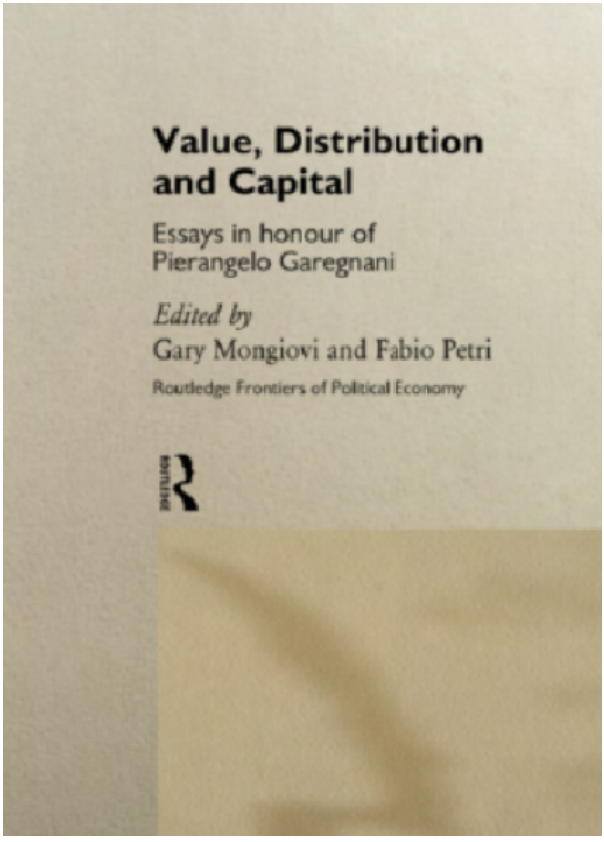
Value, Distribution and Capital

Essays in honour of Pierangelo Garegnani

Edited by

Gary Mongiovi and Fabio Petri



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This collection of essays was presented to Pierangelo Garegnani on the occasion of his 65th birthday, by economists who have great admiration for his contributions to our discipline. Many of us have learned from him what it means to do serious theoretical work, and we warmly thank him for that. These essays honour Professor Garegnani's tireless efforts to carry forward the research programme of the classical economists and Marx, and above all his unwavering commitment to the highest scientific standards in economics. This Festschrift is not a celebration of Professor Garegnani's retirement, however, because in Italy university professors need not retire before the age of 72. Professor Garegnani continues to write, publish and teach. We eagerly await his papers to come. In the meantime, we hope that these essays will contribute to the progress of economic science; for that is the sort of homage he will most appreciate.

G.M. F.P.

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1
Introduction

Gary Mongiovi

Pierangelo Garegnani's work has been central to the modern revival of the classical political economy tradition pioneered by Smith, Ricardo and Marx. That tradition was 'submerged and forgotten' (Sraffa 1960:v) in the wake of the marginalist theory of supply and demand that rose to dominance in the last decades of the nineteenth century. But in the late 1920s Piero Sraffa initiated a project to clarify and reconstruct the classical surplus approach.

The project has been carried forward, by Sraffa, Garegnani and others, including many of the contributors to this Festschrift, on several fronts. The first of these involved the development of a critique of the orthodox theory. Sraffa's penetrating criticisms of the Marshallian theory of supply (1925, 1926) opened the first cracks in the marginalist edifice. In the 1930s Keynes's *General Theory* (1936) raised troubling questions about the marginalist theory's ability to deal with unemployment, and perhaps more importantly hinted at the existence of flaws in that theory's treatment of distribution. Then a series of important contributions by Joan Robinson (1953), Sraffa (1960) and Garegnani (1970), among others, exposed the capital-theoretic defects of the marginalist framework. The capital critique was one of several factors that encouraged the shift within orthodox theory away from models that treat the endowment of capital as a value aggregate in favour of intertemporal and temporary general equilibrium models that specify it as a vector of commodities (Milgate 1979). This reformulation has been claimed to immunize the theory against the possibility of capital reversing, while keeping intact the basic supply and demand mechanism as an explanation of distribution (Bliss 1975; Hahn 1982). But this defensive manoeuver has displaced the traditional conception of equilibrium, as a long-period position characterized by a uniform rate of return, for a conception that focuses exclusively on the absence of excess demand and abandons the uniform profit rate condition. As we shall suggest below, and as the contributions by Fabio Petri and Roberto Ciccone in this volume demonstrate, this radical change in the notion of equilibrium is itself a problematic feature of modern orthodox theory.

A second element of the project to revive the classical theory is the effort to clarify the theory's logical structure. By the early part of the twentieth century the classical tradition had been nearly lost. The rapid spread of marginalism after 1890 eclipsed the classical theory so thoroughly that its distinctive analytical features had become obscured. Marshall's characterization (1920) of Ricardo's theory as an unsophisticated precursor of

marginalism—that is, as a special case, in which costs were assumed to be constant and demand was accordingly assigned a minimal role[1]—further dimmed the outlines of the classical approach. Thus, before that approach could be revived as a coherent and robust alternative to the orthodox framework, its essential structure needed not merely to be clarified and distinguished from marginalist theory: it had first to be rediscovered. While it was Sraffa's initial insight (1951, 1960) that rescued the classical theory from obscurity, much of the subsequent clarification of the logic of the theory has been due to Garegnani (1960, 1982, 1983, 1984, 1990b, 1991).

A third aspect of the project entails the reconstruction and extension of the surplus approach. Among the factors that contributed to the decline of classical economics in the nineteenth century was its inability to resolve a number of difficulties relating to the treatment of capital in its analysis of value and distribution. These difficulties had to be overcome before the classical theory could be established as a viable alternative to marginalist economics. The classical economists' insights into joint production, fixed capital and scarce natural resources awaited rigorous development. Furthermore, the relevance of the classical paradigm to problems of modern capitalism—its implications for the analysis of outputs, employment, economic growth and development, money and finance, international trade, and environmental concerns—remained to be explored. Constructive work on these problems has been an important element of the research program of the surplus approach.

Critique, interpretation and reconstruction have been interconnected and mutually reinforcing themes in the effort to revive the classical theory. Garegnani has made contributions in all three of these fields, combining critical rigour with a grasp not only of the subtleties of intellectual history but of its relevance to central theoretical issues.[2] In the decades since the publication of *Production of Commodities* economists have erected on the foundations laid by the classicals and Marx a body of work that demonstrates the analytical power of the surplus approach.[3] This work suggests that progress in understanding capitalist economies requires us, paradoxically, to look backwards to the classicals, and to restore to prominence a theoretical tradition that had been abandoned in error.

Both the classical theory and the traditional versions of the marginalist theory start from the recognition that the tendency of profit rates to equalize in conditions of free competition is the central coordinating mechanism in a capitalist economy. Profit rate differentials across industries cause capital to move from low to high rate of return sectors; the accompanying adjustments of outputs and market prices tend to equalize sectoral rates of return. A commodity's price will fluctuate in the neighbourhood of its cost of produc-tion, which is defined to include a normal rate of return for the owners of the capital required to produce it and bring it to market. The prices, outputs, and real wage consistent with the establishment of a uniform profit rate might be called a long-period position. Such positions are presumed to be established by the dominant and systematic forces operating within a market economy; deviations between the actual values of economic variables and the values they would take in a fully adjusted long-period position are caused by accidental and non-systematic forces which have negligible scientific interest. Thus the object of economic analysis is to explain long-period positions conceived as centres of gravitation for the system's variables.

The classical and marginalist theories are differentiated by the categories of data which they take as parametric in their analyses of value and distribution. What this means in effect is that they differ fundamentally in their treatments of income distribution.

Marginalist theory takes as parametric: (i) agents' preferences; (ii) technology; and (iii) the available quantities, and pattern of ownership, of resources. Within that theory, technical substitution in production and commodity substitution in consumption are held to ensure that the quantity demanded of each productive factor is an inverse function of its rate of remuneration. Wages, profits and rents are determined by a single mechanism, that is, by the forces of supply and demand, and the equilibria established by this mechanism have the property that all positively priced factors of production are fully employed. The same mechanism that determines the distribution variables simultaneously determines the technique of production, commodity prices and outputs.

