of globalization two factors play a significant role in the history of world civilization. Firstly, there are primary energy resources that are important for economic development of various nations, especially newly industrialized. Secondly, that is financial flows that provide free allocation of resource through the world economy.

Arising resource scarcity and environmental damages in world economy fall upon the period of spreading the living standard stereotype around the world. High living standard as intellectual value creates a sharp competition in postindustrial world between different nations struggling for development resources. This competition is pushing new ambitious players into the process of world income distribution.

In these conditions the power of the long wave depression as a «trigger for cluster of basis innovations»[2] is decreasing. Recently a lot of innovations in different branches of economy have been implemented, none of them could be considered as revolutional in technological or ecological terms. Of course cellular, Internet and biotechnologies create new economic branches and industries and provide new forms of economic activity. But it is hardly possible that such innovations could provide any serious breakthrough for the problem of resource scarcity. Moreover, majority of abovementioned innovations based on the technological background of old IV long wave technological paradigm, especially on the base of semiconductor industry. Hence new technological upswing is not supposed to be considered as revolutionary new one from technological point of view.

The competition for primary energy resources in world economy will be stronger and stronger as time passes. First of all major world energy producers and the representatives of main financial centers are searching for financial rent sources and the way to redistribute the financial flows. That seems to be the main obstacle for adoption of new technologies and energy resources.

So the problems of world instability and the danger of world war are the institutional ones. There are institutional obstacles forming these problems' essense that damage the adoption of new resource saving technologies. It's underestimation of basic resource saving innovation economic features that follows the main resourse market players desire to save their rent incomes.

The present task is to show new obstacles for innovation having recently appeared inside the long wave mechanism of global economy.

2. Bursting of Innovations or Stagnation During the Recovery?

As N. Nakicenovic showed in 1987 [3], long wave depression is the time of radical innovations in the sphere of energy resource substitution. My data shows that the last long wave depression had been covering the period from 1986 till 1998 in different branches of world economy and that now we are living through the long wave recovery of world economy [4, p.102, p.175].

In practice the innovation activity receives the charateristics of pseudoinnovation as proposed by G.Mensch [2, p. 47-49] and A.Kleinknecht [5, p.86]. Improving and pseudo innovations seem to prevail not only during the recovery and recession but also during depressions and early recovery of a long wave. There is a task of new statistical verification of different innovation types distribution regularition the long-waves time-scale founded by J. van Duijn [6, p. 137] that is a sphere of particular interest. Global economy investment flows are mostly directed to develop information and virtual technologies in the comparative lack of investment, which are necessary to develop new technologies based on the renewable and environmentally neutral resourses.

Despite all the efforts of environmental economics in creation and implementation of environmental policy instruments, after the passing of the lower turning point of the 4th long wave we can see extending trends of waste and exhaustible resources such as a coal and especially oil. However, the dynamics of renewable resource consumption shows relatively slow trends [4, p.157-162]. For example, oil world consumption was 115, 9 % in 2001 relative to 1990 though the world consumption of alternative energy sources (solar, wind, waste and so on) doubled at the same period. But the share of alternative sources in total world energy consumption remains critically low increasing from 0,5% in 1990 to 0,7% in 2001 only though the share of oil increased from 38,8% to 39,4% at the same period [estimated on the data of 7, p.866].

Empirical analysis of relative share changes of different primary energy resources in world energy consumption shows that no one symptom of automatically energy substitution process after the overcoming of 1986-1995 long wave depression exists. The relative share of oil in energy consumption remained at the level of 40%, while the relative coal and natural gas shares were about 22-23 % during 1990-2004.

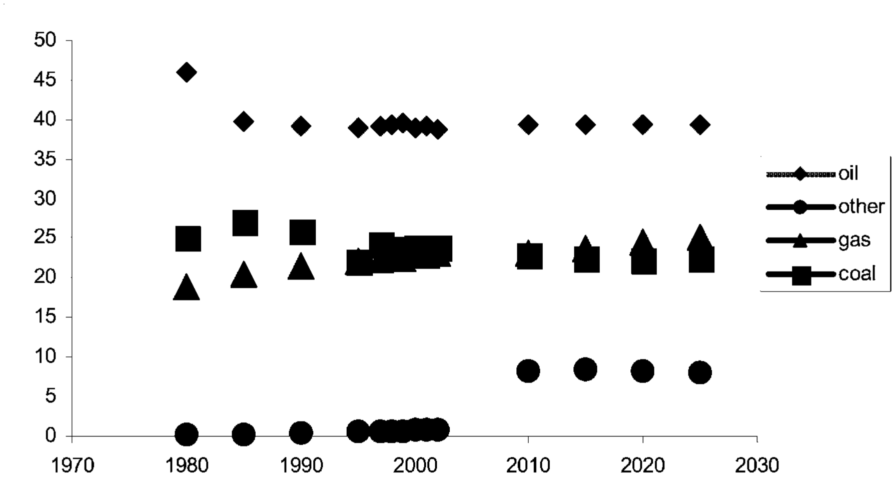

Figure 1 - World data on energy consumption 1980-2025
Shares of separate energy resources in total energy consumption (%)

The share of renewable resources is now covering not more than 0,6% in world energy consumption. As World Economic Outlook says this share in will have grown to 6-8% only by 2010-2025 (Figure 1). These figures does not inform about predicted technological substitution in the model of world energy consumption. The relative energy sources consumption shares haven't changed in the depressions periods so as long wave upswing is in power the sharply rising of oil consumption comes.

As a result the competition for the energy resources will be sharper during the long wave upswing followed by the growing possibility of global war.

3. Financial and Resource Basics of Globalization

The explanation of main economic world political instability cause can be found in the investigation of financial and resource background of globalization as the main modern mechanism of global economic development.

The estimation of wide range of economic indicators such as primary energy mining and supply dynamics, broad money stock dynamics of world trade volume and world GDP per capita rate allows presenting existence of finance-oil multiplier hypothesis. The hypothesis is it's the resourse and finance spheres interrelations that form the basis mechanism of globalozation. This kind of interrelation has been supporting the high level of global market state since the first half of the 20th century. Globalization is creating interconnection between huge global flows of virtual values and back global flows of natural resources.

Today the investigation of global instability as economic phenomenon is impossible without estimation of economic globalization mechanism. It's the globalization that creates deep causes for system conflicts based on international contradictions arising in the process of distribution of nonmaterial goods and natural resources flows.

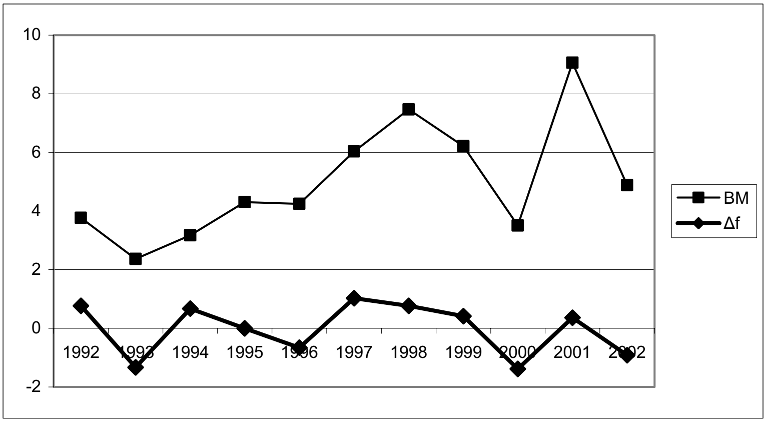

Figure 2 - Broad money (BM) and oil share growth rates (Δf) in 1992-2002 in the world. Estimated from [15, p. 843]; [7, P. 866]; [13, p.210]; [14, p.220].

During last decade the analysis of disputable economic consequences of globalization has become the central point of many investigations [8], [9]. Summarizing results of such papers [10], [11 Book 1. p.144], [12], one can find specific features of the globalization process. For instance, the growth of world trade volumes from 3064 to 9228 billion US dollars during the period from 1982 to 2003 [13, p. 216], [14, p. 226] did not lead to any positive structural shifts in national economies newly joined in global network. For example, M.Weisbrot, R.Naiman and J.Kim showed while world trade volumes doubled average wages per person remained on the same level. Some authors pointed out the hypothesis that there is a connection between inflation, oil market extension and growth in low-liquid money stock in the same time.

Primary resource market is one of the main modern market state factor with OPEC countries playng on the supply side and US playing on the demand side. One more factor is expansion of world financial flows, which becomes possible as a result of money stock structure development and growth of low-liquid part of money stock volume, which is used in national economy to hedge short-term financial operations risks and as an additional source of credit resourses. Global financial flows expansion lightens the existing resourses flows circulation and global economic power distribution.

In this short paper my only aim is to demonstrate a simple empirical example that could explain the mutual interrelationship between resource market, world trade, income distribution in the world scale and rising damage of global war.

Figure 2 shows the synchronal cycles of two significant indicators with 2-4 years durability existence. The first indicator is the growth rate of broad money in world economy. The second one is the growth rate of relative share of oil in total world energy consumption, estimated as annual percent changes. It is easy to recognise that cyclical fluctuations of broad money supply and oil shares in global energy consumption correspond one to another in the same way as the dynamics of broad money stock follows the oil share dynamics. This tendency becomes especially obvious for the period of 1997 – 2002, characterized by relatively constant level of world oil prices growth rate [13, p. 198]. Obviously, the expansion of low-liquid money stock has created good conditions for global financial flows expansion and thus lightened world resource market transactions. It has caused world trade volumes expansion, wholesale prices growth and was a stimilus for global economic growth in the multiplier way.

In that way the abovementioned broad money growth rate and growth rate of oil share interrelationship gives the explanation of the world war damage source arising at long wave upswing in the beginning of the 21st century. As I showed in one of my previous papers, the dynamics of broad money has clearly visible long wave nature [4, p. 65 – 84; 147 – 157]. Figure 3 shows the dynamics of money aggregate stock in US economy from 1955 to 2001.

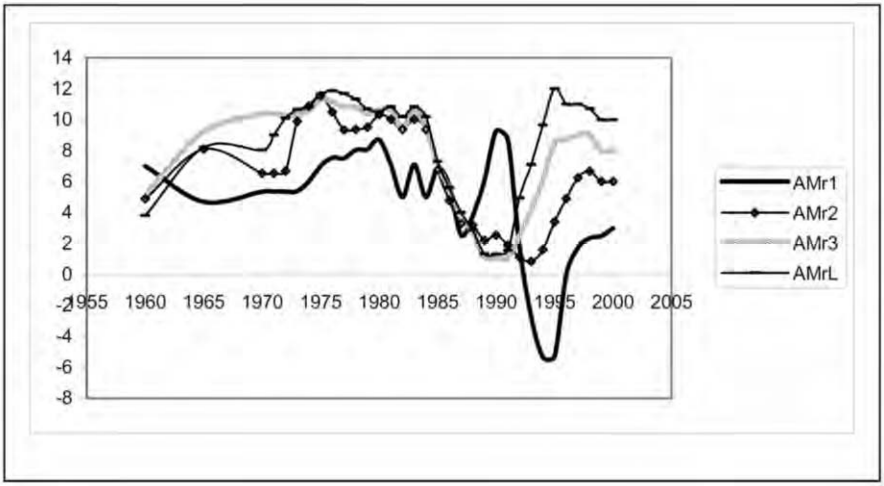

Figure 3 - Money stock growth rate in the USA, 1955-2000, 4-year moving average.
Estimated on: [16, p.521]; [17, p.504]; [18, p.507]; [19, p.518]; [20, p.736].
Note: AMri – indicators of 4-year moving average for the growth rate of money aggregate i.

It estimates the growth rate indexes for original absolute data of M1, M2, M3 and L money aggregates and smoothing by the 4-years moving average (to eliminate 4- years election cycle of US economy). We can see clear dynamics of IV long wave in indicators of M2, M3 and L and the beginning of V long wave upswing in 1990s. M2, M4 and M5 aggregates in the economy of Great Britain [4, p. 74 – 83] showed the similar results.

Taking into consideration the broad money and oil share dynamics interrelationship it is reasonable to suppose that during the long wave upswing we will face the growing rate of oil consumption. Hence the global competition for the energy resources will become sharper.

Conclusion

The fact that the long wave 1986-1998 depression did not result in any serious substitutions in energy consumption model and during the long-wave upswing which is supposed to be continued by 2020-2025 strengthening of global energy competition will take its place. Combining with the deconcentration phase of Modelski's cycle these circumstances could cause the real danger of new world war.

Using the abovementioned estimations and taking into account the peculiarities of modern global market it is easy to predict that probable global war would happen as a result of competition for primary energy resources possession. But it's more probable that present outsiders of world resource allocation system and revenue distribution would be main players of possible future world conflict. The task of reallocation would be the main reason of such a conflict.

Technologically the social welfare could be based not only on the escalation of energy consumption. I guess that the main cause for the predicted war could be eliminated by stimulating the scientific and technological progress and by removing new technologies barriers that could radically change technological style of production and revenue reallocation by amicable means. It is necessary to stimulate the development of basis innovations. It could change the world energy consumption model by growing renewable energy resources share and weakening world economy participants of resource and rent income distribution competition.

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Emergent Violence, Global Wars, And Terrorism

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Abstract. Patterns of violence in the world system are rarely constant. Two cases in point are global wars and contemporary waves of terrorism. Global wars emerged only in 1494 and may now be a relic of the past. Contemporary waves of terrorism began to emerge in the French Revolutionary Wars and are still very much with us. A co-evolutionary model, focusing on the reciprocal interactions among political-economy, political and military organizations, weaponry, and war, helps to explain the emergence of both phenomena.

Introduction

Over time, things change. One very general argument is that some major processes tend to co-evolve. That is, significant changes in one major process tend to lead to equally significant changes in other major processes. Such is the case with political-economy, political organizations, military organizations, weaponry, and warfare [1]. This perspective can be applied to the origins of warfare, its transmutations over time with expanding states, military organizations, and more lethal weaponry, and also the tendency for warfare to become less likely in selected parts of the contemporary world (aka the democratic peace). It can also be applied to the evolution of modern terrorism which is the focus of the present paper. I first preface the discussion with some observations on the emergence of global war in the 1490s and its subsequent evolutionary trajectory that are, in some respects analogous to terrorism. I then proceed to a synthesis of several arguments on the nature of terrorism put forth by Rappoport, van Creveld, and others and place this synthesis within the context of long wave analysis.

1. Global War

Prior to 1494, the phenomenon of global war did not exist. In that year, the French invaded one of the Italian city states claiming succession rights and setting off an Aragonese/Spanish organized resistance that led to a series of coalition wars involving a number of European states over the next few years. Roughly at the same time, the Portuguese were engaged in the process of breaking the Venetian-Mameluke lock on eastern spices entering the European market by innovating a new route around Africa to the Indian Ocean. The common denominator was the assault on the Italian (read primarily Venetian) privileged position as the political-economic intermediary between western and eastern Eurasia. Italian vulnerabilities encouraged others to take over their political and economic space but to do so required intensive combat. The ultimate outcome was diminished Venetian capacity, a Franco-Spanish/Hapsburg rivalry between two expanding major European powers, and the development and harnessing of global sea power to revolutionize inter-continental trade – at least from a European perspective. And, for a time, the European perspective gradually became increasingly central to world politics.

Another outcome of the wars beginning in 1494 was the series of global wars identified in table 1. From crude beginnings, the series increasingly acquired the following attributes. Warfare between coalitions usually comprising all or most of the European major powers (and later, non-European powers as well) ensued for several decades. One coalition was led either by the incumbent leading sea power or its successor (the Netherlands, Britain, or the United States). This coalition usually possessed a marked advantage in economic and sea power resources. At least one member was also a large land power providing necessary troops for engaging in land warfare in Europe (e.g., Austria or Russia). The other coalition was led by the leading land power in western Europe (Spain, France, Germany) and was perceived as attempting to establish hegemony over continental Europe. If successful, such a takeover would represent a manifest threat to control of the global (or inter-continental) economy because a European land power hegemon would now have ample access to ports and sea power and also generated a very proximate threat to the survival of the leading sea power's home base prior to the ascent of the United States.

Table 1 - Global Wars

Global War	Timing	Issues
Italian/Indian Ocean Wars	1490s-1510s	Franco-Spanish contest over Italian states; Portuguese breaking of Venetian/Mameluke eastern trade monopoly
Dutch Independence War	1580s-1600s	Opposition to Phillip II's expansion; Dutch breaking of Spanish/Portuguese eastern trade monopoly
Louis XVI Wars	1680s-1710s	Opposition to Louis XIV expansion; French attempt to break Dutch trading monopoly in Europe and elsewhere
French Revolutionary/ Napoleonic Wars	1790s-1810s	Opposition to French expansion; French attempt to resist British industrial lead and systemic leadership
World Wars I and II	1910s-1940s	Opposition to German expansion; German attempt to succeed Britain as system leader

The sea power-led coalition triumphed in each iteration thanks in part to its edge in material and financial resources. The leader of the winning coalition assumed the position of leading global power in the system. Its concentration of economic and political-military resources created a foundation for establishing some level of governance over the global economy. In the process, the leading sea power in successive intervals also became the world economy's premiere spark plug by pioneering new waves of radical innovation in economic activities ranging from trade routes to information technology. The bottom line of this particular argument is that a new global political economy emerged, characterized by a distinctive governance pattern and a rather primitive process (global war) that was increasingly deadly for determining who would govern. But this complex only gradually emerged after 1494, albeit with older roots in earlier Chinese and Genoese/Venetian activities, and continued to evolve into the modern structure of world politics [2].

This development is a clear example of the co-evolution of political-economy and warfare. Many aspects of the political-economic behavior were not novel. Long-distance trade had been around for thousands of years, although not at the scale to which it was to develop after 1494. Land powers and sea powers had certainly clashed before but the historical pattern had been one of land powers overwhelming the sea powers. This pattern continued to some extent after 1494 (e.g., Portugal was absorbed by the Spanish Empire for some 60 years, the Netherlands was finally coopted by the Napoleonic Empire for a few years) but the sea powers manifested better staying powers and sea power leadership was also subject to successive replacement by increasingly more powerful and less vulnerable sea powers. Imperial absorptions of sea power by continental powers took place only after the locus of economic innovation and global expansion had moved on to some other place.

Thus this process also had implications for state building. For instance, the sea powers increasingly became leaders of a particular formula for political organization (democracy) that was less than coincidental, just as their primary opponents' increasing authoritarianism was also not accidental. Survival in the European cockpit depended on the mobilization of increasingly large resources from the population in terms of money and manpower. One thousand political organizations in Europe became 500 and later were whittled down to less than 50 (and may ultimately be reduced to 1). Those organizations that did survive, for the most part, grew in size, scale, and capability. Along the way, their military organizations became increasingly professional, disciplined, and large in size. The weaponry wielded by these military organizations also became increasingly lethal. All five complexes – political-economy, political organization, military organization, warfare, and weaponry co-evolved between 1494 and the present.

There are of course many other things that are worth saying about this particular co-evolutionary process but space constraints insist that we move on to the topic of modern terrorism. Terrorism is, of course, an old behavioral strategy that was employed for instance in the ancient Near East against the Romans. But it does not appear to have been employed consistently throughout later periods and, therefore, seems a remarkably new kind of phenomenon (even if it is not). Many observers, for that matter, tend to view terrorism as a rather recent, largely post-World War II phenomenon. That perspective may be understandable given its recent changes in scale and ferocity. But it too has emerged as a consequence of the co-evolution of political economy, political organization, military organization, warfare, and weaponry. It also has demonstrable links to the emergence of global war and its consequences. To make a case for these arguments, I need to weave together a synthesis of several existing interpretations of contemporary terrorism, but also one that depends very heavily on Rappoport's wave model of terrorism that I will basically tweak and extend into something a bit larger in scope.

2. Rappoport Model

Rappoport's interpretation traces the modern history of terrorism and its evolution over the past century or so [3]. Terrorism is defined essentially as unconventional violence designed to influence public attitudes about political legitimation and inequality. The point is that societies have developed conventions to regulate the use of violence for political purposes. As argued by others, conventions about the monopoly of organized violence by the state and its military, the use of uniformed personnel as state agents, and the expectation that state sanctioned combatants should fight other state sanctioned combatants have evolved over the past few centuries. For example, van Creveld's Trinitarian model focuses on states, militaries, and people [4]. The main conventions are that warfare should be conducted between states, by their armed forces exclusively, and that the people should stay out of the way after they have responded to appeals for taxes, labor, and manpower. Contemporary terrorists seek to disrupt these conventions by violating the state's violence monopoly, by avoiding the use of uniforms, and by targeting both military and civilian objectives. The idea is to repeatedly highlight as dramatically as possible the political system's vulnerability to such attacks in order to accelerate the political system's ability to withstand attacks. If the conventions bolstering the status quo can be weakened and society can be polarized, the way for some new type of political system is made more probable.

Rappoport's argument is particularly distinctive, however, in terms of his emphasis on generational waves of terrorism. He sees four waves so far, beginning in the late 1870s, with each wave lasting about 40 some years. The first wave began in Russia in reaction to slow democratization processes. Russian anarchists conceptualized the idea and tactics for a strategy of overthrowing political systems by serial attacks on public conventions. The predominant strategy of this first wave was assassination attempts on authority figures, sometimes financed by robbing banks. Changes in the world economy's communication and transportation technology especially facilitated the emergence of this strategy in the last quarter of the 19th century. Information on the terrorist attacks could be circulated relatively quickly just as anarchists could travel quite widely both to carry out attacks and to encourage others to do the same. The same technological change facilitated large-scale emigration from various parts of Europe to more democratic political systems, thereby creating sympathetic audiences abroad.

Table 2 - Rappoport's First Wave (1870s-1910s)

Focus	**Anarchists**
Primary strategy	Assassination of elites; bank robberies
Target identity	Primarily European states
Precipitant	Failure or slowness of political reforms
Special characteristics	Development of basic terrorist strategies and rationale

World War I, in part precipitated by an assassination of an Austro-Hungarian Archduke, encouraged reforms and revolution and, at the same time, depressed incentives for anarchic tactics. The post-war treaties also helped delegitimize colonies and empire by breaking up the losing side's imperial and colonial structures and establishing nominally temporary mandate arrangements. Yet the idea of national self-determination could also be applied to the surviving empires of the winning side. Second wave terrorism focused on encouraging European withdrawal from overseas territories, particularly in areas where local circumstances made withdrawal less likely due to some significant portion of the local population preferring the colonial status quo over what independence might bring (Ireland, Palestine, Algeria). The duration of this second wave was made more protracted by World War II but that war's effect on the ability of European states to hang on to their empires also encouraged the disintegration of European empires and the contraction of this phase.

Table 3 - Rappoport's Second Wave (1920s-1960s)

Focus	**National self-determination in colonies in which European withdrawal was less likely**
Primary strategy	Guerrilla attacks on police and military
Target identity	European empires
Precipitant	Delegitimization of colonies after 1919
Special characteristics	Increased international support (UN and diasporas)

Third wave terrorism predominated in the last third of the 20th century. It centered on Marxist revolution and was encouraged by Viet Cong abilities to withstand the military might of the United States in Vietnam. Assassination came back into favor, along with hijackings of airplanes and public offices, as well as increasingly lucrative kidnappings of individuals whose release required concessions and/or ransoms. Within the Cold War context, training and support for terrorists became increasingly internationalized, as did the targets of terrorist attacks. The end of the Cold War and persistent resistance to third wave demands led eventually to the phasing out of this approach in the 1980s and 1990s.

Table 4 - Rappoport's Third Wave (1960s-1990s)

Focus	**New Left/Marxist**
Primary strategy	Hijacking, kidnapping, assassination
Target identity	Governments in general with increasing focus on U.S. as patron of conservative regimes
Precipitant	Viet Cong successes
Special characteristics	Increased international training/cooperation/sponsorship

A fourth wave was precipitated by the confluence of three events in what might best be termed southwest Asia. The Shah was overthrown in Iran bringing to power conservative Islamic clerics. In the same year the Soviet Union invaded Afghanistan in an attempt to save a client regime from being overthrown. The first event galvanized Shiites to improve their own status outside Iran while the second mobilized Sunnis to resist the Soviet incursion. A third event was the beginning of a new century according to the Islamic calendar that encouraged hopes for the emergence of significant changes. Fourth wave terrorism quickly assumed a strongly religious character, initially centered on conservative Islam, but also spreading to reactions to militant Islam from the conservative wings of other religions. In the process, a new tactic, suicide bombings, emerged, as did a strong emphasis on U.S. targets as critical to encouraging American withdrawal from the Middle East.

Table 5 - Rappoport's Fourth Wave (1970s-2020s)

Focus	**Religion, especially fundamental Islam**
Primary strategy	Attacks on antagonists and their symbols; suicide bombers (beheadings)
Target identity	Strong focus on U.S., Israel, and secular regimes with Muslim populations
Precipitant	Iranian revolution/USSR invasion of Afghanistan
Special characteristics	Casualty escalation; decline in number of terrorist groups

The general pattern thus is not one of random and unstructured violence. Each wave has a life cycle with initial expansion and terminal contraction phases, reflected by the number of terrorist organizations in existence and the intensity of their attacks. Organizations that survive the demise of the wave in which they originated tend to take on the characteristics and tactics of the next wave. How long each wave lasts depends on events, successes, the durability of terrorist organization, and the intensity of the resistance to terrorist claims and tactics. It may also depend on generational differences in aspirations and calculations about what works and what does not seem to be efficacious. Or, it may be that new generations simply find it easier to break with older strategies that have lost their allure. The central motivation for each wave is distinctive as are the tactics that are most likely to be employed. The violence is carried out by nonstate organizations and is directed at states and their populations deemed to be antagonistic to the aims of the revolutionary organizations. Terrorist and terrorist targets alike are apt to view their conflict as warfare, albeit an unconventional form of warfare in which terrorists hope their targets will over-react – an expectation that the state targets sometimes oblige at the expense of the terrorist groups. Yet the overall pattern is one of limited duration. Each wave is likely to play itself out and to be replaced by a new wave centered on a motivation that is as difficult to predict as are the precipitating events.

3. Tweaking and Extending the Rappoport Model

There are a variety of tasks to be carried out in tweaking and extending the Rappoport wave model of modern terrorism. Space and data constraints force me to limit my amendments to four types of modifications: 1) comments about specific wave characteristics, 2) testing the distinctiveness of the waves in a very preliminary way, 3) pushing the waves back in time two more generations, and 4) pointing out systemic-contextual factors that help drive modern terrorist behavior.

First, my amendments to the wave characteristics are not all that critical to the basic argument but deserve mention. Rappoport's first wave had more than one source. The Irish revolt used tactics similar to those employed by the Russian et al anarchists [5]. This suggests that the characteristics of the second wave began to emerge in Rapport's first one. This first wave may also have been brought to an end as much by the diversionary effect of the organized labor movement and labor-state struggles associated with World War I – as opposed to Rappoport's emphasis on the "deadening" effect of World War I on the appeal of assassinations. The ideological focus of Rappoport's third wave should also be expanded to include rightist extremism in addition to leftist extremism and perhaps partially in response to leftist activities. Without wishing to dispute the accuracy of the role played by 1979 Iran and the Soviet invasion of Afghanistan as precipitants of Rappoport's fourth wave, one should also add Saudi political unrest that, in turn, can be linked to Egyptian political dissidence. This amendment is only to suggest that the roots of the fourth wave may be more complex in space and time. One might also add beheadings to the distinctive tactics of the fourth wave.

My second extension of the model pertains to the basic structure of each wave. It is all well and good to claim that one type of terrorism predominates in successive eras. We also know that all terrorist activities in any given interval are unlikely to conform perfectly to the categorical label that an analyst might like to distinguish successive waves of activity. The question is whether there is any empirical evidence to corroborate Rappoport's wave delineations. Unfortunately, we currently lack a time series on terrorism that is long enough to tackle all four waves. We do have some data that encompasses more recent decades and the longest series that I have been able to locate extends back to 1946 [6]. I have coded each terrorist event in this series as to whether the group involved could be described as primarily interested in nationalistic (seeking political independence for some population), ideological (promoting political preferences associated with the far left or right), or religious (espousing a specific sect or fundamental interpretation of religious belief) concerns. Obviously, there are operationalization problems associated with such an undertaking in as much as group motivations can combine two or more of the three types. One can only attempt to specify which of the three seems primary. There is also a great deal of missing information in the series about the identity of the groups involved that forces an analyst to impose conservative interpretations. For instance, if we are only told that a Palestinian group executed a terrorist activity in year X, the conservative option is to code it as nationalistic. Depending on the exact group in question, however, it might better fit in the religious or ideological categories.

Figure 1 depicts the outcome of this "quick and dirty" test. Given the problems with the test, it would not be unreasonable to expect that Rappoport's wave delineation would not be supported. However, it very much is. The nationalistic wave declines from a peak portrayed in the late 1940s. The upward tic in the 1980s probably is a function of missing information that, if available, would have altered the coding of primarily nationalistic activity into the ideological column. As it is, the ideological wave is shown peaking in the 1960s. The religious wave ramps upward from the 1970s on. So, no wave era is exclusively one kind of terrorism but there does appear to be a strong tendency for one type of terrorism to be predominant at a given point in time.

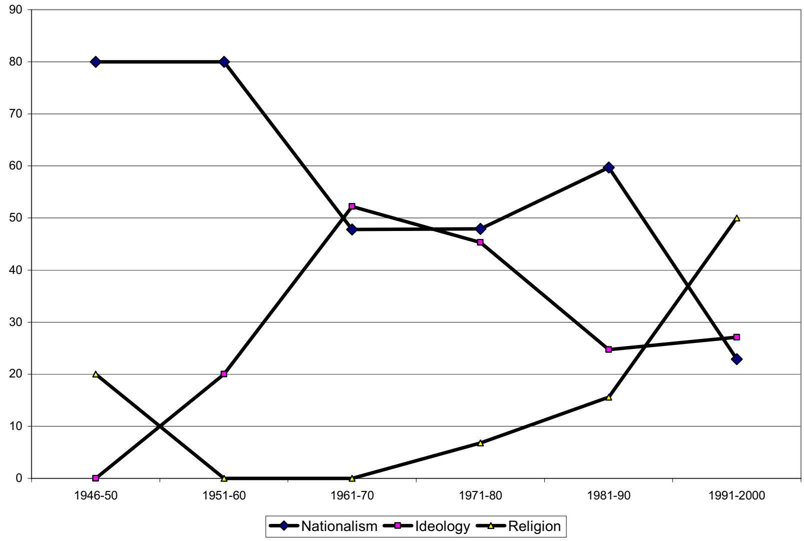

Figure 1 - Issue Waves in Terrorism

My third amendment of the Rappoport model is to suggest that the waves can be pushed back in time to the French Revolutionary/Napoleonic Wars – as opposed to the 1870s. The "terror" term was first used to describe the French Revolutionary state's suppression of opposition in the mid-1790s. However, Miller argues that the true genesis of modern terrorist groups was in the actions of the Carbonari, an underground opposition group to Napoleonic and post-1815 Restoration governments primarily in Italy and Spain [7]. These groups operated secretively and employed assassination tactics using knives. While not especially successful, Carbonari merged into the revolutionary movements that came to a head in 1848 in a number of places in Europe. Again, some of the activities aimed at conservative regimes was terrorist in nature and justified by terrorist rhetoric, later embellished by the anarchists. Clearly, this initial form of terrorist activity is less impressive because of its limited scale and intensity (compared to contemporary manifestations) but much the same can be said about the emergence of global warfare. Both global warfare and modern terrorism emerged weakly and gradually became more potent phenomena.

Finally, I wish to turn to the system drivers of contemporary terrorism. One of the weaknesses of Rappoport's model is that there is no central driver of the behavior on which the model is focused. Waves break and are succeeded by other waves but we do not know exactly why. The waves also tend to become higher and cause more damage. We can explain this wave by wave but it is possible to do less descriptively? I think the answer is yes and requires the development of a systemic appreciation of the processes underway. Van Creveld's Trinitarian model linking state, militaries, and people was mentioned before [8]. The argument is that between the 16th and 19th centuries, European conventions emerged that said war should be fought only by state armies and only between states. Most of the population should stay out of the way. Van Creveld would explain these conventions as a byproduct of European warfare and state-making in general. I would not disagree entirely but suggest that global warfare was the primary driver of European warfare and state-making of this period [9].

More to the point, however, is van Creveld's argument that the Trinitarian conventions were eroded by changes in warfare, political/military organizations, and weaponry.

Successive "total" wars (read global wars) mobilized greater proportions of the populations for war-related activities. War-driven governmental interventions in society increasingly blurred the distinction between military and civilian activities. Aerial bombardment contributed further to blurring these distinctions. Bombs dropped from the sky did not discriminate between people wearing uniforms and those in civilian garb. Regular armies in many places were not very successful in resisting German and Japanese expansion. Guerrilla warfare did enjoy some success. The advent of nuclear weapons toward the end of World War II turned out to be unusable in the Cold War. As an ironic consequence, places close to the East-West poles became unlikely to experience major power wars while more distant, less developed areas, lacking the infrastructure to support modern warfare, came to monopolize conventional warfare, but warfare that is restricted in intensity and scope. Finally, the emergence of a large number of newly independent, weak states with weak armies failed to live up to the European-inspired conventions. They could not monopolize weaponry and were highly vulnerable to substate challenges utilizing low intensity violence.

Thus, in co-evolutionary terms, we have experienced macro-co-evolution of political-economy, political/ military organizations, weaponry, and warfare first towards greater scale and scope and then away from greater scale and scope. The initial trajectory both encouraged and discouraged terrorism. The most recent shift in the evolutionary trajectory's direction has definitely encouraged terrorism in a variety of ways. But its not only van Creveld's macro-evolutionary trends at work. Table 6 summarizes some more systemic drivers, primarily in the form of long wave political-economic change, systemic leadership, and the impacts of global warfare.

Table 6 - Primary System-Contextual Factors Undergirding Terrorism Evolution

Wave	Encouragement	Discouragement
1800s-20s	Napoleonic wars	Great power suppression
1830s-60s	Industrialization diffusion	Government suppression
1870s-1910s	Dynamite, globalization, communication and transportation networks	Labor diversion, government suppression, World War I
1920s-60s	Post-WWI Versailles Treaty (Self-determination and decolonization norms)	Post-WWII decolonization due in part to war exhaustion
1960s-90s	Cold War ideological struggle	End of Cold War, government suppression
1970s-2020s	Information technology, Globalization, and US systemic leadership and patron-client ties, government suppression?	Government suppression?

The Napoleonic Wars, World War I, World War II, and the Cold War encouraged various intervals of terrorist activity. These wars gave terrorist groups new targets by weakening old regimes, installing new regimes, creating new norms justifying self-determination, and coloring the rhetoric of political discourse (e.g., Cold War left-right competition). The decline of the old system leader, Britain, and the ascent of its successor hastened the decay of old imperial holdings which helped to create a number of weak states and weak armies. It and the Cold War also created a new network of patron-client relationships linking the United States to a number of conservative regimes that have come under attack in Rappoport's last two waves. It is hardly surprising, therefore, that the incidence of terrorist attacks on the United States have increased in the same two waves.

Additional encouragement for terrorism can be found in long wave developments. Early industrialization helped alienate segments of the population from their 19th century political systems. A second wave of industrialization in the latter part of the 19th century generated more lethal and dramatic chemical tools (dynamite),as well as transportation networks and an acceleration of globalization processes that made terrorists, their ideas, and news of their activities more mobile. Another round of acceleration of globalization [4] in the late 20^{th} century and thereafter has helped to create more alienation (to which religious fundamentalism is one response). Successive waves of industrialization have also generated new techniques and tools (jet airplanes, automatic rifles, television, video, the world-wide web) to facilitate the current manifestations of terrorism.

Cooperation among states targeted by terrorists goes back at least as far as the turn of the 19^{th} century into the 20^{th}, but probably could be said to extend back to the post-1815 period as well. This development presumably makes suppression more effective. However, highly dubious strategies to suppress terrorism can also extend the wave. An example is the vigorous response of the United States to unseat the Taliban in Afghanistan only to be detoured by the expedition to Iraq. Similarly, alliances among terrorist groups and state sponsorship for terrorism can also encourage terrorist activity.

All in all, systemic change has generated an environment increasingly fertile for terrorist attacks. It, and especially global war developments, created conventions that made terrorism distinctively attractive to people frustrated and outraged by the perceived flaws of their domestic political systems. Systemic change, again manifested in the evolution of global war, also made it much easier to violate the conventions. Long wave economic developments provided a facilitative infrastructure in an increasingly globalized arena. Systemic leaders, old and new, encouraged attacks on themselves by policies pursued or problems ignored.

Is this an argument for "the system made them do it"? No. Terrorism responds foremost to local incentives, processes, and structures. Outside agents cannot be held entirely responsible for local governments that are thought to be weak, poor, slow moving, or corrupt and malign. But outside agents and structures can be critical to both encouraging and discouraging attacks on such targets. Similarly, systemic waves of terrorism help shape the tactics tried, the targets sought, and the casualties suffered. As is increasingly common in international relations, national solutions to problems that are decidedly systemic in scope are unlikely to resolve the problems at hand. They may also make them much worse than they might otherwise have been. The duration of the ongoing wave should prove to be a good test of that observation.

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Human Behaviors Encountered During the Different Phases of the Kondratieff Cycle

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Abstract. There are different behaviors appropriate to the different phases of growth. This has been observed among species in nature as they go through the four seasons, but also among humans in society as different economic-growth phases succeed one another. Typically, difficult times stimulate entrepreneurship whereas prosperity nurtures conservatism. Less obviously, preoccupation with the "what" characterizes formative times whereas preoccupation with the "how" characterizes periods of maturity.

A multitude of different behaviors can be mapped on the four phases of any growth cycle. On a larger scale, and to the extent that society is anthropomorphic, society as a whole goes through different behaviors while experiencing transitions between cyclical phases of growth. Given a growth phase we can expect specific behaviors, and inversely, given a specific behavior we can deduce the growth phase being traversed. It follows that WWII may have been survival-driven whereas WWI greed-driven.

Introduction

Borrowing images from biology to fit the marketplace is not new. Companies and organizations resemble living organisms. They are born; mature; get married; have daughters; become aggressive, sleepy, or exhausted; grow old; and eventually die or become prey to a voracious predator. As early as the turn of the century, enlightened economists and broad-minded physicists applied scientific notions such as periodic harmonic motion and Darwin's survival of the fittest to human products. In 1918 Lotka successfully predicted the size of the American railway network, via mathematical formulations from biology [1]. At about the same time (1926), the Russian economist Nikolai D. Kondratieff was establishing evidence for a long economic wave with a period of 50 to 60 years. This claim scored high points in popularity when the stock market crashed in 1987 and continued to score high with the persisting depression-like economy that, as had happened 58 years earlier, followed the 1987 crash.

Periodic swings of the economy are echoed in the preachings of management consulting gurus, who may pass easily from thesis to antithesis, and do not stop short of giving contradicting messages. Do you see your organization indulging in business process reengineering and total quality at the same time? Have you reconciled the benefits of leadership with those of empowerment and self-managed teams? Advocates of centralized control and vertical integration became rather quiet in the 1990s. Instead we heard about business units, core competencies, and horizontal corporations. These changes do not reflect conceptual breakthroughs in the theory of doing business. They are simply reactions to the economic climate and its seasonal variation.

Throughout history, periods of bureaucracy and control interspersed by waves of innovation and entrepreneurship. Notorious bureaucracies, such as the Roman Empire and the British civil service, were preceded and followed by entrepreneurial eras, such as crusades and revolutions (both social and industrial). The way to do business has followed suit. Many have addressed the question of how organizational behavior evolves over time. But it was Niccolo Machiavelli—early in the 16th century—who first pointed out the importance of adaptation. He wrote in *The Prince:* "I believe also that he will be successful who directs his actions according to the spirit of the times, and that he whose actions do not accord with the times will not be successful."

1. The Kondratieff Wave as a Sequence of Life Cycles

When S-curves cascade their respective life cycles give rise to a succession of bell-shaped peaks. A question often asked by marketers is the timing of the introduction of the follow-up curve. If the replacement product is introduced too early, it results in "cannibalization" of the previous product's sales. If the new-product introduction is too late, competition may get a foothold in the company's client base. Is there an optimum timing for the introduction of the second curve? The answer given below is based on harmony not on optimization, but to the extent that harmony generally involves paths of least resistance, optimization may also be invoked.

The natural growth processes, shown by S-curves at the top of Figure 1 cascade in a *harmonic* way. The word *harmonic* is used rigorously here. It means that the processes cascade in such a way that the overall envelope (shown in the lower graph of Figure 1) traces a sine wave, hallmark of harmonic motion [2]. That is the way a pendulum moves. The implication is that the new process must have penetrated its market niche by 1 percent when the old process approaches filling its own market niche to 90 percent. This corresponds to *just-in-time* product replacement. It ensures that when the old product reaches the end of its life cycle (99 percent of total sales) the new product has come out of "infant mortality" with 7 percent penetration of its own market niche and can thus assume the main thrust of the new growth phase. On the time axis of Figure 1 we see precisely how the market penetration levels should overlap.

Just-in-time replacement is based on the intellectually appealing hypothesis that *harmony* should be associated with sustained *natural* growth. There is hard evidence that corroborates this hypothesis, however. Market-niche succession—documented by data—has followed this rule on at least two occasions: in energy consumption worldwide, and in the evolution of coal production in the United States over the last 150 years, reported in *Predictions* [3]. Both cases depict a pattern identical to that of Figure 1.

The overall drop associated with the period of transition becomes more pronounced during product substitution if the introduction of the new product coincides with the appearance of a new technology. The additional drop of sales reflects the natural difficulties associated with a major change. But on a more macroscopic and philosophical level, there are deeper-seated reasons for the substitution dip. It constitutes a low-growth business season that gives rise to a cyclical variation. It has been otherwise observed and understood as destruction breeds growth.

As the pendulum moves, it alternates between two states: one of purely potential energy and another one of purely kinetic energy—a state of potential growth and a state of visible growth. Such periodic change has proved beneficial climatically, culturally, and socially. Such diversity is also beneficial to the business.

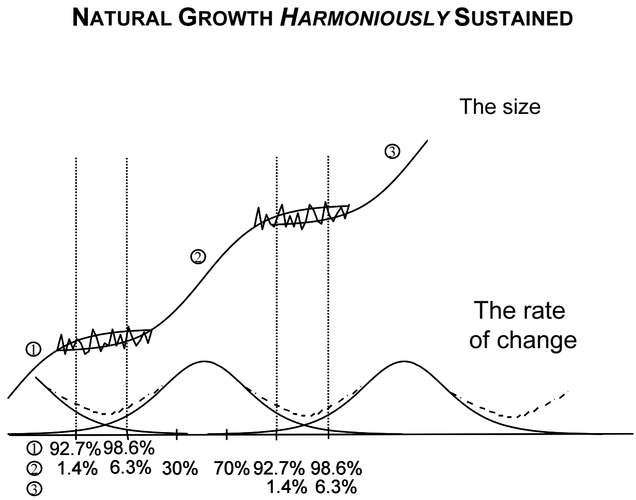

Figure 1 - Harmonic succession of natural growth processes means a pendulum swing from one market niche to the next, while survival of the fittest dictates the rule of the competition. The graph at the top shows the amount of growth achieved during the consecutive filling of three market niches. The graph at the bottom shows the rate of growth. The percentages refer to the niche penetration level. The overall rate of growth (dotted line at the bottom) indicates a cyclical sine-wave pattern. During low-growth periods chaotic oscillations become evident.

2. The Four Season of a Growth Cycle

Many management theorists have divided the growth cycle—typically a product's sales cycle—into segments. Theorists generally consider four periods according to the phase of growth: start-up, rapid growth, maturation, and decline. Their treatment is invariably qualitative, and the four phases are not necessarily of equal duration or precise definition.

Here the cycle phases are presented somewhat differently, using the four seasons as a metaphor. Winter reflects the critical growth period encountered during the beginning and the end of a natural growth process. Natural growth experiences two winters in its lifetime. The first winter is while the newcomer is struggling for a foothold in the competitive arena, and the second one when there is aging and the follow-up process is fighting for succession. By definition, the end of the first winter signals that the growth process has survived "infant mortality"—that is, it has realized around 7 percent of its growth potential.

The seasons metaphor is not used for poetic justification. The advantage over more traditional segmentations is that our familiarity with the mechanisms associated with nature's four seasons can shed light on and guide us through decisions on business and social issues. For example, the low creativity observed during summer is only partially due to the heat. New undertakings are disfavored mainly because summer living is easy and there is no reason to look for change. In contrast, animals (for example, foxes and sparrows) are known to become entrepreneurial in the winter. There is wisdom encoded in nature's seasonal patterns and behaviors. These can be studied and transferred to whatever situation depicts a succession of seasonlike stages. It is conceivable to exploit this analogy all the way down to monthly behaviors.

Like the four seasons, the segments into which we divide the cycle must be of equal length. The time scale may vary widely depending on what growth process we are looking at. For a product, a season may last 6 months to a year. For an industry, a season may be 5 to 10 years. For the Kondratieff cycle a season may be 15 years long.

We saw in Section 1 that just-in-time product substitution is achieved when 1 percent of the new product's market penetration coincides with 90 percent saturation of the old product's market niche. This timing implies that the replacing product's first winter coincides with the incumbent product's second winter. Consequently the timing also implies that the new product must be launched during the fall season of the product it is replacing (no wonder farmers sow in autumn). Winter then becomes the time of selection, when wanton death eliminates the weak and the unfit. Spring corresponds to "adolescence", the formative years. Spring is also the time for R&D of future replacements.