The fundamental data of the classical theory of value and distribution are (i) the size and composition of the social product; (ii) the technical conditions of production; and (iii) the real wage (or, as in Sraffa's formulation, the profit rate). Within this theory the wages of labour are regulated not by the forces of supply and demand, but by social, historical and institutional factors such as custom or convention and the bargaining power of workers relative to employers. That is to say, the theory treats the living standard of workers as a biologically and socially determined datum.

The classical approach to the theory of distribution was grounded in the notion of an opposition of class interests—in particular between labour and the owners of capital, but also, as in Ricardo, between capitalists and landlords. Marx's sophisticated analysis of class conflict, and the superficial and somewhat clumsy polemics of the so-called Ricardian socialists, reflect the insight that the share of the social product received by the owners of capital and land represents a surplus, a residual obtained after deducting from the social product the consumption goods required to sustain workers, and the commodities (including the depreciated capital) used up in the production process. The profit *rate* depends upon the magnitude of this surplus relative to the amount of capital utilized in production.

Thus, given the technical conditions of production, the profit rate and the real wage are inversely related to one another. The idea that at the heart of the market system is an ineradicable antagonism of class interests became a source of ideological discomfort as the nineteenth century progressed (see Dobb 1973:111–13), that is, as the class structure of capitalism crystallized into an overtly contentious division between capitalists, who owned and controlled access to the means of production, and an increasingly class-conscious proletariat.

In an important paper, Garegnani (1984) has identified the analytical *core* of the classical theory as the set of logically necessary relationships, such as those embedded in the equations of Sraffa's *Production of Commodities*, that connect prices, the real wage and the profit rate. Logical necessity in this context means that, given the fundamental data and the requirement that in competition profit rates tend to equalize across sectors, then the profit rate and long-period normal prices must coincide with those given by the solution to Sraffa's equations. The data themselves—the real wage, final outputs, and the production coefficients—depend upon the complex interplay of political and social forces; hence they are not required by the logic of capitalist competition to take one particular set of values rather than another.

Implicit in the classical method is a logical separation of two distinct categories of theoretical problem. One type concerns formal relationships which are regarded as logically binding under competitive conditions in a capitalist economy—issues that belong to the core. The other category concerns those aspects of social reality that are not reducible to questions of mathematical necessity. Thus, the classicals separated their explanations of the real wage, outputs, accumulation and the technique of production from the analysis of the forces operating within the core. The theory acknowledges that price and distribution changes have recursive effects on the data themselves; but as these recursive effects are not regulated by forces which operate with the same mathematical exactness as those which determine prices and the profit rate, they also are external to the core, and are therefore considered at a separate stage of analysis.

The core therefore constitutes the framework upon which the classical economists grounded their analyses of how a change in one variable affects other variables. But the preceding discussion should not be taken to suggest that theoretical issues located within the core are somehow more practically important than those which lie outside it. On the contrary, Smith's preoccupation with the determinants of economic growth and technical change, Ricardo's interest in the reciprocal interaction of accumulation and distribution, his discussion of the effects of machinery on employment, and Marx's analysis of how class conflict impinges upon accumulation and distribution within capitalism, indicate the crucial importance they assigned to issues which lie outside the core. The attention which Ricardo and Marx, in their discussions of value, devoted to problems relating to the core reflected their understanding that the relations which characterize the core have ramifications for the phenomena which were their ultimate concern—the processes which regulate distribution and accumulation.

Garegnani's best-known contributions are on the theory of capital. In *Il Capitale nelle Teorie della Distribuzione* (1960), a revision and extension of his 1958 Cambridge doctoral dissertation, he shows that the classical and marginalist theories both encounter the same difficulty connected with the treatment of capital: that is, the impossibility of measuring capital independently of distribution.

The classicals encountered this difficulty in their attempt to explain the profit rate which, as we have seen, they conceived as depending upon the magnitude of the social surplus relative to the quantity of capital utilized in production. Both the surplus and the capital stock are vectors containing many different kinds of commodities; thus before the profit rate can be determined these two entities must be expressed as commensurable quantities. An obvious procedure would be to weight each commodity element of the surplus and the capital stock by its long-period normal price. But since prices themselves depend upon the rate of return on capital, the classicals could not suppose them to be known prior to the calculation of the profit rate.

Ricardo was the first economist to grasp the problem, and he grappled with it until the end of his life. A correct solution, as is now well known, requires the simultaneous determination of prices and the profit rate (Dmitriev 1904; Garegnani 1960; Sraffa 1960). But mathematical tools for the solution of equation systems with multiple unknowns were not available to Ricardo or Marx, and they therefore had to fall back on a device which has, somewhat inappropriately, come to be known as the labour theory of value (neither Ricardo nor Marx ever used that expression). Ricardo (1821) adopted the assumption that commodities exchange approximately in proportion to quantities of labour required for

their production, so that the profit rate could be expressed as a ratio whose components represented the quantities of labour time embodied in the aggregate social product, in the wage goods consumed by the working class, and in the means of production which comprise the economy's circulating and fixed capital.[4] Marx's further development of the labour-embodied principle was mainly an attempt to deal with the technical problem raised by the interdependence of prices and the profit rate (Garegnani 1991). This was of course an imperfect solution, as both Ricardo and Marx realized, since sectoral differences in capital structure cause prices to deviate from labour values; hence there is no reason to suppose that a 'profit rate' calculated in terms of labour values will coincide with the correct calculation in terms of long-period normal prices.

Ricardo's identification of labour as the source of value had ideological ramifications, which the Ricardian socialists put to immediate use, that fed the reaction against the classical theory (Dobb 1973:97–9). Marx's development of the concept of exploitation—defined as the difference between the socially necessary labour time embodied in a worker's daily wage and the number of hours in the working day—underscored the class antagonisms embedded in capitalism; but his rhetorical style obscured the essentially technical role the labour-embodied principle played in his, and Ricardo's, explanation of the profit rate. By expressing the profit rate in terms of labour values, Ricardo and Marx were able to avoid the difficulties posed by the interdependence of prices and distribution. As we have noted, they understood this to be an imperfect solution; but the fundamental soundness of the classical understanding of distribution has been established by later formulations that determine prices and the profit rate simultaneously without reference to labour values.

The same problem of measuring the quantity of capital is present in marginalist theory, though there the consequences of the interdependence of prices and the profit rate are more damaging than in the classical theory. The difficulties which capital posed for the classical economists were surmountable, through the simultaneous determination of prices and the profit rate, precisely because the classicals never deployed the capital stock as a parametric resource endowment in their theory of distribution. Marginalist analysis, on the other hand, requires that the endowment of capital be specified as part of the data of the system *prior to* the determination of prices and distribution. There are two ways this specification might be approached, and the capital debates have shown that neither is satisfactory.

The endowment of capital might be specified as a collection of distinct capital goods, as in Walras's *Eléments* (1926). But there is no reason to expect that an arbitrarily specified initial endowment of the capital stock will permit the attainment of a uniform rate of return. It is precisely through adjustments of the capital stock in response to profit rate differentials that the composition of capital is made compatible with the pattern of final demand; this same adjustment process is what eliminates the profit rate differentials. In other words, the establishment of a uniform profit rate requires that the composition of the capital stock be determined through the equilibration process; it cannot be taken as parametric. Moreover, only certain initial endowments of capital goods will allow convergence to a uniform rate of return; in general, a solution cannot be presumed to exist (Garegnani 1960, 1990a; cf. also Hahn 1982).

Alternatively, the endowment of capital might be specified as a value magnitude, and the model allowed to determine the physical composition of the capital stock. This

approach, however, suffers from the well-known defect that the value of the capital stock, which in this specification is required to be parametric, varies with the interest rate and therefore cannot be given prior to the determination of the latter. A consequence of the dependence of the value of the capital stock on distribution is that the inverse relation which the theory requires to exist between the interest rate and the capital intensity of production need not hold. The possibility of reswitching and capital reversing undermines the proposition, at the heart of the orthodox theory, that as the price of a factor of production declines, the economy will utilize that factor more intensively. The ability of the theory to establish that labour will tend to be fully employed is crucially linked to this presumed inverse relation between a factor's price and the amount of it demanded.