Most marketers have intuitive knowledge of this product-succession sequence. They know, for example, that the new product is promoted most heavily while the old product phases out—we can define this period more precise here as the last 12.5 per-cent of its life cycle, its second winter. They also know that research and development for the new product must parallel capacity buildup for the old product, which is approaching maximum rate of sales and profitability.

Figure 2 defines seasons not only for products but also for anything that grows in competition: markets, technologies, industries, and so on [4]. It is generally true that in spring

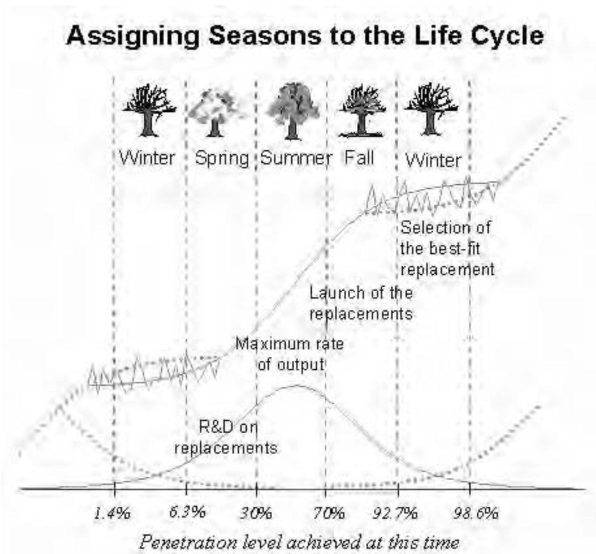

Figure 2. Segmentation of a business cycle into four seasons. The growth levels at the delimiting positions satisfy the following two conditions: (1) all seasons have the same duration, and (2) the early winter of the replacement overlaps with the late winter of the incumbent. Low-growth periods are accompanied by large and chaotic fluctuations.

one is concerned with the *what* and in fall with the *how*. That is why at the industry level product innovation occurs in spring and process innovation in fall. At the same time, at the economy level, technology and finances dominate in spring, and social and political forces dominate in fall. Spring is the time for investments. It is also the time for learning and continuous improvement. Specialists are in demand. Not so in winter. Several years ago I explained to a Geneva bank director that winter is the time to fire bureaucrats and hire Leonardo da Vincis—that is, cross-disciplinary, well-rounded men and women who stand a better chance than specialists to come up revolutionary ideas for profitable business. "Fire bureaucrats is exactly what we need to do, sir", he exclaimed. "Could you please tell us how to do it?" To my surprise, I heard two months later that the man had been fired.

But often what naturally happens is what should happen. As strange as it may sound, seeing specialists progressively evolve into bureaucrats may be a good sign. It is one indication that summer is setting in. The word *bureaucrats* carries a negative connotation, but if we call them process agents instead, we realize that they provide an important function during times of high growth and prosperity. It is during summer that enterprises become successful, centralized, conservative (no one tampers with something that works well), and in need of clockwork operations. Fine-tuning and zero defects (the original aspiration of total quality management) are particularly appropriate for a summer season. But then, what about benchmarking, continuous improvement, and BPR (business process reengineering)?

2.1 Second Thoughts about Excellence

Being second best hardly yields a competitive advantage. But positive feedback theories, that produce rapid fluctuations resembling chaos, argue that early gains for two simultaneously launched competitors eventually tilt the balance in favor of the "lucky" one and not necessarily the better one [5]. Early gains do not presuppose excellence.

When videocassette recorders were first introduced, the market was split between VHS and Beta. The two market shares fluctuated early on because of circumstances, luck, or marketing tactics. But soon early returns tilted the unstable situation toward VHS despite claims that Beta was technically superior. There are many such examples. Connoisseurs of personal computers value Apple products more highly than IBM computers and their clones, but the market-share gains of the latter have biased standardization in their favor.

Such manifestations of positive-feedback mechanisms have long been understood. During the nineteenth century Alfred Marshall—professor of political economy in Bristol, England—wrote that whatever firm first gets a good start will corner the market. To get a good early start, a product must appeal to the masses rather than to the elite, and that argues for postponing sophistication and refinements for a later season. New products are launched in the fall, but excellence is only excellent in the summer.

It is worth looking in more detail at each season's characteristics and how they can help us on everyday work decisions. There are advantages and disadvantages to each season. As we go through the various characteristics, keep in mind that they are meant to be in *relative* terms—that is, whatever happens in one season is with respect to what happened during the previous seasons. For example, to say that competition becomes lowest in spring does not mean it is negligible. It simply means that competition is *relatively* lower in spring than during the other seasons.

2.2 Winter

Advantage	*Disadvantage*
New ideas	**Low profits**

Winter is the beginning and the end. Death comes naturally only in winter. That is why survival becomes the name of the game. People are anxious, confused, and frustrated and explore new directions. During the chaos of the winter profound changes take place. Enterprises focus on core competencies, and organize themselves horizontally. Multidisciplinary generalists are in demand. This is the time to fire bureaucrats, train and re-skill the rest of the workforce, and mobilize entrepreneurs. The business becomes culture-driven, and enterprises go after niche markets with short-term strategies. Bottom-up cultural forces dominate and lead to segmentation, decentralization, and horizontal markets. Leadership becomes ineffective while empowerment becomes popular.

Winter is the most difficult but also the most fertile season. Despite low morale, innovation and creativity are at a high. New directions are set. It is a period of selection. Mutations come out in great numbers and compete for the next position in power. Most of them will die, but those that make it to springtime will be ensured of a full growth cycle. Mutations serve the purpose of emergency reserves. In industry they can take the form of new product ideas, basic innovations, or other ventures. The higher their number, the better the chance that some of them will survive and grow, paving the way for the sunnier seasons that lie ahead.

The buzzwords of the management-consulting gurus that become fashionable during this season are: *change management, self-management, BPR, SBUs (strategic business units)*, and *niche markets*. Economically winter is the period of depression. On the product side:

- Prices become customer-driven and may not yield a profit.
- The sales force becomes opportunistic.
- Recently launched products face the acid test: will they live or will they die?

During **early winter**, risk-taking is encouraged, and new ways of thinking and ideas for new lines of business abound. **Late winter** is the time to choose among these new directions. It is critical to identify which direction will realize around 7 percent of its growth potential—the hallmark of surviving infant mortality—by the end of winter.

Industrial winters are mutational. At these times industries explore and adapt themselves in order to penetrate the maximum number of new niches. The microprocessor industry, for example, demonstrated during its winter—the first 15 years of its existence, 1970 to 1985—an impressive ability to come up with an ever-increasing number of unexpected uses for chips. In the last 10 years, this industry has come out of winter and is climbing up the exponential growth rates of spring.

On the political scene winters often feature major wars.

2.3 Spring

Excitement	**High investments**
Advantage	*Disadvantage*

In spring, progressive growth and new opportunities bring hope, excitement, and elation. Competition reaches a relative low point as people concentrate on hard-work ethic to enhance prosperity. Spring is a period of learning and continuous improvement. It is also a period of acquisitions and investments in facilities and real estate. Operations can benefit from an attitude of wise wastefulness. Innovation in spring concerns the S-curves of one level below. For example, the spring of an industry means product innovation. The spring of the economy—on a longer time scale—means industry innovation.

On the product side, spring demands the following:

- Build capacity for and ramp up the sales of recently launched products.
- Set the prices according to the value offered.
- Do R&D on the follow-up products.

The most solicited human resources are specialists, engineers, and designers; men and women who resemble well-hardened and sharpened tools. Leaders are trained in view of the approaching season of prosperity. In the United States today, the pollution abatement "industry" is in its spring. It has gone beyond infant mortality but has not yet reached maturity. Now at a few percent of the GNP, pollution abatement is estimated to reach a ceiling at around 10 percent. When the whole economy is in spring, inflation is low, the value of money is high, and the recommendation for stocks is *buy*.

Early spring is the time when chaos subsides; opportunism and entrepreneurship lose their luster. **Late spring** is the right time to set up leadership schools, since leaders will abound in the up-coming summer.

2.4 Summer

Advantage	*Disadvantage*
High profits	**Low creativity**

As summer sets in, the enterprise becomes successful, centrally controlled, vision driven (top-down unifying forces), and conservative. You do not tamper with something that works well. You are only allowed to fine-tune it. This is the time for excellence and total quality (nine sigmas on the rate of rejects, if you can). Good leadership is in demand and enjoys stability. Process agents—inspectors who check and control processes—are also in demand. Conveniently, many specialists are now naturally evolving into bureaucrats. Strategies become long-term and strategic alliances frequent. A more vertical (stovepipe) organization comes back into fashion.

Output is at a maximum and supplies the S-curves one level below. That is, during the summer of a technology sees the largest number of successful products. The summer of the economy—on a longer time scale—sees the largest number of profitable industries. Buzzwords include *vision, excellence, long-range planning*, and *TQM.* On the product side:

- Sell, sell, sell (milk the cow).
- Dictate your prices (decadent profits).
- Integrate vertically.

To expand market share further, you do not hesitate to sell all things to all people. Advertising budgets swell. It is a period of fun and games. Firearms become popular. But comfort may lead to boredom and decadence.

Early summer is a time to stop investing and concentrate on reaping profits. But pay attention! **Late summer** is the turning point. Cash cows are by now getting old. It is high time to plan for the approaching days of diminishing growth.

U.S. steel companies have enjoyed the longest summer of any industry. For the better part of this century, continuous success made steelmakers conservative and immutable. But in more recent decades, the industry has been shaken by the rising popularity of competitive new materials. By the 1990s most steel industries worldwide were indulging in re-organization and process innovation, a clear sign of losing ground.

2.5 Fall

Advantage	*Disadvantage*
Bearing fruit	**Aging**

You are probably too familiar with the instinctive human reaction to loss of market share: denial, blame, and panic, in that chronological order. These are the hallmarks of the fall season. The usual rescuing efforts include tightening-the-belt programs, face-lifting efforts, and a concentration on core competencies. What is excellent to start with is benchmarking, a comparative study to find out what you are not doing quite right. A back-to-basics attitude makes operations shrink. The company disinvests from aging products and focuses on strategic accounts. On a longer time scale, the fall of an industry sees process innovation. On an even longer time scale, the fall of the economy sees recession, high inflation, and a rush toward liquidity. But deteriorating trends soon enter a state of chaos, in which erratic behavior emerges as a mechanism to explore new directions picked practically at random. Competition intensifies to a maximum resulting in high rates of homicides and criminality. Cross-disciplinary generalists must be recruited to devise revolutionary ideas for profitable new business.

On the product side:

- Set prices according to costs.
- Improve efficiency of operations, particularly on phasing-out products.
- Launch the replacement product.

During **early fall**, sobering up and tightening-the-belt tactics suffice, but as the season matures, cost-cutting and face-lifting operations are no longer effective. **Late fall** is the time to redesign your processes and begin the search for or the training of entrepreneurs. Fall is also the time to teach what you have learned.

Figure 3 provides highlights for each season. It is possible to exploit the seasons' characteristics in order to develop investment strategies. The typical pattern is to invest in spring and goes liquid in fall.

Figure 3 - Behaviors that generally fit into a given season.

3. Riding the Kondratieff Wave

It has been demonstrated that besides the economy, also homicides, feminism, alcoholism, anti-Semitism, and other anthropomorphic behaviors of society ebb and flow with the Kondratieff wave. The following excerpt is taken from *Predictions* [6]: "During periods of economic growth, criminality is low and so are bank failures. People seem to be busy working, building, increasing their prosperity. As we enter the boom years women become the preferred target for murder. Living through the prosperous years sees people starting to like guns, drink more alcohol, and break running records. Affluence by now does more harm than good, for life expectancy hits a low in its improvement. At the end of the boom, guns are ten times more popular than knives as murder weapons. A little afterwards, energy prices flare up like fireworks signaling the end of fun and games. Later feminism flourishes and then we enter the recession. Well into the recession bank failures soar and so do murders. Killings reach a maximum as life becomes difficult; the targets are men this time and the killers are gradually developing a taste for the knife. There is no bad without some good in it, however. By the end of the recession, life expectancy shows the highest gains, even if competitive sports have suffered. Technological discoveries and innovations abound again, while criminality decreases. The overall sobering up of the society serves as a natural preparation of the next growth phase lying ahead. And thus the cycle begins to repeat itself."

Hostile activities exhibit two climaxes. One climax concerns homicides, which rise as we approach "winter" as a result of the hard times and the competitive squeeze. The other climax concerns the use of firearms, which rises during "summer" and carries overtones of some kind of "entertainment". The former can be attributed to a struggle for survival during difficult times, but the latter displays the influence of affluence, gluttony, and decadence. One could appropriately characterize the two climaxes as survival-driven and greed-driven respectively.

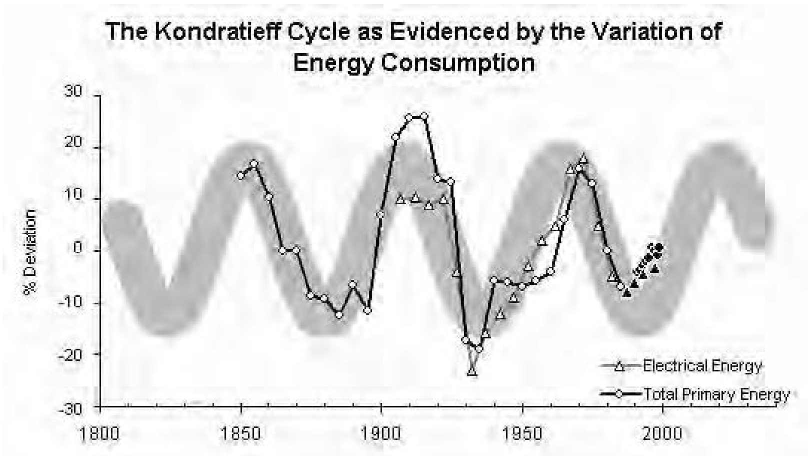

Figure 4 - The data points represent the percentage deviation of energy consumption in the US from the natural growth-trend indicated by a fitted S-curve. The gray band is an 8% interval around a sine wave with period 56 years. The black dots and black triangles show what happened after the graph was first put together in 1988.[7] Presently we are entering a "spring" season. WWI occurred in late "summer" whereas WWII in late "winter".

Wars have been shown to have a periodicity of about half that of Kondratieff's, with one outburst in times of need and another in times of affluence.[8] By analogy to criminality "winter" wars could be characterized as survival-driven and "summer" wars as greed-driven. This throws new light onto the last two world wars. It suggests that there may have been more fundamental subconscious reasons behind WWII besides Hitler's obvious imperialistic greed. Massive destruction invariably leads to growth and during the decade preceding WWII the world economy had been yearning for growth (e.g., the 1930s in the US). The implication is that WWII may have been more about survival whereas WWI and the American Viet-Nam war (one Kondratieff cycle later) may have been more about expansionism.

Conclusions

It has been amply demonstrated that society is anthropomorphic [9]. To that extent one can expect society to behave as a species while it goes through cyclical phases of growth. Wars tend to occur with a frequency double that of Kondratieff's with survival-driven wars during times of need and greed-driven wars during affluent times.

Kondratieff's cycle puts society presently in an early "spring" season. As such, we should progressively witness first chaos coming to an end, then a work ethic being installed, and then prosperity increasing worldwide. Specialists are in demand and the future directions of growth are becoming clear. Within ten to fifteen years we will have successively sampled feelings of hope, excitement, elation. The 20-year "spring" season may be foggy (in the sense of not being able to see clearly far into the future) and illusionary but it will eventually lead to economic boom and prosperity around the mid-2020s.

Present warlike activities seem to be neither of purely survival nor of purely expansionary nature but rather a mixture of the two. Next major warfare could be expected in the late 2020s and be driven by expansionism.

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The Extent of the Kondratieff Wave's Effect on Violence in the North-South Context

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Abstract. Kondratieff found that economic growth stimulated internal and interstate conflict. Leadership long cycle theory contends that the growth-conflict relationship is apt to be more complicated. Long wave economic growth leads to global war that, in turn, leads to long wave economic growth. We examine this disagreement empirically by a) correlating system leader leading sector growth and several indicators of conflict and b) assessing how far away from the source of economic growth, relationships between growth and conflict are manifested. We find that the relationship between leading sector growth and conflict is negative but that conflict leads to positive leading sector growth. We also find that these relationships weaken as one moves away from a focus on Northern economies. Both findings appear to be supportive of leadership long cycle expectations.

Introduction

Nikolai Kondratieff is well known for the early discovery of a number of distinctive long wave relationships [1]. One example is the finding that war and revolutions were more likely to occur on the long wave upswing than on the downswing. He attributed this behavior to tensions associated with rapid growth. Other analysts have supported this long wave-war relationship although not always for the same reasons. Another group of analysts, contrarily, have argued for a downswing-war relationship. There is also another cluster of arguments to be found suggesting that war leads to upswings or downswings. Still others suggest that the relationship between the long wave and conflict is hegemonic phase-dependent, changing over time, intermittent, or nonexistent. Clearly, the relationship between the long wave and conflict has remained controversial and contested throughout the 20th and into the 21st century.

One reason for the continued contestation is that analysts disagree about how best to measure the long wave with some advocating a focus on price fluctuations, as did Kondratieff himself, and others putting forth alternative measures of long-term economic growth. Another reason for continued disagreement may be that the relationship is simply more complex than the simple bivariate relationship found by Kondratieff. For instance, the research program within which we work, leadership long cycle analysis argues that long waves are generated by technological innovation within the lead economy of the system's preeminent global actor [2]. Each system leader generates at least two long waves. The first one precedes the ascent to systemic leadership and dis-equilibrates the systemic status quo.

It also triggers or brings to culmination a struggle for succession in the global pecking order that leads to a period of global warfare. A coalition that has tended to join the declining incumbent system leader with the state in possession of the newly emergent lead economy (along with others critical for providing land power to supplement systemic leadership's specialization in sea power) defeats an opposing coalition seeking regional hegemony (thereby threatening the global order).

Superior geopolitical resources determine the ultimate winner of these global wars, including the lead economy's innovation-based technological superiority and related financial resources. A new system leader emerges at the end of the global war with a position of global preeminence. Its economy is in a strong position to create another round of radical innovation, thereby generating a second long wave of economic growth before technological diffusion facilitates the catch-up efforts of other economic competitors. Early system leaders (Portugal and the Netherlands) were unable to repeat this pattern more than once. More recent system leaders (Britain and presumably the United States) have been able to, or are still in the process, of doubling the pattern by generating four long waves each.

This perspective suggests that the relationship between militarized conflict and the long wave is more complex than simply being positive or negative. An initial spike of technological innovation in the leading economy leads to intensive conflict among the system's major powers. This conflict yields a re-organization of the global political economy that encourages the generation of another spike of technological innovation in the leading economy. So, economic growth leads to conflict, which leads to more economic growth and, in some cases, less militarized conflict. This latter complication depends in part on the nature of the immediate post-global war era. Assuming a reasonably strong system leader and if there is no immediate challenge of the new system leader, as after 1815, less conflict is associated with economic growth [3]. But if there is an early challenge, as after 1945, less conflict is not assured even if it may fall short of a resumption of global war.

The point we make in this assay is not so much that the system leader suppresses militarized conflict "hegemonically," but, rather, that extensive militarized conflict, at least among the system's major powers, is discouraged by favorable systemic conditions (economic growth and the concentration of economic and political-military resources in the control of the system leader) and rebuilding efforts following an intensive global war. This post-global war era, however, is not permanent. It eventually gives way to slower economic growth rate and deconcentration of economic and political-military resources. These systemic conditions no longer favor limited militarized conflict.

Thus, the leadership long cycle perspective argues for a specific interpretation of the long wave - militarized conflict relationship, just as it has a very specific take on the source of long waves of economic growth. Long-term pulsations in economic growth lead to intensive militarized conflict that, in turn, lead to more pulsations in economic growth and, in some conditions, less conflict for some finite period of time before reverting to less growth and more conflict. The principal source of the pulsations in long-term economic growth remains throughout the radical innovations introduced into the world economy primarily by the system's lead economy and sometime system leader.

The argument of the leadership long cycle perspective has already been the subject of extensive empirical testing [4]. We and others have been able to demonstrate, among other things, that technological innovation in the system leader's economy is an important driver of the leader's own national economic growth, as well as of the growth of the world economy as a whole. Sea power capabilities of global reach cycle in and out of high phases of systemic concentration in conjunction with periodic bouts of global warfare, separated by century-long intervals. It also has been demonstrated elsewhere that these long-term oscillations in economic and political-military concentration are critical to a variety of topics and forces in international political economy, ranging from the timing of protectionism policies, to the North-South income per capita gap.

Still, many questions remain. Two such questions that we tackle without fully resolving in this paper are:

(1) Does the empirical evidence support our expectations about a sequencing pattern in economic growth and conflict? Do we find that growth leads to intensive conflict which leads to more growth and sometimes less conflict?

(2) How "deep" is the impact of growth on militarized conflict? If growth is primarily a Northern process (focused on the leader of the North), are any significant linkages to conflict found throughout the international system, or are they primarily restricted to the North? Other things being equal, one would expect a "ripple-like" process with the strongest impacts of growth being registered in the North and becoming less discernible as one moves away from the active zone of the world economy.

To probe these questions empirically, we need systematic information on technological innovation in the lead economy (hereafter labeled leading sector growth), militarized conflicts of various types and among different types of actors, and North-South distinctions of countries. Once assembled, we will be in a position to examine their interactions empirically and to test the hypotheses advanced immediately above.

1. Data and Indicators

To date, we are unaware of any accepted conventions on which states belong in the North and the South. Some studies refer to the timing and extent of industrialization as the deciding classifying factor, but leave the criteria implicit. Other analysts distinguish between North and South for relatively brief periods of time, often conflating economic and military power. We need a measurement system that focuses on modern economic development over a relatively long period. We also need a non-static index because the distinctions between more and less economically developed are not constant over time. The nature of modern economic development, characterized by successive waves of new technology, makes any absolute threshold somewhat arbitrary but also very much a moving target. Yet, at the same time, we need data that have been adjusted for inflation and equivalent purchasing comparisons. This last stipulation points us in the direction of Maddison's series for 56 states that reach back more or less to 1870, with some additional interpolations [5].

We classify a country as Northern if its real gross domestic product (GDP) per capita is equal to or larger than 25 percent of the highest real GDP per capita in the international system (determined on an annual basis). States that fail to meet this threshold are classified as Southern. Our experimentation with higher thresholds of income per capita (33 or 50 percent of the highest real GDP per capita in the international system) restricted the North to a very small group of Western European states and a few of its offshoot. The 25 percent threshold is more liberal and permits some non-West European/North American states to join the North beginning in the 1920s. We assume that a more liberal bias, summarized in Table 1, is more workable than one that is overly conservative. Equally important, our Northern group of countries does not include states that are overtly underdeveloped in terms of modern technology. All countries of this type are included in our South.

Table 1 - North-South Sample

Northern economies	Britain, United States, Belgium, Netherlands, Switzerland, Denmark, Germany (1870-1945, 1955-1992), Austria (1870-1918, 1920-1945, 1955-1992), France, Sweden, Canada, Norway, Spain, Ireland, Italy, Japan (1894-1992), Australia (1900-1992), New Zealand (1907-1992), Finland (1919-1992), Czechoslovakia (1920-1992), Hungary (1920-1992), Poland (1929-1992), Russia (1931-1992), Greece (1956-1992), Portugal (1957-1992), Taiwan (1977-1992), S. Korea (1983-1992)
Southern economies	Argentina, Bangladesh, Brazil, Bulgaria (1913-1992), Burma (1901-1992), Chile (1900-1992), China, Colombia (1900-1992), Egypt (1900-1992), Ethiopia (1950-1992), Finland (1870-1918), Ghana (1900-1992), Greece (1913-1955), India, Indonesia, Ivory Coast (1950-1992), Japan (1870-1893), Kenya (1950-1992), Mexico, Morocco (1950-1992), Nigeria (1950-1992), Pakistan, Peru (1900-1992), Philippines (1900-1992), Portugal (1870-1956), Rumania (1926-1992), Russia (1870-1930), South Africa (1913-1992), S. Korea (1900-1982), Taiwan (1900-1977), Tanzania (1950-1992), Thailand, Turkey (1913-1992), Venezuela (1900-1992), Yugoslavia (1913-1992), Zaire (1950-1992)

Note: Sample entries are for the period 1870-1992 unless otherwise indicated.

To best measure leading sector growth, one needs indicators that simplify the complex changes underway in shifting technological trajectories while not attempting to capture all possible facets of the new innovations. The indicators must represent, however, economic sectors that made significant differences for economic development and growth in their respective eras. Table 2 lists the sectors and indicators utilized in this analysis. The start-up dates indicate the periods during which particular economic activities initially were introduced in a preliminary way. The high growth dates specify the periods of actual leadership.

Table 2 - Lead Industries, Indicators, and Timing

Industry	**Indicator**	**Start-up**	**High growth**
Cotton, iron	Cotton consumption, Iron production	1740-1763	1763-1792
Railroads	Railroad trade open, Railroad trade density	1792-1815	1815-1850
Steel, chemicals, electricity	Steel production, Sulfuric acid production, Electricity consumption	1850-1873	1873-1914
Motor vehicles, electronics	Motor vehicle production, Semiconductor industry sales	1914-1945	1945-1973
Information	Industry production (ISIC group 3825,3832, and division 385)	1973-2000	2000-2030

Notes: for the periods prior to 1973, entries are based on Modelski and Thompson [6] pages 69 and 75. The idea for the ISIC code indicators for information technology is taken from Hall and Preston [2], page 190.

To aggregate these multiple indicators into a continuous series, we rely on the schedule of leading sector entries and exits advanced in Modelski and Thompson for the pre-1973 periods [6]. After 1973, we introduce indicators suggested by Hall and Preston that focus on office/computing machinery, communication equipment, and scientific equipment. [7] We also assume some lag or overlap in leading sector production. Therefore, we start a leading sector indicator in its start-up phase and include it through the following start-up phase. Since our analysis is restricted to the post-1870 period, this approach yields a reliance on iron/steel production, sulfuric acid production, and electricity consumption (1870-1945), motor vehicle and semiconductor production (1914-1992), and the selected ISIC production (1973-1992).

British values are used between 1870 and 1913 and United States data thereafter. We view this design assumption as a conservative one. Britain was in relative economic decline at the end of the nineteenth century and certainly was not the locus of long-term economic growth. Yet it is usually considered the leading economic state actor up to World War I. Its principal economic challengers, the United States and Germany, were more innovative in the second half of the nineteenth century. We might well choose to focus instead on the long-term growth of the United States that, we know with the advantage of hindsight, triumphed ultimately and initiated another round of growth at the end of the 1914-45 conflicts. An exclusive focus on U.S. economic pulsations is the one most likely to support our argument; therefore, we adopt the more challenging, spliced approach to looking at long-term growth in the world economy.

Annual conflict data are based on dyadic, aggregated, Militarized Interstate Disputes (MIDs) information. Using MIDs data also represents a challenge to an argument that is predicated on global war. The auxiliary question that we are addressing here is whether inter-(and intra) state conflict in general is impacted by long-term fluctuations in economic growth. Our assumption is that years with more MIDs represent higher levels of militarized conflict than years with fewer MIDs. The aggregations encompass: Total (conflict between all country dyads in the system), Northern (conflict between two Northern states), North-South (conflict of dyads linking one Northern and one Southern state), and Southern (conflict between two Southern states). For each year, the appropriate MIDs index is normalized by the maximal number of dyads that can be formed in each year within each of these systemic or subsystemic structures, respectively. In addition, we also include the number of Southern civil wars and normalize it by the number of Southern countries in each year [8].

2. Empirical Analysis

Our empirical analysis is conducted first in terms of a visual inspection of decadal averages of our raw time series that are noisy and difficult to view without some smoothing. Space considerations, however, preclude showing the possible combinations of smoothed conflict and leading sector growth in figures here. Keep in mind that we have spliced British leading sector growth values (prior to 1914) with American values (after 1913). As a consequence, what we observe is an initial decline in growth after the 1870s (the climacteric), a medium bump upwards around World War I, a decline into the 1930s depression, and a large climb upwards during and after World War II before marked decline after the late 1950s. Total interstate conflict in the world system, on the other hand, is characterized primarily by two world war spikes in the early and mid-twentieth century.

The other figures, focusing on different conflict aggregations, that we might have shown possess in most cases similar although less than identical configurations. Of the five types of conflict, Southern civil wars are the least similar to the other four in smoothed shape. Northern conflict has the two world war spikes but also smaller bumps in the 1880s, 1960s, and 1980s - the first one captures pre-World War I tensions while the latter two pick up on Cold War hostilities. North South conflict is most similar to total conflict in longitudinal pattern except that the two spikes in the North-South pattern have roughly the same height. Southern conflict is characterized by one major spike around World War I and a markedly smaller bump in the 1940s and 1950s. Southern civil wars were declining into a first trough in the 1880s, then increasing to a peak around the first decade of the twentieth century, declining again into the 1930s, before ramping fairly steadily from the 1930s through the 1980s.

In general then, our interstate, MIDs-based, conflict series share a bias toward focusing primarily on global warfare. The Northern conflict measure picks up some lesser activity before and after the global wars. Southern conflict is less influenced by World War II but not much variation in the smoothed data is observed after that war. Southern civil wars are least global war oriented with peaks slightly before the First World War and well after the Second World War. The smoothed leading sector growth series captures the post-World War II long wave well but does less well with the wave that preceded it because British economic growth basically missed the pre-World War I long wave. All of these considerations tell us that our measurement outcomes were less than perfect and that we need not expect exactly the same outcome in our examinations of the impact of leading sector growth on different types of conflict.

Our next step was to compute cross-correlation coefficients from the raw, annual, leading sector growth and conflict series. In each case, we perform the computations while using various leads and lags of each conflict series relative to the growth series. The cross correlations provide information on the patterns of co-movements of our variables along the long wave. Table 3 reports the results for the highest cross-correlation coefficient that is also statistically significant.

All of the correlations reported in table 3 are similar in behavior. The cross-correlation coefficients between leading sector growth and subsequent conflict (with leads varying from 12 to 21 years) are negative. With the exception of the nonsignificant North-South conflict and Southern civil wars coefficients, positive leading sector growth tends to be associated with a decline in interstate conflict a decade or two later. A decline in leading sector growth leads to a later increase in interstate conflict.

In addition, an increase in interstate conflict is associated uniformly with a subsequent increase in leading sector growth rates (although the lags vary from 4 to 17 years depending on the type of conflict). As expected theoretically, the highest coefficient (0.45) linking antecedent conflict to leading sector growth is found to be associated with Northern conflict.

Note as well that the interstate results pertaining to leading sector growth leading conflict vary hardly at all in terms of the size of the coefficient. North-South conflict is the least influenced by economic growth but there is no discernible difference between the outcomes for Northern or Southern interstate conflicts. A diminishing pattern does show up in the coefficients for the conflict to leading sector growth relationships. Northern conflict (0.45), North-South conflict (0.33), and Southern conflict (0.24) coefficients decline as one moves away from the North towards the South.

Table 3 - Cross Correlations, 1870-1992

Variables	**Correlation**
Leading sector growth (t) to Total conflict (t+12) Total conflict (t-15) to Leading sector growth (t)	-0.15* 0.28**
Leading sector growth (t) to Northern conflict (t+13) Northern conflict (t-17) to Leading sector growth (t)	-0.16* 0.45**
Leading sector growth (t) to North-South conflict (t+13) North-South conflict (t-4) to Leading sector growth (t)	-0.13 0.33**
Leading sector growth (t) to Southern conflict (t+21) Southern conflict (t-5) to Leading sector growth (t)	-0.17* 0.24**
Leading sector growth (t) to Southern civil war (t+18) Southern civil war (t-15) to Leading sector growth (t)	-0.075 -0.20**

* denotes statistical significance at the level of 5 percent
** denotes statistical significance at the level of 10 percent

The outcome for the leading sector growth and Southern civil war correlation is different. Leading sector growth does not lead significantly to more or fewer Southern civil wars. Increasing civil wars in the South, we are told, do lead to a decline in leading sector growth. This is a curious finding that deserves more scrutiny. It appears to be largely a product of the last third or so of the twentieth century (sharply increasing civil warfare and decaying leading sector growth). Prior to World War II one does not observe any clear pattern linking these two variables. In this case, we need to push the analysis back further in time (to 1815) before accepting the outcome recorded in table 3 as fully meaningful.

In sum, we find empirical support for our leadership-long cycle-based theoretical expectations. Leading sector growth in the system's leader economy, our index of the long wave, tends to be related to military conflict in a variety of the structural settings evaluated here (total conflict, Northern conflict and North-South conflict). Leading sector growth leads to less militarized conflict, not to more conflict - contrary to the expectation of Kondratieff. Leading sector growth, in turn, follows militarized conflict, as we have suspected.

The militarized conflict-> leading sector growth relationship does dissipate as one moves away from the center zone of the world economy, also as expected. The leading sector growth-> militarized conflict relationship, contrary to what one might have surmised, does not vary much across different structural settings. These relationships, as well, tend to be much stronger for interstate conflict than for intrastate conflict, again contrary to the expectation of Kondratieff.

Still, these empirical findings can be further evaluated in future research. For example, we could vary the temporal parameters of the analyses (for total conflict at least). We also could assess what difference a fully U.S. based long wave measurement from leading sector growth might make. These additional empirical analyses are expected to further our confidence in the reliability of the empirical finding reported here.

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Globalization and Risks of Instability

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Abstract. The globalization processes are developing unevenly and asymmetrically, and Kondratieff's Long-Wave concept serves a most useful and appropriate instrumental basis for analysis of major global changes. There were several long cycles of globalization. The cycle of Modern Age, for example, included the phase of differentiation and the one of integration.

The interplay of various circumstances - both economic and other than economic, internal and external factors - led to the periods of instability. One of them covered the time from 1914 through to the 1940s ("downward swing").

The first half of the 21st century would face a new wave of instability. Globalization of criminal business and challenges of international terrorism have created new fears and new factors of strategic instability.

Introduction

The globalization processes are reflecting the general civilization trends, the nonlinear dynamics of techno-economic and socio-economic systems. The globalization is developing unevenly and asymmetrically.

The risks of instability are aggravating by several factors, for instance, the following:

- economic fluctuations and crises, which reflect cyclical phenomena (including the consequences of K-long waves and shorter business cycles);
- political insecurity and conflicts rooted in the changing correlation of forces between countries of West and East, between different civilizations;
- ecological challenges and tensions, the gap between goals of sustainable strategy and unsustainable real policy;
- new threats from organized crime and international terrorism (which try to make use of processes and contradictions of the globalization).

There were several Kondratieff's Long-Waves since the 18th century; with two main stages in each wave: phase of the rise ("upward swing"); and phase of decline ("downward swing"):

Table 1 - Kondratieff's Long-Waves (Chronology)

	Rise	**Decline**
First long wave	1780s-90s to 1810-17	1810-17 to 1844-51
Second long wave	1844-51 to 1870-5	1870-5 to 1890-6
Third long wave	1890-6 to 1914-20	1914-20 to 1939-40s
Fourth long wave	1945 to 1968-73	1968-73 to 90s

And there were different periods of hegemonies in the framework of historic capitalism, during of modern history. Firstly, it was the rise of Dutch hegemony (and serious efforts to liquidate of Medieval system). Secondly, the period of British hegemony and adoption of a free trade relations. At the same time, the “Pax Britannica”[1] embraced the first **global integration** cycle. And this cycle, which began in 1846, had been coinciding mainly with the second Kondratieff Long Wave and also with an “A-phase” of the third K-wave.

The period between 1914 and early 40-s of the 20th century was the time of the serious economic downward swing, crises and political turmoil’s. Since 1945 the international social and political situation changed a lot. It was certainly influenced by consequences of the World War II: the defeat of Nazi Germany, Italy and Japan, as a result of victory over fascism in this war. It was a beginning of time of the great technological and economic shifts, new cyclical developments, deep socio-political changes and other transformations. It was also the period of the strong and active American drive for U.S. hegemony (both as “mature creditor”[2] and the strongest military power of the West).

The long cycle (which had a beginning in middle forties of 20th century and was lasting until the 1990s) was that of a typical Kondratieff cycle of the world capitalist economy. It had 2 main stages: (1) an “A phase” (upward swing), in this case economic expansion lasted from 1945 to early 1970s; and (2) “B-phase” (downward swing) – from 1973 to 1990s. The “A-phase” of this long Kondratieff cycle occurred within the framework of world order, which had been established after World War II. This period was marked by enormous American expansion of value and real production in world capitalist economy. The “B-phase” (which began in 1960s – early 1970s) was evidently influenced by consequences of “economic miracle” and of recovering by Europe and Japan, the control of their national markets; therefore they could to compete more effectively with U.S. products in the markets of other countries. It led to **decline in the profitability** of a number of industries; and to the consequent **downturn** in the world economy and new financial fluctuations. A relative economic stagnation of the World economy began since the 1970s.

Many observers in the West and East conclude that in the first half of the 21st century we again can face instability in the world economy and in the international relations. We cannot underestimate the technological and social aspects, the military, political and other dimensions of the Long Waves problematic.

Technological revolution, of course, seriously influenced the innovation and production mechanism. Certain shifts occurred in spheres of employment and in the system of labor-management relations[3]. The accelerated diffusion of new technology, especially in the military spheres, could be observed. It is necessary to keep in mind the interplay of various factors – both economic and extraeconomic.

As far as economic background and socio-economic aspects of Long-Wave cycles are concerned, these problems have been intensively studied and discussed by many authors. We can refer here, for instance, to work by J. Goldstein “Long Cycles: Prosperity and War in the Modern Age”, to S. Menshikov and L. Klimenko study dedicated to Long-Waves in Economy, to researches of P. Korpinnen, B. Kuzyk, Yu. Yakovets, D. Gordon and others on stages of accumulation, on the role and on consequences of militarism and wars within rhythms of economic cycles and crises.

We have then the possible correlation between war and socio-political change. The history of many countries reveals “the affinity of revolution and war”[4]. And it should be added that the condition for revolution has been not war, but the failure of the state military capacity. “Nevertheless, that failure happened most often as a consequence of war”[5]. According to Ch. Tilly’s data, during the period of 1492-1991 there were more than seven hundred wars and social crises situations; for instance in such regions as: Low Countries, Iberia, Balkans and Hungary, Great Britain, France, and Russia.

Certainly, the evident shifts had been happening in many countries to the growing role of evolutionary and non-violent forms of transformational processes (especially since the end of 20^{th} century). The roots of world crises started shifting more to **civilizational** concerns; since in the transition period (from 1940s to 1970s) many major processes were initiated in the two civilizational centers of the Orient: the Chinese Revolution and its aftermath; and the Islamic-Arab area.

There were two main views regarding the major international megatrends in the 20^{th} century. One approach is based on the conclusion that the world had begun to be perceived as a single entity. It became evident (especially because of the menace of nuclear holocaust) that new scientific-military revolution and its consequences created the weapons capable of completely destroying human life on our globe. At the same time, the strengthening of **world consciousness** began to develop more rapidly[6].

On the other hand, some authors began to predict, on the contrary, the inevitable "clash" of civilizations, unavoidable aggressiveness of Muslims, of "poor Islam civilization", the inevitable victories of new "Jihad wars" etc. Some researchers try to find the early roots of globalist processes even in ancient and medieval history-in the processes of changes between **waves of differentiation** and **waves of integration.**

We connect the most important changes in international division of labor – with the genesis and evolution of capitalist world-system in Modern History (in the 15^{th} – 18^{th} centuries there was the long wave of differentiation; in the 19^{th} – 20^{th} centuries dominated the integration wave). A serious attention is devoted to analysis of general crises of **transitional** epochs.

Now the world entered new global integration cycle. There is a group of researchers, who see the following two major stages in the dynamics of globalization processes: (a) it was at the beginning the evolution of **"superficial"** globalization (when a number of countries act as **secondary** consumers of alien innovations); (b) further, the stage of the **deep-rooted** globalization is emerging (when countries are acquiring strong positions in the world markets of innovations).

Contemporary globalization reflects the trend to growing ties and interconnection among countries around the world, particularly in the spheres of economy, technological change, communications etc. But many of these ties and interaction are developing asymmetrically, with different socio-economic and political outcome for countries of North and South. In this sense "The Economist", in a special report "Globalization", pointed out **"highly uneven"** results of globalization, and wrote: "not less than 2 billion people live in countries, that have become less rather than more globalize… In short, globalization is not global. Much of the world, home to one third of its people and including large tracts of Africa and many Muslim countries, has simply failed to participate"[7].

There is evident contradiction between the whole mankind's interests in the interdependent world and the preservation of nation-states; therefore between the globalization and peoples' striving for identity (social, national, ethnic, cultural etc.).

Another major phenomenon of our time is the contradiction between globalization and democracy, between globalization and its problems of effective governance. Economically it means that one of the consequences of the globalization of production and trade has been further growth of the role and influence of TNC, which accounted for near 80% of all foreign investments at the beginning of this new century. Politically, there is obvious contrast between the general principles of democratic decision-making and the one-sided, undemocratic methods used by leading figures of transnational financial and other organizations, like I.M.F., World Bank etc[8].

There are also contradictions between processes of global **homogenization** and **diversification,** between trends to integration and fragmentation. Some complexities in these spheres reflect in certain degree "the uncertainties surrounding globalization itself. If globalization truly is a novel condition, or an unprecedented set of processes, within the international political economy, then a transformational change may have took place, or be imminent, with the troubling implications for effective governance"[9] – at national, regional and global levels.

The civilizational paradigm requires the need to protect more decisively environment and public health. And all this means the new demands for further **"colorization"** of national priorities and international tasks in order to achieve sustainable development. Unfortunately, this is not coincident with the practical efforts of some countries for the realization of important documents, such as "The Johannesburg Declaration on Sustainable Development"; "Agenda – XXI: Plan of Implementation" etc. One confirmation of this rather controversial situation was the official Washington's refusal to join **Kyoto Protocol** (notwithstanding the evident strong support of this important international document by the overwhelming majority of the nations over the world). These tasks are especially urgent because of the increase of the environmental degradation, the growth of a number of natural catastrophes and technogenic accidents, and irreversible climatic changes on the Earth[10].

Another difficult and controversial problem, which the processes of globalization are confronting with, were expressed in the **contradictions between regionalism and globalization**. This contradiction is reflecting a sharp competition on various levels – in the local, regional and world markets (for instance, in the growing rivalries inside and outside "Triad" countries). Some new challenges create the processes of Asia-Pacific integration (evident economic, digital and other gaps between APEC members and so on). The APEC members support the development of APEC sub-regionalism and economic integration institutions. China, Russia and other countries pay now significant attention to what is going in Asia Pacific[11].

The great damages to the environment are connected with military conflicts. Today global security requires a comprehensive analysis, including the new approaches to these problems. It is necessary to see the main features and differences between previous and actual "cybernetic wars"[12]; and to understand the peculiarities of traditional violent politics and modern conflicts[13]. It should be not underestimated also to study the roots and forms of fundamental confessional, race and cultural divides, the contradictions in the inter-civilizational relations, new ties and correlation between internal and external factors which lead to crises, the new tension and conflicts.

Especially dangerous are consequences of the new stage of transnationalization of criminal business – the expansion of drug trafficking, international terrorism, etc. The traditional definition of transnational organized crime was concentrated in the 1990s on "the planned violation of the law for profit or to acquire power, which…are carried out for a long or undetermined time span using: (a) commercial or commercial-like structures; or (b) violence or other means of intimidation; or (c) influence on politics, media, public administration, justice" and economy[14]. Since September 11, 2001, the new reality emerged, in which the power to hurt was no longer a monopoly of states but was also exercised by transnational-networked actors. This phenomenon is incorporated into a new paradigm to understand global politics[15]. Now we speak about **"super-terrorism"** and serious challenges created by it on international level[16]. It created new risks and fears of regional and world instability. We agree with the following estimate of the activities of contemporary Islamic extremists: "Despite their backward – looking ideology, these are groups that make use of globalization. They often consist of transnational networks with partners in many different countries; nearly all have important Diasporas that are a source of money, techniques and ideas. They finance themselves through transnational organized crime… Unlike earlier terrorists, who attacked strategic targets, the new groups deliberately target civilians, often using the most macabre and spectacular violence (like the attack on the World Trade Center, in New York). Such attacks confirm the notion of grand conflict. They generate further insecurity[17].

All this and the lessons of recent events in Afghanistan, Iraq, and other countries, as well as major conclusions from events like September 11, 2001, rose the necessity of strengthening the unity of anti-terrorist coalitions – both on regional and global levels. It is necessary to use all possible tools for more effective efforts in order to overcome “fundamentalist” violence. The most important task today is the broadening of common actions against international terrorism.

And true **democratic globalization** – with “human face” – opens new opportunities for people to move on the paths for peace, prosperity, to the real dialogue and partnership (not to “clash”) among civilizations.