The reswitching and capital reversing controversy of the 1960s and 1970s demonstrated that the derivation of well-behaved factor demand curves is in general not possible. For any change in distribution can cause the prices of the commodities that comprise the capital stock to change in highly complex ways, leaving open the possibility that a decrease in the profit rate might be associated with a decrease, rather than an increase, in the amount of 'capital' employed (Garegnani 1966, 1970; Sraffa 1960). This possibility poses serious difficulties for the orthodox theory of distribution by calling into question the general validity of the factor substitution mechanisms that underlie it.

The problem, it is important to note, does not concern the empirical likelihood of capital reversing. The principle of factor substitution originated not in the observation of empirical regularities but in a process of deduction from axioms presumed by the early marginalists to be plausible. The notion of price-elastic factor and commodity demand functions has so deeply penetrated the economic intuition of our age that to doubt their existence seems to contradict the obvious. But of course these functions have never been, and never can be, directly observed. If these relations were as obvious to common sense as they are now so widely deemed to be, we might wonder how the science of political economy could have got on without them for nearly two hundred years—how they could have escaped the notice of such astute and careful intellects as Smith, Ricardo and Marx. What are observed in the marketplace are price-quantity coordinates clustered around the long-period normal magnitudes of the variables in question. The supposition that marginalist demand and supply functions underlie these observations is grounded in a particular set of premises, concerning preferences and technical substitution, that are now understood to be unsound (Garegnani 1970:424–5).[5]

Thus it is the ability of the marginalist theory to explain empirical reality that is called into question by the capital critique. The reswitching controversy established that factor demand curves cannot be derived except under special circumstances (which ironically coincide with those under which the labour theory of value holds). The critique undermines the practical usefulness of the marginalist tools by showing that they are applicable only in special cases, that is, by demonstrating that marginalist theory does not possess the generality required to explain reality.[6]

An ironic, albeit indirect, outcome of the capital controversy is that it has encouraged a defensive response that further weakens the explanatory power of the marginalist theory. We have seen that until the second half of the present century, equilibrium was generally conceived as a position of central gravitation characterized by a uniform rate of return. The models of temporary and intertemporal equilibrium that emerged in the 1930s specify the capital stock, as in Walras's *Eléments,* as a set of heterogeneous commodities.

Because they do not specify the endowment of capital as a value aggregate, these models give the appearance of not being subject to reswitching or capital reversing. This feature has encouraged their adoption in pure theoretical work on value and distribution (Garegnani 1976; Milgate 1979), and they now dominate the scene. But they abandon the traditional notion of equilibrium in favour of an alternative conception which drops the uniform profit rate condition and requires only that prices be consistent with the absence of excess demand in any market (including the labour market).

This abandonment of the traditional conception of equilibrium has substantially weakened the usefulness of the marginalist theory as an explanatory tool (Garegnani 1976, 1990a:44–61). The traditional method is grounded in the supposition that any accidental causes operating on distribution or on prices tend to offset one another over time so that the influence of the persistent and systematic forces dominates. That method enables us to make sense out of observed phenomena, which generally do not coincide exactly with any long-period position, precisely because it conceives the observed magnitudes of the economy's variables as anchored to well-defined long-period normal magnitudes that change relatively slowly over time. And the mechanism that ensures that the actual magnitudes of the system's variables gravitate towards and fluctuate around their long-period values is the tendency of profit rates to equalize in the absence of barriers to the mobility of resources.

By contrast, the positions represented by temporary and intertemporal equilibria, can have no more than a momentary existence: a competitive system is certain to move, almost immediately, away from any position characterized by profit rate differentials. Random and accidental influences are as likely to prevent the actual magnitudes of the system's variables from coinciding with these short-period equilibria as they are to prevent actual magnitudes from coinciding with the traditional long-period positions. But whereas in the traditional method, any observed variable can justifiably be presumed to be gravitating *towards* a normal level that has some practical *permanence*, in axiomatic general equilibrium theory, any observed variable must be presumed to be moving *away from* a position that in any case has passed out of existence and therefore no longer has any practical relevance. It is unclear therefore how the new conception of equilibrium can establish the correspondence between observed magnitudes and the variables of economic theory that is indispensable for scientific explanation.

Nor is it clear that the modern axiomatic reformulations of the marginalist theory do in fact avoid capital-theoretic difficulties by specifying the endowment of capital as a vector of heterogeneous commodities. These formulations require the equilibration of saving and investment through the adjustment of the rate of interest. There is no reason to suppose that this mechanism will remain intact in the face of the complex patterns of changes which variations in the interest rate can induce in the prices of capital goods. The traditional interest-elastic investment function is retained in heterogeneous capital models of general equilibrium, and this is precisely the mechanism that is vulnerable to the possibility of capital reversing. Hence the possibility cannot be ruled out that these models are as defective on capital-theoretic grounds as the traditional versions of the theory that treat capital as a value magnitude; the same difficulties appear to be present in a somewhat altered form (Garegnani 1990a:60–1, 70).

In view of what has been argued here, heterogeneous capital models of general equilibrium, far from enabling marginalist theory to evade the capital critique, merely

camouflage the theory's logical defects. Over the past four decades mainstream theorists have marshaled an increasingly sophisticated arsenal of mathematical techniques against formal problems of noticeably diminishing practical relevance. On concrete questions axiomatic general equilibrium theory gives little help to intuition; the theory's very generality precludes the derivation of simple propositions about how a change in any parameter will influence a particular economic variable (Arrow and Hahn 1971:vi–vii, 245). It is moreover well known that while the theory can demonstrate the existence of a competitive equilibrium under fairly unrestrictive conditions, the uniqueness and stability of the equilibrium can be established only in special cases. The microfoundations project appears to have killed off the theory of effective demand as a viable element of the mainstream research program; but no consensus on the nature of economic crises or persistent unemployment has emerged to replace Keynes's theory.

The remarkable early success of marginalism owed much to the theory's apparent usefulness as a tool for addressing practical questions. In its modern formulations, however, the theory is decidedly ill-suited to practical application, a point conceded even by its supporters (Hahn 1985). The sterility and irrelevance of much recent theoretical work is in large part a by-product of the orthodox response to the capital critique. That response—the specification of the economy's endowment of capital as a heterogeneous collection of produced inputs—involved a radical change in the notion of equilibrium that, as we have seen, deprived the theory of its ability to explain observed phenomena. Furthermore, it is not clear that this reformulation avoids the capital theoretic problems that arise in the traditional version of the theory. These considerations suggest that the Cambridge critique was not a minor episode in modern economic thought, as some commentators have asserted (Hahn 1982). By forcing marginalist theory to assume a form which cannot give practical results, the critique has dealt it a serious blow.

The papers which comprise this volume reflect upon and advance the enterprise which Pierangelo Garegnani has carried forward throughout his career. Appropriately, they take up, from a variety of angles, the basic themes of critique, interpretation and extension mentioned at the start of this introduction.

The first three essays are concerned with the critique of orthodox theory. Fabio Petri responds to Frank Hahn's argument (1982) that the capital theoretic criticisms of marginalist theory apply only to those unsophisticated specifications of the theory which rely upon an aggregate production function (Hahn 1982). Hahn contends that a correctly specified neoclassical model, by which he means one that treats the endowment of capital as a heterogeneous collection of commodities, is immune to such criticisms; and that the model associated with Sraffa is merely a special case, which arbitrarily incorporates a uniform profit rate condition, of a more general neoclassical theory which allows own rates of return to differ for different assets. Petri demonstrates that Hahn has wrongly interpreted the capital critique, that the logical inconsistencies of the long-period versions of the marginalist theory are present in a somewhat modified form in modern disaggregated capital models, and that the equilibria which characterize the latter class of models are incapable of providing insight into actual economic processes.

Roberto Ciccone focuses on the conceptualization of short-run prices in classical and neoclassical theory, with a view to explicating their empirical content. He examines the role of market price, as distinct from long-period normal price, in classical political economy, and then turns to a discussion of the Marshallian short period. In both cases,

short-period prices are found to have a clear and unambiguous connection to actual prices, by virtue of their being defined in reference to some long-period equilibrium position. The prices found in temporary and intertemporal general equilibrium models, however, are shown to lack any definite empirical content.