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Cycles of Political Violence: Urban Guerrilla and Insurgent Groups

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Abstract. Logistic fits are made to the populations of attacks by urban guerrilla groups in Greece, under the assumption that these organizations grow in competition like species in nature. The data cover the attacks of the major urban guerrilla groups (17N and ELA) plus a number of lesser groups. We conclude that urban guerrilla activities in Greece were triggered into existence by the military junta but had their roots deeper into the earlier political system in Greece. In any case, the life cycle of political violence in Greece had already been completed when the police finally began cracking down on the 17N. Carrying over the biological species analogy to the continuing armed conflicts in Iraq and Afghanistan it is demonstrated that logistic fits describe very well the casualties resulting from the action of "insurgent groups" resisting the US presence in these countries. We conclude that in Afghanistan the last cycle of violence will reach its completion by the early months of 2006 while in Iraq the cycle of violence will extend through 2006.

Introduction

In the beginning of the new millennium, political violence seems to be concentrated around the notion of terrorism. In the United States, political violence focuses on singular large-scale attacks on the population such as the Oklahoma bombing and the World Trade Center. In Europe, political violence has been expressed for decades through a multitude of smaller-scale less singular acts committed by self-proclaimed revolutionary terrorist groups, e.g. the German Red Army Faction (RAF), the Italian Red Brigades, the French Action Direct, and the Greek Revolutionary Organization November 17 (17N). A slowly evolving pattern of action over the years makes such groups behave like distinct ‘‘biological species’’ inside the ‘‘ecology’’ of politically violent organizations. For this reason, we employ the term ‘‘urban guerrilla groups’’ to distinguish them. The recent dismantling of the 17N group in Greece brought to light detailed data on numbers, dates, and types of attacks. Such data are amenable to a quantitative analysis.

The biological species analogy can be carried over to the recent and continuing armed conflicts in Iraq and Afghanistan. Detailed data on the casualties resulting from the action of "insurgent groups" resisting the US military presence in these countries are reported daily and complete databases are accessible through the Internet [1].

One of the goals of our work is then to analyze the evolution of 17N and similar groups during the last 30 years in Greece as that of a species growing in competition along a logistic pattern with a predetermined potential for action. Marchetti [2] originally employed this approach when he studied the attacks of the Red Brigades. In analyzing the activities of guerrilla groups as a species growing in competition, we have generalized the concept of competition. As the group realizes its potential by accumulating hits, competition appears among potential hits for the group's choice. This is not unlike competition among words for an infant's attention while the infant acquires vocabulary [3].

In addition considering that the resistance activities encountered by the US-led coalition forces in Iraq and Afghanistan are the result of a cooperative effort where many individuals are involved we examine the possibility that US engagements in these countries follow natural-growth patterns. The thinking behind this assumption is that we are dealing here with a well-defined military endeavor that has a beginning, a growth phase, a maturity phase, decline, and an end, and its evolution is subject to the law of competition (survival of the fittest). In this light, we can compare/contrast it with the older and well-documented Viet-Nam military endeavor that demonstrates a textbook logistic growth pattern (Figure 1).

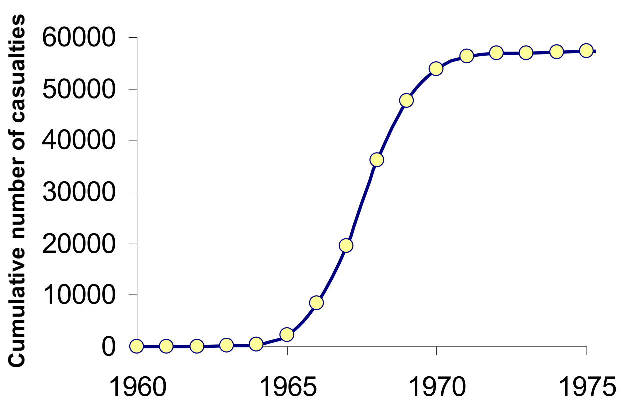

Figure 1 - US casualties in Viet Nam and logistic growth curve fit. The data have been obtained from http://www.archives.gov/research_room/research_topics/vietnam_war_casualty_lists/statistics.html#year

Our approach emphasizes the logistic character depicted by the evolution of the data. Subsequent attempts to attach political events to dates or ''explain'' things, either by us [4] or by the reader, unavoidably carry the uncertainties inherent to ''interpretations'' or are consequently subject to debate.

1. Data Sources

Attacks by urban guerrilla groups in Greece are documented in [4]. US casualty data in Iraq and Afghanistan are maintained by the Department of Defense, mass media and interest groups and are made available to the public on a number of news organizations and interest groups

Internet sites [1]. The format and time resolution of these sites varies. We have checked the data from these sources and although the trends are similar there appear to be some discrepancies in the total numbers reported. The most complete and daily updated site is http://icasualties.org/oif/Details.aspx where all casualties since the start of the Afghanistan and Iraq engagements, are tracked down and are documented with name, rank, cause of death and location of incident in a convenient spreadsheet format. With the death toll currently in excess of 1950 such discrepancies (on the order of 10) may not be as important, however we choose for concreteness to base our analysis on the data from the latter site, last accessed on Oct 7, 2005.

2. Data Analysis: Urban Guerrilla Groups

Our basic assumption is that a well-defined urban guerrilla group with members sharing political ideas and the belief that violence can be employed as a tool to achieve this goal behaves effectively like a biological species. The assumption underlying this thesis is that the group has a finite capacity for action, due to limited material resources, skills of its members, and a hostile no supportive environment. Therefore, the total number of hits an organization has to its credit by a certain date shows how far the organization has advanced toward realizing its capacity for action, i.e., its growth potential. By fitting a logistic to the cumulative number, we expect the group's activities to undergo a life cycle and eventually cease. Considering that we are dealing with a group, this is more reasonable than fitting a logistic to the population density, which would imply that the group in question would remain in operation forever.

The logistic function has the S-curve form:

$$\frac{M}{1+e^{-a(t-t_0)}}+C \tag{1}$$

where M, α, t_o and C are constants. The last constant is introduced to account for cases where the logistic does not begin at zero level. This can happen because in the framework of the conspiracy that invariably underlies the formation of an urban guerrilla group, the group's potential begins to be expressed before the ''official'' first hit. Organization, planning, and even ''rehearsal'' of attacks (as revealed in testimonials of 17N members) all constitute means of expression.

2.1. The 17N Data

Figure 2 shows the cumulative number of all 17N attacks [4] while figure 3 depicts the set of hits involving a political assassination. The latter is deemed a more appropriate data set for studying the evolution of 17N. The data seem to cover the entire growth process and are very well captured by the logistic, S-curve. The last victim, brought the total number of deaths to the 96% level of the logistic's ceiling. This makes the dismantling of the organization in 2002 a foregone conclusion because it is generally accepted that a species' extinction can be considered as a ''natural'' death whenever the growth process exceeds the 90% completion level. The results from the fits are tabulated in Table 1.

Table 1 - Parameters of Logistic Fits of Urban Guerrilla Activities

Data set	*M*	α	t_o	*C*
17 N all attacks	64.87	0.0013091	June 6, 1991	2.03
17 N only assassinations	17.58	0.0007563	Dec 21, 1989	1.16
All attacks by all groups: large-scale curve	4119.36	0.000427	February 18, 1949	-3900.
All attacks by all groups: 1st wave	76.24	0.001164	August 2, 1978	135.54
All attacks by all groups: 2nd wave	145.36	0.000964	February 23, 1991	192.204

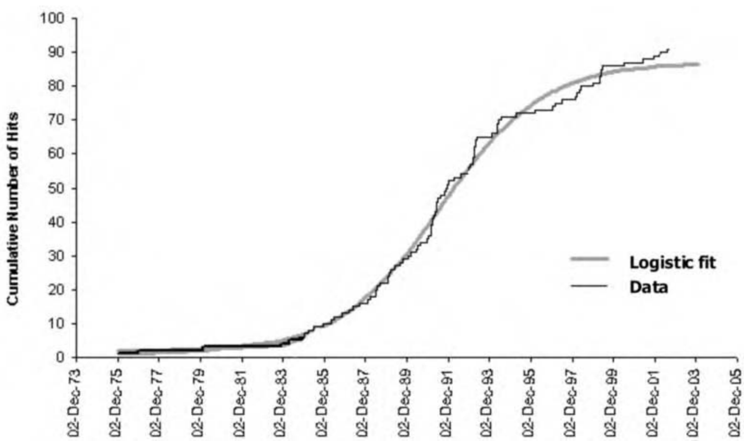

Figure 2 - Logistic fits on data for hits by the 17N [4]. The growth process is complete.

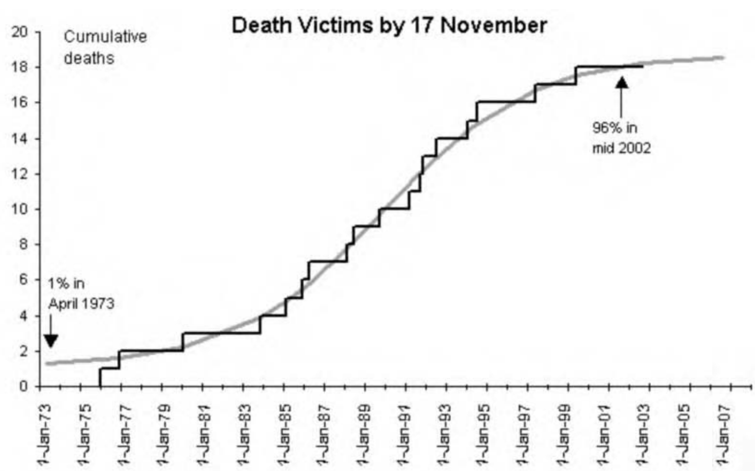

Figure 3 - Assassination hits by 17N.

2.2. All Urban Guerrilla Data

In addition to the 17N, there are two other significant urban guerrilla groups, the ELA and the May 1st. The latter has only a handful hits to its credit, whereas the former has over 100. Moreover, both organizations have declared in the press their merging into a single group in 1990, which justifies treating them as one species. Besides these groups mentioned so far, there have been several others of lesser importance that came into action after 1985. In addition, there have been several bomb attacks in the period 1967–1974 in the general framework of resistance against the junta. There is a qualitative difference between violent acts directed against a junta and violent acts directed against a democratic government. Nevertheless, it is worthwhile combining all violent activities together in order to get a picture of the long-term evolution of political violence in Greece. Figure 4 shows all attacks reported in Greece since the beginning of the dictatorship in 1967. During the years of the military junta, we see much activity by numerous urban guerrilla groups in Greece. In figure 3, one can discern a number of steps—each one a good candidate to be fitted by a small logistic curve—probably representing the comings and goings of various groups. For the sake of simplicity, we fit only three logistic curves. The first curve, of which we see only the later part, reaches more than 99% completion in the early 1980s. The curve has its origin (1% level) around 1919. The second curve (light gray line) describes activities mainly attributed to ELA. The curve reaches 90% completion in late 1983 and has its roots in early 1965. The third curve (dark gray line) describes activities mainly attributed to 17N. It reaches completion (99%) in mid-2002 and has its roots in mid-1978.

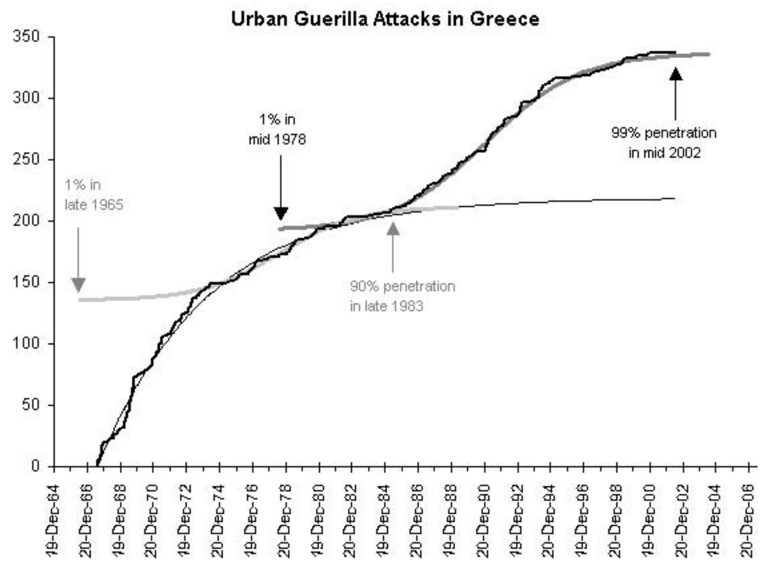

Figure 4 - The smooth lines show logistic fits on the corresponding sections of the overall data curve. The data represent all attacks. The data cover only the later part of the large logistic curve (thin black line) that reached more than 99% completion. The1% levels point to the nominal beginnings of the other two logistic curves (in light gray and dark gray respectively). The levels of completion are also shown.

3. Data Analysis: Insurgent Groups

In the case of the armed conflicts in Iraq and Afghanistan the justification for the emergence of an effectively biological behavior for the insurgent groups is rather straightforward, as the law of competition (survival of the fittest) can be assumed to apply. The cumulative number of casualties it can inflict to its opponent then provides a measure of the "fitness" of the species under discussion. The cumulative number of casualties is chosen as the relevant metric because we expect that, as mentioned in the introduction, military endeavors exhibit life-cycle characteristics (a beginning, a growth phase, a maturity phase, decline, and an end). After the defeat of the tactical army forces in these countries, the various insurgent groups may not share a common center of command, and in addition they may have differences in culture, habits or even language. However we must not underestimate the cohesion provided by their apparently common goal: to resist and eventually overturn the US-led military coalition presence on their soil. We might expect therefore that their pattern of action may not conform to a single logistic curve but exhibit some "microstructure" due to the simultaneous action of species with different "fitness" (e.g. a superposition of logistic curves).

3.1. The Afghanistan Data

The cumulative number of US casualties in Afghanistan is shown in figure 5. US military involvement in Afghanistan started on October 7, 2001 and continues to this day. Opposition to the US presence is seen to follow four consecutive cycles/waves of violence, with each one perfectly fitted by a logistic equation. The parameters of the logistic fits are shown in Table 2.

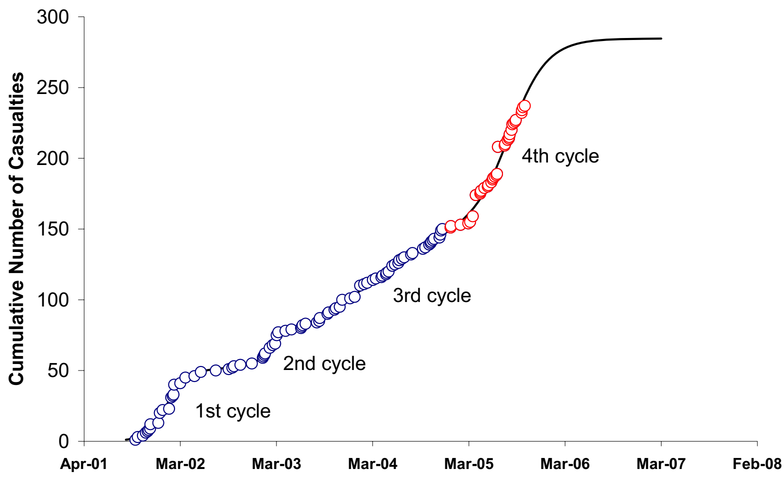

Figure 5 - Cumulative US casualties in Afghanistan (circles) and their sum of logistics fit (line).

Table 2 - Afghanistan Logistic Fit Parameters

Data set	α	t_0 *(days from start)*	*M*
First wave	0.02657	115.4	49
Second wave	0.06085	499.1	17
Third wave	0.00627	879.7	91
Fourth wave	0.01476	1402.9	128

The first two cycles of violence are characterized by relatively sharp and comparable growth rates and duration of about a year each, claiming a total of 66 casualties. The third cycle which started in early 2003 exhibits qualitatively different characteristics, with a much smaller growth rate claiming up to date an additional 91 casualties. The last cycle exhibits a sharper growth, and is forecasted to cause an additional number of 128 casualties. The fourth cycle has already traced 62% of its potential and is projected to reach completion in the first months of 2006 bringing the total number of casualties to 285.

3.2. The Iraq Data

The cumulative number of US casualties in Iraq is shown in figure 6. US military involvement in Iraq can be split in 3 periods. The major combat period with the tactical army lasted from March 20, 2003 to May 1, 2003. This was followed by a transition period from May 2, 2003 to June 28, 2004 when sovereignty was turned over to Iraq. A third period can be considered to exist from June 29, 2004 (the day after the official turnover of sovereignty to Iraq) through today.

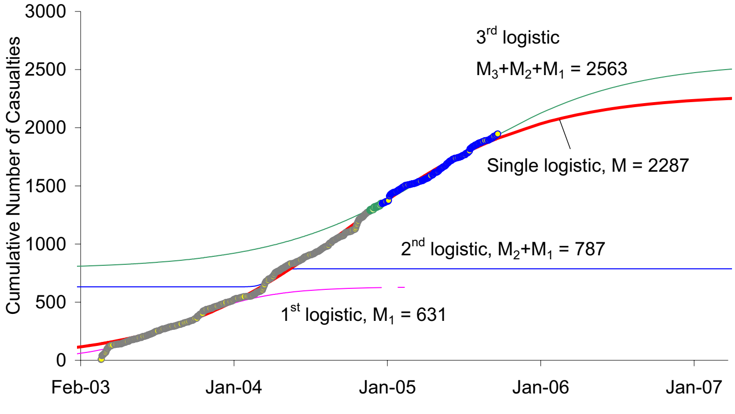

Figure 6 - Cumulative US casualties in Iraq (points) and their different logistic fits (lines). See text for explanations

As seen by the bold line in figure 6, the cumulative number of casualties can be reasonably well described by a single logistic curve with a ceiling M = 2287, currently having reached its 85% completion point. The process will be completed during 2006. However the data exhibit a pronounced (large scale) microstructure and given the earlier discussion on the existence of different insurgent groups with potentially different "fitness" profiles we have also attempted their description by a sum of logistic functions. While a finer examination of the data could reveal several features, with each one being a candidate for a logistic fit, we applied a sum of three logistics to capture the large scale steps evident in the graph of figure 6. The parameters of the logistics are given in Table 3.

Table 3 - Iraq Logistic Fit Parameters

Data Set	α	t_0 *(days from start)*	*M*
Single logistic	0.00464	583	2287.
Sum of logistics			
First wave	0.00972	182.9	$M_1 = 631.$
Second wave	0.09035	394.7	$M_2 = 156.$
Third wave	0.05038	809.8	$M_3 = 1775$

All logistic fits point to a process expected to reach completion during 2006. The third logistic is currently at its 64% completion point, so it is apparent that for the cycle of violence to end sooner a "non-natural" condition will have to occur.

4. Conclusions

Urban guerrilla groups in Greece began organizing themselves shortly after the military junta came into power but a deeper need for violent revolution seems to have its origin much further back in the age-old repression of leftist movements. The group 17N survived a generation of unchecked activity but was finally silenced as it reached the end of its life cycle. Other groups such as ELA and May 1st had already gotten quiet in the 1990s. Our analysis shows that political violence in Greece as measured by the population density of hits by urban guerrilla groups has followed natural growth curves that were completed when the police finally stepped in. Alternatively, one could say that the achievements of the Greek police were not all concentrated in the summer of 2002 but that continuous struggle over the last decades steadily chipped away on the fitness of the urban guerrilla groups, making their final eradication possible.

Carrying over the biological species analogy to the recent and continuing armed conflicts in Iraq and Afghanistan it was demonstrated that logistic fits describe very well the casualties resulting from the action of insurgent groups resisting the US presence in these countries. From the Afghanistan data, 4 consecutive cycles of violence are evident and the entire pattern is projected to reach completion in the first months of 2006 bringing the total number of casualties to 285. From the Iraq data various consecutive short cycles of violence are evident, reasonably describable by an overall composite logistic. A better description is obtained employing a sum of three logistics. According to these estimates we conclude that the last cycle of violence in Iraq will continue through 2006 and by the time of its completion it will add 300-600 casualties to today's figures.

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Reverse Engineering Asymmetric Warfare: Applying Space-Time, Matter-Energy and Organizational-Doctrinal Analysis to Al Qaeda Operations

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Abstract. The 'crime-war' operational environment, found in failed and failing-states dominated by non-state (criminal) soldiers, has been increasing in scope for decades. This trend is viewed as part of the process of transition from the modern (Third) to the post-modern (Fourth) epoch. Within this environment, non-state entities utilize asymmetric warfare against nation-states. The most dangerous of these opponents are those whose approach is asymmetric by nature (due to their network-type organization) and who thereby represent a direct challenger to the nation-state form. Al Qaeda fits both of these conditions and enough is known about its operations and structure to allow its asymmetric warfare components— based on its space-time, matter-energy, and doctrinal-organizational elements— to be analyzed. Findings indicate that Al Qaeda has a clear advantage with regard to the space-time and organizational-doctrinal components of warfare. It is currently deficient in the matter-energy component but it is projected that it (or its descendent form) will eventually obtain directed energy weapons. These findings, along with the emergence of wars increasingly fought over social and political organization rather than sovereignty, have implications for both counter-asymmetric warfare and Kondratieff Waves research.

Introduction

The 'crime-war' operational environment has been increasing in scope for decades and is dominated by non-state (criminal) soldiers. This environment is found in failed and failing-states and is populated by private armies, bandits and outlaws, terrorists and insurgents, warlords, and drug cartels. Nation-state police and military forces have a difficult time operating in this environment—so much so that it is generally accepted that a capability gap exists. As a result, mercenary companies and private security firms have returned to the battlefield in numbers not seen since pre-Westphalian times.

Fourth Epoch War theorists view the increasing scope and growing sophistication of this operational environment as part of the process of transition from the modern (Third) to the post-modern (Fourth) epoch. Hence it represents both an operational level security issue (a capability gap) for nation-states and a strategic security issue based on the rise of challengers to the nation-state form [1]. Within this operational environment, non-state entities utilize asymmetric warfare against nation-states.

This trend toward non-state threats and asymmetric warfare is of great interest to NATO planners because of the great danger that it poses to member states— the March 2004 Madrid bombing and November 2004 thwarted 9-11 style attack on London serve as recent examples.

This paper will reverse engineer asymmetric warfare by breaking down Al Qaeda operations into their component parts for analytical purposes. In this way, both this non-state threat and the asymmetric warfare it engages in can be better understood. Implications for counter-asymmetric warfare and research potentials for Kondratieff Waves will then be offered.

1. Asymmetric Warfare Components

Asymmetric warfare has numerous definitions. All of these definitions concern "dissimilarities" of one form or another between groups— in doctrine, tactics, techniques, and procedures (TTP), as well as with regard to the opponent itself (e.g. conventional force vs. insurgent force, hierarchical organized force vs. network organized force). At the most basic level, these dissimilarities are applied against an opposing force's strength in order to negate them and against their weaknesses in order to exploit them. At higher levels of asymmetric thought, opposing force strengths can be turned into vulnerabilities.

Engaging in asymmetric warfare is just a different means to the same end of any other forms of warfare—some sort of desired outcome or end state is sought by one entity over another. Asymmetry rather than symmetry in warfare is utilized when any of the three following conditions apply:

A - It provides an inherent advantage to one symmetrical force over the other (state based conventional force vs. state based conventional force).

B - One of the opposing forces cannot compete in a war of symmetry and thus is forced into asymmetry (non-state insurgency force vs. state based conventional force).

C - *The natural approach to warfare of a particular group is asymmetric (network organized force engaging in disruptive targeting vs. hierarchical organized force engaging in destructive targeting).*

From an operational and strategic standpoint, the most compelling requirement we have concerns an understanding of asymmetric warfare derived from other than nation-states threats. These non-state threats fall into the "b" and "c" conditions for asymmetry identified above. Condition "c", where asymmetry is a natural condition rather than artificially imposed or implemented as a policy, is of greatest concern because it represents a true variant to the traditional state-based conduct of warfare.

Research conducted by this author on networked non-state threats to governments speaks directly to condition 'c' with a focus on the type of non-state threats posed. Four types of threats were identified in October 2000 [2]:

(I) Threats which seek to replace a single governmental policy with their own policy.

(II) Threats which seek to replace multiple governmental policies with their own policies.

(III) Threats which seek to replace the institutions of a government with their own form of governance based upon the nation-state form.

(IV) *Threats which seek to replace the institutions of a government with their own form of governance based upon a model competing with the nation-state form.*

Type I and type II threats only challenge states on the policy level. Type III threats seek to replace the institutions of a nation-state with their own and in the process become hierarchical organizations. Type IV threats are of greatest concern because they represent post-modern entities— social and political organizational challengers to the nation-state form.

Non-state entities that fulfill condition 'c' and are a type IV threat should be focused upon when investigating asymmetric warfare because they represent the greatest danger to NATO and the modern democratic states which that organization seeks to protect. Only one non-state entity currently fulfills both of these requirements and has a structure and operational signature that is known well enough for it to be analyzed— Al Qaeda [3].

To gain more understanding, asymmetric warfare as it applies to Al Qaeda needs to somehow be reversed engineered. The simplest way to do this is to analyze this form of warfare's three fundamental component [4]:

(1) Space-Time: The spatial and temporal dimensions of the battlespace forces operate in. The spatial dimensions are defined by their x, y, z axes combinations (x = linear, xy = plane, xyz = cube). Time is designated by t and post-modern higher dimensional (non-spatial) constructs by c (c=cyberspace). Different space-time combinations exist and are dependent on the energy foundations of the societies and the military forces that they field.

(2) Matter-Energy: Weaponry is composed of m (matter) — typically solid (less frequently liquid or gaseous)— and e (energy). Over the course of millennia the ratio between m and e has been altered. Classical and medieval weaponry was dominated by m (found in spears and swords) while modern weaponry is dominated by projectiles (m) and chemical propellants (e)— hence, it is me (mechanical) based. Post-modern weaponry will be primarily dominated by directed energy (e)— examples of this weaponry include lasers, millimeter waves (such as the declassified US Area Denial System) and radio-frequency weapons.

(3) Organizational-Doctrinal: Forces can be either hierarchical (h) or network (n) based or some mixture of the two (hn). Hierarchical based forces engage in thing targeting (tt) derived from attrition and maneuver based operations and utilize destructive firepower. Network based forces engage in bond-relationship targeting (brt) and utilize disruptive firepower.

2. Reverse Engineering Asymmetric Warfare

If asymmetric warfare can be divided into these three fundamental components then a full "asymmetric warfare" advantage would require that advanced capabilities be gained in each of those components. Gaining one or two dissimilar capabilities will result in varying degrees of partial "asymmetric warfare" advantage.

Al Qaeda operations were deconstructed in two recent, September 2004, works in which "order of battle" and "operational combat analysis" were undertaken. The first work relies upon traditional military analysis of an opposing force fielded by a nation-state. This is the first time this form of analysis has ever been conducted on Al Qaeda [5]. Findings can be applied to Al Qaeda matter-energy utilization.

The second work relies upon battlespace dynamics, netwar, and bond-relationship targeting in order to conduct non-state threat analysis. Battlespace dynamics research dates back to 1996 and can be applied to Al Qaeda space-time utilization [6]. Netwar research dates back to 1993 and focuses on networked forms of organization, doctrine, strategy and communication. It is having an increasing impact on counter-terrorism planning and operations [7]. Bond-relationship targeting was developed in 1997 and provides a disruptive firepower definition for the effects of 'terrorism' and 'non-lethal weapons'[8]. Netwar and bond-relationship targeting can be applied to Al Qaeda's organizational-doctrinal capabilities.

2.1 Space-Time Findings

Table 1 - Space-Time Characteristics

Nation-States	Al Qaeda
xyz + t Four-Dimensional Battlespace	*xyz + t + c* Five-Dimensional Battlespace

Non-state opposing forces primarily operate in five-dimensional space while nation-state forces primarily operate in four-dimensional space. The result is that non-state groups, Al Qaeda in particular, are utilizing an additional dimensional component (cyberspace broadly defined) that provides them with advantages over nation-state forces. The fifth dimensional component allows for limitations in lesser dimensional battle space (space-time) to be overcome for advanced war fighting purposes. Al Qaeda has shown use of this ability through stealth masking of forces (spatial expansion) for defensive purposes and virtual psyops (spatial contraction) for offensive purposes [9]. Spatial expansion and contraction allows Al Qaeda forces to manipulate space-time for battlefield advantage. Spatial expansion can be viewed when four-dimensional based states forces are unable to target Al Qaeda forces (whom blend in with non-combatants) and thus engage in dimensional stand off. Spatial contraction is utilized by Al Qaeda's undermining of the will of Western populations in their living rooms thousands of miles away through the conduct of real-time media atrocities (i.e. beheadings and suicide bombings).

2.2 Matter-Energy Findings

Table 2 - Matter-Energy Characteristics

Nation-States	Al Qaeda
me Matter-Energy Weaponry	*me* Matter-Energy Weaponry

The order of battle, specifically the equipment list it contains, details Al Qaeda's ad hoc matter-energy weapons resources. The equipment list shows what would be expected of the terrorist and guerilla forces fielded by this entity[10]. Such meager weapons resources are no match to the destructive firepower of nation-state militaries. No attempts by Al Qaeda to procure directed energy weapons were noted, however, weapons of mass destruction were actively being sought and procured with varying levels of success.

It is projected by this author, based on program data on non-state directed energy use, that Al Qaeda (or its evolutionary descendent) will eventually recognize the value of, seek out, and obtain (*e*) directed energy weapons [11]. Such "weapons of mass disruption" would provide Al Qaeda with additional fifth-dimensional space-time capabilities and represents a doctrinal-organizational fit with preferred network use of bond-relationship (disruptive) targeting [12].

2.3 Organizational-Doctrinal Findings

Table 3 - Doctrinal-Organizational Characteristics

Nation-States	Al Qaeda
h Hierarchical Systems "Institutional"	*n* Network Systems "Experimental"
tt Thing Targeting "Destructive"	*brt* Bond-Relationship Targeting "Disruptive"

Al Qaeda is organized as a network and is now in its second generation of development. The first generation network was star-hub based with attack authority centralized and target set identification distributed to the nodal hubs[13]. Since September 2001, the network has shifted to nodal target set identification and attack authority as a response to US and coalition attacks.

Al Qaeda combat capabilities can be broken down into speed (reaction cycles), offensive, defensive and combat multipliers. They include network based parallel processing, virtual-teaming, self-healing, swarming and adaptive behavior. Bond-relationship targeting has been used in terrorist attacks in Baghdad, Iraq (September-November 2003), Madrid, Spain (March 2004), and in Yanbu, Saudi Arabia (May 2004) [14].

3. Implications for Counter-Asymmetric Warfare

Al Qaeda has a clear advantage in the space-time and doctrinal-organizational components of asymmetric warfare. No such advantage exists in the matter-energy component—in fact, Al Qaeda is at a severe disadvantage in this category—however it is projected that Al Qaeda (or its evolutionary descendent) will attempt to overcome its matter-energy disadvantage by eventually obtaining (*e*) directed energy weapons.

The implications of the two Al Qaeda asymmetric warfare component advantages are easily identifiable:

Space-Time: Nation-state military forces (including police) must re-evaluate the theoretical basis of battle space in their doctrinal and organizational (force structure) publications. State military institutions do not question the space-time basis of battle space because the *raison-d'etre* of these modern institutions is defined by the very modern battle space they should be questioning—the preservation and extension of national sovereignty within modern battle space ($xyz+t$)[15]. Until the theoretical basis of modern battlespace is fully reevaluated, Al Qaeda will continue to exploit the asymmetric warfare component advantage derived from fifth dimensional battle space ($xyz+t+c$).

Doctrinal-Organizational: Network systems and structures are an organic part of the Al Qaeda entity. Nation-state military forces (including police) are hierarchy based and suffer severe operational disadvantages when engaging network based groups such as Al Qaeda. State network based forces must be stood-up to augment the legacy hierarchy based forces that currently exist. John Arquilla and David Ronfeldt are accurate when they say —"It takes networks to fight networks"[16]. Such network based forces have started to appear among US Special Forces groups operating in Afghanistan and domestically in the US with the Los Angeles Terrorism Early Warning (TEW) Group expansion project being supported by the Department of Homeland Security (DHS).

On the doctrinal side, bond-relationship targeting (brt)/disruptive targeting acceptance by nation-state forces is still probably years off [17]. Until more advanced forms of targeting are recognized by state forces, counter-measures to them that protect both militaries and the states that they protect will not be developed. In addition, successfully countering network based forces such as Al Qaeda will require the use of disruptive targeting rather than solely the older form of destructive targeting that networks are more resilient against.

Third component implications concerning advanced matter-energy use by Al Qaeda are currently only based on projections:

Matter-Energy: Nation-states, particularly Western industrialized ones, have the technological edge over Al Qaeda when it comes to the development of (*e*) directed energy weapons. This edge, however, is blunted by international conventions— such as the blinding laser ban—that precludes the use of many of these weapons. In addition quite a few of these devices can be purchased on the international arms market, both legally and illicitly, or improvised using scientific, industrial or medical equipment[18]. Prudence would suggest nation-states developing counter-measures to this projected Al Qaeda (or descendent form) capability.

4. Research Potentials for Kondratieff Waves

This analysis of asymmetric warfare is characterized by a qualitative focus (space-time, matter-energy, and doctrinal-organizational) of a nation-state challenger (Al Qaeda) that is representative of the transition to the Fourth (post-modern) epoch. This challenger is viewed as a byproduct of an epochal transition now underway. This transition is from the modern nation-state form (based on a mechanical energy foundation) to the post-modern state form (based on a post-mechanical energy foundation). Competing forms include the regional state as in the case of the European Union model or what Philip Bobbitt terms the 'market state' [19], shadowy transnational criminal and ghost-states, and radical Islamic global insurgent networks such as Al Qaeda.

During this transitional phase from the modern to the post-modern epoch, war can be defined as "a struggle between competing forms of social and political organization over which the eventual successor to the nation-state will be built"[20]. The victor of this struggle will fully master all three components (space-time, matter-energy, and doctrinal-organizational) of the new mode of warfare that is emerging— what we currently term asymmetric warfare [21]— but what at some point in the future will be considered standard symmetrical (conventional) warfare between network organized post-nation-state entities [22].

The question that arises from this new military reality is what research potentials will it offer to K-wave theory in order to help achieve overall global stability during a period of epochal change? K-wave theory is characterized by its quantitative focus on nation-states, and at least one instance of Chinese Sung states and Italian city-states research, in the international political economy. Can this theory be extended to nation-state challengers and asymmetric conflict characteristic of early 21st century warfare? This is a question, not for military theorists, but for K-wave scholars to answer.

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The views expressed in this paper are those of the author and do not necessarily reflect the official policy of the Counter-OPFOR Program, National Law Enforcement and Corrections Technology Center-West or the US National Institute of Justice. I would like to thank Pamela L. Bunker for her comments on an earlier draft of this paper.

[1] Fourth Epoch War theory was developed in 1987 and is meant for applied use by US law enforcement and military agencies against non-state threats. For more on this theory see Robert J. Bunker, ed. *Non-State Threats and Future Wars*. London: Frank Cass, 2003.
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[3] Al Qaeda is universally recognized as a network based non-state force that seeks to destroy the United States, Israel, and the apostate regimes in the Islamic world. The end state for Al Qaeda is a return of the transnational Islamic state based on the golden age of the Caliphates in the 7th and 8th centuries. Enough information has now been gathered on Al Qaeda that we have a good understanding of its organization and operations. For example see the social network analysis of the Al Qaeda 9/11 assault force. Valdis E. Krebbs, "Uncloaking Terrorist Networks." *First Monday*. Vol. 7. No. 4. http://www.firstmonday.dk/issues/issue7_4/krebs/
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[5] See Lisa J. Campbell, "Applying Order-of-Battle to Al Qaeda Operations." Robert J. Bunker, ed. Special Issue "Networks, Terrorism and Global Insurgency". *Low Intensity Conflict and Law Enforcement*. Vol. 11. No. 2/3. Winter 2002. pp. 299-315. Note— Journal is behind in publication dates. Special issue came out in September 2004.
[6] See Robert J. Bunker, "Battlespace Dynamics, Information Warfare to Netwar, and Bond-Relationship Targeting." Robert J. Bunker, ed. *Non-State Threats and Future Wars*. pp. 97-101., for an overview.
[7] Ibid., pp. 101-104.
[8] Ibid., pp. 104-107. Bond-relationship targeting can include the co-optation of a nation-state's institutions by criminal organizations by means of corruption and symbolic violence (silver and lead). The definition of brt is as follows: "Rather than gross physical destruction or injury, the desired end state is tailored disruption within a thing, between it and other things or between it and its environment by degrading, severing or altering the bonds and relationships which define its existence."
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[10] The list is too large for reprint because of the space limitations in this paper. OB categories are air force, missile, naval, ground, ordnance and misc. See Table 1. Al Qaeda Equipment Order of Battle (OB) in Lisa J. Campbell, "Applying Order-of-Battle to Al Qaeda Operations." Robert J. Bunker, ed. Special Issue "Networks, Terrorism and Global Insurgency". *Low Intensity Conflict and Law Enforcement*. p. 301.
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[12] Robert J. Bunker, "Weapons of Mass Disruption and Terrorism." *Terrorism and Political Violence*. Vol. 12. No. 1 (Spring 2000) pp. 37-46.
[13] Refer to Netwar publications for an explanation of network structures such as star-hubs, smuggler chains and all-channel networks and basic building blocks such as nodes and their linkages.
[14] Robert J. Bunker and Matt Begert, "Operational Combat Analysis of the Al Qaeda Network." pp. 316-339.
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[16] This falls into one of the three netwar challenges. John Arquilla and David Ronfeldt, "The Advent of Netwar (Revisited)". John Arquilla and David Ronfeldt, eds. *Networks and Netwars*. Santa Monica: RAND, 2001. pp. 15-16.
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[21] Max Manwaring views traditional asymmetric warfare as fourth-generation conflict. His concept of sixth-generation warfare—‘New Terror War’—with the idea of cocktail mixes of earlier generations fits more with the analysis of asymmetric warfare in this paper. See Max Manwaring, “The Asymmetrical 21st Century Security Reality” in this collection of writings.
[22] At the point asymmetric warfare becomes thought of as conventional warfare, Martin van Creveld’s prophetic statement “in the future, war will not be waged by armies but by groups whom we today call terrorists, guerillas, bandits and robbers, but who will undoubtedly hit upon more formal titles to describe themselves” will become realized. Martin van Creveld, *The Transformation of War*. New York: The Free Press, 1991. p. 197.

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The Asymmetrical 21st Century Security Reality

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Abstract. If one could look through the familiar artificial political lines and colors of a current world map into the 21st Century strategic reality, one could see a complex and dangerous security arena. With some adjustments of focus, we could discern a number of issues that cannot be shown in two-dimensional space. The most salient are briefly outlined as follows. First, one could get a better idea of the threat situation that reveals a vision of the transformation of conflict from First-Generation through Sixth-Generation warfare, and to what we call "Chinese" and "Bunker" Cocktails. Second, we can see deviations on the road leading into the 21st Century in several different ways. They include: the problems of ambiguity; the need to redefine "enemy," the fact that contemporary conflict is multi-dimensional, multi-lateral, and multi-organizational; and the realization that war has become "total." Finally, a closer examination of the situation reveals a short list of the basic challenges and tasks that can help discerning civilian and military leaders negotiate the road through the inescapable global security environment.

1. A Vision of Current and Future Conflict

The United States, Europe, and those other parts of the global community most integrated into the interdependent world economy are embroiled in a security arena in which time-honored concepts of national security and the classical military means to attain it, while still necessary, are no longer sufficient. In addition to traditional regional security issues, an array of non-traditional threats now challenges the global community, at home and abroad. These include state and non-state, military and non-military, lethal and non-lethal, direct and indirect, and a mixture of some or all of the above kinds of threats. The logic of the situation demonstrates that the conscious choices that the international community and individual nation-states make about how to deal with the contemporary threat situation will define the processes of national, regional, and global security and well-being, for now and well into the future.

In this connection, there is only one governing rule for contemporary conflict—there are no rules; nothing is forbidden [1]. This is warfare in the age of globalization. While possibly less bloody, it is no less brutal. We can see these characteristics in a brief outline of what is more and more frequently being called first through sixth generation warfare methods [2]. It is important to note, also, that each generation or method of warfare is not completely different and separate from another. Each successive methodology builds on the previous one, and all overlap. Finally, there is the "mix and match" of the past that can produce what one might call a "Chinese Cocktail" or a "Bunker Cocktail"[3]. Clearly, effective involvement in the contemporary global security environment requires some serious conceptual adjustments that center on understanding the transformation of conflict.

1.1. First-Generation War

Low-technology attrition war has been the principal means of conducting conflict from the beginning of time. The basic idea is that the more opponents killed or incapacitated relative to one's own side, the better. Historically, attrition war appears to serve only those protagonists with the largest reserves of human resources. When facing a numerically superior opponent, it has been important to find other means to compensate for numerical inferiority [4].

1.2. Second-Generation War

Over 2,500 years ago, Sun Tzu warned that, "In war, numbers alone confer no advantage. Do not advance relying on sheer military power" [5]. Thus, relatively higher technology-led maneuver warfare was intended to provide the numerically inferior combatant with the means to out-perform his opponent. The basic concept is to employ surprise, speed, and lethality to bring pressure to bear on an adversary's weak spots. In essence, the military force that can "move, shoot, and communicate" more effectively relative to the opponent has the advantage, and is more likely to prevail. The German *blitzkrieg* of the Second World War and the American "shock and awe" approach to the recent war in Iraq are examples of second-generation methods, and take us to the next generation of warfare.

1.3. Third-Generation Conflict

At this point, the concept is to move from the blatant use of force toward the employment of "brainpower" to achieve success against an "enemy." This entails a transition from "hard" to "soft" power. In addition to using transport (movement), weaponry (shoot), and command and control (communication), third-generation conflict methodology tends to take advantage of intelligence, psychological operations, and knowledge-based technologies as "force-multipliers." The addition of "soft" power to the military equation provides an efficient and effective means by which to paralyze enemy action [6]. It should also be noted that, while intelligence, psychology, and other forms of "soft" power are less bloody than the use of "hard" power assets (infantry, tanks, artillery, and aircraft) the ultimate objective of war remains the same: to compel the enemy to accede to one's own interests [7].

1.4. Fourth-Generation Conflict

This is the methodology of the weak against the strong. The primary characteristic is that of asymmetry—or the use of disparity between the contending parties to gain advantage. Strategic asymmetry has been defined as "acting, organizing, and thinking differently than opponents in order to maximize one's own advantages, exploit an opponent's weaknesses, attain the initiative, or gain greater freedom of action. It can have both psychological and physical dimensions" [8]. This is a concept as old as war itself, but some military officers and political leaders do not like it. They argue that asymmetry is not the way "real soldiers' fight because they are not "fighting fair." This view is unfortunate. What many military and political leaders seem not to have learned about contemporary conflict is that terrorists, insurgents, drug traffickers, paramilitaries, and other non-state and state actors can be what Ralph Peters calls "wise competitors." He argues, "Wise competitors will not even attempt to defeat us on our terms; rather, they will seek to shift the playing field away from conventional military confrontations or turn to terrorism and other non-traditional forms of assault on our national integrity. Only the foolish will fight fair" [9]. Thus, what is required more than weaponry and technology is lucid and incisive thinking, resourcefulness, determination, and a certain disregard for convention.

1.5. Fifth-Generation Methods

This methodology tends to emphasize the use of information (or propaganda) and high technology, and is aimed at both civilian and military organizations. On one level, it involves the propaganda-oriented strategy derived from Maoist insurgency doctrine against a vulnerable government or a set of targeted institutions. As an example, Peru's Sendero Luminoso (Shining Path) still uses the term "armed propaganda" to refer to destabilizing activities that facilitate the process of state failure and generate greater freedom of movement for the insurgents. Additionally, Colombia's narco-terrorists call the same type of activities "business incentives"[10]. Those transnational non-state organizations operate with psychological, political, and military objectives—in that order.

On a more sophisticated information and technology level, fifth-generation conflict includes, but is not restricted to, financial war, trade war, economic warfare, media war, cyber war, net war, and bond-relationship targeting [11]. As one example, Chancellor Helmut Kohl used the powerful German deutsche mark to breach the Berlin Wall—not tanks, artillery, or aircraft. The point in fifth-generation conflict, according to Qiao Liang and Wang Xiangsui, is to "fight the fight that fits one's weapons, and make [asymmetric] weapons to fit the fight." In these terms, one uses "all means, including armed force or non-armed force, military and nonmilitary and lethal and non-lethal means to compel the enemy to concede to one's interests "[12].

1.6. Sixth-Generation Warfare

This type of conflict is sometimes called "New Terror War." It elaborates on all the previous generations, but emphasizes biological and informational methods to achieve desired ends [13]. From an informational war perspective, we can see this in a single computer virus invasion that can destroy or distort data upon which military and civilian life depends. We can also see this in a single man-made stock market crash, or the exposing of a single scandal that could lead to the fall of a government. Additionally, we can see the introduction of biological weapons—as in the poisoning of a water system of a major metropolitan area, poisoning the air in a subway system, and/or the introduction of a single biological virus, such as "mad cow disease" or anthrax, into a target country. The mix of possibilities is only limited by the imagination and willingness to use "unethical" bio-informational technology to disrupt, control, or destroy an enemy. Thus, in Sixth-Generation conflict, the traditional lines between civilian and military and lethal and non-lethal are eliminated, and the "battlefield" is extended to everyone, everything, and everywhere [14].