Starting from the insight that the concept of equilibrium derives its economic meaning from the process of competition, John Eatwell and Murray Milgate clarify the deficiencies of Walrasian intertemporal general equilibrium theory. Neoclassical theory, they argue, has transformed—corrupted—the original conception of competition, understood simply as the absence of impediments to the movement of resources across sectors, into the modern notion of perfect competition, defined as price-taking behaviour by an infinity of infinitesimally small agents. The original meaning of competitive equilibrium—the equalization of profit rates—has likewise been distorted so that it now refers to the mathematical solution of formal models. The degeneration of these concepts for the sake of an empty formalism has led neoclassical theory to a scientific dead-end in which, unable to provide answers to meaningful questions, its attention must be confined to problems of little practical relevance.

Several of the papers in this volume take up various aspects of the interpretation of classical political economy and of its relation to marginalism. A distinguishing feature of the classical theory is its focus on objective, as opposed to subjective, elements in its analysis of value and distribution. Alessandro Roncaglia traces the connections between Jeremy Bentham's version of utilitarianism, in particular the 'felicific calculus', and the marginalist conception of rational economic man. John Stuart Mill's criticisms of Bentham's utilitarianism are shown to be reflective of an alternative conception of rational behaviour, that which is found in classical political economy, according to which individuals are recognized to be multifaceted, their tastes shaped by habits and customs, and their behaviour regulated not by a cold calculus of pleasure and pain but by a rich and complex social matrix.

Bertram Schefold's contribution explores the meaning and role of the concept of use value in political economy, a topic which appears to have received no systematic exposition in the classical literature. The remarks of Smith, Ricardo, Say and Marx on value in use, Schefold contends, fail to distinguish adequately their conceptions of it from subjective utility. Drawing on the writings of William Petty and Jacques Savary, Schefold argues that the key to a clear understanding of value in use can be derived from the communications of European merchants who, during capitalism's formative period, confronted the problem of describing increasingly standardized commodities. The use value of such commodities consists in their objective properties and the socially determined uses to which they can be put.

Marginalist economics originated in part as a generalization of classical rent theory to all factors of production. In the first half of the nineteenth century two German economists, Friedrich B.W.Hermann and Johann H. von Thünen, made pioneering attempts to explain the distribution of income among wages, profits and rents via the symmetric application of the principle of intensive diminishing returns. These efforts are surveyed and critically evaluated here by Heinz D.Kurz, who shows how Hermann and von Thünen anticipated important elements of the marginal productivity theory of distribution, including the latter's capital theoretic difficulties.

In the next paper Fernando Vianello attempts to make sense out of the 'tangled skein' of Adam Smith's social accounting, with a view to assessing the valdity of Marx's criticisms of it. In the process, Vianello clarifies Smith's distinction between productive and unproductive labour.

Two of the papers in this collection consider the treatment of wages in classical political economy. Tony Aspromourgos and Peter Groenewegen examine the notion of the subsistence wage in the British and French classical literature prior to the publication of Adam Smith's *Wealth of Nations* (1776). Their emphasis on the pre-Smithian literature underscores the fact that the classical surplus approach had come into existence more than a century before the publication of Smith's book. The distinguishing properties of that approach are already evident in the wage literature of the second half of the seventeenth century.

Antonella Stirati takes up the contentious question of the extent to which Ricardo held a wages fund view of the labour market. Stirati forcefully demonstrates that no traces of a wages fund can be found in Ricardo's writings, and that the wages fund notion of an inverse relationship between the wage rate and employment is in fact inconsistent with important elements of Ricardo's theoretical system. She also shows that Ricardo's theory, in contrast to both the wages fund doctrine and marginalist theory, contains no mechanism which promotes a tendency towards full employment, but on the contrary conceives of some measure of unemployment as a normal feature of a market economy.

Paul A.Samuelson offers some reflections on Sraffa's legacy from a neoclassical perspective. The editors are grateful to Professor Samuelson for contributing a lively paper that is certain to stimulate debate. The paper raises a number of interesting questions (for example, the extent to which Irving Fisher anticipated Sraffa; the extent to which Sraffa's theorems were already known to 'the savvy youngsters in Leontief's circle'). But above all it is useful because it starkly reveals the degree to which clarification is still needed in order to make the importance of Sraffa's and Garegnani's contributions understood by neoclassical economists. Samuelson emphasizes the influence of the composition of demand on distribution, and suggests that the classical theory endorsed by Sraffa somehow denies this role. But no Sraffian economist would deny that when the real wage or the profit rate is given, and aside from those cases in which the non-substitution theorem holds, the composition and level of demand do affect relative prices and the residual distribution variable. On this point there is no disagreement between orthodox and Sraffian economists. The real issue is whether preferences can play the role assigned to them in the neoclassical theory of distribution, that of providing a basis for the simultaneous determination of all distribution variables via the forces of supply and demand. Sraffa implicitly, and Garegnani explicitly, argue that preferences cannot play that role, because the neoclassical treatment of capital is radically and irremediably flawed.

Towards the end of his paper Professor Samuelson expresses puzzlement about the precise character of the 'critique' of marginalism Sraffa had in mind in his subtitle to *Production of Commodities*, and he surmises that Sraffa believed the fundamental error of neoclassical 'parables' was the assumption of smooth differentiability of production functions. This conjecture cannot be squared with Sraffa's very clear remark (1960:38) that the traditional neoclassical conception of a quantity of capital measurable independently of distribution is untenable. The critique Sraffa had in mind surely was the

elucidation of this result for the various versions of marginalist theory; this task has been largely accomplished, in good part by Garegnani.

The next two papers address problems of accumulation and technical change in the light of the surplus approach. Sergio Cesaratto presents a critique of neoclassical growth theory, with particular emphasis on the relatively new endogenous growth models. He argues that the marginalist foundations of mainstream growth theory, in particular the commitment to Say's Law and the related idea that growth originates ultimately in saving, constrains the ways in which the theory can approach accumulation and technical change. The rejection of Say's Law, and of the neoclassical distribution mechanism that is presumed to establish full employment, opens the way to alternative approaches that assign an important role to demand in explaining accumulation and technical change. These alternative routes are explored at the end of the paper.

Edward J.Nell considers the implications of Keynesian animal spirits, as a determinant of investment, for our understanding of accumulation. His discussion ranges over several related topics, including the capacity of the central bank to set the real interest rate, the ability of a permanent change in the interest rate to influence the profit rate, and the question of whether the profit rate does in fact gravitate towards the money rate of interest.

In their papers Neri Salvadori and Ian Steedman take up some technical theoretical issues. Salvadori revisits the classical treatment of fixed capital goods as joint products and extends this approach to cases in which old machines are transferable to the production of different finished commodities. Steedman proposes a device for describing production techniques, which applies Sraffa's dated labour analysis to a vertically integrated production system, and shows that this device has important advantages in simplicity and applicability for the analysis of the relations between price and distribution.

The last two papers, by Massimo Pivetti and Carlo Panico, address questions of economic policy. Pivetti examines, with special reference to the case of Italy, the European movement toward economic and monetary union, which he interprets as a disciplinary exercise aimed at containing inflation, government deficits and government debt. The EMU project, Pivetti argues, stems from a radical reorientation of macroeconomic policy away from the reduction of unemployment and the amelioration of poverty; the basis of this reorientation is the restoration to prominence of pre-Keynesian modes of thinking about macroeconomic problems, as embodied in the notion of a natural rate of unemployment.

Panico incorporates the government sector into a post-Keynesian model of growth and distribution. He shows that the introduction of the government sector limits the applicability of the Cambridge equation. He then uses the model to elucidate two features of Nicholas Kaldor's thinking on monetary and fiscal policy: the notion that the money supply is endogenous; and the idea of varying government expenditure to maintain steady growth. Finally, Panico uses his model to show how two hitherto competing post-Keynesian traditions on income distribution—the view that the profit rate depends upon the economy's growth rate and the view that distribution is regulated by the money rate of interest—might be reconciled.

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Notes

1 A modern counterpart to this view contends that the classical theory represents a special case of marginalist theory in which the composition of the initial endowment of capital goods happens to coincide with the composition that would yield a uniform profit rate (Bliss 1975; Hahn 1982). This interpretation presupposes the legitimacy of a conception of equilibrium that is not characterized by a uniform rate of profit.

2 See Mongiovi (1998) and Petri (1992) for more detailed accounts of Garegnani's contributions to economic theory.

3 See Kurz and Salvadori (1995) for a rigorous and comprehensive account of the theory of value, distribution and growth from the perspective of the surplus approach.