1.7. The "Chinese Cocktail"

Liang and Xiangsui explain that any number of completely different scenarios and actions can occur using a mix of the various generations or methods of conflict. As one example:

> If the attacking side secretly musters large amounts of capital Without the enemy nation being aware of this, and launches a Sneak attack against its financial markets, then after causing a Financial crisis, buries a computer virus and hacker detachment In the opponent's computer system in advance, while at the same Time carrying out a network attack against the enemy so that the Civilian electricity network, traffic dispatching network, financial Transaction network, telephone communications network, and mass Media network are completely paralyzed, this will cause the enemy Nation to fall into social panic, street riots, and a political crisis. There is finally the forceful bearing down by the army, and military Means are utilized in gradual stages until the enemy is forced to Sign a dishonorable peace treaty [15].

1.8. The "Bunker Cocktail"

Robert Bunker postulates a very realistic mix of non-military and non-lethal methods of conflict. Because of their flat organization and informal attributes, sophisticated criminal "gangs" can be considered net-warriors. These transnational non-state groups have the capabilities to challenge the dominance of hierarchal and highly formalized nation-states, and carve out new realms of activity for the non-state soldier. As an example:

> If the irregular attacker—terrorists, drug cartels, criminal gangs, Militant environmentalists, or a combination of such actors—blends Crime, terrorism, and war, he can extend his already significant influence. After embracing advanced technology weaponry, including Weapons of Mass Destruction (including chemical and biological agents), radio frequency weapons, and advanced intelligence gathering technology, along with more common weapons systems, the attacker can transcend drug running, robbery, kidnapping, and murder and pose a significant challenge to the nation-state and its institutions. Then, using complicity, intimidation, corruption, and indifference, the irregular attacker can quietly and subtly co-opt individual politicians and bureaucrats and gain political control of a given geographical or political enclave. Such corruption and distortion can potentially lead to the emergence of a network of government protection of illicit activities, and the emergence of a virtual criminal state or political entity. A series of networked enclaves could, then, become a dominant political actor within a state or group of states. Thus, rather than violently competing with a nation-state, an irregular attacker can criminally co-opt and seize control of the state [16].

1.9 Conclusions

War has changed. It is no longer limited to using military violence to bring about desired political change. Rather, all means that can be brought to bear on a given situation must be used to compel the enemy to do one's will. Superior firepower is no panacea, and technology may not give one a knowledge or information advantage. The astute warrior will tailor his campaign to the adversary's political-economic vulnerabilities and to his psychological perceptions. This represents a sea-change in warfare, and requires nothing less than a paradigm change in how conflict is conceived and managed [17]. The direction of change may be seen in some points of interest on the road ahead.

2. Some Signposts on the Road Through the Security Landscape

In protecting one's interests and confronting and influencing an adversary today, the proverbial road ahead is not easy. There are curves and bumps, and, perhaps, detours. We can see these supplementary deviations in the contemporary conflict situation in a minimum of three different ways.

2.1. Ambiguity

First, distinguishing among crime, terrorism, natural occurrences, and war is almost impossible. The definitions of "enemy" and "victor" are elusive; there is a lack of consensus regarding the use of "power"; and victory is no longer the acknowledged destruction of an enemy's military capability. In these terms, the assumed center of gravity is no longer enemy military formations or his ability to conduct traditional conflict. Political and military leaders must differentiate accurately between nodes of vulnerability, and the "hub of all power and movement, on which everything depends" [18]. At the same time, deterrence is not necessarily nuclear or military—although both are important. Deterrence is broader than that. It is the creation of a state of mind among opponents that either encourages one thing or discourages another. Thus, culturally effective ways and means must be found to convince various political actors that it is not in their best interests to continue perceived negative and destructive behavior [19]. Additionally, the accustomed distinctions between "here and abroad," "military and civilian," and "defense and security" are no longer relevant. These anachronistic distinctions—along with the sanctity of porous national borders—must be rethought and replaced by more realistic concepts [20].

In contemporary conflict, clear-cut conditions do not apply or are not present. As a consequence, there are: (1) no formal declarations or terminations of conflict; (2) no easily identified human foe to attack and defeat; (3) no specific territory to take and hold; (4) no single credible government or political actor with which to deal; (5) no legal niceties, such as mutually recognized national borders and Geneva Conventions, to help control the situation; and (6) no guarantee that any agreement between or among contending factions will be honored. All these aspects of the global security environment in general and any given specific context in particular are not only ambiguous—they are also political and psychological, and complex [21].

2.2. Conflict Has Become Multi-dimensional, Multi-lateral, and Multi-organizational

Contemporary conflict now involves ALL the political, economic, social, moral, and security instruments of national and international power, and entire populations. As a result, conflict now involves a large number of indigenous national civilian agencies, other national civilian organizations, international organizations, non-governmental organizations (NGOs), private voluntary organizations, and sub-national indigenous actors. These organizations must work together to deal with complex unconventional internal and transnational threats to security, peace, and well-being. As a result, an almost unheard of unity of effort is required to coordinate the multi-lateral, multi-dimensional, and multi-organizational paradigm necessary to play effectively and achieve strategic clarity in a given security arena [22].

2.3. Contemporary Conflict is Not Limited, It is Total

Lastly, contemporary nontraditional war is not a kind of appendage (a lesser or limited thing) to the more comfortable conventional military attritional and maneuver warfare paradigms. It is a great deal more. As long as opposition exists that is willing to risk violence to control or take down and government, there is war. Again, it may be military or nonmilitary, lethal or non-lethal, or a Chinese mix of everything in an unrestricted arsenal. This is a zero-sum game in which there is only one winner or, in a worst-case scenario, no winners. It is, thus, total. This is the case with other governments, rogue states, Maoist insurgents, Osama bin Laden's terrorists, the Japanese Aum Shinrikyo cult, Mafia families, Southeast Asian warlords, or any group's ethnic cleansers—among others. It is also the case with the deliberate financial attack or hacker attack—again, among others—that can impair the security of a nation as effectively as a nuclear bomb [23].

2.4. Conclusions

Over the years, national security has been viewed largely in terms of military defenses against external military threats. Given the opportunities and threats inherent in the predominantly interdependent global security environment, that is clearly too narrow a conception. The historical record demonstrates that the better a government or another political actor is at conducting the military aspects of conventional war near the top of the conflict ladder, the more a potential external or internal enemy is inclined to move asymmetrically toward the political-psychological conflict at the lower end of the spectrum. Thus, as General Sir Frank Kitson argues, "instead of thinking of the various manifestations of war as being singularly military, it is imperative to regard them as steps in the ladder of warfare as a whole" [24].

3. The Challenges and Tasks for the Road Ahead

The primary challenge, then, is to come to terms with the fact that contemporary security, at whatever level, is at its base a holistic political-diplomatic, socio-economic, psychological-moral, and military-police effort. There is a pressing need to shift from a singular military-police approach to a multi-dimensional, multi-organizational, multicultural, and multi-national paradigm. That, in turn, requires a conceptual framework and an organizational structure to promulgate unified civil-military planning and the implementation of the multi-lateral concept.

3.1. Associated Tasks

Given today's realities, failure to prepare adequately for present and future contingencies is unconscionable. There are at least five fundamental educational and organizational imperatives needed to implement the challenges noted above.

- Civilian and military leaders at all levels must learn the fundamental nature of subversion and insurgency with particular reference to the way in which military and nonmilitary, lethal and non-lethal, and direct and indirect force can be employed to achieve political ends. Leaders must also understand the way in which political-psychological considerations affect the use of force.
- Civilian and military personnel are expected to be able to operate effectively and collegially in coalitions or multi-national contingents. They must also acquire the ability to deal collegially with civilian populations, and local and global media. As a consequence, efforts that enhance interagency as well as international cultural awareness—such as civilian and military exchange programs, language training programs, and combined (multi-national) exercises—must be revitalized and expanded.
- Leaders must learn that an intelligence capability several steps beyond the usual is required for small, internal wars. This capability involves active utilization of intelligence operations as a dominant element of both strategy and tactics.
- Non-state political actors in any kind of intrastate conflict are likely to have at their disposal and awesome array of conventional and unconventional weaponry. The "savage wars of peace' have and will continue to place military forces and civilian support contingents into harm's way. Thus, leadership development must prepare "peacekeepers' to be effective war fighters.
- Governments must restructure themselves to the extent necessary to establish the appropriate political mechanisms to achieve effective unity of effort. The intent is to ensure that the application of the various civil-military instruments to power directly contributes to a mutually agreed political end-state. Generating a more complete unity of effort will require contributions at the international and multilateral levels, as well.

3.2 Conclusions

These challenges and tasks are the basic realities of twenty-first century conflict. The consequences of failing to take them seriously are clear. Unless thinking, actions, and organization are reoriented to deal with these asymmetric, knowledge-based information and technology realities, the problems of global, regional, and sub-regional stability and security will resolve themselves—and not in a manner to anyone's liking.

Conclusions

The challenges and tasks outlined above are not radical. They are only the logical extensions of basic security strategy and national and international asset management. By accepting these realities, and challenges and tasks, the United States, NATO, and the West can help to replace conflict with cooperation and to harvest the hope and fulfill the promise that a new multidimensional paradigm for a more peaceful and prosperous tomorrow offers. These cooperative efforts may not be easy to establish. However, they should prove in the medium to long-term to be far less demanding and costly in political, economic, military, and ethical terms than to continue a "business-as-usual', reactive crisis management approach to global security.

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* The views expressed in this paper are those of the author and do not necessarily reflect the official policy or position of the Department of the Army, the Department of Defense, or the U.S. Government.

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The Emergence of Modern Terrorism

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Abstract. Modern terrorism is presented in capsulated form as an emergent and innovation-like phenomenon characteristic of the downturn phase of the current 4th K-wave. It presents some new aspects, overlooked by previous authors, as for instance the fact to be strongly state sponsored and religious (fundamentalist) inspired. Terrorism has gained its new (modern) dimension at the peak of the 4th K-wave and has steadily increased in violence and in the number of incidents since then. A quantitative analysis using logistic fit is attempted from which either a bothering scenario or a window of hope can be drawn.

Introduction

At the dawn of the new millennium, political violence seems to be concentrated around the notion of terrorism. Terrorism has become a major issue in current times, but it is not a new practice. Thompson's contribution in this volume [1] describes Rappoport Model [2] of terrorism, which presents different forms of terrorism unfolding since the end of the 19th century in four succeeding waves with their own set of characteristics and enduring for a time span of approximately 40-50 years each, that is, with a duration corresponding more or less to the duration of a K-wave. In this short paper we wish to point out some aspects of modern terrorism overlooked in Rappoport model, as well as in the extension of Rappoport model proposed by Thompson [1].

1. The Evolving Nature of Terrorism

Terrorism is when a group or individual uses force or the threat of force against the public or government with the purpose of intimidating their victims. Thompson [1] defines it essentially as unconventional violence designed to influence public attitudes about political legitimating and inequality. We want to add to Thompson's analysis the fact that terrorism has experienced an evolution on its basic inspiration carrying within it a deep and serious transformation on the subjacent forces that sponsor the terrorist activities.

The driving forces underlying the inspirations of the Rappoport's first three waves were basically ideological in nature, involving nationalistic ideals, struggle for freedom or independence, opposition to oppressive regimes and ethnic liberation. Since the second wave we have witnessed an increasing international support (in the sense of sympathy, not sponsorship) to these movements. This kind of support ended suddenly in the 1970's mainly due to three fundamental aspects: the escalade in brutality (killing and/or injuring innocent people), the quick spread all around the world, and the emergence of a new kind of terrorism: *the state-sponsored terrorism*.

One can say that it was during the Rappoport's third wave that such signatures of change began to emerge. Terrorism has been prevalent for most of the century, but no decade was as active as the 1970's. The decade was so riddled with terrorism that we can say that modern terrorism emerged during the decade.

2. Why the 1970's?

The historical record shows many different radical groups acting all around the world at the beginning of the 1970s. We had the Baader-Meinhoff Gang in Germany, the Red Brigades in Italy, The Irish Republican Army Provisional Wing (IRA Provos), the Black Panthers in the USA, the Greek Revolutionary Organization November 17 (17N), and many other spread on all continents. In spite of most of their inspiration be basically ideological in nature and grounded on nationalistic and/or ethnic ideals, some new features began to emerge, as for instance international training, the use of similar methods, and cooperation among different terrorist groups. At this time appeared the Palestinian Liberation Organization (PLO), Black September and the ground was ready for the birth of the Islamic Jihad.

By the end of the 1970's emerged another novelty – the entrenching of the *state sponsored terrorism*. On November 4, 1979 an Iranian Islamic cleric, the Ayatollah Ruhollah Khomeini, declared war on America when his militant Islamic followers invaded the United States by attacking the sovereign territory of the US embassy in Tehran, kidnapping 52 US diplomats and holding them hostage for 444 days. The weak and ineffectual response of President Jimmy Carter to this invasion of the United States provided the radical Islamic world with all the evidence it needed to convince itself the West was a culture in decline, and it's leading country, America, could be humiliated and defeated easily, and with impunity. America's failure to respond to the Iranian Invasion of America with a severe and decisive military action gave the necessary push encouraging further fanatic actions.

Exhilarated and invigorated by Iran's successful Invasion of 1979, the radical Islamic world began a determined and concerted campaign of fund raising, recruitment, training, armament and mobilization that resulted in the formation of an alliance of Anti Western Islamic nations which included Saudi Arabia, Pakistan, Iran, Egypt, Syria, Libya, Yemen, Sudan, and Afghanistan. While on the surface the titular heads of many of these national governments maintained a posture of "friendly" relations with the West, the true leaders of these nations, the ruling tribal and theocratic oligarchs, quietly kept their ambitious war plans and preparations proceeding apace, many with the express knowledge, funding and consent of the nominal heads of the national governments.

Such development configures Rappoport's fourth wave. The number of active terrorist groups diminished, terrorism assumed in the following years a strong religious character and state sponsored terrorism leaded to the world-political circumstances we live today. But a question remained to be answered: why the 1970's.

The 1970's were prone to terrorism for multiple reasons. Some reasons are:

1 - There was a growing disparity in economic classes. Also the percentage of population in poverty was increasing. This drove many people to join groups that participated in terrorist acts.

2 - The overall spreading of Utopian ideals, such as Marxism, led many to desire such unattainable systems. This encouraged Ideological Inspiration.

3 - Poorly run government services caused many to feel oppressed by their own government and encouraged them to retaliate, many times in the form of terrorism.

4 - We were at the peak of the 4th K-wave! That is a very important aspect overlooked in Rappoport model and in Thompson's analysis in this volume. The years 1972-1974 marked the end of the upwave and the onset of the deepest recession since the 1930s, perfectly on schedule with previous waves as pointed out by Ayres [3] in this volume.

3. Modern Terrorism as a Typical Innovation of the 4th K-Wave

What is then the meaning of this emerging phenomenon – again a peak war? Or a new type of conflict? We don't see it as a typical peak war that marked previous K-waves, whose characteristic was the hegemonic dispute for power, territory or resources. But undoubtedly it is a new type of warfare carrying within it a strong new characteristic – *asymmetry*!

In a recently published paper we presented a graph (figure 2 of ref. [4]) bringing strong empirical evidence that all inventions and innovations leading to the basic innovation *Internet* clustered at the peak and downturn of the 4th K-wave. In this paper we defend the thesis that *modern terrorism* is a non-technical basic innovation characteristic of the recession phase of the 4th K-wave. As we can see in figure 1 (inspired in figure 2 of ref. [4]) all events/incidents leading to the consolidation of modern terrorism/asymmetric warfare occurred on schedule with the peak and downturn of the 4th K-wave.

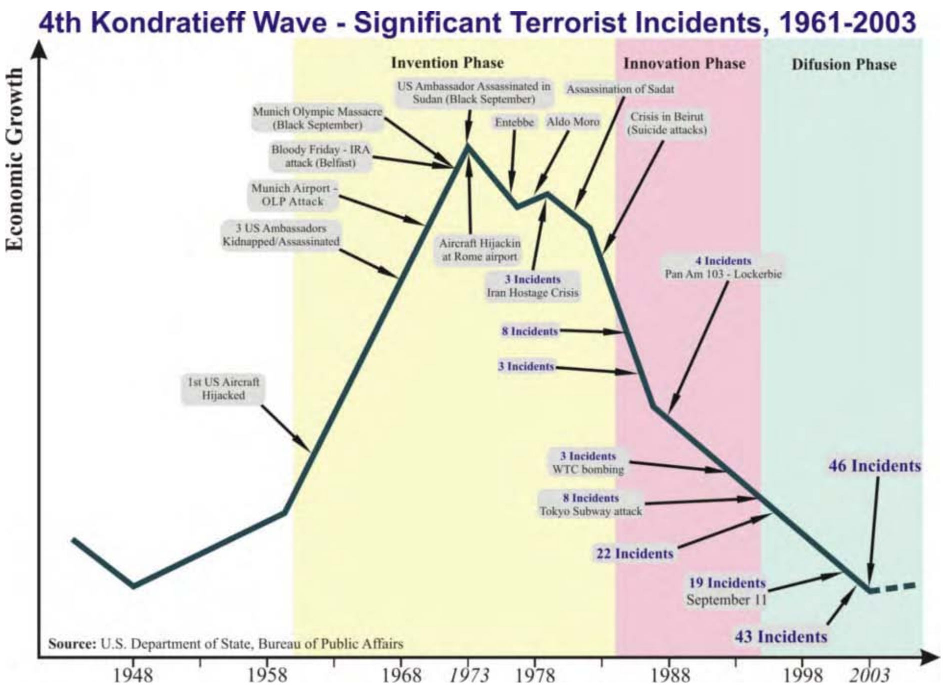

Figure 1 – Succession of terrorist events/incidents spreading during the unfolding of the 4th K-wave.

In a very similar way as shown in reference [4] for the Internet, this picture suggests also the existence of the typical three phases of development of a basic innovation – an invention phase, an innovation phase, and a diffusion phase. Undoubtedly we are living in a typical diffusion phase, witnessing an unexampled escalation of terrorism, mainly in the form of suicide bombing (another novelty of modern terrorism). This bothering scenario can be clearly glimpsed when we look to figure 2 below.

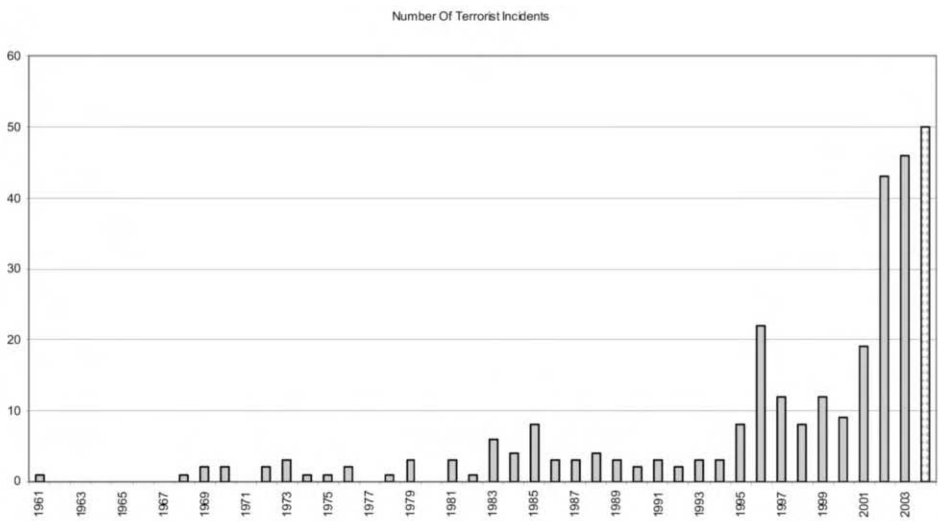

Figure 2 – Reckoning of significant terrorist incidents since 1961. The data for 1961-2003 are from the US Department of State, Bureau of Public Affairs [5]. The data for 2004 were estimated from other several sources.

4. A Bothering Scenario

Modern terrorism has then some innovative characteristics, as for instance the fact to be strongly state sponsored and religious (fundamentalist) inspired. It seems to be a long running process and unfortunately the end is not in sight. Some authors in this volume, like Berry [6] and Goldstein [7], see the current warfare events as a truly trough war, the War on Terror, menacing to hit home (USA) in the coming years. What is likely to happen in the next quarter-century dragged by the growth phase of the 5th K-wave?

In the quest for an answer we have tried to fit a logistic curve to the accumulated number of incidents shown in figure 2. Several attempts were made using different fitting functions and all exhibit a very poor convergence, signalling that we are still very low (below 3% of the whole process) in the logistic process. An example of fitting is shown in the figure 3 below. The result of this fitting points to a ceiling of over 10.000 incidents and a turning point at the beginning of 2030s.

May be that such an attempt has no meaning for two reasons. First we are summing up events of very different nature, coming from very different motivations. Second, and perhaps most important to consider, is that experience shows that attempts to fit logistic curves at the very beginning of the growth process (below the critical threshold of 10%) lead to big deviations in the ceiling values and the extrapolation does not work. This second consideration opens some window of hope – natural growth processes when below the critical threshold point (10%) do not have momentum and may abort under the work of some surrounding circumstances. This is a plausible scenario also considered by Berry [6] in his chapter, supported by the view that Islam is likely to fragment.

If that is not the case in point, the unfolding of this logistic curve might mean that we are entering a very dangerous phase of warfare development, which may be controlled by the US and allies for a while, but can finally set the stage for a terrifying power conflict at the peak of the 5th Kondratieff wave. It interesting to observe that President Bush's own way of talking about the future, in Iraq and beyond, has undergone a subtle but significant change in recent weeks [8]. In several speeches, he has begun warning that the insurgency is already metastasizing into a far broader struggle to "establish a radical Islamic empire that spans from Spain to Indonesia." While he still predicts victory, he appears to be preparing the country for a struggle of cold war proportions

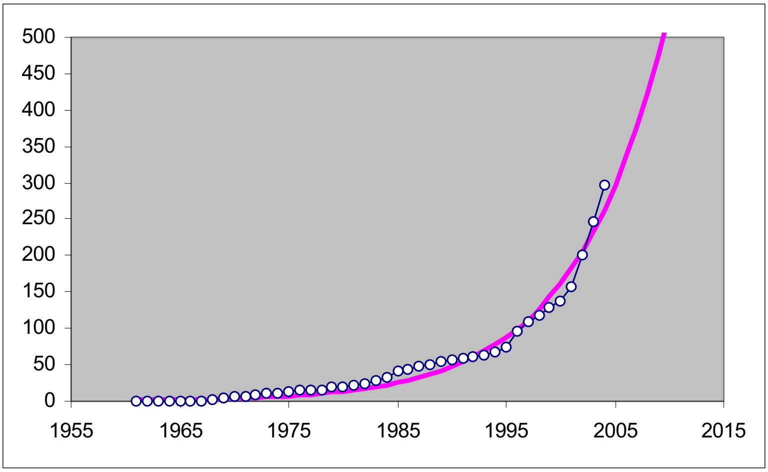

Figure 3 – Logistic fit of the accumulated data presented in figure 2. This fitting results in a ceiling value of 10.670 incidents, with a growth rate of 0,123, and a center point in 2033.

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PART III

Looking into the Future

Kondratieff Waves, Warfare and World Security
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The Russian Potential of Asymmetrical Wars of the 21st Century: Social-Economic Aspect

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Abstract. The trajectory of the social-economic development of Russia that was formed during the last decade of the 20th century, and has been lasting in the first decade of this century, is leading Russia to be a potential source of asymmetrical wars of the 21st century. Some reasons are:
1. Russia stands at the crossroads of the three civilized world centers: the European, the Chinese, and the Islamic one. With that Russia is full of resources needed by each of the centers. It is also clear that the North American civilized center and particularly the USA will not be aside from the struggle for Russia's resources.
2. The formed trajectory of Russian economic growth has been leading the nation to be a resource agent of the world economy, and hence to further "vacate" the Russian area at the expense of its population reduction. Thus Russia is seemed to provoke the struggle for access to its resource potential.
3. As for at least the twenty years ahead, Russia will secure its defense potential that will exclude the direct military actions for its resources. Providing this, and with the purpose to weaken the government power, the unleashed asymmetric war conflicts over the Russian territory seem to be a seductive instrument to gain control on the Russian resource potential.
4. The social policy of Russia leads to stronger differentiation of the Russian population as regards incomes and living standards. This differentiation is just close to the situation when the social conflicts and uprising are very possible. Thus Russia might become both the area and the source of the asymmetrical wars.
5. The avoidance of the mentioned above prospects is possible through only such a change of the trajectory of social-economic development that will lead to the establishment of Russia as another civilized and modern center of the globe.

Introduction

As history shows, the fundamental cause of wars has been the struggle for natural resources in broad sense. It might have been the territorial resource, natural resource, human resource, and so on. The wars for power (civil wars) were also based to seize the natural resources.

1. Technological Cycles and War Conflicts

Each new cycle of technological development is characterized as involving the new kinds of resources into the capital turnover. Therefore, there is a very possibility of the struggle for these resources, and under some circumstances the struggle might be held in the form of war conflicts.

Besides, a new cycle of technological development can lead to change the powers of the established centers, which have possessed control on resources. It results in struggle for the new split of already split resources. The First and the Second World Wars are the glaring examples of this thesis.

Thus, we might conclude that the meeting point of technological cycles (the termination of one cycle and start of the next one) might potentially stimulate the war conflicts.

The transfer to a new technological cycle is a long process that might last over decades. With that each nation has its own time period of transfer from one cycle to another. Thus the threat of war conflicts is not definite as regards time period. Therefore there is a need to monitor the technological cycles to make prognosis of war conflict potentials.

2. The Specifics of the Current Technological Cycle and the Threat of War Conflicts

The specific of current cycle is that its scale and consequences embrace all humanity rather then one or several nations. It connects with that the current cycle has led to the situation when the human being – for the fist time over the history – has gained possessions of energy and technologies that could be equal to the powers of nature, and hence this problem has a global aspect. The consequences of use of those energy and technologies are just the concern of all humanity.

With that, these energy and technologies are capable to change (may be it is already begun) the biosocial nature of the human being in the scales which might be equal to those evolutions led to appearance of "Homo sapiens".

The spoken is of development and spread of technologies based on use of deep features of alive and not alive nature: biotechnology (genes engineering), technological development of processes on atomic and subatomic levels, and so on. These technologies can potentially influence on the bio nature of a human, including realizable and unrealizable efforts that can lead to disappearance or deep change of a human as the biological creature. The discussions of the possible long-run impact of radiation on genetic set are intensifying.

The special problem is a development of information technologies (IT). This development has resulted in creation of Internet. At the same time, the costs of information transfer have been reduced significantly that resulted in that more people can afford to access to the global information resources.

One of the most important political and economic consequences of this development is that in late XX century the global information net allowed the management of the resources operating in the real time mode (on-line), regardless of location of "managers" and "resources". In its turn, this has led to that the global resources became involved in the unified world reproduction that has got the name of global economy. Such a system has principally new opportunities for economic development, involving all the world population into economic activity.

On the one hand, this has been for the first time in history when there are possibilities for stable social-economic growth worldwide, for "smooth" over fluctuations of economic cycles, and for prevention of disproportions which could destroy the reproduction processes.

On the other hand, there are possibilities to capture the resources with plainly selfish purposes of their use, to aggravate the struggle for "management tools" between the rivals, which possess energy, and technologies of global application.

With that, the staff and potentials of participants in the global reproduction have changed. The new role is now played by the world organizations (World Bank, IMF, WBRD, and regional international economic organizations), and by transnational corporations 100-150 of which could be comparable to some nations in terms of economy.

There in the world economy the new "players" have appeared, including the industrial areas – the territorially independent complexes that play own role in reproduction on both the global and national levels (the economic phenomenon of “big cities” is also relevant here).

The IT has brought the new phenomenon as well – the global financial market. On the one hand, the market is rather independent of real economic sectors (“virtual economy”); on the other hand, it deeply influences on national reproduction complexes. Also, the market “gave birth” to financial speculators which can rapidly change the financial-economic situation in one or several nations.

Simultaneously, a new system of social links is being formed. On the one hand, the managers of globally informational level gain much more access to the intellectual wealth of humanity, and collaboration between civilizations is in process. It results in the intellectual breakthrough that deals with higher degrees of human thought.

On the other hand, under certain conditions there is a possibility to “program” the behavior both of the individuals and social groups. It seems real because the individual brings up him/herself through alternative of the virtual live, and it is not yet clear how it will impact on individual and on society at all.

At the same time, the big scales of productions led to “overload” of the natural environment. This situation can result in reduction of territories regarded good for inhabitation. Thus, by some assessment, by 2032 the half of the world population will suffer the lack of drinking water.

Herewith, it is not surprising that exactly the postindustrial nations are the main pollutants. The USA with its population of 4.6% of the world exhausts 20% of carbon – the largest share. As to EEC, the situation is rather the like, i.e. with population of 6.2% the carbon emission is 20% (excluding the new EEC members of Eastern Europe).

It should be pointed out that in order to reach the European living standards, Russia will have to increase its per-capita energy consumption two or three times. One can imagine the dramatic consequences of such hypothetic “transition” of Russia and, say, China which populations exceed the American population four times. But, currently their joint carbon emission is 24%.

The 2002 UN report underlined that by the year of 2032 the 70% of earth can be ecologically ruined, and the most damage will be suffered by the developing countries. Such a situation has potentiality to encourage the struggles for favorable territories as well as to change the established forms of social organizations.

It is a very important point that the technological and economic possibilities to control the global resources are in hands of a rather small group of nations which leader is the USA undoubtedly. These nations with 16% of the world population consume more than a half of all natural resources.

Thus the resource expansionism of the “Golden Billion” is accompanied by global social-economic differences. The IMF World Economic Outlook (May 2002) – which included assessment of political and economic outcomes of the last century – pointed out that the gap between rich and poor nations had increased significantly. The basic characteristic of the economic growth of the last century was believed to be the “loose of inequality” in terms of GDP per capita.

It is clear that such a situation is sure to cause some counter activity of those who have not entered that “Golden Club”. Some tendencies of the world development have shown that there is an economic basis made for the counter activity. Thus, the current technological cycle has the potential of the new global war conflict.

With that, on the one hand, the modern energy and technologies exclude possibility to use war conflicts as political means, at least, between “the members of the Nuclear Club”. On the other hand, the technological and economic advantages of the West are believed to be left very strong and stable over the near future, and it will be the factor restraining any war conflict against the West on the international level.

So, the possible war conflict for the control on resources transfers from the international level to asymmetric one, i.e. when a state or group of states confronts a not state organization that is capable to seriously damage its counterpart.

It is not very important what kind will be the not state organization: either religious, or ethnic, or else. It should be understood that exactly the global social-economic inequality has the potential of creation of such organization. In modern world there are enough people who are ready for any severe measures to bring their children out of poverty and starvation rather than to take such measures for ideological purposes. The potential leaders of such organizations will always find the recruits to implement the tasks. With that, there is a strong seduction to use such organizations for some nation's purposes of national security or expansionism. With the result, when such organizations have shaped on their own, they can count on other nations if the interests alike, in one view. In other view, another nation can stimulate a formation of such organizations to be a tool of realization of its own national policies. The vivid example is Afghanistan.

3. Russia – Potential Area of Asymmetrical Wars

Russia possesses the resources that are of interest of any existing world centers (or intended to be such one) to gain control on.

First of all, it is the territorial resource. The scale and location of Russia might be used to place the ecologically unfavorable productions. The territory of Russia is a natural "bridge" for goods in the global sales net. The many areas of Russia which are good for settlements (inhabitation), are characterized as small in population (low population density).

Secondly, Russia is the biggest potential of mineral-natural resources. Russia possesses the following resources (in terms of global):

- about 2/3 of apatite resources;
- more 40% of prospective gas reserves;
- about 40% of metals of platinum class;
- about 30% of nickel and ore metals;
- more 25% of tin;
- more 20% of coal and cobalt;
- about 13% of oil;
- more 10% of copper, zinc, uranium, lead.

The Russian government report, which was lately presented to the parliament of Russia, showed that the value of prospected minerals was equal to $US 28.6 trillion with the prospective figure is up to $US 140 trillion. The cost of total natural resource potential (mineral and other) is estimated as $US 240-280 trillion.

Thirdly, Russia is rich in wood resources, sea foods, drinking water, and it has the areas which are ecologically good for agricultural developments.

With that, Russia stands in the crossroad of the world-civilized centers – Western Europe, China, Japan, and the Islamic one. Thus Russia is full of resources needed by each of the centers and this defines their expansion for this-or-that Russian resource.

Europe needs the Russian energy resources and Russian territories to place the ecologically unfavorable productions. China needs the like Russian energy resources and territories for new settlements of its excessive population. Bearing in mind that at least for the half of this century China expects the crucial point of its economic development cycle, and hence the demand for these resources is likely increasing. For the Islamic world, Russia is a competitor in the world oil market, on the one hand. On the other hand, given that Russia is a multiethnic and many confessions country, the nation is believed to be a bridgehead for the expansion of radical companies and a source for recruiting its supporters.

However, it is clear that, in one case, the subject of expansion will be the territorial resource. In other case, the subject will be the mineral resource. Reaching the one resource might keep aside the other. Therefore, this is a matter of the strategy choice of the mentioned above world centers.

The inclusion of the separated Russian western and southern territories into some political, economic, and military unions; requirements to be interior to the territorial claims; and the “de-facto” expansion to the East are just the examples of this thesis.

It is also clear that the USA cannot make itself to be just an outside watcher of the struggle for Russian resources that might result in reinforcement of one of competing centers. Under such conditions the USA has been seeking to obtain more favorable initial positions in the struggle.

Thus, the geopolitical location of Russia becomes “a strife point” of the main world centers. With that, as for the twenty years ahead, Russia will secure its defense potential that excludes the direct military actions for its resources. Providing this, and with the purpose to weaken the government power, the unleashed asymmetric wars over the Russian territory seem to be a seductive instrument to get control on Russia’s resource potential.

4. Factors that Facilitate the Asymmetric Wars on Russian Territory

The main condition for wars to be unleashed on the nation’s territory is the lessening of the political power of the nation. The weakening of political power is mainly caused by poor social-economic polices, and weak economic position of the nation. The political power of the American government, which rests on the strong national economy, did not allow the asymmetric war to take place in its territory. On the contrary, the economic crisis and subsequent political crisis of the former USSR led to that the territory became the area of war conflicts.

In the 1990s, Russia experienced the further deterioration of its economic performances. Thus, comparing with 1989 which was the last year of economic growth, in 1999 – the worst period in terms of economy – the GDP decreased by 44.2%; the production fell by 54.2%; the agricultural produce lessened by 46.1%; and the investment into fixed capital lowered by 79.1%. These falls can be comparable to the losses of Russia during the First World War and subsequent civil war in Russia. In 1920 the Russian GDP was equal to 57% of the year 1913, the production decreased to about 20%, and the agriculture produce fell to near 66%.

With the result, in 1990s the government power continued to weaken and hence there were war conflicts taking place which constantly threatened to extend over the Russian territory.

The start of Russian economic growth as of 1998 might cherish the illusion that strategic changes have been made. First of all, it should be underlined that there is no economic growth in recent years, and no such expectations for coming years. The spoken is the restoration of the economy after the crisis, rather than the growth.

The Russian GDP of 2003 was equal to 76.4% of 1998; the production reached only 66.1%; the agricultural produce – 68.9%; and the investment into the fixed capital – 36.6%. As to the government forecast, these figures will be equal to 98.1%; 83.8%; 76.8%; and 54.4% respectively. It should be noticed that 77% of industrial production growth in 1999-2003 was achieved due to the favorable world markets, as the assessments of the Institute of Economics of Russian Science Academy showed.

However, the dynamic of investment into fixed capital is not so optimistic. As assessments show, the current and prospective amounts of investment will not be sufficient to renew the basic capital to the extent of competitiveness, and more so will lead to further wear of machinery. In 1991-2000 the number of aged-and-worn machinery increased by 2.5 times, and in 2000-2003 the number went up by 1.2 times more. It might result in real threat of technogenic disasters.

Thus, the current and forecast parameters of economic development of Russia can neither be regarded as stable, nor as well perspective.

At the same time, the poor living conditions and social difficulties of most Russian population can provoke the people to be involved in asymmetric wars. In 1992 the income of 10% of the rich was 4.5% times more than 10% of the poor. In 2003 the income of the rich increased by 14.3 times. It should be noticed that the maximum – 15.1 times – was recorded in 1994. In 1998 the figure was 13.8 times. But, in January-September of 2004 the gap equaled to 14.8% times.

With that, the "upper" 10% of population possessed 29.3% of total money income in 2002, in 2003 – 29.5%, and for the first half of 2004 – 30%. As to the "lower" 10% of population this figure was not changed in 2002-2003 and equaled to 2.1%. In the first half of 2004 the figure fell to 2.0%. As to the period of January-September, 2004, the income of the "upper" 10% of population increased by 14.8%, bearing in mind that the average increase of incomes of Russian population equaled to 9.3%.

Relatively, the coefficient of income concentration increased from 0.289 (1992) to 0.400 (2003), and to 0.404 in 2004 which was the maximum over the concerned period.

According to the assessment of Doctor D.Lyvov (chairman, economic division, Russian Academy of Sciences), the 15% of Russian population possess 85% of all individual bank deposits, 92% of all dividends from property, and 98% of all hard currency purchases.

In the picture of the social-economic differentiation of Russian population one can clearly see a large group of people whose incomes are below the formal living minimum. In 2003 the group constituted 20.6% of population.

Considering this problem in the aspect of possible asymmetric wars on the Russian territory, it should be in mind that the large gap between incomes of the poor and rich could lead to the extreme movements of nationalism. According to the social research of the Institute of Complex Social Studies, RAS, the number of Russian nationalism supporters grew up to 37.1% in 2003 (in 1995 the number was 25.1%, and in 1998 the number was 30.6%). With that, the 37.1% of supporters included 32.7% of the well-to-do and 40.6% of the poor. The number of people who did not yet decide whether to support the Russian nationalism or not, was reduced from 10.5% (1995) to 8.5% (2003).

Apparently there is no need to explain what it means for Russia regarding it is a multinational, many confessional, and many civilizations country.

It has to be noticed that the Russian president Vladimir Putin in his speech to the government – September 13, 2004 that was concerning the terrorist attack on the Beslan hospital – spoke of a direct connection between terrorism and the mentioned above problems. He said that "…the terrorism is caused by …the massive unemployment, the lack of effective social policies, the low degree of education of the young, and sometimes the lack of possibility to be educated. All of these are viewed as is a good ground for extremism propaganda, more flash-points of terrorism, and recruiting new terrorist members".

Nevertheless, the expenditure plan of the federal budget of 2005 that was put forward to the Parliament to be passed, has shown that the share of expenditures – which goes to improve the living standards of the population – is decreasing to 38.6% as against 39.7% of 2004 (according to assessment of the Institute of Economics, RAS).

With that, the share of the budget expenditures of GDP is decreasing as follows:

- in social sector from 2.79% to 2.39%;
- in utilities sector from 0.06% to 0.04% (due to reduction of this budget expenditure line by 24.4%);

- in educational sector from 1.02% to 0.83% (due to reduction of this budget expenditure line by 1.3%);
- in social policies from 1.06% to 0.92% (due to reduction of this budget expenditure line by 2.6%).

Thus, the Russian potential of asymmetric wars might develop on three following ways.

First – the struggle for the power resources inside Russia itself.

Second – the struggle for control on Russian resources from outside Russia.

Third – the discontent of the population with poor social-economic conditions can negatively influence on the external factors.

Fourth – the necessity to maintain the Russian security with the lack of strong national economy can nudge Russia into "indirect" support or non interference in asymmetric wars held by the nations-competitors.

With that, this potentiality rests on the unstable social-economic situations of the nations that are neighboring Russia on the west, south, and southeast sides and have the like potentials of asymmetric wars.

The positive change of such a situation is only possible through the restoration of Russia to one of the world powers that is capable to sustain the national security on its own.

Conclusion

Strategically weak Russia does not meet interests of any of the currently dominated world centers. The weak Russia is sure to be a "battle field" of countering civilizations, and this might evolve a threat to destroy not only the existence of civilizations which compete for the Russian legacy, but all humanity. On the contrary, the strong Russia, firstly, does not make any threat to its neighboring civilizations, because Russia's territorial and mineral resources have not been fully developed by the nation itself. Secondly, the strong Russia will be an independent civilization if there is a threat of international conflicts, and then Russia at least will be a factor to confront such conflicts. Thirdly, only the strong Russia can be a bridge between civilizations, including joint and mutually advantageous development of Russian territorial and mineral resources.

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The Information and Molecular Ages: Will K-Waves Persist?

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Abstract. We are concerned in this paper with the overarching technologies in the period corresponding to two Kondratiev cycles. The first, beginning with the downswing of the 4th K-wave will be termed the Information Era, the following one the Molecular Era. The latter is dominated by biotechnology and nanotechnology. The dramatic changes produced, such as the shift in human life patterns and space-time relationship, and the blurring of boundaries between carbon and non-carbon life, raise questions and speculations about the prospects of the Kondratiev cycles in the 21st century.

> *Nothing is what it seems, the future all the more so.*
> David A. Kier, Deputy Director
> U.S. National Reconnaissance Office

Introduction

There is general agreement that the Kondratiev or K-waves have a periodicity of 50 to 60 years (Fig. 1). We may view a cycle as consisting of two parts: (1) First, there is the downswing corresponding to the period of creative destruction (in Schumpeter's words) or innovation structural phase (Devezas' term). In the economic sphere it is characterized by stagnation and recession followed by depression; in the technological sphere it involves the development of basic innovations, the creation by innovators and entrepreneurs of a new technological environment with new knowledge accumulating in an S-shape pattern. (2) This is followed by the upswing, a time of economic recovery and prosperity galvanized by knowledge consolidation and exploitation of the new technologies, another S-shaped pattern. Kondratiev himself already recognized these phases. He wrote in 1935 that during a downswing there was "an especially large number of important discoveries and inventions in the technique of production…which, however, are usually applied on a large scale only at the beginning of the next long upswing"[1].

Each of these two components of the cycle is approximately one generation in length and each constitutes a learning process. Devezas views the generation of the downswing as the "unlucky" innovators who are the risk takers, the upswing generation as the "lucky" consolidators who reap the benefits [2].

We shall be concerned with two eras, each dominated by distinct technologies. Information and communication technologies clearly constitute the overarching technologies of the downswing of the 4th and the upswing of the 5th K wave.

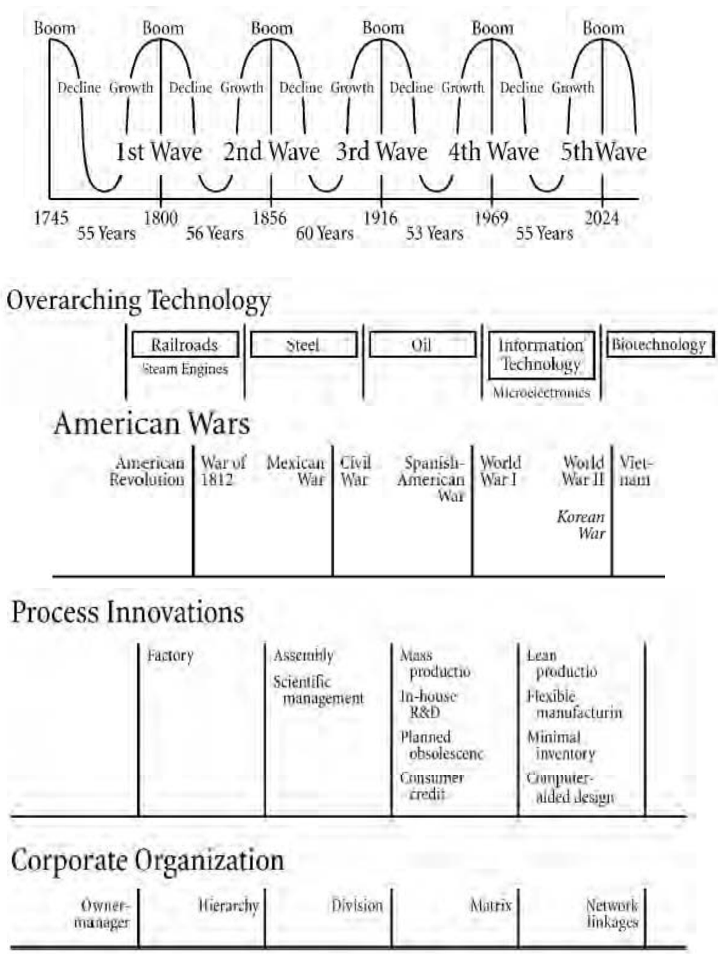

Figure 1 – Kondratiev (or K) wave cycles. Note: The K wave peak year approximations are based on Mensch [3, p. 73]. There are minor date variations among the many authors (see [2]).

Nanotechnology[1] and biotechnology are expected to play an analogous role in the downswing of the 5th and upswing of the 6th K wave. For our purposes we define these eras to begin and end at the peaks of the respective K-waves. We shall label the first the INFORMATION ERA and the second the MOLECULAR ERA. Taking each as a 55-year span, together they encompass the period of about 1970 to 2080. Perez [4] places technological eras into the societal and cultural context by means of a historical example. Frederick Taylor planted the seeds of the 4th K wave with his transformation of steel yard operations in the early 20th century during the upswing of the 3rd K wave. The downswing of the 3rd K wave in the 1920s saw the development of mass production with the assembly line as a new process technology. Other new technologies also clustered as the downswing proceeded into the trough: radar, jet engines, television, and computers. All created new industries. The trough which ended the 3rd and initiated the 4th K wave was marked by the Great Depression and the social turbulence evident in the rise of Nazism and the New Deal.