4 Ricardo's initial approach to the problem was grounded in the supposition that the sector which produces corn utilizes only corn as an input, with wages also being paid entirely in com. On that assumption the rate of profit in agriculture could be calculated as a ratio of quantities of corn, without reference to prices. Competition would then cause the market prices of manufactured goods to adjust to bring all rates of return into line with the agricultural profit rate. But Ricardo was forced to acknowledge the validity of Malthus's observation that even in agriculture output is never 'exactly of the same nature as the capital advanced', and his search for a more defensible solution led him to the labour-embodied approach.

5 The above discussion has emphasized the foundational weaknesses relating to the specification of capital, and their consequences for the derivation of factor demand functions. But the premises underlying *commodity* demand functions are equally questionable. The notion of price-elastic commodity demand curves was not derived from observation: the range of price-quantity observations for any commodity is generally too narrow to permit the empirical construction of a demand curve. Demand curves are conceivable only on the supposition that agents' preferences have certain properties, summarized in the standard choice axioms of orthodox theory (convexity, completeness, transitivity, etc.). But these axioms are themselves not susceptible of empirical verification, and there is good reason to think them inappropriate (cf. Sen 1973). If preference orderings are lexicographic, as in Maslow's hierarchy of needs (1943), commodity demand curves cannot generally be derived. There are, moreover, numerous cases in which we might sensibly doubt, on intuitive grounds, the usefulness of demand curves: what, for example, is the price-elasticity of demand for coffins?

6 Similarly, Sraffa's early work on the laws of returns (1925, 1926) shows that the Marshallian theory of supply holds only under special circumstances. The point of his critique was that the theory's inability to accommodate important phenomena like increasing returns severely limits its usefulness as a tool for understanding reality. The editors would therefore disagree with Professor Samuelson's suggestion, in his contribution to this volume, that Sraffa's aim in 1925 and 1926 was to make a case for a constant cost assumption. In fact, Sraffa's position was precisely the opposite: he wanted to call attention to the inadequacy of the Marshallian theory for handling non-constant, particularly increasing, returns. *Production of Commodities* was, at least in part, a by-product of Sraffa's early reflections on the problem of reconciling value theory with increasing returns (see Mongiovi 1996 for an account of Sraffa's critique of Marshall and its connection to *Production of Commodities*).

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Part I
The critique of neoclassical theory

2
Professor Hahn on the 'neo-Ricardian' criticism of neoclassical economics

Fabio Petri

1 Introduction

The purpose of the present contribution is to dispel a number of frequent misunderstandings concerning the targets and the implications of the so-called Cambridge or 'Sraffian' criticisms of the 'neoclassical' or 'marginalist' theory of capital (and of value, distribution and employment).[1] This aim will be pursued through a discussion of Frank H.Hahn's article 'The neo-Ricardians' (1982).[2]

Hahn's article contains a forceful and analytically detailed statement of a thesis, shared by most authors on the neoclassical side of the debate, and no doubt largely responsible for the little impact which so far the Cambridge criticisms have had on mainstream economic theory. This thesis is that the Sraffian criticisms of neoclassical or marginalist capital theory, although correct in pointing out the non-generalizability of certain properties of one-good neoclassical models, have no bearing on the logical consistency of the rigorous, fully disaggregated general equilibrium microfoundations of the neoclassical approach to value and distribution. This opinion, it will be argued, is mistaken and rests on misunderstandings of the logic of marginalist theory and of the aims of the critics.

The main points of the present paper are four.

Point one: Hahn does not correctly reconstruct the Sraffian or neo-Ricardian criticism. He wrongly interprets the Sraffian criticism of the notion of 'aggregate capital' as only aimed at the versions of the marginalist theory of distribution relying on an aggregate production function Y=F(K, L): since these versions were never claimed to be more than non-rigorous approximations, he can conclude that their rejection leaves the rigorous, disaggregated versions unscathed. He thereby shows an imperfect grasp of the meaning of the assumption of a uniform rate of profits (or of return on supply price)[3] in value theory, and, therefore, also an imperfect grasp of Garegnani's fundamental distinction between two groups of versions of marginalist disaggregated general equilibrium theory: the traditional ones, which attempted the determination of long-period prices (uniform-profit-rate prices) and were thus internal to what Garegnani (1976) has called the 'method of long-period positions'; and the more recent, neo-Walrasian ones (Arrow-Debreu intertemporal equilibria and various kinds of temporary equilibria), which attempt the determination of very-short-period prices.[4] Hahn is apparently unaware that in the traditional, long-period versions of neoclassical theory one finds *both* a fully disaggregated treatment of general equilibrium *and* a notion of capital as a single factor,

and that the reason is the treatment of the relative endowments of the several capital goods as unknowns, in turn due to the absence of the assumption of instantaneous adjustment; so he wrongly takes the neo-Walrasian versions to be the sole disaggregated, and hence rigorous, representatives of the marginalist approach, and the aggregate-production-function models to be the only neoclassical models where there appears capital as a single factor. Sraffa, on the contrary, clearly aimed his criticism at the traditional long-period versions. The analytics of these versions are briefly described, and the connection with Hahn's misleadingly different model—which makes it nearly impossible to understand the rationale for the hypothesis of a uniform rate of profits with constant relative prices—is then clarified.

Point two: because of what was argued under Point one, it is first of all with respect to the traditional, long-period versions of marginalist general equilibrium theory that one must ask whether the critics are right or not in claiming, in Hahn's words:

> that Sraffa's work shows that orthodoxy cannot logically provide a closed model which treats relative prices and the rate of profit as endogenous variables determined within the system.
>
> (Hahn 1982:353).

With respect to those versions, it will be argued, the critics are indeed correct: Hahn's own analysis confirms—when correctly interpreted—the analytical need to treat the relative endowments of capital goods as variables if one wants to assume a uniform rate of return on supply price, and the consequent need for a given endowment of 'capital' measured as a single factor of variable 'form'; but there is no logically satisfactory way to 'close' a long-period equilibrium system of equations, because the datum relative to the endowment of 'capital' cannot be determined. (Why the criticism of those traditional versions is important is explained under Point four.)

Point three: Hahn's claim that 'the neo-Ricardian attack via logic is easily beaten off' (p. 353), i.e. that neoclassical theory is logically consistent, is incorrect even when restricted to those neo-Walrasian versions of general equilibrium which Hahn identifies with the whole of 'rigorous' neoclassical theory. Once the nature of the logical inconsistency characterising the long-period versions is correctly grasped (it is *not* a formal inconsistency of the system of equations), it becomes clear that a strictly analogous logical inconsistency is also present in the neo-Walrasian versions: an inconsistency between assuming equilibration on the products' markets, and not allowing the endowments of capital goods to change during the equilibration process.

Point four: the traditional marginalist conception of capital undermined by Sraffa remains to this day the real microfoundation of the applications of the neoclassical approach to explanations and predictions of real-world events, and is the only possible foundation of the belief that neo-Walrasian analyses may have any connection with reality. This is because, owing to its need to assume instantaneous equilibration, the theory of neo-Walrasian equilibria by itself tells us *strictly nothing* on the actual behaviour of economies not continuously in neoclassical equilibrium. The traditional notion of capital will be argued to be indispensable to the standard labour demand curve and to the thesis that investment is a decreasing function of the rate of interest. It will be

concluded that Sraffa's criticism undermines all attempts to apply the neoclassical approach to the explanation and prediction of real-world events.

These clarifications should be helpful both in overcoming, and in making sense of, the grave difficulties of communication which have marred the debate on capital theory, and which have prompted statements such as: 'I have long since abandoned the illusion that participants in this debate actually communicate with one another' (Solow 1962:207). The difficulties were due to insufficient clarity on the issues discussed in the present paper. An explanation of the central points needing clarification—the difference between the long-period and the neo-Walrasian formulations of the marginalist general equilibrium, the need for capital as a single factor of variable 'form' in the long-period versions, and the inability of the neo-Walrasian versions to be an alternative microfoundation of the applications of neoclassical theory—was not available in print in English in the first rounds of the debate: it only started becoming available with the publication of Garegnani (1976). Until then the debate had indeed been largely at cross purposes: the Cambridge critics had been meaning by 'neoclassical theory' its traditional versions, based on the notion of capital as a homogeneous factor, and aiming at long-period analyses (cf. e.g. Garegnani 1970, and his reply to Bliss's Comment, *ibid.*, Pasinetti 1977); the neoclassicals had been answering that their theory in its rigorous versions (by which they meant the neo-Walrasian reformulations) did not need to aggregate anything.