[1] Nanotechnology involves the manipulation and control of matter at the nanometer scale (nano = one billionth).

The upswing of the 4th wave led after World War II to profound infrastructure changes in the U.S., such as the interstate highway system, higher education and consumer credit expansion. A new socio-institutional environment developed. Cheap oil was a key factor and we could well label oil as the overarching technological force from the peak of the 3rd to the peak of the 4th K wave. Going even further back we can associate the cycle beginning at the peak of the 1st K wave around 1800 the railroad era and that starting with the peak of the 2nd K wave the steel era. (Fig. 1)

Returning to the information and molecular technology eras, they raise intriguing questions regarding their societal and cultural impacts as well as the persistence of K waves in the 21st century. We shall indulge in some brief speculations.

1. The Information Age

The impact of information since 1970 is glaringly apparent today as it is replacing matter and energy. Its most powerful manifestation is the Internet, which began with the Arpanet around 1970 and is now much more than a network; it is creating a parallel universe [5]. As distinct from the familiar carbon-based physical universe, this is a global silicon-based universe and it is an evolving vehicle for wealth and power. Whereas in earlier times natural resources and industrial capability were their source, now it is information. No longer are the sources of knowledge confined to the traditional ones of authority, empiricism, and God. The information "haves" will be able to exploit knowledge and the world will be increasingly divided into the information rich and information poor. Furthermore, the old boundaries and categories of knowledge become blurred and subject to continual change.

Virtual reality is a feature of this parallel universe and it carries with it enormous benefits and risks. The access to knowledge becomes universal and democratic, but so does misinformation. There is no obvious way to distinguish between truth and falsehood. Thus perception management and manipulation become feasible on a global scale and a new reality can be rapidly created. The Internet not only compresses both time and space, but it makes time the dominant dimension. "The future Internet is a place where sophisticated software agents evolve and interact in complex ways in time, not space" [5 p. 79].

We have already witnessed the dominance of the time dimension in the recent Iraq invasion [6]. Coalition commanders at forward locations had the ability to

- continuously receive updated precise information on all their own and opposition forces,
- respond rapidly to changing circumstances,
- call in precision air strikes or redirect weapon systems within minutes of receiving new information,
- have analysis of surveillance data performed by experts in U.S. centers 6300 miles away, yet receive their results in the field in minutes,
- call opposition commanders on their cell phones,
- operate effectively with a flattened hierarchy as well as leaner forces, and
- conduct "swarm warfare", i.e., rapid convergence of forces on targets, then rapid dispersal.

We anticipate profound shifts in management and operations during the upswing of the 5th K wave. The Pentagon is now building its own war Internet, the Global Information Grid (GIG). It was conceived six years ago and may take two decades and more than $200 billion. (New York Times, Nov. 13, 2004). It will fuse weapons, secret intelligence, and soldiers in a globe-girdling network. It is expected to change the military just as the Internet has changed business and will result in a new theory of war. Most significantly, it will cut through the traditional military service boundaries, as well as those between military and intelligence services. The question is whether this enormous system will be outdated by the time it is operational, a fate that has befallen previous military information systems, such as the 1960s Worldwide Military Command and Control System and Milstar, only completed in 2003 after two decades of work.

Integration of data bases is also of prime concern for the Office of Homeland Security, for example, the collection of health care information from hospital emergency rooms across the U.S. to provide early warning of biological attacks.

Organizations have to become complex adaptive systems (CAS) themselves in managing their evolution. This implies unprecedented fluidity. We see clues today in crisis management, where high reliability organizations (HRO) exhibit the ability to change from hierarchical to flat form almost instantaneously. We also already have virtual corporations. These may be of limited duration and reinvent themselves periodically. Small independent companies are linking themselves into "flexible manufacturing networks" with the aid of "network brokers". Each company makes a part of a series of joint products. Research and development, training, quality control, marketing, and accounting services are shared to create cost-effective common capabilities. A decade ago 150 such manufacturing networks were already identified in the U.S. Group cohesion will be far more difficult to maintain in this environment as loyalties readily shift.

Probably the most striking and fundamental societal effect in the 5th K-wave upswing which is produced by information technology is the simultaneous localization and globalization, sometimes referred to as 'glocalization' (Table 1). The table makes clear the pervasive nature of the impact.

Process innovations that differentiate the oil era from the information technology era include the shifts from mass production, in-house R&D, and matrix organizations to flexible manufacturing, minimal inventory, network linkages and computer-aided design (Figure 1).

The computer has become a laboratory tool and is thus changing research itself. It can perform extensive modeling to simulate the behavior of CAS and draw important insights concerning their regions of stability and chaos or the appropriate balance between globalization and localization. Of particular importance is the realization that there are inherent limits to the ability to forecast CAS behavior in its chaotic phase.

The computer can be harnessed to consider thousands of scenarios to identify, test, and shape near-term actions that yield robust adaptive policy strategies which move us in desirable directions in the long-term [10]. Another remarkable feature of our greatly enhanced computer capability is database search or data mining using database tomography and bibliometric analysis.

In the domain of conflict the impact of 'glocalization' is manifested in an increased likelihood of asymmetric warfare. Although the 20th century was primarily noted for wars between nation-states, asymmetric war has a very long history. The Roman legions fought against barbarian tribes; Cortez defeated Montezuma and his Aztec Empire in the 16th century with a force of 600; more recently Great Britain's military power unsuccessfully confronted Gandhi's passive resistance in India.

Information technology empowers the individual and small groups in unprecedented ways. Terrorists use the Internet to conceal their identities, move money, encrypt messages, plan and conduct operations remotely. (New York Times, Sept. 23, 2004). One internet site carries instructions on how to use a cell phone to remotely detonate a bomb. The Internet has become a front in the war on Al Qaeda.

The arsenal of today's terrorist may include suicide bombers, kidnapping, trucks, tankers, shoulder-fired anti-aircraft missiles, cyberwarfare, and unmanned aircraft. In the near future chemical and biological weapons will be available. Thus the individual, the proverbial Everyman, is gaining access to a Faustian power only dreamt of in times past.

Moreover, the technology facilitates loose networks and acts as a powerful memetic multiplier. We recall Khomeini's successful use of audiotapes, sent from Paris to Iranian supporters and Al Qaeda's use of videotapes played to millions over the al Jazeera network.

Terrorism generally has five aspects: (1) violence as a sacramental act or divine duty, (2) targeting non-combatants, (3) a desire for power, (4) gaining resonance (attention, theater, sending a message), and (5) getting the government to overreact, thus aiding recruitment. With 8 of the 10 fastest growing countries having Moslem majorities and a multitude of disaffected youths, the Internet plays a decisive role in (4) and (5).

Table 1 – Information Technology and Organizational Change – Some Examples of 'Glocalization' [7]

	Localization	**Globalization**
Media	e-mail, desktop publishing	giant media conglomerates, CNN
Languages	Provençal, Catalan	global English
Cultures	ethnic enclaves	"McWorld" (jeans, Coca-Cola, Disney) Global corporations and finance "the electronic herd" [8]
Religion	sects informal religious groups	global Catholic Church quasi-global Islamic nation
Crime	neighborhood violence	global crime syndicates
Conflicts	terrorism, insurgency, ethnic war "Everyman as Faust" [9]	nuclear war, electronic war
Governance	tribalism, separation (Soviet Union, Canada, Italy)	integration (European Union, NAFTA, OPEC)
Corporations	--- c o o r d i n a t i o n - i n t e n s i v e s t r u c t u r e s ---	
	internal markets	global alliances of enterprise units
	decentralized information services (American Airlines)	global sourcing (General Motors)
	customization of products (clothes manufactured to order)	global franchising (Hertz, Best Western)
	---m u l t i l o c a l or 'g l o c a l' (global-local) c o m p a n i e s---	
	McDonald	
	local ownership	
	local food variations (different chicken sandwiches in UK, Germany)	
	regional supplies/sourcing (Poland: meat, potatoes, bread)	
		global management concepts
		global quality standards
		global sourcing (Mexico: sesame seeds)
	------------- v i r t u a l c o r p o r a t i o n s -------------	
	Nokia Display Products	
	Marketing and sales done by International Technology Associates Inc.	
	Customer services and tech. support done by Trillium Industries Inc.	

2. The Molecular Age

This technology era is defined by the focus on the molecular scale, with nanotechnology and biotechnology creating a wholly new environment. We are dealing here with:
• self-assembly at the molecular level or programmed molecular factories, e.g., to create photonic crystals for data storage and transmission or low cost fault-tolerant microprocessors,
• nanotubes, molecules organized in three dimensions to store memory bits and act as logic gates, e.g., to act as absorbents for dioxins,
• genetic recombination and molecule reprogramming, starting with natural genes to develop new and improved molecules to fit diverse demands,
• embryonic stem cells that can yield medicines to combat life-threatening diseases,
• nutritional genomics and pharmacogenomics, linking genes to diet and to drug response, respectively, to improve human health,
• combinatorial chemistry, creating a vast library of molecules and evaluating them by automated techniques for factors like solubility, stability, and toxicity.

Indicative of the R&D is the new Institute for Soldier Nanotechnologies at MIT, supported by the Department of Defense, DuPont, Raytheon, and Mass General Hospital. The focus will be on nanoscale materials, active nanodevices, and active self-assembled nanosystems. The Naval Research Laboratory is also pursuing nanotech R&D [11]. Among the applications of interest:
• Reduction of the weight of soldiers' packs from 90 lbs. to 15 lbs.
• Night vision contact lenses
• Machinable ceramic superconductors
• Microfabricated electron sources
• Machine vision for integrated autonomous vehicles

We are developing micro-electro-mechanical systems (MEMS) and "smart dust", a system of millions of extremely small computers and communications devices that can form self-organizing networks of cheap wireless sensors with many potential applications in military and civilian areas.

Among the evolutionary concepts we encounter in this technology are bottom-up self-organization, emergence, adaptive capability, simple rules, codes, and self-assembly. It is a universe very different from that of physical laws, top-down organization, and stable, quasi-linear systems. Can we use the lessons of natural biological evolution to enable us to forecast evolution in a molecular technology era? The new tools - genetic algorithms, neural networks, and molecular programming - reflect the centrality of evolution as the paradigm of this age.

Just as the information technology era was built on the foundation of the industrial era, so the molecular technology era is being built on that of the information technology era. Some writers suggest that biology is becoming a computer science; others see information technology adopting characteristics of biological systems. Still others talk about convergence of the physical sciences and of information and molecular technologies.

Molecular scale operations inherently result in converging technologies. The effects with information (IT) and molecular (MT) technologies are suggested in Table 2.

Table 2 – Aspects of Convergence [12]

Information technology	→	complex system modeling, networking, multifunctionality
Nanotechnology	→	molecular engineering
Biotechnology	→	cellular, genetic organization
Four characteristics:		
1. pervasive, small:		an invisible technical infrastructure
2. unlimited reach.		
IT	→	everything becomes information
MT	→	everything controllable at the molecular level
3. specificity:		
MT	→	custom tailored drugs and sensors
MT	→	custom designed materials
4. engineering for the human mind and body:		
IT, MT	→	prostheses to extend physical and mental capabilities

The convergence of nanotechnology, biotechnology, information technology and cognitive science is creating a set of powerful tools that have the potential to significantly enhance human performance as well as transform society, science, economics and human evolution. As [this] convergence becomes more understood, the possibility that we may be able to enhance human performance in the three domains of therapy, augmentation and designed evolution will become anticipated and even expected. In addition, [this] convergence represents entirely new challenges for scientists, policy makers and business leaders who will have, for the first time, vast new power tools to shape future markets, societies and lifestyles [13, quote p. 546, Chap. 1)

Optimistic futurists insist that the 21st century with its exponential rate of growth will see technological progress equivalent to thousands of years measured at today's pace. Kurzweil [14], for example, sees an accelerating rate of technological change, leading to a "singularity", exemplified by the merging of biological and non-biological intelligence, before mid-century. He envisions nanoscale robots the size of human blood cells (medical nanobots) coursing through the blood stream and making possible internal brain scanning.[14, pp. 163, 253]. While this extreme level of optimism may be discounted by many as a consequence of the typical technologist's assumption that "what can be technically done will be done", we must also remember that historically the optimists have been right more often than the doomsday pessimists. It is certainly reasonable to expect new energy sources to overcome any energy shortages and genetic advances to overcome any food shortages and extend life. But it is also reasonable to anticipate serious adverse impacts.

This era may raise the level of weapon capability beyond nuclear-chemical-biological to an even more frightening level: genetic-nanotechnologic-robotic (GNR). It should be noted that the latter require no large facilities or rare raw materials. Massive destructive nanotech devices should be easy to produce while molecular assemblers can initiate destructive self-replication. Nuclear technology could be reasonably controlled as it was confined to the military and energy industry. However, the GNR technologies do not easily divide into commercial and military uses. Micro-mechanically generated life forms are also conceivable. Voluntary banning of research on all these technologies by any one country or NATO would not be effective as others, individuals or organizations, could take the lead in a new arms race.

Table 3 summarizes the two new technological eras.

Table 3 – A Comparison of Information and Molecular Ages

	4th K-wave peak to 5th peak	**5th K-wave peak to 6th peak**
Overarching technologies	Information Communication	Nanotechnology Biotechnology
Major paradigm shift	Time as critical dimension	Molecular scale
Management	Globalization-localization Virtual corporations	Molecular economy enterprise
Energy source	Chemical	Molecular
Intelligence	Information networks Internet as a parallel universe	Nonbiological intelligence (nanobots) Molecular computing
Industrial commodity	Silicon, software	Nanomaterials
Weapons of mass destruction	Nuclear Chemical Biological	Genetic Nanotechnological Robotic

3. Questions

We already perceive some basic characteristics of the global environment in the molecular era. By 2050 the global population will have risen by nearly 40% over that of 2000 to nearly 9 billion. Of this, mostly urban, flood of people, 40% will live in China and India. The pressure on Europe and North America produced by the demographic changes will inexorably intensify, but the tensions within the poor world will be even more severe. Adding to this the rising carbon dioxide emissions and global temperature as well as the declining biodiversity and forests, we face a distinctly different physical environment. In Sections 1 and 2 we perceived the future in terms of dramatic changes in the time-space relationship, in the miniaturization of the mass economy, as well as the blurring of boundaries between the sciences and technologies, between the real and the virtual, between carbon and non-carbon life. Energy and material resource limitations will diminish significantly. But each new age also has its downsides: we recall urban slums, sweatshops, automotive gridlock, computer viruses, as well as weapons of mass destruction.

All of the forthcoming developments will have significant impacts on the 5th and 6th K wave concept. In the words of Bill Joy, former chief scientist of Sun Microsystems,

> As [the] enormous computing power is combined with the manipulative advances of the physical sciences and the new, deep understandings in genetics, enormous transformative power is being unleashed. These combinations open up the opportunity to completely redesign the world, for better or worse: The replicating and evolving processes that have been confined to the natural world are about to become realms of human endeavor [16].

Devezas and associates have probed deeply into the factors that can account for the behavior represented by the K-cycles [2, 17, 18]. The preceding discussion leads inevitably to speculations regarding the K-wave pattern and its prospects in the 21st century.

a. Consider, for example, the contention that natural human biological clocks are determinants or drivers of the long wave rhythm [2]. We have already recognized that medicine has extended the human expected lifetime dramatically in the 20th century. The impact on social institutions such as social security systems and employment is already significant. The molecular age may see an even more significant change in human life patterns through genetics such as cell aging process modification as well as nanotechnology [14]. This could, in turn, prolong the working life span and thus the K wave duration.
b. The Internet constitutes a technology that is exerting enormous impact on the social and cultural institutions in the 5th K wave upswing. A knowledge-based society calls for fundamental rethinking of economic measures of performance. Business cycles have traditionally been identified by measures that are increasingly inadequate. In particular, they seriously undervalue information, such as the free resources we now access on our computers, and its role in productivity [14, pp. 103-107].

   In one view the analogy used is that of

   "the Earth in Cambrian times, when biological life underwent an unprecedented explosion of speciation [and] new life cropped up everywhere [with] more than 300,000 new distinct forms in a geologic instant. If the Internet is a parallel universe – a silicon-based version of the carbon-based one we know – then the incredible uploading of global knowledge we are about to experience might produce a digital explosion in which an amazing array of digital "beings" will arise. And if that is true, then the present attempts to understand the future Internet topographically will be like trying to understand the development of life on Earth by meticulously cataloging its geology! …In a Digital Cambrian all kinds of unpredictable digital life could emerge – from software herbivores that graze the knowledge bases of tomorrow to frightening new kinds of predators that would make today's hackers look like little salamanders …[T]hese digital beings leave only virtual trails – we can imagine them, but we can't actually see them "[5, p. 77].

Such powerful effect was hardly forecast when the Arpanet was deployed for connecting scientific centers a generation ago. If we still cannot fathom the depth of the impact today, how can we possibly imagine the effect of the molecular technologies on social and cultural institutions, as well as on evolving concepts of wealth and value, in the era corresponding to the 6th K wave upswing?

c. The history of U.S. wars shows a clear pattern of one major war every generation, or two wars in a K wave (Fig. 1), with one exception – the Korean War. Will this trend continue in the 21st century?

   Some clues:

•A war with fundamentalist Islam may burst into a full-scale war as governments such as those of Jordan and Saudi Arabia fall to radical elements. The failure of these states to develop economically, combined with the flood of underemployed young people, makes them vulnerable to extremist elements purveying a vision of a return to the days of past greatness. History tells us that a religious war can last for centuries.

•21st century wars may appear virtual to most citizens. It is a vastly different setting than the 20th century which produced 200 million war dead. How is war defined when the enemies may be individuals, tribes, multinational corporations, criminal enterprises, or religious fundamentalist sects? Similarly, the range of possible weapons will be unprecedented: perception manipulation via internet, viral diseases, molecular assembly of micromachines, and genetic mutations.

•Global peace is an ever hoped-for utopia, but conflict has been an ever-present feature of human existence. It is a reflection of the evolutionary characteristic of natural systems: the constant presence of both cooperation and competition. Whether this duality can be concretized into new forms as boundaries between living and nonliving blur remains for now an enigma.

d. Information is redefining and reducing the historic roles of matter and energy. Nanotechnology will further diminish their functions. For example, energy requirements for nanofactories are minuscule. Silicon and molecular combinations are resources that are virtually inexhaustible. The result may or may not be a continuation of the global energy substitution pattern observed a generation ago by Marchetti [19].
e. Finally, one must also consider the possibility that the biological determinants of the K waves are strong enough to resist the tendency to reshape human life in the molecular era and impose severe constraints on the transformations of life patterns. In particular, religious or other ideological movements may override science and technology to redefine the age in very different terms. History tells us that such a dramatic change is not without precedent.

We conclude that it is critical to question the assumptions undergirding the K wave concept in the 21st century and that we should prepare to surf waves that may give us a rather precarious ride.

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Kondratieff Waves, Warfare and World Security
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Warfare and International Security: Future Perspective

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Abstract. Warfare and asymmetric warfare is not an effect of casual events, but rather of profound general laws, which could be identified, if this problem is addressed from the future rather than from past and present, through herein offered methodology for cognition of human-community development laws. The problem of "wars and international security" could be addressed in a new perspective based on the understanding that development of human community is oriented inherently to one objective – development of a concrete individual with entire diversity of material and spiritual needs, through to the need to reach Creator's image and liking, with guaranteed equal and free access to the infinite variety of goods. Second, the time between appearance and satisfaction of any material/spiritual need of every man and whole society is the only criteria of efficiency in attaining this objective. Today such time is different for different societies and does not coincide either at any given moment or in dynamics. Therefore, if civilizations, ***peoples*****,** countries, minor/major communities and specifics humans are in ***different linear or spherical temporal space***, they will always misunderstand one another and be in confrontation rather than dialogue.

Introduction

Today, as never before, the world seeks to get out the lingering global crisis and to find a tool to block the global terrorist threat to the world stability. Many scholars and institutions are doing their R&D of proper roads to sustainable development, and the same task is in the focus of currently made forecasts for decades or a century ahead.

In February 2004, Russian mass media highlighted contents of a secret report, prepared under the Pentagon order by world's prominent experts including the venerable and influential Andrew Marshall, age 82, now in charge of the DoD think-tank. By the experts' view, U.S. and the world at large are faced with a serious and probably inescapable threat to their security on the part of environment degradation plus domestic conflicts and disorders that would tear apart India, South America and Indonesia. The planet might be plunged into a real anarchy, as countries would be using nuclear threat in order to gain and retain the shrinking stock of foods, water and energy resources. Meanwhile, as a result of nuclear-weapon proliferation, Japan, South Korea and Germany will develop their own nuclear programs, and the same will be done by Iran, Egypt and North Korea. By 2020, nuclear conflicts would start their deadly march throughout the globe. Alas, the forecast for tomorrow has started becoming true today. Together with Russia, the whole reasonable-minded world was shocked by the rampantly cruel terrorist action in Beslan, North Ossetia.

With the above examples of forecasted and actual events, it would be a bit premature to discuss sustainable development of human community. Therefore, many scholars ask a very correct question: shall we see warfare, including the asymmetric one, as a result of casual events, or rather as an effect of action by profound general laws laid in the basis of co-evolutional development of the global system? [1]

1. Methodology for Sustainable Development Analysis and Forecast: State-of-the-Art

In the late 1960s, the Club of Rome – an international NGO founded by initiative of Italian economist Aurelio Peccei, set forth a program of world-problems studies that would serve a methodology for reliable analysis of all difficulties of mankind and for forecast of its sustainable development.

As noted at the UN world forum, held in Rio-de-Janeiro 12 years ago, and at another World Summit on sustainable development (Johannesburg, 2002), global catastrophe has become more imminent, and hence the ever more acute need to identify the regularities (logical laws) determining the processes that have caused such problems. Even within interdisciplinary studies, no answer has been found so far.

By N. Moiseev, a well-known Russian scholar, “at a certain development stage of civilization, the mankind would have to assume responsibility for its further evolution”.[2]

At the same time, his book “To Be Or Not To Be … For the Mankind” contains two as if mutually exclusive statements: (i) “If a man fails to find a proper key to his relations with nature, he will be doomed to extinction”, and, (ii) “I want to warn the readers in advance that they would not find here any specific recipes for rescue of mankind. No such recipes can be available, because the future is unpredictable”. [3]

However, if this problem is viewed directly from the future, rather than from the past and present perspectives as done usually in traditional scientific knowledge, then we see that human beings can cognize the laws of their existence in evolution and to learn how to direct such evolution. It is for quite a time that this approach has been applied in my studies.

The over 20-year long search of an answer to the question as how to find the human-community development form (model), that would help to coordinate interests of any individual with interests of others and to solve many problems of mankind, produced an amazing result. To find an answer to this question and to describe the desired model of human relations, it was required to approach the higher level of theoretical thinking – i.e., to develop a new methodology of cognition of regularities in development of human community [4]. Accumulated data and practical probation of the obtained results have allowed offering a clear-cut algorithm of this methodology and the sought societal development model.

2. New Methodology for Cognition of Human Community Development Regularities

What is the novelty of the offered methodology? This new tool for cognition of regularities in development of human community is based on the systemic, cross-disciplinary and synergic approach.

2.1. The Objective Function of Societal System Development

In any cluster (civilizational, formational, national, confessional, territorial, socio-economic, organizational, etc.), evolution of the entire human community and its parts is seen through the prism of attaining the shared objective as development of an integral system. The shared objective is the one that cannot become a sub-purpose or an instrument of attaining a higher objective, and that at the same time serves a start (reverse connection) of the qualitatively new spiral in development of the whole system and each of its subsystems. If evolution of the entire human community and its parts is seen as development of an integral system through the prism of attaining the shared objective, then we can and must *juxtapose* the past, present or forecasted situation to the given *objective*. This will help to see the state of development, contents of direct and reverse connections as well as their influence on development of subsystems and the system at large. So, if any socio-economic or political system can be seen through the prism of realizing the objective, then such objective is of planetary, global nature. Hence, if we juxtapose the current practices of socio-economic and political development (in civilizational or any other context) in Russia or any other country of the world to the theoretically outlined objective, we may identify the redundant or missing links in the mechanism for its realization and then define the most rapid and thus most efficient sustainable way to realize the objective in the foreseeable future. With such theoretical approach, I have found that in any country, in any civilization, or even at the global scale *the objective of socio-economic system development* must be and is nothing else but a *concrete human being with all the diversity of material and spiritual needs, through to the one to acquire the image and liking of the Creator, with provided conditions for equal and free access to the infinite variety of goods*. Hence, the man is neither a link nor an element in the natural evolution of wildlife, but rather is its objective.

However, a human individual is as well the start of such evolution, because the first human need was not to improve the tools of labor, but rather to identify oneself as human, to survive and to reproduce a new human life. This first realized need helped the human being to realize that in order to survive and reproduce a new human life, it is necessary to satisfy the need in products that support such life. On this road, there appeared a new human need – to create and improve the tools of labor. In other terms, satisfaction of a *human* need sets a direct connection with attainment of the human development objective at the given point of time, while appearance and elevation of new needs would set a reverse connection in the system development. At the modern level of material production, when manufacturing and end consumption are divided in time and space, the most important conclusion is: if the socio-economic system development objective is *other than the human being*, such development would *inevitably* result in a blind-alley option – most probably, in a *global crisis* with catastrophic consequences. So, that man is the focus of development has been predestined superiorly and objectively, and any deviations from the given objective would cause negative consequences.

For example, if some country or civilization selects its development objective as to militarize economy, the inevitable result would be a confrontation rather than dialogue among countries/civilizations, and deceleration of domestic socio-economic growth for the sake of senseless arms race – that is, sustainable development in relation to the given objective would be impossible. Or, such objective as economic liberalization being realized, would result inevitably in societal stratification between the poor (majority) and rich (minority), and stratification of countries/civilizations by the per capita GDP, human capital accumulation, etc., and thus in inevitable confrontation rather than dialogue between them. If the whole society selects separate human needs rather than a specific man as the development objective, and preserves the same model of public production growth, oriented to satisfy the needs of abstracts consumers, then – as evidenced by the studies – it would not avoid the same negative result plus fast depletion of all resources, and would fail to attain the objective. Even if the goals were selected in the most sensitive aspects of development, as defined by the UN GA in the Millennium Development Objectives, the result would be the same. [5]

Therefore, in overcoming of crises, in a relevant selection of forms and methods of government regulating, in transformation of socio-cultural, political, and science-tech spheres of society, and in building proper conditions for transition to innovative development, the functional task is to select and theoretically support an objective for socio-economic system development, which selection would allow to address sustainable development of the given system and the proper conditions for efficient, dynamic and harmonious socio-economic development as well as for resolution of all painful problems of the world, including such as terrorism and war.

2.2. The Sole Indicator of Societal System Development

The *new methodology* for cognition is also based on the point that all the variety of processes, as well as their regularity, essence, objectivity and direction to a positive or negative *development of the human system* in relation to the objective have been viewed through the sole universal indicator, i.e. *time*. Today, neither the GNP index nor the human potential growth index would solve this problem, as the change rate of economic reality is higher than the rate of its studies. For example, the picture of the world would change immediately because of a bank crisis, bankruptcy of major companies, replacement of a political leader, etc. Moreover, as noted by contemporary analysts, most of the sources addressing the economic problems – for example, of the U.S. – tend to consider the phenomenon of the so-called 'new economy' at the empirical level. The latter circumstance is seen as a natural outcome of the current condition of the world statistics. First, sometimes reliability of statistical data is quite questionable, and the world has seen many legal procedures in this connection. China's economy is a good case in point. Purchasing power of population is quite low there. While the government says that there is no inflation, prices for foods and commodities are growing. Exactly for this reason, experts do not trust official statistics. In their view, the data of China's GDP growth – for example, by 9% in 2004 – are "puffed". Second, the bigger part of statistical data, being considered today in the study of economic developments, is a certain extrapolation of basic parameters on the base of certain models. However, most of these models were developed during the 'boom' in math programming from the late 1950s through to the early 1970s. As a result, these models, in principle, are futile to describe the phenomenon of the 'new' (that is, modern) economy in any relevant terms – at least, because the new economic growth rates do not fit within the small-error area of such models. In this sense, the modern science cannot find whether it has approached the dangerous brink of ignorance, or has crossed the latter, or still has a strong potential for future knowledge. It seems that the traditional (the so-called orthodox) science does not have solidity potential any longer. So, the avalanche-like growing human knowledge of economic reality becomes outdated immediately, as when this knowledge is used and conclusion drawn the picture of the world is already entirely different. Hence, we need another paradigm, another index and another speed of information inflow.

2.3. Societal System Development Efficiency Criteria

To receive knowledge *from the future* is the only chance to attain the level, where *knowledge* would not get outdated but rather would *prognosticate the really occurring socio-economic, political, science-tech, organizational, and other processes*. And, the *time* between *emergence* and *satisfaction* of a material / spiritual *need* of each specific individual and the society at large should become *the only criteria of efficiency in attainment of the objective*. As far as attainment of the human community development objective is concerned, we must know in advance, which socio-economic and political structures plus technological system would be relevant to the given objective, and what should be the mechanism for its realization. If the said structures and technological system are not made relevant to the objective, and if the mechanism for its realization is not available, the system could take any abnormal forms up to its self-annihilation. While finding the terms of mutual relevance among socio-economic and political structures, technological system and the objective-realization mechanism, the nearer we approach the objective, the more rapid pace of the processes. Should the time shrink, this would mean evolutional development of human community in respect to the objective; should the time be longer, the prevalence will be taken over by involution process and retrogressive movement. Many researchers do have a reason to note at the empirical level that in the course of evolution the society at large as well as individual civilizations, communities and countries experience alternatively the periods of rapid development, slow development and even collapse. The case in point is found in Russia's socio-economic situation in the reform years. For most of population, the time has grown tangibly between the emergence of, and a possibility to satisfy the need in primary goods, to say nothing of such socially important needs as education, medical care, better housing, etc. Therefore, using the term of 'view from the future', *we interpret such 'future' as the state in development of societal system, which is reached when the time between emergence and satisfaction of a need of a specific individual and society at large would universally gravitate to zero.* Then, any problem, including the one of warfare and international security, can be viewed panoramically, as if from above, from the future, and through the single prism.

As known, to forecast the future is a job thankless and sometimes even dangerous, because negative scenarios and therein laid mental forms tend to come true. However, when we proceed from the future - which is not understood as thoroughly depicted scenarios or applied vectors of development (for example, forecasts of science-tech and technological growth), but rather as the quality condition, which means minimization or, in the perfect case, nullification of time between appearance and satisfaction of diverse needs of any human individual, we understand that the future generations of humans are already thinking about us, rather than we think of them. However, while thinking of ourselves in terms of realizing the objective, we thus lay down a solid basis for future generations.

2.4. Profound Causes of Wars

So, what are the theoretical and applied fruits of the new methodological knowledge of regularities in development of global community, Russia, and each human individual, viewed from the future through the prism of goal-attainment efficiency criteria? Some results are presented briefly below.

Theoretically, by the new methodology, the time between emergence and satisfaction of the need in terms of the goal attainment is the *vector (or axis) of time from infinity to zero*. Development of mankind and its various structures through to a specific individual has been distributed along this vector in different point, and at each moment of time one could get closer to, or at a distance from the objective. The vector of time is a linear vision of the problem and can be discussed when the human community life is considered statically, as of the specific point of time. In fact, dynamically, everything is much more complex. Today the time between emergence and satisfaction of the need for different communities is different and not coinciding either in time or in dynamics. Moreover, the time-change processes can be positive and negative, cyclic and sinusoidal, direct and reverse. If these processes are considered in relation to an individual rather than to communities, the numerical value of this variety would be defined by multi-degree figures, So, every individual lives as if in his/her own sphere, under the effect of his own centrifugal and centripetal forces, within the Brownian motion, within his/her own microcosm, which does not overlap with others' cosmos. Therefore, if civilizations, ***peoples,*** countries, major and minor communities are located *in different linear and spherical space of time*, they would have different levels of consciousness, never be able to coordinate their interests or understand each other, and would plunge in confrontation rather than start a dialogue.

As Spengler stated, peoples from different communities (by my theory – from different spaces of time) are not able to communicate with one another successfully, and thereby developed theories would be incompatible. Hence the perception that one and the same historical time hosts the overlapping processes of evolution and involution development in relation to the objective; and the synergy conclusion is made that crisis, chaos, nonlinearity, etc., would be a necessary and even useful condition for development, and methods (tight rules) are being invented for co-evolution – i.e., forceful unification of different-level world into the single organism. Therefore, *socio-economic and political thinking as well as theories, developed by people living in different time dimensions, at different points along the vector of time, do not coincide and are not applicable to one another*. So, Adam Smith's concept with its 'invisible hand' of the market, which modeled an ideal structure of society where everything would be balanced while its self-motion and self-improvement would be provided, had been only correct until the imbalance occurred in the time proportions of production, distribution, exchange and consumption, and then that society was thrown far behind. The same can be said regarding the theory of Karl Marx and many others, whose teachings were correct – but only when applied to a certain mono-vector historical time.

In 1990s, Samuel Huntington warned that in the 21st century mankind would probably have to experience a new world war [6]. Unlike the past cases, it would not be caused by economic, political or ideological disagreements, but rather by incompatibility of human cultures and civilizations. So, uneven and different-vector (evolution and involution) development of various socio-economic subsystems and the whole global system has resulted in the situation, where communities from different spaces of time exist in parallel along one and the same axis of time, while their peoples reproduce different views of societal development and enter in irreconcilable relations with one another.

The new methodology of cognition gives an entirely new interpretation to such theories as evolution of machines and evolution of human beings and their consciousness. From the Neolith epoch to the present, evolution of machines has passed (with periodic decelerations and accelerations) from primitive tools of labor through to advanced complex machine systems for production of various products on the base of cal-technologies allowing to continuously improve and sustain the life cycle of these products and to arrange a more orderly technological interaction of its developers, manufacturers, as well as trading and service organizations. The second industrial revolution, started in mid-20th century and going on now, is connected with replacement of man by computers in processing information on technological coupling of machines and regulating of technological regimes of their operation. Evolution of machines is featured not only by reduction of time for manufacturing, transportation, storage and service of the product unit, but is also synchronized between the links and at junctures of different stages of the product life cycle.

Evolution of human individual and his/her consciousness is an entirely different matter. As evidenced above, the time between emergence and satisfaction of the need does not shrink, but gets longer for most of population in Russia and the whole world. Therefore, the end-consumption product, manufactured by the super-modern technological chain of machines and people, synchronized in time and space, would be demanded only by the smaller part of the population. For the rest, the end-consumption product either would not be manufactured, or would be lost – together with all kinds of resources expended for manufacturing purposes. So, on the one side we see unproductive manufacturing of unconsumed product, and on the other side – unsatisfied need. But, the unsatisfied need would not leave a room for a higher-level need and therefore would not create any purpose for production. The circle has closed. Hence, the reverse connection to the whole machines-and-people technological link starts evidently and exactly from the end consumer and his/her consciousness. It is the human consciousness that starts the reverse connection, because, as observed by A. Ivanitskiy, a well-known Russian neurophysiologist, consciousness is based on the idea of renovation (in social sciences – the idea of raising and satisfying the new spiritual and material needs – V.B.) that would attach the supreme spiritual reason to life and determine permanent human strive for novelty. [7] The above analysis suggests that if the time between emergence and satisfaction of the need tends to shrink, the given individual would have a higher-level level human consciousness and undergo evolution.

So, the herein outlined objective of human-community development, apart from being the only possible one and predestined superiorly, is as well biologically preconditioned by human nature. Incompliance with biological laws as well as disregarding and neglect of regularities in human-community development could be manifested in the form of necessity to conduct cruel repressions, or in waves of violence and insubordination flooding the society, or even in rapid deterioration of population health with the growing number of neuroses and suicides. In our view, direct (evolution) and reverse (involution) processes would take place unless the regularities, identified through the new methodology of cognition, are perceived, or unless the relevance of socio-economic and political structures plus technological systems occurs spontaneously, and all of them provide the human-community development toward the objective.

An ample illustration to this fact is found in data on IT development and on the growing numbers of Internet users, as introduction of the Web fantastically reduced the time between emergence and satisfaction of needs. So, today over a half of U.S. population has access to Internet. At the same time, Internet just starts to be introduced in life of Arab countries, where access to the web is made available only for officials of government and universities.

On the other hand, however, the United States and other countries of the 'Golden Billion' are faced with the catastrophically growing time between the emergence of the need in dollars and actual productive use thereof. Dollars are available, but it's difficult to find where to apply the same. The time of money circulation multiply exceeds the time of commodity production and commodity circulation. Therefore today, in order to reduce time between emergence of the need in USD and its real payback, efforts are being taken to find the object of investment; while in the years of great depression the manufactured goods were burned for such purpose, the current trend is to launch terror and warfare.

2.5. Warfare-Free World Can Be Made A Reality

The only possible remedy (this is my practical conclusion) would be to proceed to a new development model that would be oriented to realization of the human community's objective. To this end, it seems necessary to introduce a specific individual into the system of relations – that is, to orient production of material and spiritual goods in their infinite variety to the needs of specific individuals; to link the interests of consumers and manufacturers with a direct rather than indirect connection, and to launch the mechanism of coordination in time and space. The prospect for producers to stay with inactivated production capacities plus other potentials, and for consumers – to be left without an opportunity to satisfy their needs is an effective incentive, which would make them permanently, in time and space, to look for and find a means to reconcile their interests for the purpose of attaining their own (rather than imposed or rationed) living standard and quality of life – the life that would be secure, free and comfortable, with mature democracy and developed civil society.

All material conditions for a transition to such relations are already available on the planet. The released resources should be channeled to eradicate unevenness in development and to introduce IT, Internet included, in the life of various social strata, thus to eliminate inequality in economic, social and science-tech development, and then, as an aftermath, to eliminate poverty (this seems to be the only feasible way to realize the Millennium Development Objectives). This would *lead to synchronization of all factors of production, distribution, exchange and consumption*, as synchronization of manufacturers' work with suppliers and customers has become a most important criterion of efficiency for the companies that use Internet and logistic systems. For each specific human individual, the time between emergence and satisfaction of needs, with infinite diversity thereof, would be leveled up and reduce synchronously, and then, gradually, the entire human community would find itself in the single, real rather than virtual space of time – the space of dialogue, cooperation and security.

A most important point to understand is that today many countries, including Russia, have started to develop their national innovative systems, the arsenal of which includes the R&D of the sixth technological structure, nanotechnologies, biotechnologies, fantastic information technologies, and security-systems technologies. However, if the world continues to be a different-level one as it is now, which means that mankind would have different levels of consciousness, there will be no guarantee that these achievements would not be used for destructive purposes. Even now we see mass media reports saying that terrorist leaders and ideologues, using advanced technologies and acquiring the most advanced weaponry, cherish their plans to use mass destruction weapons. Closely associated with terrorists, criminal groups also apply the most advanced science-tech achievements in their activities. Hence, there is a real threat of entirely new kinds of technological terrorism. Extremist and terrorist organizations build strong mutual connections and may grow into powerful terrorist international networks that sometimes might become able to challenge whole states.

Therefore, the human community must see clearly what a deep precipice it has approached, and to build the proper conditions, under which the time between emergence and satisfaction of a need for any human individual and society at large would be shrinking the ever more rapidly, and the whole human community would find itself in the same space of time – the warless space of security.

Conclusion

The new systemic knowledge of regularities in development of the global community and each individual, viewed from the future perspective through the prism of efficiency criteria for attainment of the objective, has been instrumental for reaching a new theoretical level in understanding the causes of warfare. Furthermore, in theoretical and applied planes, this new systemic knowledge allowed to substantiate the possibility for transition to another development model of human relations, where reduction of time between emergence of a spiritual/material need of an individual and society at large, on the one part, and satisfaction of the given need, on the other part, would quite logically eliminate the grounds of warfare and elevate the level of international security.

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Economic Cycles in a Closed Finite World

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Abstract. Economic long cycles, driven by the uneven and unsteady growth of productive capital, labor and knowledge inputs, imply also intense material and energy flows. But the "human" and the "natural" worlds are two faces of the same fundamental interactive reality as they co-evolve. It is becoming ever more evident that the limits of the "natural" world impose limits to the "human" world. The amounts of finite resources and the rate of use of renewable resources impose constraints to the economic growth. It is questionable whether Kondratieff waves may go on or whether they will be forcibly changed by such natural constraints. When looking at the economic organization and the corresponding social formation at the basis of the world political system, one might expect renewed or unforeseen contradictions and actual conflicts to take place, eventually leading to undecided outcomes.

Introduction

Primary energy sources (such as coal, oil, natural gas and uranium) and infrastructures associated with the conversion and the transport of the derived energy forms for final use (energy carriers, such as gasoline and electricity) exhibit regular long term trends which, by time scale or by synchronization, appear correlated with the Kondratieff cycles [1]. During the XX century, the consumption of primary energy has worldwide increased at a rate of nearly 3 % per annum.

At present, we are observing the decline of the share of coal supply but, on the contrary, the growth of the share of natural gas, whereas the growth of crude oil production rate and world share are declining. This has been a slow process requiring heavy investment in long-range transportation. Worldwide trunk-line gasoducts have grown logistically to a saturation extent of about one million km over a characteristic time (10% through 90%) of about 45 years. LNG overseas transportation also grew logistically, in the size of both the tanker fleet and the annual amount of shipped gas, but up to a relatively low saturation level and in a short characteristic time.

One faces thus two problems in the near future: the constraint on oil availability right now and a likely, possibly more severe constraint, on natural gas availability in about twenty years time [2] or some time later. Expansion of either the gas offer, over a new logistic curve up to larger saturation extension and carrying capacity, or the coal production, over a new logistic curve based on innovative "clean coal" concepts, might be observed in future, in connection with a new Kondratieff long-wave. The recourse to diversified energy sources and the improvement in the use of energy (efficiency) are the main policy measures formulated by the International Energy Agency, since it was set up, in the wake of the oil crises of the 1970's. But it is becoming ever obvious that the policy measures taken so far are insufficient *viz à viz* the imminent decline of oil supply.

1. Material Growth

Since pre-colonial times, raw materials were object of commercial transaction. With the onset of the industrial revolution by the end of the 18th century, the capitalist colonial empires were set up as networks for the recollection of natural resources (and labor force when necessary) and as outlets for the export of mass-production goods from the industrialized colonial powers. Today's capitalism is not different in its purposes although being different in its means.

Entering the 20th century, the world population was 1.7 billion inhabitants; from 1950 through 2000 it increased 2.38 times, at an annual rate of 1.7%/year, to attain 6 billion. That was a dramatic acceleration of the growth of a process initiated around mid XVII century, when population is supposed to have been stabilized at around 500 million. This growth process is simultaneous with the emergence of modern scientific thought, the scientific and technical revolution and the consolidation and globalization of the capitalist social formation and mode of economic production. These phenomena of distinct qualities, cannot be considered separately in their reciprocal connections, and cooperatively brought about great changes in the organizations, level and content of production and consumption worldwide.

From 1950 through 1994, the World's aggregate GDP multiplied 5.5 times and the trade of goods and services multiplied 14 times; that is to say, since the end of the II World War the annual rate of increment of trade was 6%/year and that of product 4%/year, worldwide. In the mid 90's, the import/export volume of freight exceeded US$ 5 trillion and that of services US$ 1 trillion. At about 1950, the USA and UK together secured in excess of half the world exports flow in monetary terms, in 1987 the share of those two countries had declined to 30% whereas the share of Japan plus Germany had increased to the same 30%. An impressive leveling had taken place between the main winner (in the capitalist field) and main defeated parties of that World War [3].

In the period 1980-2000, worldwide, the transportation of sea freight increased six fold and the airfreight transportation increased five fold; in Europe, the road transportation doubled in the same period. Nowadays, 98% of the intercontinental commercial trade is carried out by sea and its volume was foreseen to grow at a rate of 5%/year until 2010. In 2005, a new generation of super containers carrier (having a capacity for 12 thousand containers of 40 m3 each) are due to come on line. Airfreight was expected to increase at the same rate. In 2008, Airbus is due to bring on line new super air carriers with 150 ton capacity and 10 thousand km range; this means to triple the capacity and double the distance of the present air carriers' generation. Overland transportation is carried out by railway, road or waterway. It is estimated to grow at a rate of 3%/year within the European space, secured by the increment of the road mode. The "logistic" service sector, urged to manage the huge fluxes of freight in ever stringent terms, relies on innovations based on the communication and information technologies to expand quickly; the cash flow of this sector being estimated to triple in a ten years time span, mostly in automated technologies for warehouses and end-to-end tracking systems, which make it possible to follow a product's entire path all the way from supplier to customer.

Population, production and trade are, by increasing order, expanding fast. How can this growth be sustained, given the closed finite world we live in? Energy, which cannot be recycled and necessary degrades, is the most likely and imminent constraint.

In the half century span from 1950 through 2000, the world consumption of fossil fuels increased 4,6 times, that is at the average annual rate of 3.5%/year, and represents 77% of world primary energy supply. This growth was differentiated, though, 2.1 times for coal, 7.5 times for oil and 12.6 times for natural gas. Coal, having been the predominant primary energy source until 1965, was then overtaken by oil which, in turn, appears will be overtaken by gas in about two decades time. Nowadays, the relative weight of these three energy sources is 28%, 45% and 27% respectively [3]. However, the resource base of coal is several times that of oil and gas (these two being similar); the substitution was driven by the superior fuel quality of oil versus coal and the technological innovations in prime movers which valued that higher quality. That is why the transportation by railway and barges gave way to transportation on road and by air.

2. Material Resources

Life on earth exists as a result of the availability of solar irradiation upon which autotrophic living organisms feed and, along the trophic chain, the heterotrophic beings feed either directly or indirectly upon those. All the relevant energy reservoirs on earth were created and are supported by that "permanent" flux of solar energy. It was the biological activity of autotrophic organisms that produced the fixation of atmospheric carbon from the primeval atmosphere in the biosphere, the ocean and the soil (and consequently led to the formation of carbonate rocks as well as fossil hydrocarbon deposits); in this process the atmosphere was enriched in oxygen, later required by heterotrophic organisms; we recall these facts because of lately there is much talk about the accumulation of carbon dioxide in the atmosphere just as a result of the intensive use of fossil fuels that consists in reverting in part the past evolution [4].

But we have come to the point when the average world energy consumption corresponds to the somatic power of some 300 billion inhabitants; that means that each individual (on average) commands 50 times his own somatic power; it also means an enormous stress put upon the environment as far as resources and wastes. Can such a situation be maintained and can economic growth be sustained? The physical difficulty lies in the finite resources that are being used; the world society doesn't subsist on free and permanent solar energy; it feeds mostly on finite sources of primary energy which, in the case of coal and now of oil too, in several countries have reached decline and are approaching exhaustion. The more accessible (more concentrate and closer to the surface) is a resource, the sooner it will harvested and used up, by the simple reason that less labor and energy are required to collect it; less accessible resources are exploited later (at a higher labor and energy cost and possibly requiring the assistance of newer technology). The progress realized in the geological sciences and the exploration carried out till the confines of the planet, in the past two centuries, don't leave room to make guesses or being surprised about high-grade fossil fuels. We have come to accept with natural inclination that gold will not be found in any significant quantities as coarse nuggets in alluvial placers (which have already been thoroughly searched), but has to be extracted from deep veins of low grade ore at high energy costs (a few grams per ton of hard rock). It is the same with oil, whose production is nowadays largely provided by a certain number of giant oil fields, already being exploited for a number of decades, and consequently getting old and exhausted, most of them having already attained a declining rate of production; so that the maintenance of the actual rate of production demands bringing into production a much larger number of ever smaller reservoirs (at higher energy costs).

Economic power requires the command of material resources and, first among these, primary energy sources. The British Empire cannot be thought of without the support of the industrial revolution, based on an abundant coal and iron domestic resource base. Prior to 1870, Britain was self-sufficient in iron ore, copper, lead and tin, and was the most important mining nation in the world by that time. In the 1860's the House of Commons raised the question whether Britain's world economic power could in the long run be threatened by the exhaustion of the coal reserves. That was the stimulus for Jevons writing the *Coal Question: An Inquire Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal-Mines* (1865); he argued that industrial growth had relied on cheap coal and that increasing cost, as deeper seams were mined, threatened economic stagnation; the importance of resource base was therefore questioned and assessed as essential [5].

USA leadership in coal production did not surpass Germany's until 1880 and Great Britain's in 1900. Leadership in iron, copper, nickel, zinc, and many other mineral commodities, was attained between 1870 and 1910. By 1913 the United States was already the world's dominant producer of virtually every one of the major industrial minerals of the time; no other country could compare with the USA in depth and range of overall mineral abundance. The relative mineral intensity in their manufacturing exports increased steeply from 1879 through 1914, the same period in which the country conquered manufacturing leadership. In 1850 – 1919, a significant materials-using bias in technological change was identified in nine of twenty manufacturing industries. A study of the world steel industry in 1907-09 places the USA at the level of Germany and slightly ahead of Great Britain, in total factor productivity; however, the installed power per worker was twice as large in the USA as compared with the other two countries. On the basis of contemporary estimates, the USA share of world's mineral production in 1913 was far in excess of its share of world's reserves. Mineral development appears as an integral part of the broader process of national economic development for the USA in early XX century as it had been to Great Britain a century before [6].

Resource abundance was evidently a distinguishing feature of the American economy, to its large advantage, and must have played an important role in propelling the USA to world economic hegemony. But there was another most important factor, namely USA's strong petroleum resource base and the technical invention of the internal combustion engine, which supported a second industrial revolution.

3. Hydrocarbon Resources

Petroleum is actually a large family of hydrocarbons whose properties reflect different origins and different degrees of natural processing. In general, the large reservoirs of light oil were exploited first, because larger reservoirs are easier to find and exploit and lighter oils are more valuable and require less energy to extract and refine. Over time, in mature regions, lowering quality has often required shifting the exploitation to increasingly small and deep or offshore or heavy resources. Progressive depletion also means that oil, that formerly emerged driven by natural pressure, requires now energy-intensive secondary and enhanced technologies to be extracted. In addition, there remain unconventional resources such as deep-water oil, polar oil, heavy oil, oil sands and shale oils which are, however, very energy intensive to be exploited.

As a rule, the energy returned on energy invested (EROI) tends to decline over time for all energy resources examined. For example, the EROI of oil in the US has decreased from at least 100 to 1 for oil discoveries in the 1930s, to about 17 to 1 today. Both heavy oil in Venezuela and tar sands in Canada exhibit rather low EROI, because they require a very large fraction of energy to be extracted as well as substantial supplies of hydrogen from natural gas to produce useful distillates. The very low economic cost of finding and producing new oil supplies in the Arabian Peninsula is inextricably related to the very high EROI value realized there. Alternative liquid fuels, such as ethanol from biomass, have very low EROI. An EROI much greater than 1:1 is needed to run an economy, because energy is required to make the machines that use the energy, feed, house, train and provide health care and so on to the workers, besides being required to extract further energy from the natural deposits [7].

Past the peak of oil discovery in the early 1960's, and given the persistence of the trend for increasing demand, since the beginning of the 1980's the declining rate of discovery has been exceeded by the rising rate of extraction. That plainly means that the world is spending fast from a reservoir for which the replenishing capacity is dwindling fast. The natural capital is being exhausted at a rate that attained nearly 20 billion barrels per year in 2002 (amounting to about 80% of the world consumption). As it is, the production capacity must peak not much later than 40 years past the discovery peaked.

This prognosis is nothing new. In 1974, King Hubbert presented crude oil production curves for both the World and the USA. He referred to a bell-shaped curve, which we can understand as depicting the derivative of the logistic curve, but he gave no equations. His initial study concerned the USA Lower 48 States, which had a single cycle of continuous exploration in a large number of basins. He founded his study in a necessary relationship between discovery and production and in quantifying the *Ultimate Recovery Resource* (that is the sum of *Cumulative Production*, *Reserves* and the *Yet-to-Find* extrapolation). He realized that the discovery cycle peaked in the late 1930s and was followed by a corresponding production cycle peaking around 1970 [8]. As a matter of fact he had already anticipated that event in 1956. Referring to the world, on the basis of the data then available (current URR are not far off his estimate then), his forecast was a production peak around the year 2000. It is to be noted that Hubbert's symmetrical curve is not generally followed in an individual field, but can better approach reality at aggregate level. It cannot account for politico-economical factors, but is a useful tool in conveying the concept of finite resource base and in offering estimates on the limits imposed by nature.

One can obtain further perception of the ongoing depletion process by looking at what is happening with the giant oil fields. The world's 120 largest oilfields produce close to 33 million barrels a day, almost 50% of the world's crude oil supplies. Thirty-six giant oilfields that were all discovered more than 40-years ago still collectively produce close to 16 million barrels a day (about 20% of the world supply). In contrast, the twelve giant oilfields found in the past decade together now produce less than 1.5 million barrels a day (2% of the world's supply). Another 20 to 25 new giant fields have been discovered but are still being developed. However, no new field whose development is now underway is projected to have production in excess of 250,000 barrels per day. In sharp contrast, the world's 19 largest old giant fields still produce on average more than 500,000 barrels per day, in spite of an average age of almost 70 years.

In the last two decades, only three giant oilfield discoveries were made, all in the 1980s, whose daily production exceeded 200,000 barrels per day. They are Brazil's Marlim field (530,000 barrels per day), Columbia's Cusiana field (300,000 barrels per day), and Norway's Draugen field (215,000 barrels per day). Only a handful of deepwater projects are now under development whose peak production will get close to 250,000 barrels per day. Two or three recent onshore Middle East discoveries apparently have multibillion barrels of probable reserves, but none seems to have the capacity to produce more than 300,000 to 400,000 barrels per day, none is close to development and all would only reach this level by 2010 at the earliest [9].

The diversity of supply is a myth. The reality is that 14 old individual oilfields alone make up more than 20% of the world's total supply, so the supply base is anything but diverse. An inverted pyramid reflects how this supply is allocated, from super giant fields (with capacity in excess of 500,000 barrels per day) at the bottom, providing 20% of the world demand, to over 4000 small fields (of less than 100, 000 barrels per day) at the top, providing 53% of the world demand. This resource base distribution highlights how critical giant fields are to the global oil supply.

4. Resource Wars

World economic powers are very well aware of the scarcity of oil and gas supply, but usually play down their concerns for the sake of financial stability. Nevertheless they are willing to go to war for securing its supply. Most reserves of crude oil and its swing production capacity are very much in the hands of OPEC, most of whose members are Persian Gulf countries; other important producing countries are in the Gulf of Guinea (including Nigeria, an OPEC member), the Gulf of Mexico (including Venezuela, an OPEC member) and the Southeast Asia (including Indonesia, an OPEC member). This is the geography of actual or potential conflict for resource wars.

According to Brzezinski (1997) [10]: «A power that dominates Eurasia would control two of the world's three most advanced and economically productive regions. A mere glance at the map also suggests that control over Eurasia would almost automatically entail Africa's subordination, rendering the Western Hemisphere and Oceania geopolitical peripheral to the world's central continent (…) About 75 percent of the world's people live in Eurasia, and most of the world's physical wealth is there as well, both in its enterprises and underneath its soil. Eurasia accounts for about 60 percent of the world's GNP and about three-fourths of the world's known energy resources (…) After the United States, the next six largest economies and the next six biggest spenders on military weaponry are located in Eurasia (…) All of the potential political and/or economic challengers to American primacy are Eurasian». The Middle East and Central Asia are at the epicenter of such a worldview converted into geopolitical master plan.

The Gulf War (initiated in 1990), the invasion of Afghanistan (October 2001) and the occupation of Iraq (since March 2003) are just some of the most recent episodes of this imperialist plan. An article published on the front page of the *Washington Post*, "*In Iraqi War Scenario, Oil Is Key Issue: U.S. Drillers Eye Huge Petroleum Pool*", September 15, 2002, begins: «A U.S.-led ouster of Iraqi President Saddam Hussein could open a bonanza for American oil companies long banished from Iraq, scuttling oil deals between Baghdad and Russia, France and other countries, and reshuffling world petroleum markets, according to industry officials and leaders of the Iraqi opposition».

According to up-to-date information, Iraq has fifty oil fields half of which are giant fields, together holding some 90 billion barrels of oil, of which about 50 billion lie in just three fields (Rumaila, Kirkuk and East Baghdad); extrapolating past discoveries, the total of past and future production is estimated at 135 billion barrels, of which 27 billion is past production. Statistics show the discovery peaked in 1948 and predicts the peak production date in 2013 (ASPO Newsletter N.º 24, December 2002). Production rate, having little spare capacity, was at about 2 million barrels a day before the invasion; under unconstrained conditions it could have been brought up to 3 million by 2010; the production rate has now been disrupted by the military occupation and insurgency.

One realizes that Iraq oil reserves are indeed important, second to Saudi Arabia, when most oil provinces around the world are either in decline (namely in USA and Europe) or are at saturation level (the ensemble of Africa, Southeast Asia and South-America). Just the Middle East and the Persian Gulf and, to a lesser extent, Russia can still provide some increment of the production capacity of conventional oil.

Iran status in the Persian Gulf is of paramount importance for a number of reasons: it holds among the largest crude oil and natural gas reserves of the world, a large and young population and a strong national identity; and it occupies a unique strategic location spanning the Caspian Sea, the Persian Gulf and the Arabian Sea (Indian Sea). Iran is obviously under threat.

With regard to oil, Iran holds 90 billion barrels of proven reserves, the fifth largest in the world. Most of these are concentrated in the Southwestern region of Khuzestan, near the Iraq border and the Persian Gulf and in the Gulf itself, near the Strait of Hormuz. With regard to natural gas, Iran holds 16% of the world's reserves, of which the larger part lies in the South Pars gas field, the largest in the world, across the border between Qatari and Iranian waters in the Persian Gulf (ASPO Newsletter N.º 32, August 2003). Iran's gas reserves are the world's second largest, next to Russia's, and Qatar follows third. Those three countries - Russia, Iran and Qatar - possess together about half the proven global natural gas reserves. By coordinating their strategies within a gas-exporting organization, including other Persian Gulf countries also possessing significant gas reserves, they could surely have a major impact on the international gas market. Among other things, they could impose rules and regulations on gas production, export and prices among a growing number of smaller gas exporters [11].

All the states of Central Asia are landlocked or border on the Caspian Sea, which has no outlet to the open ocean. A major issue in the exploitation of the region's resources is how to transport them to the world market. The construction of pipelines has become the focus of a vicious struggle among the major powers and the oil corporations. Russia favors a northern route to carry the oil and gas of Central Asia through its own pipeline system to Europe and to the Pacific coast. China seeks an eastern route through Kazakhstan. And Iran offers the shortest and most direct route southwards to the Indian Ocean. But the USA has pushed a western route, through Georgia and Turkey to the Mediterranean, as well as a longer and meandering southern route across Afghanistan and Pakistan to the Indian Ocean. For its own strategic reasons Washington opposes all the other routes.

5. Epilogue

The Oil Age dawned by the turn of the XX century, initially to provide lamp oil for illumination, but later to fuel transport, following the invention of the internal combustion engine, on which the automobile and aeronautical industries were built. Electricity generation expanded widely, fuelled first by coal, but later by oil, gas and nuclear fuels.

The second half of the Oil Age now dawns and will be characterized by the decline of oil, followed by gas, and all that depends upon these prime energy sources. The actual decline of oil will be gradual at less than three percent a year, such that the production of all liquid hydrocarbons in 2020 will have fallen to what it was in 1990. In could appear like a forced steady state economic spell. But in reality it is a devastating development because it implies that the oil-based economy has entered in permanent decline, deeply questioning the confidence in perpetual economic growth, required for capital accumulation, that has been embedded in the official economic thought and on which the financial system stands. Without the confidence on ever-onward growth, borrowing and lending dry up. Cultural difficulties are anticipated during the transition period from a phase of exponential growth to a stable state. The transition will likely be a time of acute international tension and ongoing resource wars, of which the first stages have already been set (ASPO Newsletter, N.º 50, February 2005).

Let's recall M. King Hubbert in the Hearings before the House of Representatives of the USA, in June 6, 1974: «Yet, during the last two centuries of unbroken industrial growth we have evolved what amounts to an exponential-growth culture. Our institutions, our legal system, our financial system, and our most cherished folkways and beliefs are all based upon the premise of continuing growth. Since physical and biological constraints make it impossible to continue such rates of growth indefinitely, it is inevitable that with the slowing down in the rates of physical growth cultural adjustments must be made. One example of such a cultural difficulty is afforded by the fundamental difference between the properties of money and those of matter and energy upon which the operation of the physical world depends. Money, being a system of accounting, is, in effect, paper and so is not constrained by the laws within which material and energy systems must operate. In fact money grows exponentially by the rule of compound interest. Since the tenets of our exponential-growth culture (such as a nonzero interest rate) are incompatible with a state of non-growth, it is understandable that extraordinary efforts will be made to avoid a cessation of growth. Inexorable, however, physical and biological constraints must eventually prevail and appropriate cultural adjustments will have to be made» [8].

We are living through the decisive final of the fourth Kondratieff long-wave, pending the course of technological and organizational innovations, economic sectors and political powers, which will support and launch the fifth. But in view of the foregoing circumstances, the control over the oil and gas resources and industries appears to be presently one of the deciding factors in determining the evolution of the world economy. Given the increasing degree of connectivity and complexity of the world political system, as well as the ever stricter boundary conditions imposed by the limits of labor and physical resources availability, could the historic course of the world system go through a fundamental change, a bifurcation, leading into a still undecided new economic structure?

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Innovation Economy: Challenges and Threats to Russia

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Abstract. There is a high probability of Russia's exposure to threats in the shape of military conflicts and social disruptions during the progress of the current upward wave of Kondratieff's long cycle. The main underlying reasons are the incompleteness of the constituent framework of the market economy and the inadequacy of its present economic policy. Not just impeding the emergence of a new "innovation paradigm" of economic development, they render it virtually impossible. Gaps in awareness or deliberate disregard on the part of the Russian ruling establishment of objective demands that the "new economy" places on economic development may lead to irreversible changes of a regressive, disintegrative type. Should this happen, the Russian economy may lose its cyclic dynamics and head for collapse, which is fraught with serious security threats. Proactive measures are proposed, which if developed and implemented by both the Russian government and the international academic community, could help to reverse the negative trends and to prevent and counteract the threats to international security caused by socioeconomic factors.

Introduction

N. D. Kondratieff noted the second "empiric regularity," namely that "most social disturbances, whether revolutionary or military, fall on the upward wave periods of major business cycles" [1]. It has been borne out by the extremely unfavorable course of Russia's development in the post-Soviet period.

The uniqueness of this trend in the Russian context is that disturbances were unconnected with the country's shift to a new, innovative economic growth paradigm. They were unaccompanied by either struggle for resources or marketing outlets or the mobilization of internal resources, involving strict austerity measures and social restrictions. It was largely due to the wrong choice of the economic reform strategy, as well as to efforts by globalization leaders to weaken their Russian competitor. As a consequence, Russia is not taking part in the shaping of a new socioeconomic paradigm, but instead became a major supplier of the necessary resources.

1. Some Negative Lessons

The steering of Russia, with Western "aid," to the path of so-called transition market economy came down to a barefaced destruction of its past sci-tech and production potential and the development of a 19th century version of "wild capitalism." It is an insuperable obstacle to Russia's revival, a real threat to its very existence as a sovereign state, and a potential source of grave social and military conflicts. Having lost the cold war, Russia has become, in a manner of speaking, a casualty of the fourth world war. Russia is losing territories, mineral resources, scientific and industrial potential, and population [2]. Experts gauge the decade of the 1990s as the greatest civilization crisis since the Russian Civil War, which has thrown the country back by decades [3]. During this period Russia lost about half of its GDP and basic production assets, and 4/5 of investments. The national economy underwent scientific and technological degradation: the share of the modern, fifth, technological structure has shrunk to one-third, and the share of the obsolete third and preceding structures increased. R&D spending is about one-third and its share in GDP is half of the former figures [4].

Industries and production operations, once highly competitive, which could have started so-called lead markets, are on the brink of collapse. In the aircraft and space industry the average qualified specialist has approached the age of retirement. According to experts, the loss of continuity in know-how is probably inevitable, even if the personnel training and retraining system is rebuilt [5]. In fact, the country's research and production potential is disintegrating, the public image of scientific and engineering labor is falling, and academics and engineers are underpaid.

Certain buoyancy, which the Russian economy developed from 1999 mainly thanks to the raw materials factor and the degradation of national wealth, is, unfortunately, market-dependent, very unstable, and hardly encouraging as far as the reversal of the above-mentioned negative trends is concerned. We have not succeeded in reversing the negative dynamics of "supermortality" in Russia, which is characteristic of a nation waging a full-scale war. Russia's population continues to decrease by about one million every year.

Still outstanding are crucial problems in developing the constituent foundations of a modern market economy – an efficient and socially responsible private property and an adequately priced labor, the principal market commodity. Parasitic privatization is still under way in Russia, where private property has, for the most part, low or no efficiency and often ignores public interest. The wage share in GDP stays at 30%, whereas in developed countries it may be as high as 70-75%. Given steadily increasing income differences in Russia in recent years, this poses a serious threat to the country's social and political stability. The commonly used social security threshold is an income ratio of 1 to 5 or 6. In Russia this index has been greatly surpassed, reaching 1:14 by some official estimates or 1:60 by unofficial ones.

Russia today has a "reputation" for the world's most liberal laws, which even members of international high finance find striking. A noteworthy observation was made in his memoir by David Rockefeller III, a scion of the famous dynasty, who wrote that "the passing of a law on the lowermost and single tax for all may have one of the two explanations: either the law-makers are themselves millionaires or they were bought by millionaires. No other country in the world has such a great difference between the highest and the lowest level of earnings in society" [6].

The great majority of Western experts also agree that Russia's social development is stagnant, lacks an improvement potential, features a high degree of corruption, and an inefficient economy [7]. Furthermore, some studies, e.g., by the Rand Corporation, point to a very high likelihood of the occurrence, in the short term, of social calamities and international military conflicts in the Russian territory if the above negative tendencies persist [8]. For this reason the United States Air Force, which, incidentally, had commissioned this report, was "in duty bound" to develop corresponding pre-emptive scenarios in case of Russia's very likely "collapse." They include different variants of direct military invasion of the Russian territory, also along the lines of the United States occupation of Iraq.

These sorry results of the Russian economic "reform" make it imperative that an appropriate economic policy be developed, which recognizes objective demands of modern innovative development. Adding urgency to this task is the fact that Russia's economic policy and its targets do not take into account relevant experience of developed countries.

2. Challenges of the New Economy

The emergence of a new socio-economic paradigm in the course of the current upward wave (the fifth in the traditional Kondratieff chronology) is being accompanied by the movement of developed economies to an innovative development path.

An essentially new, innovative, knowledge-based economics is evolving. The academic and business communities, as well as the ruling elites in developed countries, are becoming aware of the objective demands that scientific and technological progress places on economic growth today. These demands are incorporated in appropriate political decisions in a timely, and in most cases proactive, manner [9].

The building of an innovation economy is a systemic process, which calls for sound conceptualization and thoroughly verified implementation steps. Today, broad public participation in discussing innovative development issues and working out respective proposals leading to political decision-making is a prerequisite.

Government has an active role to play in shaping the new economy and promoting it by the use of both direct and indirect means of support. It is recognized that an advanced public R&D and innovation sector is an important factor in generating investment flows from the private sector to the domain of innovation.

A mature credit and financial sphere, geared to risk financing, is a critical instrument in building the new economy. A high and rising dynamics of financial provision is considered to be essential for the success of innovative development.

The emergence of a new, innovation structure in the contemporary context of increasing economic integration defines its regional vector. National innovative entities are transforming into a single (at least, within the EU) innovative system. Globalization processes – the global integration of innovation activities – are getting under way. Their full development is to be expected in the course of the next, fifth, K-cycle in the middle of this century. Yet, they are already quite visible in network technologies today.

Regrettably, the outcomes of the almost 15-year long “reform” of Russia’s economy, which has led to the degradation of its scientific, engineering, production, and general economic potential, preclude us as yet from meeting the innovation challenge of the time on any of the above or other known points. Moreover, it is very doubtful that this challenge will be met in the foreseeable future, as long as our official economic ideology follows the notorious Washington Consensus, which advocates the since long outdated super liberal market forms of economic management. Meanwhile little attention is being given to the philosophy of social market economy, which has been verified in practice worldwide, conjointly with “innovation order” elements.

I believe that the main threats to Russia’s development lie in the political field, in its lasting alignment to the long compromised super liberal economic strategy, and also in the great corruption and criminalization of Russian society, which permeates all of its quarters.

Liberal advisers, liberal economists, and liberal politicians surrounding Russia’s president are a serious internal threat; they will push through, typically without consulting public opinion and contrary to the vital interests of the population, very dubious and, in most cases, patently erroneous theoretical ideas, which have long been discarded in the West.

Our failure to transform the centralized economy and to create prerequisites for building an innovation economy, which are among the primary reasons behind the appearance of the threat of social convulsions and asymmetric armed conflicts, stems also from external as well as internal factors. Russia – which has failed in bringing about the socio-economic and political change required for passing to the upward wave of the K-cycle, but which used to have and, hopefully, still has the necessary potential – has become an object of patent exploitation on the part of the developed world. Its obvious aim is to remove a possible competitor and to perpetuate Russia's status as a raw-materials appendage. What other explanation can be offered, for example, for an increasingly conspicuous policy of "gentle" keeping Russia back from participating in European integration, innovation, and other cooperation actions, or for the cynically engineered mass flight to the West of qualified academics and complete scientific schools, as well as intellectual property and financial resources?

These facts are a valid confirmation of the existence of the other side of the ongoing globalization, which applies not just to backward developing countries, but also to Russia, which seems to be much too liberal economically for the present-day environment. It is increasingly lagging behind leading countries on account of the unequal exchange of goods, capital, and information. Contrary to the commonly held view outside Russia, were not Western countries that have bankrolled Russia throughout the perestroika years, but Russia that has bankrolled the West owing to the legal and illegal flight of Russian capital [10].

The Russian ruling and business elite, when establishing a modern economic policy, largely ignores an important circumstance, namely, that the global world market is more than just the acceleration and deepening of integration processes and the creation of new opportunities for national companies and populations. It is also the polarization of countries, which are segregating into those that form the core of the global system and those that form its periphery. Russia seems to be increasingly shifting to the periphery of the world's development, turning into the intellectual and technological backwoods of the world community.

3. Breaking the Deadlock

Measures aimed both at the fundamental modernization of the Russian economy and the creation of favorable external conditions can be instrumental in reversing the foregoing negative trends and preventing and counteracting security threats stemming from socio-economic factors in the evolution of the modern innovation economy under the present K-cycle. Both in the first and the second case the international academic community can make a very substantial contribution to addressing this problem. It is essential that we concentrate our efforts in following primary objectives.

We need to complete the development in Russia of the constituent framework of a modern market economy and the institution of private property, and to secure the legal and effective regime of its use with due regard for public interest, for which government and market controls must be actively used.

The imperative of Russia's change to the innovative type of development should be promulgated as a national idea, in the same way as in post-war West Germany, when it conceptualized and successfully implemented a social market economy, or in other industrialized countries building new economies. Addressing this issue is a national priority for Russia, a necessary condition preventing possible socioeconomic and military conflicts. Under the circumstances, any tightening of government control is justified, to the extent of establishing an "innovation diktat" with regard to any action impeding the progress of the national vision.

The government's role in economic policy should be cardinally enhanced. At the same time, the subsidiary philosophy, which is adequate to the Russian realities, should be observed, primarily, in developing democratic and law enforcement institutions and establishing modern financial, industrial and scientific and technological policies and the national innovation system at large. We should be fully aware that in the absence of the constituent framework for an evolved marked economy in today's Russia, the key role in creating this system should belong to government.

All the stakeholders---government, business and society---need to embark, as soon as possible, on establishing the concept, policy, specific measures and financial provision for Russia's innovative development. After making the necessary prognostic studies, priority targets and objectives of innovation policy should be defined, and public authorities be made responsible for their attainment. Broad public debate, including the media, and interactivity should be an inseparable part of this process. Special attention should be paid to comprehensive financial backing of actions in the framework of national innovation system policy and to greatly increasing outlays for R&D in the years to come. The new economy today sets the value of this index at 2-3% of GDP. Attempts to handle this problem post-haste and in the absence of requisite funds, which is the case, are resource wasteful and unwarrantable.

A possibility that cannot be ruled out, however, is that our attempts to address these issues will be impeded by the developed world's unflagging efforts toward an inequitable and unequal redistribution of financial, monopoly, natural, intellectual and other kinds of rent. Practice shows that the developed world is using increasing aggressiveness, taking advantage of its position in the contemporary world order. Therefore, it would be quite legitimate to insist on reinvesting this rent in less developed donor countries in order to remedy existing injustices and create new opportunities for these countries. This issue has particular relevance for Russia with regard to its brain drain and loss of intellectual property. Naturally, we must make every effort to restrict the practices of various offshore zones, which offer opportunities for illegal transfer and stashing of capital.

The molding of a Western public opinion intolerant to developed countries' attempts to steer their economies to an innovative course by using resources of transition economies without duly compensating them can be instrumental in resolving these issues.

It would be appropriate to back repeatedly demonstrated initiatives to form specialized international organizations with the responsibility of preventing unequal rent redistribution between developed and developing countries due to the operations of multinational and transnational corporations, as well as through international trade mechanisms, and other similar proposals [11].

We should provide across-the-board support to public debate in Russia that aims to explain the true values and principles of the market structure of today's economy and features and success stories of the assimilation of its socially oriented models. This kind of debate is supposed to promote the molding of civil society in Russia, its consolidation and the mustering of efforts for an innovation breakthrough.

It would be proper to specify that this kind of support is contingent on the broad participation not only of academics, but also of unions, government, business, and various nongovernmental organizations.

Developments in years to come may show how seriously the Russian establishment has taken these and other known challenges and threats to Russia. The absence of real shifts in its general economic policy away from the Washington Consensus line and toward modern social-market development models would mean the loss by Russia of its still available chance of building an innovation economy and entering a post-industrial future. Should this happen, irreversible alterations of a regressive, disintegrative nature inside Russian society and outside intervention cannot be ruled out. Bringing them under control, using the West's well-tested tools of velvet, rosy or orange revolutions, will hardly work in Russia. The development of the Russian economy would most probably lose its cyclic pattern and it would head for collapse, which is fraught with serious threats to international security. This scenario of developments may occur as early as the second decade of the 21st century, at the final stage of the K-cycle upward wave.

Conclusions

The wrong choice of the neo-liberal economic reform strategy, and the practice to set all government's hope upon a situation when modernization of Russian economy may happen on its own, as a result of activation of self-regulated market forces under minimal governmental participation, can be considered as the main reason for the failure in formation of national innovation economy and its simplification. Adherence to such policy has already caused considerable social disturbances and military threats. They can rise sharply in the future confirming Kondratieff's "second empiric regularity" that indicates their primary concentration during upward wave periods.

Pragmatic policy for market reforms aimed at cardinal modernization of national economy when preserving democratic values can be regarded as desirable alternative to present economic course. Alternative of this kind couldn't be realized spontaneously without rational behavior of the state. It presumes the formation and realization of the adequate structural and innovation public policy.

Implementation of that attitude could be promoted by the systematic western support of real functioning institutions of the civilized market and pluralistic democracy rather than separate groups of market-liberals.

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GLOBAL POLITICAL EVOLUTION, LONG CYCLES, AND K-WAVES

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Abstract. This paper is about the inter-relation of global politics (world security) and the global economy (K-waves). It reviews the current and prospective state of two major processes of global politics: the long cycle (of the rise and decline of world powers), and global political evolution (global level institutional change), and then ask: how they are related to the current Kondratieff (or K-) wave of the rise of the computer-internet industries (as the global leading industrial sectors). The evolution of global politics that is in the long-term period of forming planetary-level organization now offers opportunities for building a global democratic community but also suffers from the structural weaknesses of the institution of global leadership (in the long cycle), and runs into dangers of large-scale warfare two-three decades ahead. Both these processes interact strongly with the current (1975-2026) K-wave that diffuses information technology, lays the information bases of democratization, and enables world-wide cooperation but also diffuses power in the world at large, and to likely competitors. These are not forecasts but rather elements of a framework of orientation for the discussion of the next several decades of some crucial global processes.

1. Some Preliminaries

The context of this discussion is a set of ideas known originally as the theory of long cycles and more recently described as “evolutionary world politics”. Accounting for that shift was the dawning realization that “long cycles” in fact are evolutionary processes. They are a pattern of regularity in global politics but as an evolutionary process they chart change rather than exact repetition [1,2].

Evolutionary world politics (EWP) is the employment of evolutionary theory in the study of long-tem changes in planetary political arrangements. The approach is holistic – in that the basic unit of analysis is planetary; it is diachronic in that it is about processes (rather than structures) in world system time; it is evolutionary because the key to it are learning processes centered on variation and selection; and in its methodology it is social-scientific in that it confronts observational data with theory and then tests and retests it. It is not a “general theory” of world politics but it is an account of certain critical global processes.

Two such self-similar *processes* lie at the heart of this argument: long cycles, and global political evolution [3,4]. *Long cycles* have in the past half-millennium taken the form of the rise and decline of world powers, of which the most recent instances have been, the global leadership role of Britain in the 19th century and of the United States in the 20th. This has been an agent-level process involving global political competition centered on priority global problems. *Global political evolution* is an institutional-level process of millennial proportions activated by the long cycle and animating the search for new forms of collective organization and the transformation of world-wide structures away from traditional 9classical) empire and toward global governance. It is the process of political globalization, each period of which comprises (in a nested, self-similar process) four long cycles. We have here two processes that are underway, and the question is: what stage have these processes reached in 2005, where might they be heading in the next generation or so, and how do they relate to K-waves? Begin with some conceptual items. We conceive of world system time not as continuous or flowing but as discrete or grainy, reckoned in generations, and unfolding in distinct *periods*. The long cycle has a characteristic period of some 120 years (four generations), which in turn nests within global political evolution (with a period of some 500 years). Each *period* is a four-*phased* learning process: an event sequence embodying a built-in ***program*** that consist of the four evolutionary *phases* the generic names of which are variation, cooperation, selection, and amplification.

Each long cycle and each period of global political evolution (as well as each K-wave) are programmed by the same learning algorithm (that is, the enhanced Lewontin-Campbell heuristic: g-c-t-r: generate-cooperate-test-regenerate) [2]. Each such *period* is given focus by a (higher-level) problem of political organization, and by the innovations that are proposed and explored for dealing with that problem. The agenda of the long cycle is in part the function of its place in global political evolution. The periodicity is hardly what we are accustomed to expect e.g. from moon phases, but it is there, confirmed by both by empirical evidence and theoretical considerations and reinforced i.a. by synchronization.

Table 1: Political and economic globalization 1850-2080 is a partial representation of these processes that is in effect a calendar of recent global politics and economics, calibrated in terms of generations. It summarizes a century and a half of the past, and opens a window on the remainder of this, 21st, century. The table shows the phase-structure of two long cycles (LC 9 and 10), that in turn synchronize with the first two (hence preparatory) phases of “Global Organization” (that in turn is a period of global political evolution). These preparatory phases are those of (formation of) inter-governmental organizations, and the democratic transition. They run parallel to LC9 as the base-laying, informational phase of that process, and LC10 that establishes the democratic matrix (or framework) within which a form of global governance might be selected in LC11 (to reach its peak in the 22nd century). All three processes (part of an entire “cascade’) are related in a manner governed by a *power law*.

It is the conjecture underlying this argument that these learning processes reveal a program (or set of rules) that actuates the social evolution of the human species, via a process of extended group selection. The following principles derive from the theoretical analysis [in 4]: the human species is capable of self-organization at multiple levels (including also at the species-hierarchical level), over time, in a cascade of (autocatalytic) learning algorithms, and in such a manner as to give rise to interactors and replicators, and constitute a lineage, assuring continuity (for general context see [5,6]).

One other point. The processes in Table 1 are learning experiments, accounting for the *rise* of world powers, and of global institutions. That is why each such “rise” comprises two preliminary phases that ready the ground for, and lead up to, the third one that activates the selection mechanisms of collective decision and, in the fourth, achieves the completion of the process and “full tenure”. We reckon the US (learning) long cycle as extending from 1850 to 1975, with its preparatory phases lasting up to 1914-45, laying down the foundations for global leadership that was fully established only after 1940. But the United States’ (lightly institutionalized) "term of office", then started, extends beyond 1975, until another selection is achieved (on our timetable, after 2026). Thus in respect of that US cycle, the learning sequence ends in 1975, but the "term of office" lasts longer, on this accounting, until 2026, but might also appear as a "lame duck" season, in which the global political system (as though in an election campaign mode), sets up the conditions for "macrodecision", that is for a new selection, or re-selection.

Table 1 - Political and economic globalization, 1850-2080

	Evolution of global politics	Long cycles of global politics	K-waves (IT Revolution)
1850	**3. Global organization** Inter-government.	**LC9 - USA** Agenda-setting	**K17 - Electric-steel** Take-off
1878		Coalition-building	High growth
1914		Macro-decision: World Wars I, II	**K18 - Electronic-auto-aero** Take-off
1945		Execution	High growth
1975	Democratic transition.	**LC10** Agenda-setting	**K19 - Computer-internet** Take-off
2000		Coalition-building	High growth
2026		Macro-decision	**K20 - Digital-networks?**
2050		Execution	
2080	Global governance	**LC11**	

Periods (of learning process) in bold letters, Modelski [7] phases in smaller print.
Each column represents one process; each row represents one generation.

We shall now examine in some more detail problems raised by these two processes. We begin with the long cycle and follow up with global political evolution. For each we shall ask: where in its trajectory is global politics located at the present time, and what might be the prognosis for the future, up to a generation ahead. We shall then review the relationship of thee political processes to the K-wave in the global economy, another global process.

2. LC 10: From Agenda-Setting to Coalition-Building

The concept of long (or 'hegemonic') cycles of the 'rise and decline of world powers' is basically familiar to students of world politics; its principal role is to highlight the several leading states that shaped global structures, and of the imperial challengers that squared off against them (this, and the next section draws on [7]). We keep in mind that the long cycle has assumed the 'global leadership' (or 'hegemonic') form only in the second period of global political evolution, in the "long" sixteenth century, that is, midway in its (so far) millennial trajectory.

At this point in time, in the first decade of the 21st century, the new long cycle (LC10) has moved, as shown in Table 1, from the initial phase of Agenda-setting (1975-2000) to that of Coalition-building. Agenda-setting shook up the comforts and certainties of the post-World War II world, and placed new problems on the list of world priorities. The information revolution created nuclear threats to human survival, and the success of the industrial revolution brought in its train environmental problems. The collapse of the Soviet bloc cleared the way for the possibility of a majority-community of world democracies, to be acted upon in the next phase of Coalition-building. Even while the United States is still filling its role of leadership assumed in 1945, the system of global politics is now in the preparatory phases of a new "macro-decision" (selection). On the analogy of a four-year electoral cycle, global leadership is moving into the lame duck season, anticipating an approaching (s)electoral test. In the current phase, the principal question is: how will the key players of the global political system line up in view of the approaching problem of re-selection?

2.1. Alliance Systems, or Democratic Community?

The Coalition-building that on this particular calendar began in 2000 highlights this period of alignments, and realignments. In previous cycles this has been the time when blocs were starting to form that then squared off in generation-long global wars. The "balance of power" of the two-three decades prior to 1914, when the European system of states, after a period of uncertainty, came to line up into two opposing camps that ultimately faced off in World Wars I and II, is a classic example of such a formation. The current phase is equally likely to be increasingly influenced by the selection process of competition for leadership, one that is likely to set in the third decade of this century: This may take the form of a desire to oppose the sitting, *status quo,* power or else the need to line up a winning coalition that would sustain renewed global leadership that will emerge from that process if and when it prevails over the inevitable challengers, or coalitions of challengers. In the next two decades, the respective positions of i.a. China, India, Russia, and the European Union, in relation to these issues will be closely watched and their geopolitical positioning carefully monitored. The general tendency is toward deconcentration, most clearly economic and also political.

It is our conjecture, too, that a similarly strong focus of contemporary coalitioning will be the tendency for increased cooperation among democracies. Indeed that latter process may have had one beginning of sorts actually in June of 2000, when an international conference of ministers from 107 countries met in Warsaw, Poland, and (with minimal media coverage) laid down the foundations for a "Community of Democracies" as an inter-governmental organization (together with a number of associated non-governmental bodies). The "Warsaw Declaration" proclaimed a number of common principles and a follow-up meeting was held in Seoul in 2002, with a third planned for Santiago, Chile in 2005. One of the recommendations of the Warsaw conference was the formation of "democracy caucuses" at the United Nations that could become a notable adaptation of the institution of parliamentary diplomacy.

Five years onward, that Community can hardly be said to be a major feature of international organization, and the "caucus" proposal is yet to be implemented. Some view it as a potential competitor to the United Nations. A late initiative of the Clinton presidency, it languished until it was recently revived by the Bush administration, when "global democracy" is in the air again. But its future shape and governance is as yet uncertain because the Iraq war has led to much friction and loss of momentum.

The main alternative vision has been, since the collapse of the Soviet bloc, the concept of "multipolarity" That is a notion advocated prominently by President Chirac of France, but also one that at various times was also espoused by leaders in i.a. Moscow, Beijing and New Delhi. It harks back to late-19th century conceptions of balance of power just mentioned and lacks in specificity but some concrete developments may be underway i.a. in East Asia, involving e.g. the Shanghai Cooperation Organization. At bottom, and in present conditions, multipolarity is a product of deconcentration, and is a counter to unipolarity that is seen to have arisen from the predominance that the United States' had achieved in the aftermath of the Cold-War.

Do world developments of the coming decade or two trend toward multipolarity? Measured in terms of *raw power*, military force distributions at the global level (nuclear-missile-space and air-naval) suggest unipolarity but at the regional and national levels the situation is far less clear. On the other hand, the distribution of economic power (in GNP terms) indicates, with the anticipated rise of China and India, a situation that is increasingly multi-polar. In terms of *institutional power* (that is the power to influence the decisions of international organizations, in summits, UN bodies, global financial institutions, world trade talks) the situation appears even more fluid, and is currently marked by ad hoc coalitions. In other words, the strategic option of multipolarity may not be easily dismissed.

But it is also a hallmark of this current, Coalition-building, phase that, accounting for over one-half of the world's population, democracies have (for the first time ever) acquired a majority position, a condition that favors cooperation and makes war less likely among a large portion of the world's peoples. That is why arguably the other strategic option, that of democracy, has a good chance of gaining ground, and why the odds for the long term may lie on the side of democratic institutions, even at the global level. A democratic 'lineage' (the sequence of democratic-leaning world powers) runs through a millennium of global political evolution and is closely linked to democratization (the world-wide spread of democratic practices).

All in all, we are still early in the Coalition-building phase, with some two more decades to go, and much is yet to happen. Our framework suggests that the major institutional innovation of the current long cycle will be the consolidation of the transition to a majority-democratic world as the basis for enhanced global governance, but that it is unlikely to be fully in effect until after it had been fully "selected", says after 2050.

2.2. Imperial Detour?

A rounded conception of the two preparatory phases of the long cycle would also draws attention to the "lame duck" feature of that season of world politics. At a time when the sitting world power is past the phase of executing its primary agenda, that whose execution placed it in office in the first place, and whose major achievements involved the defense of clusters of autonomous states from the designs of imperial powers, friction and uncertainty arise, powered by hubris, that tend to prompt projects that amount to an "imperial detour" (a similar pattern can be observed in the "lame duck" seasons following each one of the four earlier cycles of global politics).

A case in point, and a significant current example, is the Iraq war of 2003. For in the moment of transition away from one completed (learning) cycle of global leadership, world politics is poised uneasily between the historically familiar form of large-scale political rule that is "empire", on the one side, and "global organization", as the wave of the future, on the other. The incumbents of the office of global leadership are torn between the "traditional" pull of empire and the beckoning but uncertain promises of global organization. Their primary agenda will have tackled the then urgent global problems (that included the defeat of earlier imperial challengers) but as these problems have been met, they then tend to slip into a routine, and yield to imperial temptation.

Those in positions of global leadership who succumb to the lure of empire ignore one of the main rules of their "tradecraft". For the essence of that role is 'global network control' that consists of a skillful employment of forces of global reach for constructing, and maintaining, a world-wide disposition of fleets, bases, and alliances that has in the past yielded 'command of the seas', and may now extend to 'space control'. But a specialization in network control also implies abstention from territorial conquests at regional and national levels. Those who engage in colonial wars, 'nation-building', land campaigns on the "Asian mainland", for instance, risk wasteful expenditure, and a dilution of legitimacy.

Past its second (learning) cycle (1750-1850), Britain offers an illuminating example of this structural problem. In 1899 a Conservative government authorized a war against two small Boer Republics in Southern Africa that brought early reverses and substantial casualties, and gave rise to a guerilla insurgency that was met by the deployment of large Imperial forces, all at great cost to Britain's international standing. Historians now minimize the official pretexts for that war, and stress the determination of Alfred Milner (high commissioner for South Africa) and Joseph Chamberlain (Colonial Secretary) to assume political control of the Transvaal, so as to demonstrate the strength of the Empire and to prevent trouble elsewhere in Southern Africa (in 1884-90 Germany had established colonies in Southwest Africa, and Tanganyika). Milner and Chamberlain and those associated with them came to be known as "Liberal Imperialists". Transvaal and the Orange Free State were annexed in 1902 but as early as 1910, under a Liberal government in London, all of South Africa became self-governing, soon to be led by the former leaders of the Boer commandos. One British historian summed up the lessons of that war as follows: "It put an end to the somewhat boastful type of Imperialism, which dominated the last years of the Nineteenth century, a spirit which … would have made trouble in the dangerous epoch now approaching".

The Boer war was hardly an isolated incident in the period that followed Britain's second (learning) cycle. The prevailing foreign policy orientation of Conservative governments under Lord Salisbury was one of going it alone, of shunning alliances, and a free hand. By 1858 Britain government was ruling over the entire Indian subcontinent, and in 1877 Queen Victoria was declared Empress of India. The other great powers each had their own imperial designs: i.a. France in North and West Africa, Russia in Central Asia, Italy in the Horn of Africa, Japan in Korea and China. But for Britain the Boer war had revealed the dangers of its isolation that some had earlier called "splendid". The war's ending was followed, in short order, by the Anglo-Japanese alliance (1902), the *Entente Cordiale* (1904), and the Anglo-Russian agreement (1907).