Garegnani's 1976 contribution was quickly followed by a number of other writings insisting and expanding on the same points (e.g. Garegnani 1978; Petri 1978; Eatwell 1979, 1982; Milgate 1979, 1982). Unfortunately, by then the neoclassical side had made up its mind. All the main neoclassical assessments of the debate before Hahn, i.e. Blaug (1974), Stiglitz (1974), Bliss (1975), Dougherty (1980), Burmeister (1980), as shown by their dates of publication, were written before Garegnani's 1976 contribution or at least before it was possible to appreciate its importance. Reflecting the little clarity at the time on the evolution of the marginalist approach to value, all these contributions share with Hahn the belief that the only general equilibrium versions of neoclassical theory are the neo-Walrasian ones, and that aggregate capital is therefore not essential to neoclassical theory. The insistence of the Cambridge critics on the thesis that the abandonment of the notion of aggregate capital was fatal to the whole of neoclassical theory must have appeared to these authors as inexplicable, except as the fruit of ignorance of the modern developments of value theory: in one word, as the fruit of *incompetence*. This may help explain the otherwise surprising fact that Hahn apparently felt little need to bring his knowledge of the critics' contributions, and his References, up to date when, after several years, he went back to prepare for publication the 1975 lecture notes from which, as he tells us (p. 353, note), the 1982 article resulted. And it may also help one explain the absence of neoclassical replies to this second wave of critical articles. Thus, it would seem, the neoclassical side decided to stop reading the critics' contributions just when these were finally supplying the necessary clarifications and extensions of the criticism to the neo-Walrasian versions.[5]

As implicit in these observations, the general drift of the argument of the present paper is not new. Some observations are however new and some others are formulated in new ways which make them, I believe, easier to grasp for the neoclassically-trained economist. Let me single out: the stress on non-instantaneous adjustment as the reason

for the endogenous relative capital endowments and for the uniform rate of profits in the traditional versions of neoclassical theory; the simple model of long-period equilibrium; the discussion of the applicability of long-period equilibria to non-stationary economies; the discussion of the legitimacy of the assumption of constant relative prices; the clarification of the misleading nature of Hahn's model; the indication of Sraffa's contribution on the problem of determining the endowment of capital viewed as a single factor; the comments on Hahn's and Bliss's views on the problem of aggregation; the thesis that neo-Walrasian equilibria are as logically inconsistent in their data relative to the capital endowment as long-period general equilibria resting on a given value of capital; the thesis that neo-Walrasian equilibria tell us nothing at all on actual economies; the illustrations of the persistent reliance of mainstream macroeconomics on the traditional notion of capital; the thesis that neo-Walrasian equilibria are not the microfoundation of the 'vision' embodied in one-good neoclassical models, the reverse being rather the case.

A fruitful resumption of the debate should now encounter few barriers to communication. If the absence of neoclassical replies should continue, the reason, one will have the right to presume, will be that convincing replies are not to be found.

2 The assumption of a uniform rate of profits

2.1

On p. 370 Hahn writes that 'The Sraffian picture of neoclassical theory' is that there is an aggregate production function Y=F(K, L) and that, once K, L and F(·) are known, the distribution of income is known. He gives no textual support for such a statement. Now, it is true that some of the critics had occasionally expressed themselves in ways which could give some support to such an interpretation. But Hahn uses the term 'Sraffian', so it would seem natural to check whether that is what Sraffa had in mind. Now, Sraffa (1960) only criticizes the notion of a 'quantity of capital' and the attempt to give a foundation to that notion via the average period of production; and the authors who used the average period of production did *not* base their theory on aggregate production functions.[6] And Garegnani (1970:269)—a paper which does appear in Hahn's references—is explicit on the minor importance only of the aggregate-production-function versions of the marginalist approach.

In order to understand what Sraffa intended to criticize, one must start from the fact that his price equations assume a uniform rate of profits, or of return, on supply price (i.e. on cost of production). Sraffa is very traditional in this. The postulate of a uniform rate of profits can be found not only in Adam Smith, Ricardo, Marx, but also in J.B.Clark, Böhm-Bawerk, Wicksell, Marshall, Robertson, etc., *and Walras*. Thus—what one would not imagine from Hahn's article—the price equations one finds not only in Wicksell, but also in Walras, imply that, if the same assumptions (yearly production cycle etc.) were made as to the kind of technology, their equilibrium prices would satisfy Sraffa's equations.[7]

Now, those same founders and developers of the marginalist, or neoclassical, approach to value and distribution who all assumed a uniform profit rate, also treated (with the only

exception of Walras, on whom more below) the endowments of the several capital goods as *variables* endogenously determined by the equilibrium; what they took as given was the endowment of 'capital', a single factor 'embodied', so to speak, in the heterogeneous capital goods and measured as an amount of value.

The reason is simple: they wanted their equilibrium prices and quantities to have the same role as the 'normal' or 'natural' prices and quantities determined by the earlier classical economists: the role of indicators of the average, or trend, of day-by-day prices and quantities, because indicators of the position towards or around which the economy would gravitate owing to the time-consuming adjustment processes going on in it. Like the earlier classical authors, they were distinguishing the accidental and temporary results of day-by-day markets from the persistent forces which determined the average or trend of market prices and quantities, and they thought that economic theory can only in general aim at determining the latter.[8] But the moment it is admitted that disequilibrium adjustments to equilibrium take time, then it must also be admitted that the data of a marginalist general equilibrium cannot include given endowments of each capital good. The time required in order considerably to alter the endowments of most capital goods is not different from e.g. the time required to ascertain whether the demand for and supply of a product are in equilibrium (an apparent disequilibrium might in fact only be due to the random component in the flow of demand, present in most markets—so one must wait to make sure), or from the time required for the price of all the units of a good to tend to uniformity (it takes time to learn the price set by competitors, their reactions to one's price change, etc.); so it is intrinsically contradictory to assume equilibration on the product markets while not allowing the relative endowments of capital goods to change.

(This contradiction is avoided in the neo-Walrasian versions by assuming that, as in Walras's tâtonnement with 'tickets', the adjustment to equilibrium goes on while economic activity is suspended, i.e.—since in actual economies such a suspension does not exist—in a 'logical time' which takes zero actual time, i.e., to all effects, that the adjustment process is infinitely fast. But, even granting stability, an assumption like instantaneous equilibration, which is clearly unrealistic and which furthermore—by making it possible to treat as given what otherwise would have to be considered endogenously determined variables—drastically alters the analytical structure of a theory, can only be accepted after it is demonstrated that it makes no significant difference to the conclusions; if it does make a significant difference, then the conclusions are at most as solid as the assumption, i.e. they only apply to fairy-tale worlds since the assumption can only hold in fairy-tale worlds. Now, in order to demonstrate that the assumption of instantaneous equilibration makes no significant difference, one must be able to compare the results of analyses based on it, with those reached without assuming instantaneous equilibration. The determination of the behaviour of the economy without instantaneous equilibration—a determination which, it will be argued, the neoclassical approach is unable to achieve—appears therefore to be a necessary prerequisite for assessing the acceptability of the assumption of instantaneous equilibration.)

2.2

The traditional, long-period formulations of general equilibrium theory did nothing more than accept this indisputable truth. The equilibrium had then to determine the

composition of the capital stock endogenously, and the obvious way to determine it was to assume that this composition would adjust so as to guarantee a uniform rate of return on cost of production or supply price (URRSP in the sequel). In fact, if the rate of return obtainable by purchasing (at a price equal to its cost of production) a capital good were higher than for other capital goods, investors would scramble to buy that capital good only, causing disequilibrium, and rapid changes in the quantities produced (but then also in the quantities consumed) of the different capital goods and thus also in their relative endowments.