The South African war experience suggests, in an optimistic scenario, that 'imperial detour' is a structural problem of the 'lame duck' phases of the 'global leadership' period of the long cycle that is troublesome but not beyond remedy.

2.3. What Shape Macrodecision: Global War, or Democratic Process?

A 2005 US intelligence analysis asserts that "the likelihood of great power conflict escalating into total war in the next 15 years is lower than in any other time in the past century" [10]. But looking beyond 2020 we come to the next phase of the current long cycle, its "selection" phase of Macrodecision (2026-2050). In the four-five earlier cycles this was the phase that generated global wars, and as their product, new leadership. A consensus of world system history scholars judges this to be a period fraught with dangers of large-scale warfare [8]. In fact, such a "worst case scenario" cannot be excluded from an assessment of world security two-three decades ahead. But our long-standing argument has been that in principle there is no reason why in this case the process should not assume a new form, in that the global polity could arrive at a collective decision about leadership and global priorities without resort to large-scale violence because substitutes for global war can arise from within an emerging democratic base. For it is the chief characteristic of democratic procedures that they are explicit substitutes for civic or internal violence and civil warfare [3].

We might consider two scenarios: in the first, an emerging global democratic community, comprising not only the majority of the world's population, but also the preponderance of its military, economic, and technological resources, and forming a majority "party' within international bodies, in fact guarantees world peace. This arrangement might present such unassailable strength that a direct military challenge would obviously be unproductive, if not utterly disastrous. But such position calls for constructive initiatives and some structural innovation in the institution of global leadership.

The second, multipolar, scenario, is more "traditional" and allows for the possibility of alliances between the several poles of that system, and within the United Nations, hence also between democratic and non-democratic states. This alternative could cut the chances of a polarizing divide but is basically opportunistic and courts the dangers of large-scale military confrontation possibly leading up to a nuclear catastrophe.

So much for the *form* that a contested macrodecision might take two-three decades from now. We need additional information to answer about its *substance*.

3. Evolution of Global Politics is Political Globalization

As we noted in the introduction, the basis of this approach to world politics is evolutionary. Since we know that in the past millennium politics at the global level has undeniably undergone dramatic change, such structural transformation is best explicable with the help of evolutionary concepts. From what we know of that millennium we can tell that such change has been regular, and that an evolutionary explanation makes sense. What slowly but in its own time is evolving through processes of innovation and selection is global-level organization that is a necessary condition of on ordered world society, and that organization evolves via the mechanism of evolutionary learning. We can call that process political globalization.

The evolution of global politics is a higher-order learning process than the long cycle just reviewed. It is a process of globalization because it is creative of political institutions of worldwide scope albeit in *periods* spanning half-a-millennium. It is one of political globalization because it accounts for the formation of political structures that weave together several strands of relationships of worldwide range. Where earlier, in the classical era, political interaction was mainly either local or regional, at about the year 1000 interactors (conquerors, traders, explorers) began to emerge at the planetary level and they set in motion a process of global political evolution. Driving that process at the agent level are long cycles of political competition but at the higher, institutional, level this adds up to global political evolution. That is creative of globally active rules, agents, and organizations.

Since the start of the modern era, about 1000, global political evolution has established, in its *first period*, the technical preconditions of global order, in part by defeating the project of the Mongol world empire. The *second period* (say 1430 to 1850) created the (oceanic) nucleus of global organization by defeating (continental) imperial challengers, in a process that fashioned the institution of global leadership. The two British cycles were the mature form of that structure as it moved from selection to amplification. The *third, current, period*, is shown in Table 1, from 1850 onward as "Global Organization", that is to be completed in about two-three centuries. If the first period was one of no (or failed), and the second one of minimal organization, the third is one of selecting an adequate structure (to be completed in the fourth period). By adequate structure I mean one that has the capacity to master the problems of human survival, especially those posed by threats that are nuclear and environmental.

Where in this scheme do we stand at the beginning of the 21st century? The *third period* of major institutional innovation that takes the form of "global organization" that we have now entered is certainly critical. That period is currently in the second (hence integrative, community-building) of its preparatory *phases,* and it lends an agenda to LC10 that, as we have earlier noted, centers on the democratic transition. That in turn lays the ground – the sub-structure of solidarity – that will serve as the foundation for significant institutional change in the next (selectional) *phase* of that process, a century from now. Table 1 shows that since about 1975 we have been in that second, cooperation-oriented, *phase* of "democratic transition", and that phase might extend to the last quarter of 21st century.

The prognosis is this: global politics has been, since 1850, in transition to a presumptively democratic global organization (facing off challengers that offered anarchic, Nazi, Communist, and now Islamist, substitutes), and that means that the US cycle has been no mere repetition of the British experience, but was shaped by that very fact. But at the start of the 21st century we are still in the second, cooperative, or transitional, *phase* of that process that is unlikely to be completed until mid-21st century. This will establish the solidarity matrix within which future global organization will take shape. It is less likely to emerge from within a system of multipolarity. As political globalization gains additional strength, the control of world organizations, e.g. via majority voting blocs or veto power, (hence institutional power) will increasingly become the condition of organizational leadership. Such a context will favor a functioning democratic community; it is less likely to encourage multipolarity.

To recapitulate, global politics is now approaching end of the "term of office" of sitting global leadership, say in two-three decades time but the procedures of renewing its mandate remain uncertain. In even longer perspective, we are now in the process of evolving new organization to tackle global problems. How are economic forces likely to interact with these developments?

4. Global Political Processes, and Economic Globalization

Long cycles have a close affinity to K-waves (just as global political evolution parallels the evolution of the global economy). The rise and decline of world powers runs in tandem with the rise and decline of leading industrial sectors (except that to every one long cycle correspond two K-waves). Both are evolutionary processes in that they exhibit, at the minimum, variation (innovation) and selection (power or market competition). They are therefore self-similar (symmetric across scale), nested, in that K-waves, initially locate in world powers, and synchronized. They are also in the first place global, processes viewed primarily in a qualitative fashion [9].

The computer-internet K-wave (or K19, see Table 1) took off in the United States, and more precisely in California's Silicon Valley at about 1973-75 (Intel microprocessors), and around 2000, after experiencing a (selectional) shake-out, entered upon high growth likely to last some two-three decades. While shaping and reshaping the global economy this has been a burst of innovative energy spearheaded principally by American enterprise. Its significance lies primarily in the qualitative changes it has wrought in the world economy.

As such K19 serves as a productive platform that, overall, could support a bid for a second "term" of global leadership. For the United States, it has renewed its status as a "lead economy" and boosted the productivity of American enterprises, and that in turn helped to generate resources in support of global action. Just as K17 and K18 provided the sinews of American power in World Wars I and II, K19 has induced a "military revolution" in equipping US forces with high precision-guided weapons earlier than others, and enhancing their capacity for global reach.

A principal worldwide impact of K19 has been a dramatic increase in global connectivity. Most prominently, the information revolution favors networks. In the past several decades, instantaneous communication became not just possible (as it has been since the 1860s) but user-friendly, widely available, and virtually costless. By the end of K19, the majority of the world population is likely to be connected to the Internet. Critical events (such as a war, or a catastrophic tsunami) can now be observed, and assessed, worldwide, from day one. This creates conditions favorable to community-formation, even on a planetary scale, and makes a global democratic community conceivable, as well as practical, for the first time ever. The community of democracies is just one instance of possible global networks. More generally, it creates increasingly well-grounded opportunities for collective and cooperative action.

However, past 2000, K19 is now in the phases of high growth, and the advantage now increasingly shifts from early to late adopters. Producers outside the United States have mastered the manufacture of computers and the writing of software, and joining the Internet-cell phone explosion. The relative advantage of US producers and users of the new technology is declining, competition rises, and new productive centers, as in China, India, or Brazil, emerge, while older centers, as in Europe or Japan, retool. Such trends reinforce multipolarity.

The Internet favors the emergence of a democratic community but (if it survives as a planetary infrastructure) it also helps to promote a wide variety of other global networks. It has been argued that for Muslims in non-Muslim countries it helps create a virtual community, serving to make concrete the abstract concept of the Islamic *umma. G*lobal networks such as al-Qaeda, can use it to address pronouncements to international publics, encrypt messages, raise and move funds, and plan and conduct operations from remote locations. For insurgents, especially in urban contexts, it is one instrument for conducting asymmetric warfare.

K19 is in the high growth phase that will take us into the 2020s. What is next? We do not know for sure because the set of innovations that will define K20 are yet to surface. We might speculate, though, that they could extend, and complete, via the process of economic globalization, the entire series of four information-bearing waves, by responding to the global problems now on the horizon. They might firm up the democratic transition of the world system, by making it world-wide, and war-proof, and furthermore, both on the very small scale – possibly nano- and bio-, and at the very large, in geo-, and possibly space-technology, and might make the world system capable of meeting the emerging threats to the environment (such as, for instance, the climate-changing effects of rapid urbanization via large cities, sources of heat, and of carbon dioxide).

5. Summing-Up

1. *Coalition-building:* “the shape and nature of international alignments is in a state of flux” [10]. Looming ahead (through our theoretical lenses) is the approaching expiration of the current “term of office” of global leadership. Rival coalitions are beginning to form around that issue.

2. *Democratic Community:* is in the process of emergence, strongly aided by the diffusion of democratic practices aided by the information revolution. Such a “democratic transition” to a majority-democratic world system is the principal innovation on the agenda of the current phase of global political evolution.

3. *Macrodecision – global war?* Democratization makes it possible to argue that the evolution of democratic procedures at the global level might facilitate the avoidance of global war as a mechanism of selection of new leadership, and of global policies responding to new challenges.

4. *The United States' status as lead economy* in the Information Revolution, as well as their position as open democratic society, are at this time two of the factors making probable American re-selection to a second term of global leadership in an evolving global democratic polity.

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The Social Progress and Security Problems

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Abstract. The article seeks to define social progress in the context of current security problems. It focuses on the security threats that are brought about in a contemporary world by inappropriate means of spreading the Western-type social progress and related conceptual, political, ideological and cultural values.

Social Progress

The definition of "the social progress" is a common notion in the dictionary of every politician, but we do not always think about what really it is: a real phenomenon or just fiction! One cannot ignore the issue of its transformation into the modern and historical conditions. We have the traumatic historical experience of the 20th century, two world wars, the threat of mankind self-destruction during the period of the "cold war", and finally, the events of September 11, 2001, Afghanistan and Iraq campaigns of states' coalition leaded by the USA.

Considerable skepticism of many theorists and analysts in the existence of the social progress phenomenon is not hard to explain admitting some socio-economic realities that brightly emerged at the end of 20th century. The analysis presented by G.P. Martin and H. Shuman in their monograph "The Trap of Globalization: Attack on Prosperity and Democracy" illustrates to some extent the issue.

It is conventional knowledge that at the end of the last century just 358 billionaires had "… the same wealth as the 2,5 billion people, almost half the Earth's population"[1]. Therefore, unlike past periods, the level of wealth concentration and opportunities related to it substantially increased. This fact inevitably gives birth to the process of socio-economic misbalance and the subsequent misbalance of socio-political, socio-cultural, recreational and spiritual spheres. Such deregulation ignites misbalance of social aspirations, which is fraught with worldwide social cataclysms.

What is more important is that several contemporary processes determined a specific situation. Some experts say that according to this type of situation in this "…century only 20 percent of the population will be sufficient for the functioning of the world economy.. …These 20 percent no matter in what country will actively take part in the life of the society, earn and spend …"[2]. What about the rest 80 percent of the Earth's population? …We hardly have enough sufficient grounds to suppose that they will tolerate such situation.

At this point a lot of questions arise. Future of mankind actually depends on the answers to these questions. First of all, let's spell out the above mentioned question: can we use the term social progress to define the situation, in which according to Martin and Shuman "…the world by and large is mutating into the lumped-planet, main part of its wealth is concentrated in megalopolises full of mega slums, where billions of people live miserable lives”[3]. It looks like that we cannot.

All the more so the greatest socio-economic misbalances in the contemporary world lead to distortions in the humanitarian sphere - in the range from any kind of xenophobia to the religious zeal, represented by unhidden extremism and terrorism. Such manifestations are typical not only for the countries of the third world but also for the developed countries of Western Europe and United States.

According to the above-mentioned authors, during recent years “Canada and Belgium are being disturbed by conflicts among their linguistic groups. In the United States where waves of immigrants acquired common nation-wide language, millions of Latin Americans even from second and third generations discard English nowadays. Tribalism (division by tribal indications, giving preferences to the persons from own tribe) grows around the world and in many regions it can directly lead to aggressive nationalism or regional chauvinism [4].

“Xenophobes take offensive stance even in Sweden, the country that previously was known for its openness same as in Switzerland, Italy, France and Belgium”. That is why G.P. Martin and H.Shuman state that “… the everyday life of the major part of the mankind is not formed by the progress and the rise of welfare but by the disintegration, environment destruction and cultural degradation”[5].

It means that people do not dream about welfare as such, but more about security. They strive not to live but to survive. That is why if we address the issue of social progress, it currently makes sense to interpret this notion not as the form of setting man free from any form of restriction and oppression (starting from the economic to social restrictions) but as a form of raising the level of personal, state and mankind security.

But the main historical paradox that we face nowadays is the fact that despite increasing the means and technologies of providing security, the number of threats does not lessen but on the contrary, it increases. As in the old myth about the Hercules and his struggle with the beast, when one cuts the beast’s head appear two new ones. This analogy is not occasional while any technology that is invented to defeat some threat eventually gives birth to new dangers and subsequently creates the feeling of historical weakness of the man in this eternal struggle with natural and social Evil.

A situation has emerged in the world, which Doctor Mattias Rat, who is considered to be the “conscience of the world”, characterized in the following way: six billion people live nowadays in conditions of growing crises, new wars and corporations’ greed.

Mentioning of the corporations makes us remember about globalization, which in spite of its ambiguity is quite often identified with social progress. I mentioned about it because the process of globalization – it’s not only the one among the main trends of the world development but also is the indirect characteristic of the new system of international economic and political relations that changed the system which existed from 1945 till the beginning of 1990s and was characterized by the opposition of two super powers: USSR and USA.

The new system of international relations depends much more on economic interests of market economy, than on altruism of political and ideological decisions. While market relations with reservations are recognized to be the optimal index of social progress then “globalization” from the first glance is also considered to be an unambiguous criterion of the progress. Nevertheless the growing process of globalization gives birth to new problems for states and regional interstate unions, one of which is the security problem.

The problem of security in the context of globalization could be viewed differently, depending on the aspect of globalization, which will be chosen to be the focal point. Considering the process of globalization as the spontaneous objectively determined process of extending the world labor division accompanied with integration and cooperation trends between the world's economies, creation of supranational regional and international institutes, than the security problem will attain one dimension. The other face of the problem is if this process in its political and economic content is the result of coordinated actions of some group of countries, directed towards solving certain problems and reaching specific goals.

However, in the phenomenon of globalization there are objective and subjective constituents. Events of global policy show that spontaneous tendencies towards integration of economies and political systems of certain countries into a single world political and economic system at present are consciously being used by the most developed states of the world to protect their interests. These governments launched the unification of international system into an amalgamated whole but this time on the other grounds - on the basis of free market and democratic state system of western style.

Precisely this course directed towards the unification of the world on the grounds of western European political and economic model is being consistently implemented by the governments of developed countries, not necessarily taking into consideration interests of lesser-developed states. This approach in its essence is similar to Marxism, which allowed to identify such type of conscience as "market fundamentalism" (George Soros) or "imperialism of neoliberal mind" that probably led to the birth of the "liberal empire" of A.Chubais. Precisely this process determines the setting up of the security issue in the context of globalization, including different aspects of the security problem. Also it specifies various security aspects, e.g. national security, security of regional integration blocks, security of sustainable development of the world, information security etc.

The main problem which I would like to focus is that globalization, contrary to the meaning of this word, touched only the small group of developed countries. To be more specific, it spread almost around the whole world; however only the most developed countries enjoy the opportunity to use its results.

For instance, 81% of foreign direct investments are directed towards the countries with high standards of living – USA, Great Britain, Germany and Canada. Concentration of capital in these countries has increased during the last quarter of century for 12%. As result of this situation the great number of less developed countries entering the world economic and political integration on disadvantageous conditions, refuse to accept the role of raw material providers or the role of agricultural supplement of industrial and postindustrial world.

Whereas these countries in their greater part are the carriers of other cultural types, the socio-economic underdevelopment complemented with the cultural differences exacerbate the estrangement of the population of developing countries of non European (mostly Islamic) world from the developed states of the West. These countries do not want to see they playing the role of the object of western cultural expansion.

Therefore, the essence of the problem of worsening the state of security during globalization – which is the only possible present scenario of social progress – is not only the gap between poverty of the third world countries and the wealth of a small number of "leading states", which are utilizing 40-60% of the Earth's resources, but in the conservation of this gap, supported by the ideology of messianic liberal market that West is trying to implement in the rest of the world. In this regard, for the leaders of the developed countries it is important to admit that in the period of the worldwide political awakening and common international vulnerability security depends not only from the military power but also from the prevailing atmosphere of thoughts in the society, political interpretation of social emotions and centers of fanatic hatred.

Therefore, in the current situation of reviving colonial thought there are grounds to beware of the retaliations from the backward states, which are practicing in their radical form the anti-west extremist ideologies and terrorism. These days more and more signs appear that during the next decades the threat of terrorist actions would determine political and economic life. Reasons are concealed not so much in the constant growth of disproportions between rich and poor of the world's regions but more in the swift deepening of inequality between military potentials of leading technological countries and the "rest of the world". Terrorism is not, as it is often said, the weapon of the poor – it is the mean of struggle for the poor. In this regard it replaced the guerilla war complemented with its defense strategy, which carried out this function for a long time during the 20th century.

If we can relate social progress solely with achievements of western civilization because it supposedly consistently created conditions for the versatile economic, political and cultural liberation of men, than the prospective spreading of such model around the world should be considered useful and desirable. The utopian approach of violent intrusion of such principle to other countries and local civilizations with lower level of economic development, gives serious grounds to forecast the failure of such project around the world. In the framework of this approach, governments of the developed states on the basis of mythological determinism make the same mistake that was previously made in the Soviet Union with its revolutionary liberating movement.

It should be emphasized that the symptoms of such failure will be the increasing security risks and threats in various aspects and manifestations. Such risks and threats could be generalized as in the following analysis, relying on three main points.

1. The Transformation of the Classical Understanding of Democracy into the "Democracy of Financial Groups"

The essence of such threat is that economic globalization while creating the optimal conditions for existence of financial groups simultaneously creates conditions to ignore the sustained principles of international law (sovereignty, non-intervention into domestic affairs of the states, territorial integrity) thus it makes states' borders transparent. The democracy of financial and economic groups differs from the traditional understanding of this definition mostly with the fact that in this type of democracy the basis for decision-making is in principle that of the IMF voting where the number of votes is proportional to the amount of money invested by the voter to the statutory fund.

In this regard, the prevailing principle of implementing the neoliberal globalization that gradually becomes more and more popular in both developed and developing countries, subordination, changing traditional understanding of democracy puts as the top interest of the whole system – the interest of it's (system's) main branch, which consists of leading financial and industrial groups. Support of such order and guaranteed subordination from other members of the world community is provided using methods of power and military influence. USA has clearly shown this type of influence in Iraq.

The menacing symptom of such trend has been the changing of the UN functions that after the well-known recent events stopped to serve as a guarantor of national sovereignty and national security and to protect weak states against the despotism of powerful.

2. Predominance of the "War Ideology" and Various Forms of Intolerance Over Ideologies of Tolerance and Mutual Respect

The above-mentioned form of ideology is so widespread and penetrating into international relations that it could be really considered as "global". At first sight, the mentioned threat refers to ethics, i.e. humanitarian sphere. It is hard to predict real consequences of such transfer of neoliberal economic competition principles towards international relations in general. However, the fact that in international relations "the power of law" is latently replaced with "the law of power", by the ideology of predominance, by the strategy of gaining victory over real or virtual “enemy” testifies about the real danger of cataclysms, the most impressive omen of which, but not the first one, was the 9/11 terrorist attacks.

This ideology is thrown into public mass consciousness in the form of respectable conceptions of “geopolitical realism”, “clash of civilizations” (S. Huntington), Islamic fundamentalists ideology of intolerance. Moreover, absence of alternative to these mythologies of domination and total war threats to cause a chain of permanent violence. Let us give some examples of the ideologies mentioned.

Aggressive nationalism of the lesser developed states. Present type of threats to security originates in clash of the two opposite trends: a) peculiar globalization trend of internationalization and cosmopolitation of all societies’ and states’ vitality processes starting from economy and concluding with cultural influences, opening all kinds of borders and elimination of all separations both geographical and social; b) strengthening trends by young and developing states of their sovereignty using ideological nationalistic slogans.

In the same way as economic processes previously caused nationalism, while creating centralized linguistically homogenous society, nowadays these essentially transformed economic processes promoting the crash of national frontiers by creating common integrated world market. Development of global economic forces forms the new world which is a more integrate one where some substantial functions of sovereign state fade away, the new economic situation demands adequately educated labor force and mobility as a factor of increasing productivity of labor. However this process caught unawares young (for instance, on post Soviet space) and developing states, where formation of political nation is in full swing. Ruling elites of these states believe that internalization harms this process and oppose it with all means. Such opposition could acquire various forms starting from isolation, armed struggle and concluding with encouragement of international terrorism against developed countries.

Xenophobia and racial - ethnical intolerance of rich countries. Movement of huge masses of emigrants (it could be emigration on both economic and political reasons) from poor countries to more developed and richer ones, constitutes the essence of this process. From poor countries people immigrate to regions with higher standards of living and this “South-North” flow constantly increases. Taking into consideration prospects of world demographic development this flow will further increase. It becomes harder and harder, for example, to stop a stream of Algerians to France, where multimillion Arabic community has already settled in and where a worker earns about $ 30 000 per year comparing with $ 700 in his home country.

According to the World Bank data emigrants send their families at least $ 70 billion per annum. This amount considerably exceeds official help of rich countries to poor ones. Only oil export profits exceed this amount. This circumstance causes an outburst of hostility to foreigners (xenophobia) in developed countries. Ethnic intolerance and discrimination gradually become the common phenomenon in all parts of Europe that strengthens the danger of coming to power extremist national forces in European countries, possibly, even with fascist flavor. Therefore, Western opposition arguing against emigrant flood is supposed to strengthen its (opposition’s) positions.

3. Absence of Management Paradigm in Contemporary World

Interpreting the above mentioned we will indicate that the essence of this threat is contained in difficulties of finding the optimal way between Scylla of Chaos and Charybdis of violent order – two forms, which are fundamentally related to globalization and between which contemporary world tosses nowadays. In other words, globalization strengthens centripetal trends towards integration, but at the same time it stipulates centrifugal trends towards *dis-integration, regionalization and marginalization.*

In the context of the above mentioned, it is possible to state that the a revolution paradox in the sphere of information technologies consists in, on the one hand, increasing a zone of total control, and on the other hand, an area of uncontrolled information anarchy of the "world wide web". It could be compared to a situation where a free movement of capital creates an opportunity of loosing control from the side of a nation state. In the light of such trend, i.e. loosing traditional functions of national state, globalization processes have brought mankind to the necessity of creation of a supranational control body. However, there is no consensus about essence of this body. Let us give two examples of rather controversial attempts of integration scenario.

European Union. Speaking about the EU I share G .Soros' opinion that this structure is "a gigantic experiment in social engineering", and we also agree that on the present stage this union of states has not yet elaborated adequate paradigm and strategy of management, while it has ruined with the fact of its existence national sovereignty of member states. The main problem, which is not solved yet, lies in the measure of functions, which have to be delegated to EU ruling bodies and this in turn raises a question to what form of state structure EU must be related?

This causes some acute problems, directly connected with internal European security. Nowadays, EU as a state body has a wobbly bureaucratic structure. Moreover, according to many experts this structure is not accountable to public. As a result of erosion of the role of the national state as a decision-making and responsible for these decisions' implementation body a shift of this responsibility to the EU government takes place. G. Soros marked this process as a "bad habit to accuse Brussels in what their citizens do not like", a feeling of civility is decreasing, and the process of shaping of European identity is being hampered. All these trends cause a sharp increase of the anti-integration forms of identity – regional, ethnic, that in many cases are based on the aggressive xenophobia mentioned above.

Further EU enlargement after accession of new member states does not solve the mentioned problems. Moreover, it aggravates them by forming the basis of fundamental opposition between "the old Europe" and "the new Europe", which is geopolitically directed towards the US. Sufficiently significant in this sense is hampering of the EU integration on the stage of creation of the common Constitution for the enlarged EU. Inequality of economic development could be noticed in this case as well: lesser-developed countries of "the new Europe" are afraid of falling under the direct influence of the more powerful "old Europe". Political and legal constituents of European integration fall behind rather high level of economic integration, which has already been reached by the EU countries. This process might in turn cause hindering of economic development of the region with all subsequent consequences.

United States. US is a significant example of no less interesting experiment of an attempt to establish the world order by means of *superpower* - the paradigm, which replaced other paradigm of *"the balance of powers"* of the cold war epoch. It is obvious that there are some serious omissions in this case, and we accept this fact without a slightest hint of groundless criticism. We understand that taking into consideration unprecedented nature of this situation in the history of the world, the US gropes its way using the method of samples and mistakes.

The main problem such control paradigm lies in the correlation area between international law and possible violence. If the main problem for security in European management paradigm consists in a wobbly structure, and as a result, insufficient efficiency, then main risks and threats, which are concealed within the world control paradigm with the help of superpower are the result of potential cruelty of this type of technology.

Such cruelty has already led to dangerous results – yet partly demolished traditional institutions of international law (i.e. the United Nations). Moreover, such cruelty inevitably causes retaliation that we are all witnessing nowadays – struggle with terrorism, and this struggle threatens to become *permanently endless*, taking into consideration our original thesis that broadening of technologies and instruments of fighting with threats will multiply these threats.

Thus, one might state that given management paradigm in its strict amendment generates, i.e. intensifies two types of threats – *a threat of intimidation of a weak state by a strong one* (because of the deteriorating international law mechanism) and *a threat of intimidation of a strong state by a weak one*, explicitly shown by the practice of contemporary terrorism.

Therefore, decreasing of actual standard of living of population, destroying of established democratic traditions and direct threat to national interests of specific countries are among legible negative results of implementation of the present scenario of the so-called social progress.

In this regard the following questions arise:

- Should the existing social progress be considered as a basis of the strategy for the development of the new independent or developing states, offered by the western world, if it is related to the growing threat to security?
- Can social progress exist in other forms?
- Is the existence of the authentic social progress possible for local civilizations, whose value and sense constituents are considerably different one from the other?
- Whether violence is an inevitable attribute of social progress's spreading?

It is obvious that there is no sense for representatives of West and western system of spiritual and value course even theoretically and hypothetically to refuse from their understanding of the social progress. By the same token there is no need for representatives of other cultures to refuse from their own understanding of the social progress.

Understanding of the social progress, which is formed in the framework of western culture, is based upon western history and traditions and has substantial cultural, economic, political, religious grounds. It is obvious at the same time that in the framework of other cultural, economic, political, religious traditions its own understanding of social progress and social regress should exist. This understanding should be adequate to other non-western systems of spiritual and value course in the world of reality.

Moreover, one has to admit unequivocally, that there are no generally logical, historical or other absolute criteria of the social progress, with which it is possible to correlate its understanding, which is formed in different cultures and to give absolutely unbiased evaluation of one or another interpretation of the social progress. It doesn't matter who gives what evaluation – it will be inevitably an evaluation formed in the framework of certain cultural and civilization conceptions; therefore, this evaluation in any case will be unilateral and thus inevitably limited.

At the same time, it is necessary to take into consideration the fact that power (economic, political, military) superiority of one or another adherent of social progress interpretation is not concerned with the value and culture spheres at all. And it is not a criterion of advantage of a particular country in social and cultural progress compared to other countries and nations.

It seems that the main reason of broadening and increasing of the degree of threats to security in the contemporary world is related to precisely not optimal (often – violent) form of spreading of western interpretation of the social progress and related to its philosophical, political, ideological and cultural values. This vision does not exclude the possibility of voluntary borrowing by nations of other cultures of western culture and western version of social progress, in particular, principles of law supremacy, the genuinely democratic standards etc.

But voluntary adoption of such notion assumes that *general direction of solving the above mentioned problems, risks and threats to security is contained in refusing from universal neoliberal unification of the world on the basis of market economy and admitting of complete equality of rights of non western spiritual and cultural courses in the world of reality, including interpretations of that phenomenon which we call the social progress.*

Before elaborating the strategy and tactics of neutralization of new challenges and threats to security we have to accept as fundamental principle and basis for this type of strategy and tactics the right of Other to be the Other and the right of everyone to be what he/she is indeed. One has to look for the new, more perfect forms of integration and new forms of global management based on *culture of mutual respect, solidarity and multicultural Dialog!* – This is the imperative of our time.

Elaboration of this new *Dialog culture based on a belief of equality and parity of different systems of spiritual and value course in the world, respect of every person's right to be the Other, but at the same time to possess the full range of rights and freedoms, finally, tolerance and toleration*, after lessons of the nearest past is not simply a wish, demagogic demarche or a some kind of a religious sermon. Such culture of Dialog as a result of rejection from rigid, power integration models and of management of a globalizing world is the only condition of survival of contemporary mankind. Then it would not act like Hercules fighting threats generated by its activities, but more like Sisyphus not pulling on its back the increasing load of its own mistakes and illusions.

I am confident that facing these new challenges on the edge of existence, mankind will find reasonable solutions leading away from the situation of approaching catastrophe. That is why I will repeat W.Folkner's words: "there is no doubt, that human being will not merely survive, but also will succeed!" And this will be the sole unquestioned evidence that the phenomenon called the social progress really exists, while only triumphed man can be its peremptory criteria and vector guiding line.

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Alternative Futures for K-Waves

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Abstract. Technological change may underlie significant social and environmental change. It also appears to drive the K-Wave phenomenon. The "most likely" future of society, and of K-Wave analysis, is that new technologies will continue to drive new K-Waves that will have in the future the form and duration they had in the past. But there are alternative futures, and the "most likely" future may be only one among many possibilities, some of which are considered here.

1. Assumptions About the Future and About K-Waves

I believe it is useful to assume that "the future" will derive from three components. One will be the continuation of things found in the present, and also found in the past. The second component will be things that existed in the past, but not in the present, that will appear again in the future--and their opposite: things that did not exist in the past but are very much a part of the present but that will not exist (or be as important) in the future. These things often appear as cycles or "spirals". The third component will be novelties--things that do not exist now and never existed before, but will in the future. I believe the major--if not sole--cause of novelties to be new technologies that permit novel behavior and modify or restrain earlier behavior [1].

A popular kind of cyclical analysis focuses on Kondratieff Long Waves. Even though they are among the more seriously-studied cyclical perspectives, there is considerable uncertainty about all phases of the phenomenon--including whether K-Waves actually exist, and, if so, their cause(s), duration, and (even if they are understood correctly historically) whether or not they have any predictive power or even future utility.

Since I have become convinced that technological change is the main agent underlying social and environmental change[1], I assume there must be technological factors underlying all aspects of K-Waves as well. So do some others. Changes of energy sources that led to new forms of transportation which progressively (but cyclically) transformed time and space are emphasized by some scholars. Others now say that communications technologies are further transforming time and space and are or will be the major drivers of the rise of future waves.[2]

The peaking and decline of waves also has a technological basis, many feel, as the market for the once-innovative technology becomes saturated, demand drops, profits fall, unemployment rises, and the End of the World appears to be nigh--until a new technological base shakily emerges and eventually does its transformational magic, over and over, world, in fact, without end.

2. The Official and "Most Likely" Future: K-Waves Forever

New technology not only drives the cycles but also produces the novelties that will be found in the future. And since we live in a world where imagining, creating, advertising, disseminating, and/or consuming new technologies is the major occupation of most people in more and more parts of the world, we live in a world of ever-increasing novelty and ever-decreasing continuity, as we cycle--or spiral--through time endlessly.

The endless continuation of new K-Waves into the future as the world advances forward technologically and socially seems unquestionably to be "the most likely future" to most analysts[3]. Thus most K-Wave specialists assume that K-Wave analysis will continue to be useful in the immediate future as it has been in the immediate past--perhaps even more so if more conferences are held and more scholars find out more about the causes and consequences of K-Waves in their various phases. Age-cohort analysis may be fully integrated into K-Wave analysis[4], and scholars will finally decide when the 5^{th} wave started (at least by the time it has fully emerged), and arguments can then begin about when and why it will end, and what the "cause" of the 6^{th} will be. Or is it the 7^{th}?

In an essay in *Futures*, December 1984, that I mentioned in my 1999 evaluation of K-Waves in futures studies, Immanuel Wallerstein noted that "A long-standing witticism has it that the credibility of the existence of long economic cycles is a function of whether or not the discussion on this topic takes place during the A-phase of expansion or the B-phase of economic stagnation." He also observed that there are "two camps" of K-Wave analysts. "One group approaches the issues as a technical economic problem." Their "hidden agenda" is "the search for a set of economic measures (primarily by governments) that will either speed up the recovery or allow given states to emerge from the B-phase in a good relative position." The second camp views long waves "as a central expression of the political economy of capitalism...in the B-phase." Its "hidden agenda" is "the improvement of the political tactics of the world class struggle." [15]

Neither camp seems to make much of debt--and especially consumer-debt creation--that I believe to be a major factor in distorting and prolonging recent waves. Without massive and increasing consumer debt creation, especially credit-cards, since the 1970s, on the one hand, and massive and increasing military-welfare, pseudo-Keynesian, governmental deficit-spending (since World War II, but especially since 1980 with Reagan and under Bush the Second now), on the other in the US, there seems little doubt that a true global depression would have occurred by now, and the 4th/5th Wave finally have come more obviously crashing down. More on this point later.

3. Some Alternative Futures

But, even with its cycles of booms and busts, is continued technological and economic progress like that of the immediate past the only possible--or at least "most likely"--future? For most of human history, most of the future was, or appeared to be, a flat, linear continuation of the past and present. Change was rare, and fundamental change rarer still. Since the "industrial" age, technologically-induced change has increased, perhaps exponentially. K-Wave analysis is a product of the industrial era. If the rate of technological, and hence social and environmental, change is increasing (or should it substantially decrease), will classical K-Wave analysis still be valid? Perhaps it will. But I am not so sure.

At the very least we should consider the possibilities of some alternative futures. One of Dator's "Laws of the Futures" says that what is often considered to be "the most likely future" usually turns out to have been highly unlikely indeed. I believe we should view the continuation of K-Waves among the alternatives, but no more or less likely than some others.

3.1. Brain Waves May Push Faster K-Waves.

For example, in *Brain Wave,* Zack Lynch suggests that a 6th K-Wave, the "neurotechonology wave", is emerging that will be driven by biotechnology and nanotechnology, and will feature brain chips, brain imaging, neuroceuticals, and bio-education: "The nascent neurotechnology wave (2010-2060) is being accelerated by the development of biochips and brain imaging technologies that make biological analysis inexpensive and pervasive. Biochips that can perform the basic bio-analysis functions (genomic, proteomic, biosimulation, and microfluidics) at a low cost will transform biological analysis and production in a very similar fashion as the microprocessor did for data. Nano-imaging techniques will also play a vital role in making the analysis of neuro-molecular level events possible. When data from advanced biochips and brain imaging are combined they will accelerate the development of neurotechnology, the set of tools that can influence the human central nervous system, especially the brain. Neurotechnology will be used for therapeutic ends and to enhance human emotional, cognitive and sensory system performance" [16].

Some of the more extravagant claims of nanotechnology, both pro and con, suggest that a true nanotech world will not be business as usual in any way [5]. If, so, then K-Wave analysis may be superfluous as the waves morph too rapidly to be understood quickly enough. On the other hand, things are being called "nanotech" now that are clearly important, but seem to be marginal improvements and not revolutionary technologies in any significant way [19].

3. 2. "A Dream Society of Icons and Aesthetic Experience"

In what might be a version of the "neurotechnology K-Wave" future, but which focuses on advances in media, and especially interactive game, technologies, a colleague of mine at the University of Hawaii, Yongseok Seo, and I have recently adopted the notion put forward by Sternberg [20], Jensen [21] and others that "the information society" is already nearing an end, and that a new "society" that we call "a Dream Society of icons and aesthetic experience" may be emerging. It is seen most clearly in South Korea because it has been accepted as a basis for national economic policy [22].

As Rolf Jensen puts it, "The sun is setting on the Information Society--even before we have fully adjusted to its demands as individuals and as companies. We have lived as hunters and as farmers, we have worked in factories, and now we live in an information-based society whose icon is the computer: We stand facing the fifth type of society: the Dream Society" [21, p. vii]. "Today, knowledge is stored as letters; we learn through the alphabet--this is the medium of the Information Society. Most likely, the medium of the Dream Society will be the picture" [21, p. 40]. Jensen concludes that while Henry Ford was the icon of the Industrial Age and Bill Gates is the icon of the Information Age, "the icon of the Dream Society has probably been born, but she or he is most likely still at school and is probably not the best pupil in the class. Today, the best pupil is the one who makes a first-rate symbolic analyst. In the future, it may be the student who gives the teacher a hard time--an imaginative pupil who is always staging new games that put things into new perspectives." "He or she will be the great storyteller of the twenty-first century" [21, p.121].

Sternberg, Jensen, Postel [23], Pine and Gilmer [24], and Pink [25] write about the Dream Society (as Lynch [16] does about the "neurotechnology wave") as though it were simply a new phase of capitalist development fully compatible with K-Wave analysis. I am not so sure. The Dream Society I anticipate is a development that finally throws humanity into the long-anticipated era of sustainable abundance in which the economy is driven and the environment managed by autonomous intelligences and artificial life, leaving humans free to do what they do best--dream and play [6].

On the other hand, the ability of capitalists to keep their exploitative system going however much new technologies render it unnecessary and undesirable continues to amaze me and to confound such hopes and possibilities.

3.3. Clash of Fundamentalists

But what chance does a society of dreams and icons have in a world rent asunder by a battle between two fundamentalist camps?[7] In such a world of mutual terror, only dead people can safely dream. The technologies of both the Information and the Dream societies are too powerful to allow individuals to control and use them freely, both camps agree. Dreams, most of all, must be monitored in the interests of homeland security and scriptural conformity. If technology is the root of social change, and if essential moral values are being destroyed by the new behaviors that new technologies allow, then the process that produces new technologies and destroys essential values must be cut off at the root. Indeed, both camps understand that the real enemies to be overcome are new technologies and the science that produces them; so governmental funding for science and for technology research and development is drying up. Everything important to know has already been revealed in the Scriptures and its authorized interpreters. No new knowledge is possible or needed, and none should be sought. With no new technologies to drive them, K-Waves, if they will exist at all, will come to move at a much more leisurely pace than they have for a very long time.

3.4 Permanent War Economies and K-Waves

In contrast to the orthodox interpretation based largely on free-market forces, some observers see an historic connection between the weight and debt of war and K-Wave phases. Even without accepting a fundamentalist future, given the dominance of permanently militarized economies and societies in the world today and apparently tomorrow, is the connection between war and K-waves going to become more pronounced? The role of the military, and "security" broadly speaking, is so dominant that no major country today has an economy even faintly "free-market", and some, such as the US since the Second World War and profoundly so since 2000 (if not 1980), can better be understood as a "command economy" [48-50]. This fact, and the growing role of national, corporate, and private debt in economic life [51-54], if not in formal accounting, may make classical interpretations of K-Waves problematic. If serious efforts are made to militarize space--and though the US is leading the way in space militarization, the US must no longer be viewed as the only important actor in space, considering the rise of China, India, Japan, and the European Space Agency--then the war basis of K-Waves may become even stronger [55, 56].

3. 5. The Environment Strikes Back

In stark contrast to all of the above (though a direct consequence of it), even though increasing the production and consumption of goods and services via resource-intensive industrial processes has been the focus of life for most people for the past several hundred years, there is increasing evidence that warding off or perhaps surviving a wide variety of environmental backlashes may become the main preoccupation of all people worldwide by the midpoint of the 21st Century, if not sooner. What K-Waves will be like, or whether they will be relevant at all, in such a very different world is unclear [8].

4. Concluding Remark

So there are many possible futures for K-Waves and their analysis, and "the most likely future" of continued cyclical technological and economic growth is by no means inevitable. I hope that if there are other conferences on K-Waves such as this one that the organizers will bring in people from different cultures holding many different views of the futures to enrich our understanding, our work, and our contribution towards creating a better tomorrow.

Endnotes

1. Two useful introductions to futures studies are [1] and [2].
2. The basic concepts of such a theory are found in the first several pages of [3]. A more detailed version is in preparation.
3. For two earlier summaries of how Kondratieff Wave analysis has been used in the futures literature, see [4, 5].
4. I believe that age-cohort analysis is at least as powerful a tool for anticipating the futures as is K-Wave analysis. I first explored this relationship in [3]. Since then, William Strauss and Neill Howe have put forward a series of studies of successive waves of American age-cohorts. See: [6, 7, 8]. While they do not link their analysis to K-Waves, others have, including [9, 10]. Tessaleno Devezas has also discussed generational change in relation to long waves very usefully. Although he did specifically address the perspectives of Berry and Kim, and of Mallman and LeMarchand, he did not consider the age-cohort theory of Strauss and Howe [11, pp. 13f, 35-49] and [12, pp. 828-837]. The relationship has been explored more extensively by [13]. Though Strauss and Howe base their analysis of US data, they claim the underlying theory is universally valid, with due allowances for cultural and other specific differences. Yongseok Seo has used their methods to explain and forecast developments in South Korea [14].
5. Compare [16] with [17].
6. For "strong" claims about the futures of autonomous intelligence, see [26-31]. On the evolution of "artilects", see [32] and a recent discussion in *The Journal of Futures Studies* [33].
7. See my analysis of American visions in this regard [34]. For some of many recent books enthusiastically supporting a heavily-militarized Christian global American Imperium, see [35-38]. For examples of many recent books opposing such a vision, see [39-47].
8. Though America officially refuses to acknowledge it, the reality of serious of anthropogenic global climate change is too overwhelming to deny, I believe. Moreover, I am convinced the matter is well beyond solution by even some of the more aggressive plans for "sustainability." I believe we must accept the challenge laid down some time ago by Walter Truett Anderson that because of its long and growing history of interfering with once "natural" processes, humanity must now learn how "to govern evolution" [57]. This position is spelled out in some detail in [58]. For a sobering update of one of the earliest major warnings, see [59]. See also [60-62].

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Risk Management In Uncertain Times

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Abstract. There is a lot of literature announcing the advent of Information Society; in the meantime, though, we are living in a transitional period that has been labeled as Risk Society (RS). One of the specific traits of RS is the spreading of this perception of risk and the growing wish for higher security. However, this paper argues that risk is poorly treated nowadays and that a new approach is in demand. Futures Studies (FS) can provide this perspective, but only as long as it is able to integrate the inputs of other disciplines such as Chaos Theory, Evolutionary Theory and Kondratieff Waves (KW). KW can have a key role in this endeavor as they can offer ways to surpass one of FS shortcomings, their difficulty to incorporate in a solid way human variables in systemic methods. On the other hand, FS can help KW in several aspects: to improve their capacity to work with inputs from diverse sources, to assimilate with greater ease the normative aspects inherent to risk researches and, finally, a way to get around the not-so-appealing determinism implicit in KW.

1. Risk Society

Despite the enormous literature about the incoming Information Society and its imminent arrival, the truth is that we are still struggling with the Industrial Society or, more likely, with its epilogue. The present world remains largely industrial; yet, at the same time, we see new realities, new structures and new paradigms emerging everywhere. This leaves us with the puzzling question: which times are we living? This is no trivial query. These are transitional times, in which the old is fading and the new is not fully in place, these are the days of the RS.

The RS is the result of the combination of three factors: modern technology, capitalist economy and wealth. The first two factors, technology and economy, proportionate the physical conditions to generate risk; wealth provides the social context in which risk becomes relevant. Some of the factors that made Industrial society possible were the arrival of new technologies combined with the emergence of novel forms of production that, in turn, were backed by fresh economic theories. But it was also the combination of these three elements what made it possible for humanity to affect the biosphere at a scale and at a pace never experienced before. Steam gave people the muscle to tame and shape nature and the new theories (Newtonian physics, Darwinism and liberalism) provided the context in which humans felt entitled to master nature. Thus, what we have is a particular combination of increasingly more powerful technologies with a particular economic model that excludes of the equation all non-desired costs via externalization. These two factors have put the conditions that have made possible for the severe deterioration of the biosphere, the widening of the gap between wealthy and poor and the generation of new forms of economic, social and health hazards.

Here it has to be noted a most outstanding feature of this new form of danger: its borderless character. Regardless of where it is generated, risk moves around the globe and reaches its farther corners. This transnational nature of risk has to do with its effects, it is worth to note that the worse consequences of greenhouse gases are felt in the more distant spots of the globe: the poles; but also, and due to the globalization inertia, risk sources can be transferred from a place to another as Chicken Grip has proved. In can be argued that risk is the one thing that equalizes us all.