The analytical problems posed by a general equilibrium where the endowments of the several capital goods are endogenous variables and there is URRSP are nowadays not generally appreciated, because most economists are not even aware that this was the dominant notion of general equilibrium until the 1930s. It must also be added that very few theorists explicitly attempted the writing down of the complete system of equations of such a general equilibrium; indeed, none apart from Wicksell and some of his pupils. One can consult Garegnani (1990a) for an exposition of Wicksell's own work. Here the task will be more limited: to show that Hahn rediscovers two important analytical results reached by the critics' examination of the logic of long-period marginalist general equilibria, but that a work of 'translation' is necessary because the model he chooses makes the connection with traditional analyses very difficult to perceive.

In order to clarify the logic of a long-period general equilibrium, let us formulate its equations as simply as possible. I shall follow a formulation as close as possible to Walras's. There are $m+n$ goods; the first m of these are pure consumption goods, the last n are pure capital goods. Consumption makes the goods disappear; utilization as capital goods makes them depreciate radioactively at a constant rate d_j, $j=m+1,\ldots, m+n$. There are constant returns to scale, free entry and no joint production. For simplicity there are no factors except the capital goods and one kind of labour. Because of constant returns to scale, equilibrium prices must equal minimum average costs, so we have $n+m$ price=cost equations:

$p_i=MAC_i(v, w)$, all i; in matrix form: $p=vB+wl$ (A)

where p is the vector of product prices, $i=1,\ldots, m+n$; MAC stands for minimum average cost; v is the vector of capital goods' rentals, w the wage rate, B is the $n\times(m+n)$ matrix of technical coefficients of material inputs (each column representing the input coefficients of a different industry), l the $(m+n)$-vector of labour coefficients. These technical coefficients depend on technical choice, i.e., given the available production sets, on v and w.

Again because of constant returns to scale, one must assume that production adapts passively to demand at the prices equal to minimum average costs. Let q be the vector of outputs, $q=(q_c, q_k)$, the first m elements q_c are consumption goods, the last n elements q_k are capital goods. $Q(p,v,w)$ is the vector of consumer demand functions for consumption goods, and k the vector of investment demands. Then in equilibrium we have $n+m$ production=demand equations; in vector notation:

$q=Q(p, v, w)+k$ (B)

Q is zero for the last n goods, k is zero for the first m goods. Now let X be the vector of endowments of capital goods and L the endowment of labour. These endowments are, for simplicity, assumed to be entirely offered. The demands for capital goods and for labour are determined by the quantities to be produced q, and by the technical coefficients B, l. The demands for the endowments of capital goods are given by Bq, the demand for labour by lq. The equality between supply and demand gives us n+1 equations; in matrix notation:

$$X=Bq,\ L=lq \qquad \text{(C)}$$

Let us now add the condition of URRSP. This was universally formulated by neglecting the slow changes over time that relative prices may be undergoing in a situation in which the composition of capital has had time to adjust to the composition of demand. Then, if r is the rate of return or (neglecting risk, for simplicity) of interest, it must be:

$$r=(v_i-d_ip_i)/p_i,\ i=m+1,\ldots,\ m+n \qquad \text{(D)}$$

which gives us n more equations. Thus we have $2(n+m)+2n+1$ equations, in the following unknowns: p, q, X, v, w, k, r. These are $n+1$ more than the equations; one equation is derivable from the other ones because of Walras's Law, but we are only interested in (and indeed the equations can only determine) relative prices, so after choosing one price as numéraire we still have $n+1$ more unknowns than independent equations.

What is glaringly missing so far is the determination of the k_i's. Traditionally, it was assumed that the economy be stationary; I discuss this assumption in the next paragraph, for the moment let us suppose that tastes are such that consumers want to perform zero net savings whatever the prices and the rate of interest, and that the composition of investment has had time to adapt to the replacement needs of the existing stock of capital goods. This yields:

$$k_i=d_iX_i,\ i=m+1,\ldots,\ m+n \qquad \text{(E)}$$

This gives us n more equations. There remains one degree of freedom. Its nature can be grasped by treating r, the rate of interest, as a parameter. For each level of the rate of interest, this system of equations will endogenously determine the vector X of capital endowments. Clearly, in the marginalist perspective, what is missing is some condition fixing whether the economy is, to put it approximately, richly or poorly endowed with capital goods.

Now the role becomes clear of the conception of the several capital goods as embodiments of 'capital', a homogeneous factor variable in 'form', that is composition, but given in quantity, and the demand for which is a decreasing function of the rate of interest: the equilibrium interest rate can then be determined as the one bringing the supply of and the demand for 'capital' into equality; i.e. equilibrium obtains when the rate of interest requires endowments of the several capital goods embodying the given endowment of 'capital' of the economy under study.[9,10]

The endowment of ‘capital’ was universally measured as an amount of value, and the final equation can therefore be:

$$\Sigma_i X_{ipi} = K^*, \; i = m+1, \ldots, m+n. \qquad \text{(F)}$$

where K^* is the given endowment of ‘capital’ of the economy, an amount of value.

2.3

Before discussing the legitimacy of the given K^*, let me comment on the assumption of constant relative prices and on the stationary state assumption, because these traditional assumptions have been occasionally considered intrinsically necessary to the notion of a long-period equilibrium; the switch to neo-Walrasian equilibria is accordingly sometimes explained as the outcome of the attempts to remove those restrictive assumptions.[11] I shall now try to argue that these views are ill-founded.

One may start by noticing how wrong it would be to view the stationary state assumption as the justification for the assumption of constant relative prices: the same neglect of the slow changes over time that long-period prices may be undergoing can be found in the earlier classical authors and in Marx, who were far from assuming a stationary economy. The reason for that neglect is rather to be found in the slowness with which normal long-period prices can be assumed to be changing, if at all, owing to the slowness with which the data determining them will be changing.[12]

There remains the stationary state assumption. On this, two observations. First, one should be clear that what was traditionally assumed was a *static* stationary state, i.e. the constancy of the *given* amounts of factors, among which a given amount of ‘capital’.[13] This assumption has been occasionally confused (e.g. by Hicks 1946) with the assumption of a *secular* stationary equilibrium, in which tastes are assumed given and the amount of ‘capital’ is endogenously determined at the level determining such levels of income and of the rate of interest (assuming they exist) as to induce zero net accumulation (cf. Robbins 1930). This second kind of stationary equilibrium does not need a given endowment of ‘capital’; and the same holds for the non-stationary steady-growth equilibria determinable when there are no scarce natural resources and there is population growth at a constant rate. But even a neoclassical economist would have to admit that either kind of secular equilibrium would have little to teach us about any concrete economy under study, given the possibly vast difference between the latter and the corresponding secularly stationary or steady-growth economy: Solow’s growth model suffices to see that the income distribution associated—assuming the validity of the marginalist approach—with a given capital-labour ratio may be vastly different from the steady-growth one. And even for the usefulness that a neoclassical steady state might be claimed to have for the understanding of concrete economies, i.e., at most, as a guide to the very-long-run, or secular, tendencies of economies, one would need the validity of the notion of long-period equilibrium and of its role as centre of gravitation, because one would need to prove the tendency to the steady state of the *actual* path of the economy, and such a proof cannot rely on neo-Walrasian theory for reasons which will be explained later; so the proof must rely—as in Solow’s analysis—on the acceptance of the notion of ‘capital’ (cf. Sections 4 and 5 below).

Second, the assumption of static stationarity was made not as a logical necessity, but only for purposes of simplicity, cf. for example:

> The real theoretical difficulty is rather to explain how, under stationary conditions, the possession of capital can remain a permanent source of income. The application to non-stationary conditions offers no difficulty in principle. […] Böhm-Bawerk neglected to base his argument on the fundamental simplifying assumption of stationary economic conditions.
>
> (Wicksell 1934:154–5)

That really the extension of the theory to non-stationary conditions offered 'no difficulty in principle' was not demonstrated by Wicksell. But, if one grants the legitimacy of the notion of 'capital', then it is difficult not to agree with Wicksell. Let us remember that in the marginalist approach, owing to constant returns to scale, the influence of the composition of demand on product prices acts through its influence on the demands for factors and hence on distribution.[14] Now, for an author believing in the traditional marginalist approach to distribution, and hence in 'capital', the changes in distribution due to unsteady growth cannot but be slow and gradual.[15] The assumption, that equilibrium distribution is constant relative to the speed of adaptation of the composition of capital to the composition of demand, appears therefore a legitimate simplification; and, with it, the assumption of constant relative prices. There remains to determine the composition of the demand for final goods. But, given tastes, consumer choices will determine a) the composition of consumption and b) the share of investment in the gross product, so the only remaining degrees of freedom concern the *composition* of investment. The latter composition is only relevant for the determination of equilibrium in so far as it influences the relative demands for factors and hence distribution. If, as seems to have been the case with traditional marginalist authors, this influence is considered to be of secondary importance (also in view of the likely limits to the variability of that composition, established by the reproduction needs of the economy), then one can take the composition of investment as exogenous, and the long-period equilibrium will be perfectly determinate. The causes affecting the composition of investment can then be studied separately, at a second stage of the analysis, and connected with the specifics of each situation.