However, new technologies and new economic doctrines, with its far-reaching results, have been necessary conditions to provoke RS, necessary but not sufficient, a third factor has been needed: wealth. The improvement in the living standards, which, in turn, has been one of the effects of the former factors, has become the key element to trigger RS. Hence, the appearance of new dangers and hazards has been not enough -by themselves- to generate RS, they have created the conditions but they have lacked the tangibility to make them real. Risk is just a possibility, no matter how high the probability is it is only a chance. What is required to become tangible is the perception of that state of affairs as a risk, and this only comes with affluence. The question here could be: why a situation is perceived as a risk only under certain conditions? The reason is simple: poverty is objective, self-evident and its effects are acutely felt, whereas, risk is a probability. Given the chance to opt between a reality of misery and a prospect of wealth -regardless of the associated threat- it is understandable that risk would tend to be underestimated. The fact is that the perception of risk is intimately tied to affluence. Security in only treasured once a minimum degree of development and affluence is attained, just when there is something to loose. That is why the more rich we are the more we try to avoid risk, beyond a certain level of prosperity, safety becomes the main concern. In this regard it is worth to note a recent study on three foresight projects from Canada, Germany and Sweden in which security has become a major topic [1]. Thus, for the Canadian one, among the six main topics (those that will have more importance from now until 2025) we can find: national security & emergencies and risk factors; the German one openly refers to *Approaches to tackling risks resulting form the complexity and increased interdependence of technologies and organizations involving technological, social science and economics research on complexity* (Rader; 2004, page 7); the Swedish one includes very telling allusions in its chapter of global drivers in which it explicitly states that there is *no territorial security* and that *the monopoly of the state on the use of force is no longer effective* but it stresses that *fear has served as an important driving force, both in a positive and negative sense, in every age: "Angst" is a powerful driver* (Rader; 2004, page 9). The conclusion of the study states that all these elements have contributed to determine the *Zeitgeist* (the spirit of our age) deeply influenced by the fear derived from new threats such as global terrorism, pandemics and climate change.

2. Managing Risk

If we accept that we are living in the RS, then we have to learn how to manage risk. Here, it is important to notice the choice of words: to manage it, not to avoid it, not even to prevent it. By definition, life is an unstable phenomenon; very resilient and extraordinarily enduring to adverse circumstances, that is true, but inherently fragile and always walking on a fine thread. Accordingly with the predominant *Zeitgeist*, a lot of resources are poured nowadays to eliminate all kinds of dangers and threats; or, to be more accurate, to fight or cover the effects of risk more than preventing its causes. This is just food for today and hunger for tomorrow. A more rational and holistic approach is called for. Within the Islamic tradition a useful concept can be found: *Mudaraba*. According to Sardar, *Mudaraba means sharing* *and participation founded on the proposition that all human activity includes risk; what is unavoidable and common to all should be equitable shared by all* [2]. Such a conceptualization of the subject seems promising for two reasons: first it eludes the idea that risk is necessarily someone's fault, hence avoiding the sterile exercise of assigning culpabilities; and, secondly, what is really relevant is the common obligation we all have in preventing, fighting or mitigating any given menace's causes or effects. But, from a futures standpoint, there is required addendum: the need to understand the causal mechanisms, dynamics and behavior of risk. Otherwise *Muduraba* could also be interpreted as a fatalistic and resigned acceptance of risk as another agent of fate as long as everybody does it equitably. The aim of this paper is the opposite, regardless the inherent uncertainty of present times, it is possible to acquire a deeper knowledge of the different risks that threaten our life and find ways in which we can avoid its worse consequences, or even prevent them completely.

Therefore, the first step should be to attain a deep knowledge of risk causes. This is a challenging endeavor in itself as we are living in a complex world: we are just beginning to understand the subtle processes and dynamic equilibriums that rule the biosphere, we are just starting to grasp up to which point our actions have distorted those processes and, as a result of that, endangered our own survival. The one lesson that RS has taught to the Industrial world is that there are no minor factors that can be ignored, there are no lesser characters in the drama of life, all of them play a role and all can be key under a specific set of circumstances. It may be true, as Anderson states, that humanity is no longer the object of evolution but its catalyst [3], but then we certainly lack the knowledge to do it properly. We have to start acting with the responsibility that our capacity has placed on us and stop acting like an octopus in a garage putting events into motion without the slightest idea of where they may take us. As Ben Parker did put it: *With great power comes great responsibility*[1].

Accepted that the phenomena we may be dealing with are complex, then we must try to find a course of action that allow us to handle this complexity. My option is for a systemic approach, not only it is a good manner to schematize intricate issues but also there is long tradition within the FS field to rely on it for complex issues[2]. The problem is that to use properly it demands an additional effort: to transform the object under research into a system, a model if you want. This is a challenge in itself as we seldom have in advance all the required knowledge to do it. This sort of previous quest bothers many scholars but in a FS research it proves to be extremely valuable as, many times, the clues of tomorrow rest in the past. In any case, the final object of this preliminary part is to map the object of the research, that is, to identify all its components and the vinculums among them. Therefore, we will try to detect and list all these components and, most important, which interactions exist among them, aiming to establish their intensity, direction and implications. Typically, all this elements would be transformed into variables that can be input into matrixes and expressed in mathematical form. The final objective of all this process is to reveal which of those variables are independent, or to use the futures jargon, act as motors of the system[3]. The rationale that grounds all this construction is that, if we are able to determine how we can influence a given system in a way in which we are more sure that we will provoke what we want to provoke and nothing else, then we have a mean to mould the future[4]. Another question to find out is if any given variable falls within a trend, that is, if we can define a time series for that variable that falls –more or less neatly- within a mathematical function. If so, we will have a strong signal that there is an inner logic in the functioning of that variable, a logic that we will be able to extrapolate into the future and that will give us relevant information about the forthcoming behavior of the variable. Frequently, natural phenomena do fall into trends more neatly as their patterns often are more solid; but human variables seldom form trends with pattern quite as stable. Again, the question to answer is why it is so.

One of the reasons of this lies in the intrinsic difficulties that pose the variables that reflect human activities or human agenda. Generally, this kind of variables tend to be considered as independent variables simply because they seem to be too random and erratic to make them fall into any kind of trend. The problem is that, when dealing with risk issues, the "human" variables are key but, if we do not know if there is a pattern in their functioning, they become too problematic to be used safely; that is to say that there will be no guaranty that any action exerted on them will caused the desired effects.

The dilemma then appears clearly, we can hardly manage any kind of risk properly if we are unable to understand the internal logic of human activity and human agenda. We cannot just turn the human factor into the independent factor unless we begin to comprehend the causes and the patterns of its behavior. The obstacle is that social science has been traditionally very suspicious of any try to make human activity fall into preordained archetypes. One reason for this is that, because of the inherent complexity and difficulty to systematize human behavior, many attempts to hypothesize human performance have resulted in utterly simplification or feeble theories. But, within the futures domain, there is a deeper reason that has to do with its philosophical foundations. One of the tenets of the field is that humans must have the chance to choose between alternative futures[5]. In other words, it is fundamental for futures that we have the freedom to opt, and without this capacity there is no point in engaging in any foresight activity. That is why futures methods have implicitly tended to overemphasize the randomness in human activity, as a way to make human will relevant. The rationale supporting this oxymoron, paradoxical as it may seem, postulates that only in a context in which there are no laws or rules, that is random, we are really free to choose. In a sense, it is almost as if foresight would loathe the very idea that human behavior could fall into patterns as natural phenomena does, humanity should be one step above even it that mean to give up any notion of order in the cosmos. This, no doubt, is a sublimated anthropocentrism that has been affecting the field and hurting its capacity to open new lines of work. KW may offer us a way out of this situation.

3. Catching the Wave

Trends are a powerful tool when trying to understand the future. They are like rivers that allow us to enter into unmapped territory, but they are tricky and can provide a false sense of security that is why they always must be used with precaution. The first point is to identify them properly and to do that it is essential to analyze a long enough time period. Take for instance a trend that oscillates in a cycle of 90 years, if you take a period of 5 years, it may be that you consider that trend to be linear and stable; if you encompass 15 to 20, you will probably detect a tendency to grow or to shrink but, chances are that you may still believe it to be linear, if you take 25 to 35 the increase or decrease will be too obvious to ignore, surely the curvature will be evident as well, but depending on the moment of the cycle that you are analyzing you might be driven to think that you are in front of an exponential trend; only if you take a period of more than 45 years you will discover that some values are repeated and, therefore, you will get an indication that you may be in front of a cyclical trend. Theoretically, the solution seems easy: in case of doubt, enlarge the segment to examine. Yet, most of times it is difficult to find reliable data that goes beyond thirty years. Not only that, a trend only tells us about its inner logic, it helps us to describe its past performance and, under certain conditions, predicts its future behavior; this certain conditions being that there will be no changes or that change will keep its direction and rhythm. Well, the one thing that we have learned in FS, is that the least likely future is that in which nothing changes. Therefore, we have to assume that changes will happen and they will affect trends. But if cyclic trends in general are tricky, those connected to human activity or dynamics can be devilishly volatile. That would explain why there are some authors such as Makridakis or Bas [4] that discriminate cyclical trends whose sequence is due to natural phenomena and those caused by human activity, for the former they use the label seasonal for the later they reserve the brand of cyclic. The underlying principle here is that succession patterns caused by natural phenomena are much more reliable and stable, whereas human cycles are much more contingent. But, is that so?

There is a sort of inferiority complex of the social sciences in front of the predictive power of the natural ones. In this regard, it is true that most of social science theories do work quite well explaining what has occurred, some work fairly well describing what is happening, but they prove to be rather weak when predicting what will take place. For many it has been accepted that the value of social theory rests more in its capacity to propose suggestive enlightenment than in its effective capacity to offer sound description and confirmable predictions. But the intellectual landscape has changed, it has appeared Chaos Theory that has postulated that chaos is just subtle order and that delicate patterns can be found in –apparently- random phenomena. Chaos Theory has also introduced the concept of bifurcation, those chaotic jumps that could take any given system from an evolutive stage to another but whose outcome in inherently unpredictable. Later on has come Evolutionary Theories that, in my view, have represented the most successful attempt in integrating natural and social disciplines. Evolutionary Theories basic principle is that the driving force that is pushing evolution is not the betterment of life (through progressively superior and most sophisticate life forms) but the improvement of any given system to acquire, to process, to store and to transmit information or, in other words, the capacity of that system to tolerate complexity[6]. Thus, any system or organization will be stable while complexity remain within its tolerance parameters, the system will be unstable when complexity surpasses them and eventually a bifurcation will take place; what the theory is unable to say is under which circumstances the bifurcation will allow the emergence of a new system with a higher tolerance capacity and, therefore, in a superior evolutive stage or it will lead to an inferior state and, consequently, result in an involution.

KW may the next piece to complete the puzzle. They represent a significant advance for two reasons: first, they prove that human performance can fall into cyclical patterns, which opens up for a whole new world of opportunities for trends and, second, they may provide the missing datum to predict the outcome of any given bifurcation as it will be argued later on. Accepting that humans are ruled by cycles, like the rest of the biosphere beings, while distasteful for our anthropocentrism is coherent with the conclusions of many disciplines and deepens in the previously mentioned process of integrating the knowledge from different sciences. The path in front of us is clear, what is needed now is to determine the sensitivity of KW to historical and social milieu, in other words, is the cycle independent of the context or the environment settings do affect the wave performance? Although there are more qualified people to answer this question, I'm inclined to say that while the sequence is rather independent only under certain conditions any organization or system can use its inertia to foster its evolution. To use a surf simile, the waves are the same for all, but only the surfers that are at the right spot at the right moment will get a good ride. Several arguments can be used to support this posture. To begin with, it would be in total contradiction with the very essence of KW studies to think that there are different rhythms for diverse species, organizations, ethnicities or societies. The basic tenet of KW is that we come from the cosmic fabric that has created the whole cosmos and, like all creatures we also have this primigenial pulse in us. Let us put it this way, if there is a watch that governs our existence is ticking at the same pace for all of us. In a second place, it is undeniable that different human communities have evolved dissimilarly through time. If we accept that the cycle is the same regardless of geographical, economical or social conditions, then there must be something else. According to Devezas the clue lies in the generational and cognitive, or more precisely, learning capacities of any given system or organization [5], something that makes perfect sense. Only a community that has the physical and intellectual capacity will be able to ride the KW.

Now, let us think for a minute of the implications of KW when studying bifurcations. It is quite accepted that there is a great deal of uncertainty when exploring the possible outcomes of a chaotic bifurcation. Basically it is assumed that there are three big alternatives: to jump to a superior evolutive state, to stagnate in a similar level or to decline to an inferior one. However, according to KW we know that there must exist two circumstances to allow for a –let us say- positive development: favorable generational and cognitive conditions. Therefore, it would be possible to determine, when a given system is approaching its complexity tolerance threshold, if it has the conditions to jump to a superior state or f it is collapsing. It would be a question of establish if that organization has met the demographic and learning requirements to advance to a superior level, in other words, to find out if that system is in condition to surf the next KW or not.

4. Putting It All Together

Up to this point we have seen how risk has permeated in our societies (more in the developed areas though) to a point that it has even got into the *Zeitgeist* of many communities. We have also argued how risk is defectively treated as resources are poured fighting –or hiding- the effects instead of being used to thwart the causes. So, in order to undertake a sound, thorough and integral comprehension of risk sources and dynamics, it is needed to attain a deeper understanding of the involved human factor. Traditionally, the study of human behavior has been limited for several reasons, among them: the inherent difficulty to grasp human motivations, an implicit anthropocentrism, and –for what it matters to FS- a particular philosophical standpoint. The arrival of new disciplines such as Chaos Theory, Evolutionary Theory and KW studies open up new perspectives in which the human factor can be analyzed in a more holistic manner and thus obtain a more comprehensive perspective of risk and, ultimately, a better chance to manage it properly.

What is missing now is the glue to put all this together. FS can be this cement, and there are three arguments to support this posture.

First of all, FS have been, from its very beginning an instrumental discipline, which means that they have always had to borrow data, information and knowledge from different sources and, as a consequence of this, they have grown to be transdisciplinar. As a matter of fact, the transdisciplinarity has become so ingrained in them that it can be stated that FS are ontologically and epistemologically transdisciplinary[7].

In second place, and due to the nature of the stuff FS work with, they have had to develop the capacity to work with normative input and treat them in a rigorous and systematic way[8]. Here, it is worth to note, as a secondary plus, that there are some psychological advantages when approaching a conflictive issue –such as risk- from a FS standpoint. These kinds of subjects are heavily biased with perceptions, prejudices, phobias and values; the very subjectivity of these factors often provokes that the emotional factors would prevail over rational discussion. But FS, by placing the object is a somewhat distant future, change the focus: the present problem is no longer the main interest; the goal now is to find solutions for the future. Therefore, the way to approach the existing struggles will be totally different: they only interest us as long as they can help or they can prevent the future scenarios we may be working on. This *modus operandi* facilitates to ease the value charge and to move towards consensus action for the future simply because it offers way outs of present conflicts.

The third argument has to do with the discomfort that some feel in front of KW's flavor of determinism. The image of the clock ticking and the wave pushing us all can be distasteful to some, yet the enormous diversity in human condition through the entire world should be proof enough that the KW determinism is not so deterministic. FS, on the other hand, have always been very wary to avoid the very idea of necessity related to the future, they have always been very careful to present their results in a manner that emphasizes the role of human agenda in shaping the future. Even more, in order to offer inputs that can be used to ground present decisions, FS always try to present results in an alternative way: different options that can lead to distinct scenarios (or future situations) with dissimilar implications and consequences for each one. One of the effects of this working style is that it tends to highlight the role of the decision agent. No matter how obvious the implication, no matter how clear the probabilities, no matter how evident the outcome someone will have to review the information and pass judgment on it. This, in full coherence with FS underpinnings, makes human will relevant. If KW would deliver its results in a similar fashion that determinism ghost could be vanished. Not only that, KW would help to improve FS scenarios' quality and, even more, could proportionate a healthy antidote to shun excessive wishful thinking when trying to design future goals.

The main flaw for FS to take this agglutinating role is the weakness of their conclusions and previsions when the human factor is involved. Without pretending to diminish this question, it can be object that KW can proportionate sounder grounds to process human variables and, therefore, offer better inputs for FS to work with. That is, in the aforementioned process of defining the study object as a system, KW can input the required data to discern which human variables would fall into trends and which possible extrapolations can be done of their performance in the future. This supposes a totally different ballgame; it will be possible to effectively determine the motricity of any human variable. But FS can also supply a valuable input, if we keep in mind that trends can only proportionate useful information about the future until a limited point, then we need something to provide us with the events, wildcards or emerging issues that eventually will impact those trends. Even more, we have to find out how these trends will interact with each other and with those unexpected events and FS are the best discipline to do this.

At the end, FS can also provide a call for pragmatism. The final motivation of FS is to supply fine, useful data, information and knowledge if possible, about the future so we could take better, sounder assessments today. Within this framework, KW will only be valid as long as they help to produce this good data, information and knowledge. It would be tragic that KW would be deemed as an intellectually stimulating subject but with no practical application. One way to do it is by presenting their results in a manner that can be more easily used by decision takers as FS have been doing for so long. Scenarios, as it has been argued, are well suited for this as they display the available options in a manner that human agenda becomes relevant.

Conclusion

FS are in a very good position to offer innovative and comprehensive ways to manage risk. First of all, they have the capacity to integrate the required knowledge from diverse sources; they have the epistemological capability to articulate dissimilar data and different information and transform them into usable knowledge to deal with risk in a future oriented way. However, FS are limited by its present inability to process human factors in systemic analysis. KW can be a key element in this regard as they can offer a way to improve our knowledge, and hence the treatment, of human performance variables. The combination of FS and KW seems very promising in many fields, but particularly for risk issues: they can offer a comprehensive way to handle complexity; they can give additional psychological benefits for the agents involved and they are action oriented. What is needed now is to deepen this process and to develop theoretical models that could help us to find better, more efficient and fairer means to manage and, hopefully, to prevent risk.

Notes

1. This was one of the most used sayings of Ben Parker who was the uncle of Peter Parker a.k.a. Spiderman, and in time became the personal mantra of the comic book arachnid character
2. Many authors in the field have advocated for such a focus like Masini (1993) or Serra (1995)). However, it is within the French school where it has reached the status of main approach (if not the only one): La demarche prospective as presented by Jouvenel (1993) relies heavily on system theory.
3. Typically, in any given system we will try to classify all the variables in four categories: stable, those that act quite independently from the influence of the rest of variables; dependent, the passive ones, those that are affected by the action of other variables but do not have influence on the system; unstable, the ones that are –at the same time- dependent and motor, therefore too risky to be used and, finally, the motor ones, those that are influential and no dependent, the ones that pull the system.
4. Here is important to note that FS, in the European continental tradition, has always and primarily been a mean to discover how we have to act in the present to provoke our preferred futures, Berger's canonical definition states that *Prospective* (futures studies) *is the discipline that studies the future to understand and to shape it*. Therefore, is perfectly coherent that the methods that have been developed within this tradition emphasize this aspect of how to affect the future through present action. But also within the American school FS is action oriented, as the point 1,b of *Dator´s Laws of the Future* stresses: *The future cannot be predicted, but 'preferred futures' can and should be envisioned, invented, implemented, continuously evaluates, revised and re-envisioned.* (Slaughter; 1996, page XX)
5. For instance, *Dator's Laws of the future* declares in its first article, point A that: *The future cannot be 'predicted', but 'alternative futures' can and should be 'forecast'* (...). (Slaughter; 1996, page XX)
6. In this field I'm particularly impressed by the work of Jan Huston, his dissertation *Passion to evolve*, published though UMI in 2000, offers an excellent introduction to the field.
7. In this regard, it is worth to check Masini's posture in favor of FS transdisciplinarity instead of inter or multidisciplinarity as advocated by other authors (Masini; 1993). Bell also talks of Transdisciplinarity Matrix for Futures Studies (Bell; 1997)
8. This aspect has been heavily emphasized by non-Western authors such as El Mandjra (1984), Nandy (1999), Sardar (1999) and Inayatullah (1990), but also or Western ones like Bas (1999), Masini (1993) and Serra (1994 and 2001).

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Cyclicity of Strategic Challenges in Russian History and Development Scenario for the 21st Century

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Abstract. Unsatisfactory knowledge of historical trends predetermines confusion of politicians, experts and businessmen in the face of the future. Together with the seriousness of the challenges facing modern Russia and the entire world, all this results in high strategic vulnerability of major decisions being made nowadays in Russia and the world community.

The multifactorial analysis made by us allowed to find out rather distinct rhythms in occurrence, actualization and change of series of development strategic problems of Russia against the background of global trends. The question is about both extra long 400-year cycles, and long 80-years ones. They are expressed in the dynamics of such major society subsystems as its economy, science and culture, positioning in the world, control systems, etc. Reconstruction of the picture of the past through the prism of long-term fluctuations of constant set of the problems that need solution by means of the internal and foreign policy, provides us with the information on system requirements of «the way passed». In turn, it also allows planning outline of future scenarios.

1. Ecclesiast's Argument

Unsatisfactory knowledge of historical trends predetermines confusion or conceit of politicians, experts and businessmen in the face of the future. Together with the seriousness of the challenges facing modern Russia and the entire world, all this results in high strategic vulnerability of major decisions being made nowadays in Russia and the world community.

Thus, at development and realization of series of scientific and industrial projects, programs of restructuring of large branch complexes of Russia, an extremely interesting though rather unpleasant phenomenon was found out. Its essence was that, administrative decisions which efficiency proved to be true by practice and theory, even if worked out in details and being supported by serious powers, at their implementation did not reach the purpose and degenerated. The explanations by means of known arguments such as bad macro-environment, high risks, lack of political will, other barriers put against innovations turned out to be unconvincing. In all these cases deeper reasons took place. Interpretation of these reasons, factors, interrelations led step by step to the well-known Ecclesiast's experience - «everything in its own time».

The economic and administrative theories of "life cycle" of products and technologies are well-known, but in our case it was a question of something more complex than a cycle of major industrial systems or Kondratieff's conjuncture cycles. This "something" is not obviously connected with influence of forces regarding to which the players visible to their coalitions and us look like fragile constructions of Florida State or resorts of Thailand during a typhoon. Whirlwinds of an epoch, a kind of Hollywood's "the day after tomorrow", «fatal minutes» operate more powerfully than conjuncture cycles.

The logic of the scenarios analysis of the future for a whole century forward with its inevitable selection by different bases should make us sooner or later to address to the past, proceeding from necessity to reveal the key parameters of «dependence on the way chosen in the past». Further, it is difficult to stop: first, going back for decades, then for centuries, to reach all sources of the Russian civilization in the first century A.D. The result of such observation appeared rather intriguing: during the centuries-old Russian history amazing repeatability of strategic challenges that faced the country and its ruling elites was found out. The knowledge of this repeatability, that is the rhythm of occurrence, aggravation and attenuation of the set of strategic problems of the country is regarded crucial for comprehension of the applied questions concerning destiny of entire branches of economy, its technological style, life style, foreign policy, control system.

Our state during all its history experienced cyclic fluctuations of its integral power (see figure 1). From the beginning of the first century A.D. we have gone through almost five large extra long strategic cycles, each with 400 years duration , when we get in approximately the same strategic situation. Somehow, the country periodically pays the bills of the generations of ruling elites, which become proud by greatness and neglected laborious work on diligent adjustment of the system purposes in conformity with its opportunities and allowing serious deviation from the natural course of events.

2. Strategic Matrix of Russian History

Gerodot mentioned that tribes in the territory of modern Russia have the life style specified to them by the nature of the country. Today we can treat "nature conditions" with today's natural-scientific completeness, not being limited with just concepts of landscape and climate. D.I.Mendeleyev, A.L.Chizhevsky, N.D.Kondratieff, V. I.Vernadsky, L.N.Gumilev, etc. made the major break in this respect. In all versions of historical events not only the subjective moment appear, but also the circumstances having fundamental influence traced on significant time periods. First of all, they include territory, climate, population, energy consumption, and position in the world. Many theories take into account (in the explicit or concealed form) only some of the specified factors.

For the system view at historical trends it is necessary to coordinate historical time, space and behavior strategies of the basic characters of history in a single whole. Such combination is necessary to be structured not only by events, but also in system of spatial-temporal coordinates that may also be described in the language of matrix variables.

The matrix of history variables as nonequilibrium social and natural system contains both rather steady and more dynamical variables. It is also important that not only changes of quantitative characteristics of the matrix, but also qualitative leaps in its development take place with the certain periodicity. Definition of the most important variables forming the matrix basis has considerable value. In other terminology it is the question of archetypes of historical behavior. An archetype is a structural principle of the collective unconscious, a priori, before-experienced form of behavior. It represents deep characteristics of social matter and is expressed in behavior of people, their thinking, decisions, attitude to reality.

The next logical step in our reasoning is directed to the strategic matrix (matrix of strategic factors). As strategy is the attempt to transform a system in qualitatively new

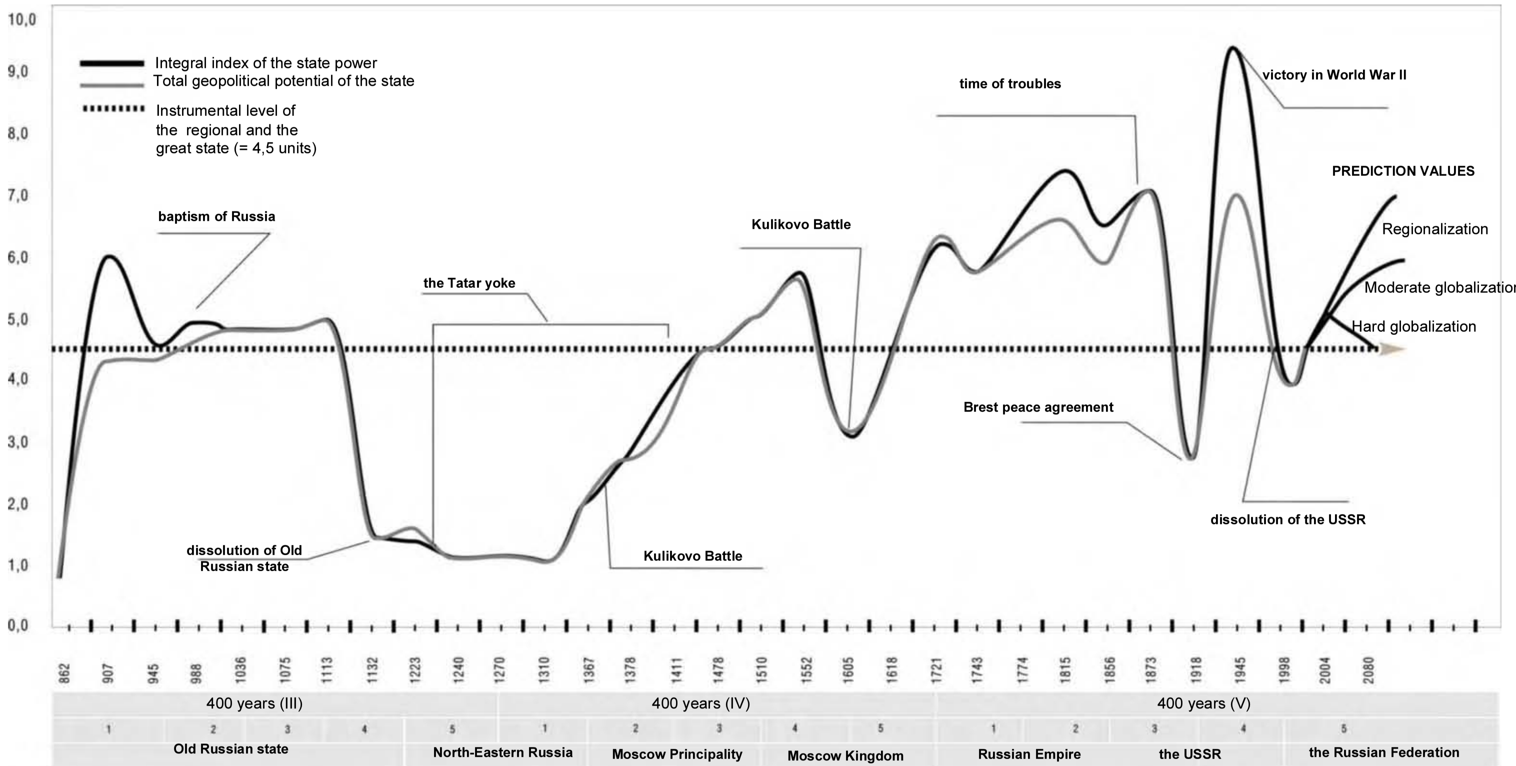

Figure 1 - Change of integral factor of power of the Russian State

condition according to opportunities or purposes of its subjects, primary value for it is received by infinitesimal variables of the second-order that provide conditions for this transition.

In case of successful transition to a new condition of a social and natural system (that is, a successfully realized strategy) we deal with harmonization or expansion of the system, and in case of failure - with chaos, simplification, falling into archaism and barbarization.

Cyclic occurrence of certain variables allows to consider history as a series of accomplished steady states in which only separate quantitative variables and qualitative characteristics eventually change. Thus, their particularly physical characteristic as life cycle length is kept. If we define this value, it would not be difficult to calculate the range of changes, of that historical sluggishness, at which the course of events, obeying «Ecclesiast's imperative», simply "squeezes out" us towards quite a certain future. Having estimated the force of such "squeezing", it is possible to understand its direction and to move not forcedly any more, but purposefully, influencing this "squeezing out" force.

Choice of system evolution direction is the key problem of strategic management. At the level of practical policy the choice of system development direction is shown either in revolutionary events, or in some reforms of the previous government mode or in effective external influence on internal policy.

The choice of the direction frequently takes place as guessing of the orientation of evolutionary processes, and only later as an attempt of their reasoning and selection. The problem is that in what degree the realized direction choice will correspond to internal tendencies of the system, what efforts will be required for its passing to the target direction and the target condition and whether the tempo and rhythm of the environment will coincide with those of the given system. The history knows a number of attempts to direct violently the evolution of society contrary to natural laws, but any deviation from them was punished by cataclysms expressed differently. Certainly, the success of the strategy depends not only on validity of strategic decisions, but also on managing, intuition, harmony of motivations of process participants and a number of other circumstances. Therefore, studying of particular strategy histories is doubtlessly interesting. In fact, the source of strategic routes of countries and nations can be both: discoveries that took place or expected, and motives of struggle for power, religious impulses and requirements, changes of technologies, demand or production opportunities, pressure of competitors, natural accidents. Equally, such sources can be Utopias, illusions, fancies, greed, petty tyranny and voluntarism of leaders. In the latter case deviation from natural society evolution corridor, unreasoned waste of resources take place that can lead to ruining of systems themselves.

For more vivid representation of strategies character realized during centuries, we generated the multifactor model of the most important objects of strategic decisions. From multitude of the circumstances influencing dynamics of historical process, nine the most important have been chosen. As a matter of fact, there is nothing new in such a set; all historians mention these factors anyhow.

We performed the careful analysis of mutual relations and interferences of all mentioned factors, their relevance and completeness. As a result of such research nine most significant factors of dynamics of state development were found. They are government, territory, natural resources, population, economy, culture and religion, science and education, army (armed forces), foreign policy (geopolitical environment), which are shown in figure 2. Revelation of specific values of these factors for the period of Russian history was made on the basis of expert evaluation with the method of progressive approximation.

Figure 2 represents the graphic expression of potential and kinetic social energy factors providing development potential and realization. Respectively, the first group includes territory, natural resources, population, culture and religion; the second group consists of economy, science and education, army and foreign policy. Government is considered as a factor synthesizing all these elements. Increase or decrease of matrix profile amount is a sigh of orientation of combined vector of evolution either to creation or to destruction of the system. For instance, it is obvious looking at initial and final volume of the full matrix of the Russian empire for the period 1837-1917 (Figure. 3) and the first part of the matrix of the Soviet Union for the period 1917-1945 (Figure 4).

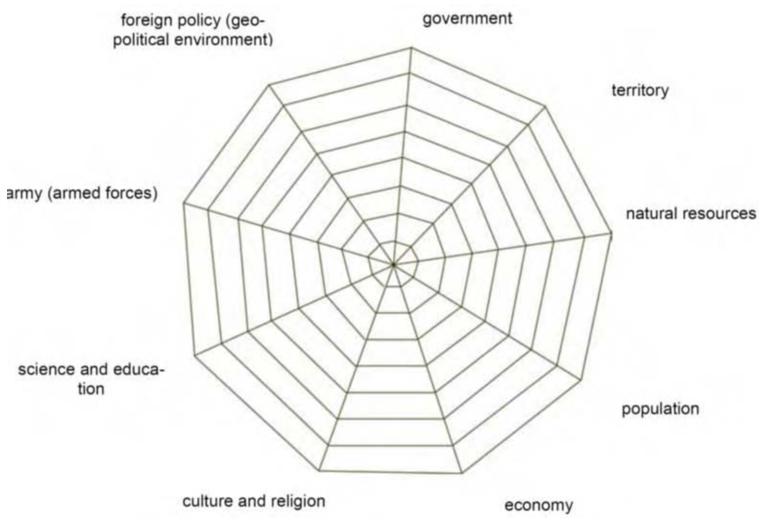

Figure 2 - Strategic matrix of historical trends

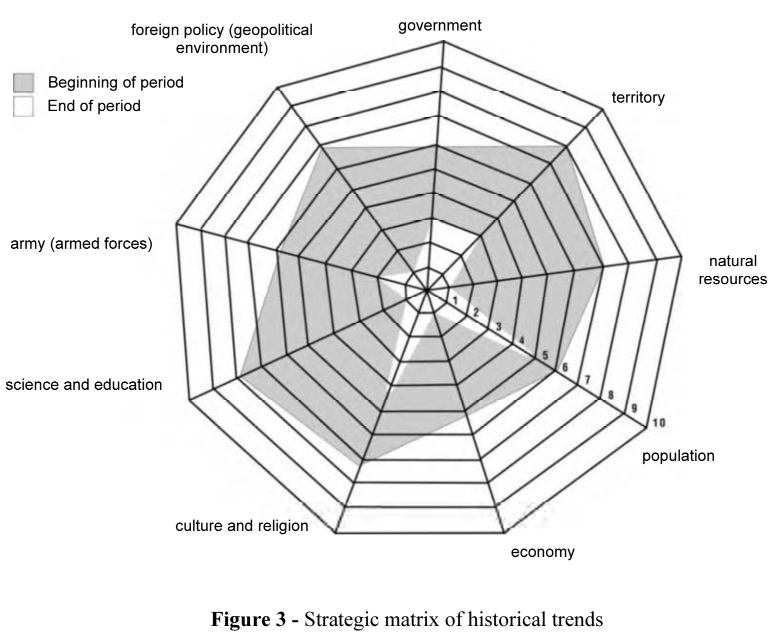

Figure 3 - Strategic matrix of historical trends

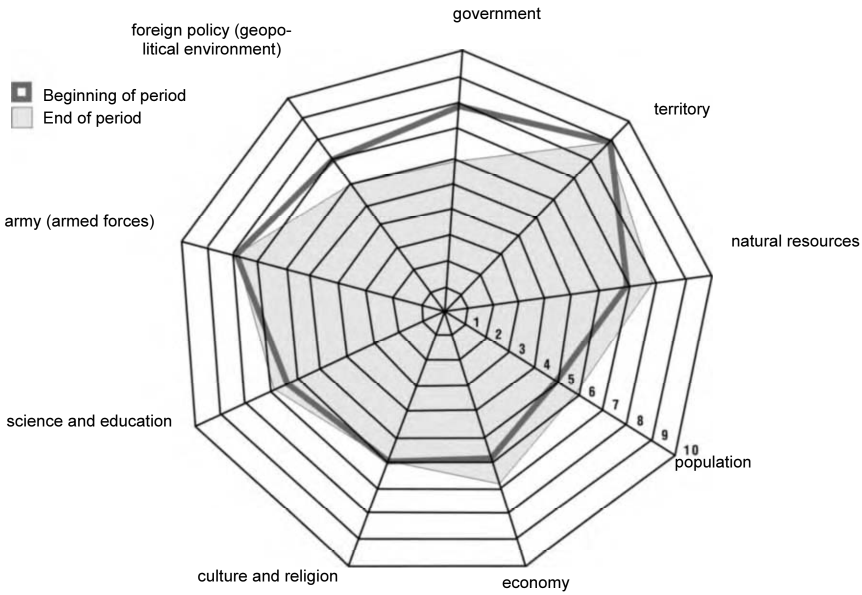

Figure 4 - Strategic matrix of the Soviet Union for the period from the end of World War II to "stagnation period" 4-V (1945-1973)

3. Features of the Current Cycle

Having finished a full 80-years cycle from 1917 to 1998, Russia nowadays got into a definitely new, though not finally determined state. Its main dynamic feature is coexistence of several destinations of possible evolution, one of which is sure become dominant in several years. These destinations differ by their driving social forces, ways of interconnection with the environment, potential, and consequences of development. On the surface of events, it is plurality of destinations, though, in the framework of changes range fixed in its major properties, it appears as active searching of «national idea», hesitation of political preferences of body of electors, competitive struggle of different sectors and ways of economy, regional differences, languor of foreign policy having no strong framework of distinctly interpreted « vitally important interests», etc.

The list above presents the main features of the initial phase of long cycles. The time limitation of this phase, some kind of «roaming» in the multitude of evolution models, is same typical limitation as found in the past. Proceeding from the total length of social and economic cycle of the country development calculated by us (about 80 years) and referring of the beginning of its modern kind to year 1998, we may expect the maximum of development of its social activity approximately in the years 2020s–2040s, and the relaxation phase of this wave of transformation in the years 2060s–2070s. Besides, it is this cycle of the current extra long 400-years wave scaled social, technological, scientific and cultural changes. The historic analogue of the coming rise of social energy is, for instance, the period of crisis of the Ryurikovichs dynasty and establishment of the new dynasty of the Romanovs, stabilization of government, strengthening of religious aspect and quite harmonic development of Russia in the years 1620–1640.

As a whole, we may expect that in the years 2015-20 the internal life in Russia will stabilize, quite stable relations with neighbor countries will be formed. At this time, the country will still be weak and its status will vary between «regional» and «great state», according to the typology accepted by us.

In particular, evaluating the prospects of changing of administrative function for the period corresponding to the 2080s we deduce that for Russia, according to the current state, the “Government” function will be positioned at the level of a regional power and, besides, the balance of state power factors is far from ideal.

Table 1 - State status factor values by «government» parameter

State status	Value (by grades)	Characteristics
Superstate	8–10	High quality of government, providing stable progressive development of the state, harmonic combination of its development factors. The dependence on the foreign influence is minimal.
Great state	5–7	High quality of government, but dependence on the foreign influence is more sufficient than ant the level of superstate. State development factors balance is satisfactory but not ideal.
Regional state	2–4	Governmental system is unstable, considerable dependence on the foreign influence is obvious.
Small state	1	High degree of dependence of governmental decisions on the foreign influence.

However, it is significant that for relatively short period the «government» function performed considerable rise, because in 1991-1998 its values were within the range of 1-2. Yet, the beginning of 1990s of the previous century was characterized by actually full loss of state organization in Russia, the final event of this period was the economic crisis of year 1998.

In these conditions, rise of function of government up to level 4 was the reflection of stabilization of the government in Russia (in other words, gaining more stability according to the scale accepted by us) at keeping quite a high degree of dependence on foreign influence. Proceeding from that, for consideration of the further strategic choice of Russia within the limits of the time period specified by us (up to year 2080) on the basis of the expert advice in the context of Institute of Economic Strategies variants of transformation of the "government" factor till 2080 presented on figure 5 were modeled.

The realistic sight at possible dynamics of development of government function proves that change of political administration mode is unlikely in 2010. As a whole, formation of five variants of incompatible hypotheses of realization of government function allowed to formulate a complete group of possible events, whose probability of occurrence was estimated by experts of «Strategic matrix» club of Institute of Economic Strategies. The results on the basis of processing of experts' opinions testify that up to 2020 the most probable outcome will be retention of the existing system of prevailing influence of one political force.

At the same time, most social expectation of Russian population are connected, first of all, with the third variant - reintegration of the post-soviet area. The probability of realization of the fourth and fifth variants for all the prediction period was determined as extremely low by the expert group.

By year 2030 under the «optimistic scenario» by academician A. G. Aganbegyan the GDP value of Russia will reach 4.5–5 trillion USD in current prices, that will make half of current value of GDP of the USA. By economic potential, GDP value, volume of industrial production, key assets and investments Russia will rise from the 10th to 4-5th place and outgo Brazil, Italy, France, Great Britain, Germany and, probably, India, letting only the USA, China and Japan ahead. The structure of economy will change fundamentally, that will obtain post-industrial features. Russia will be able to become one of the world leaders in no less than 8 of 50 macrotechnologies. Service sector will make 75–80% of all GDP, the most effective of them will be educational services (not less than 10% of GDP), scientific (5%), and also in the area of health protection (15%).

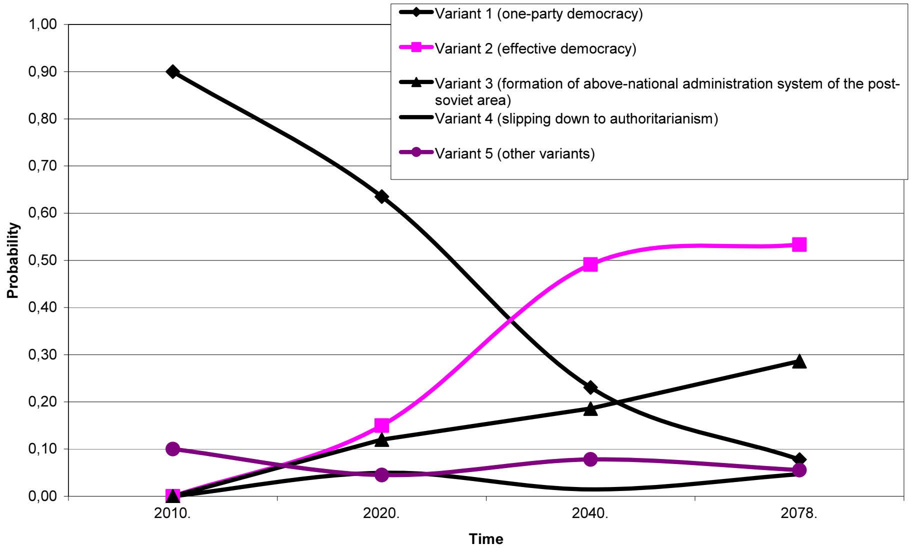

Figure 5 - Government variants realization probability change for the period up to year 2078

The conclusions of academician A. G. Aganbegyan also coincide with the «optimistic scenario» presented by academician L. I. Abalkin, and the opinion of academician N. P. Fedorenko, that «Russia will be able to return to the maximum level it had in the 20th century before the years 2025–2030». This conclusion was also reached by academicians N. P. Laverov and A. Y. Kontorovich.in their results of forecasting analysis of energy trends in Russia for the forthcoming years.

The results of our analysis of different strategies consequences are presented in figure 6. Thedynamic structure of all previous cycles of strategic evolution of Russia gives the opportunity to make general assumptions for the future. First of all, Russia in 2020–2040 will pass through a technological revolution. During this period we may expect the establishment of a new, more close union of CIS countries (including the 'rouble' zone and zone of collective security). At this time, expansion of Russia will have not a military character. Yet, like in the past, in the last quarter of the present cycle, with considerable probability, it is possible to expect an increase of development disproportion, formation of conditions for internal crisis that will again provoke activation of external menaces. However, at the end of this cycle the beginning of a new one will come, demonstrating the enduring law of generations change.

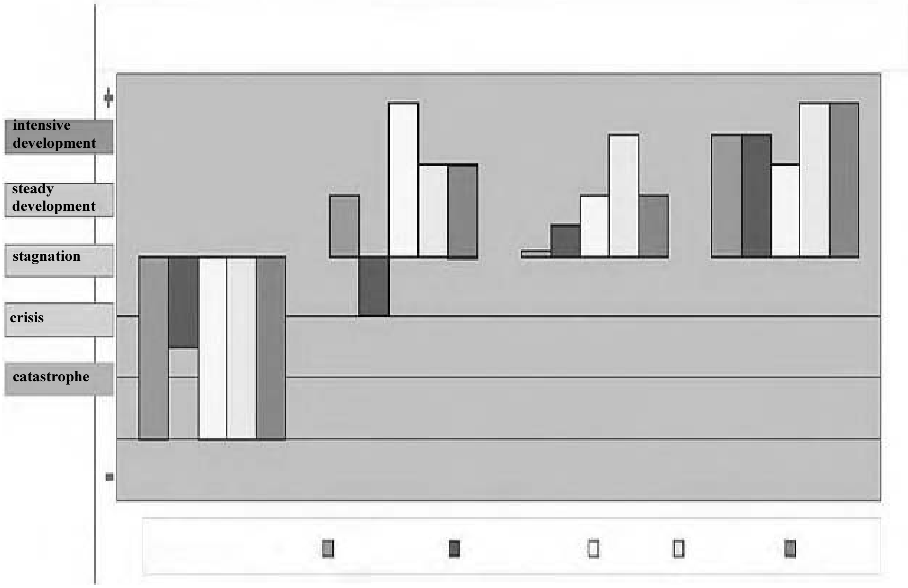

Figure 6 - Relative balance of possible strategies realization consequences of development of Russia

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