It would seem anyway that, if they had wanted, traditional marginalist authors might have said more about the composition of investment, and might have determined it largely endogenously even in non-stationary situations. They could in fact have distinguished two kinds of situation: one, in which the slow change in distribution is not significantly altering the optimal techniques; and one in which the change in distribution, albeit nearly negligible, is nonetheless significantly altering the kinds of capital goods that it is optimal to employ.[16] In the former situation, they might have argued, the composition of investment can be presumed to be such as to maintain the composition of the capital stock unaltered (except for the possible irregularities in the age distribution of fixed plants), and therefore to be, on an average, the stationary or steady-growth one.[17] In the latter situation, the effect of the slight change in distribution is similar to that of a change in technical knowledge, and the composition of investment can be significantly different from the composition of the capital stock; but then it does not seem possible to

treat the composition of capital as entirely endogenous: the ‘form’ of the more long-lived elements of the capital stock is at least partly fixed, and the economy must then be conceived as being in transition toward the new equilibrium composition of capital. Even for the study of this transition, anyway, the determination of the long-period demand for ‘capital’ could have been argued to be very useful:[18] the rate of interest must be such as to ensure that the flow of gross savings is absorbed by the flow of gross investment; the latter will be reconstituting the working capital used up in the current production, and will be building new plants employing the flow of labour ‘freed’ by the closure of the fixed plants which have reached the end of their economic life (plus possibly new labour coming from increases in labour supply). In both respects, the composition of investment will be well determined: by the needs for working capital on existing plants, and by the optimal technology (determined by the given rate of interest) and the rate of creation of new plants (determined by the flow of ‘free’ labour). For this latter part, investment will depend on the new optimal K/L ratio. If the propensities to save change over time in such a way as to maintain the rate of interest constant, the gradual substitution of existing fixed plants (created in the past and possibly not optimal at the given rate of interest) with optimal plants will cause the amount and form of ‘capital’ to tend to the level and composition associated with the given rate of interest and with the given composition of demand for consumption goods, technological knowledge, and supply of labour (and its rate of growth): i.e. associated with the stationary or steady-growth state corresponding to those givens. And even along this transition, relative prices will be gravitating around the long-period ones associated with the given rate of interest, because determined on the new plants (the already existing old-technology plants will be yielding residual quasi-rents). The path of a non-stationary economy can therefore be well approximated, those traditional marginalist economists might have argued, by assuming the composition of its investment to be on an average the one appropriate to the successive stationary or steady-growth equilibria implied by the successive levels of the rate of interest. (The error caused by neglecting the fact that, in determining the optimal factor proportions on durable plants, entrepreneurs will try to take into account the expectable evolution of distribution, could legitimately be argued to be negligible, given the slowness with which distribution can be expected to change; it would anyway be certainly swamped by the greater divergences from the theoretically determined composition of investment, due, in any concrete economy, to the accidents and irregularities of the short period: irregular age distribution of plants, erroneous forecasts, etc.)

2.4

A possible objection may at this point spring to the mind of the reader. The above reconstruction, of the internal consistency (assuming the legitimacy of the notion of ‘capital’) of the traditional marginalist approach to non-stationary economies, rests on the legitimacy of the neglect of changes of relative prices over time; a legitimacy which has been justified by referring to the slowness in the change over time of distribution. But is a constant distribution (e.g. a constant real wage) sufficient to justify the assumption that relative product prices are constant? As noticed, for example, in the discussions of the so-called ‘Hahn Problem’ (Hahn 1987b), a uniform rate of return on supply price (in the sense of equal convenience of investment in the purchase of any newly produced capital

good), and thus a positive production of all capital goods, is compatible with changing relative product prices. Therefore if one drops the assumption of constant relative prices, the URRSP assumption does not avoid the fact that in the equations of a long-period general equilibrium there appear as many new degrees of freedom, as there are rates of change of relative prices of capital goods, i.e. $n-1$ degrees of freedom if there are n capital goods. It may then appear that, unless one arbitrarily assumes constant relative prices, a long-period equilibrium is indeterminate even if one grants the legitimacy of the notion of 'capital'.

If the question of interest is the historical reasons for the switch to the neo-Walrasian versions of general equilibrium theory, then the thing to be noticed is that such an objection was never advanced in the decades when the switch was occurring: indeed, it is only much later, after the discovery of the Hahn Problem, that this objection or similar ones have started occurring (see e.g. Howard and King 1992:301). This objection does not appear, for instance, in the criticisms of the assumption of stationarity expressed by Lindahl or Hicks.[19]

It may nonetheless be of some interest to give reasons why the objection appears to have little, if any, intrinsic strength. Given the purposes of the discussion in this paragraph—to inquire whether a traditional marginalist author fully accepting the notion of 'capital' might have found reasons to abandon the method of analysis based on long-period equilibria in the difficulties of extending the method to non-stationary economies—it would appear that even the tentative argument I shall advance, although admittedly in need of more rigorous proof, may be of interest because not too far from the modes of reasoning often adopted by theorists such as Hicks or Lindahl, and therefore indicative of the results they themselves might have reached if called upon to reflect on the issue.

Let us start by considering an economy which produces two goods, say, wheat and barley, in yearly production cycles, by the use of labour, and of wheat and barley which when used as means of production are circulating capital goods. Let a_{ij} be the technical coefficient of input i into the production of one unit of output j, where $i=w, b, l$ and $j=w, b$. Let $p_{i,t}$ be the price paid at time t for the purchase of wheat or barley, and $p_{l,t}$ the wage rate. Then a uniform rate of return obtains if (with wages paid in arrears, but nothing would change if they were paid in advance):

$$p_{w,t+1}=(a_{ww}p_{w,t}+a_{bw}p_{b,t})(1+r)+a_{lw}p_{l,t}$$
$$p_{b,t+1}=(a_{wb}p_{w,t}+a_{bb}p_{b,t})(1+r)+a_{lb}p_{l,t}$$

Taking one of the two goods as numéraire, and assuming the rate of return r to be given, or the wage rate to be fixed in terms of the numéraire, it is well known that the dynamical paths generated by this system of difference equations converge to constant relative prices if the economy is viable. Along the path converging to constant relative prices the URRSP assumption is satisfied. But a long-period position aims at describing the situation the economy gravitates towards given time—the situation the economy would be in today if the adjustments had already had sufficient time to operate—so it seems clear that one can take the constant-relative-prices situation as the centre of gravitation of market prices: even if the speed of convergence of market prices toward non-constant relative prices satisfying URRSP were sufficiently high as to suggest that the economy may get close to the URRSP path faster than the latter gets close to the constant-relative-

prices path, still the URRSP path would be converging to constant relative prices, and the latter would therefore generally sufficiently indicate the trend of market prices. When what is given is not the vector of initial capital endowments but only the quantity of 'capital', there are many paths converging to a common constant-relative-prices path, but the difference among the several URRSP paths tends to disappear over time; and since the speed with which the composition of capital can change is generally much greater than the speed with which the overall K/L ratio (conceding for the sake of argument the legitimacy of this notion) can be presumed to change, the treatment of distribution as constant while relative prices converge to constancy appears legitimate. So if the URRSP paths converge to constant relative prices when distribution is constant, then the assumption of constant relative prices is legitimate in order to determine the centre of gravitation of market prices (if such a gravitation can be presumed, of course—but on this there appears to be unanimity in the history of economic thought).

Thus, the above objection can only have relevance if URRSP paths can plausibly be such as to entail a non-convergence of relative prices to constancy. The above example shows that in order for this to be possible there must be durable capital. (The study of the case of pure joint production I leave for economists better equipped than myself for the task.)

Let us indeed make the same assumptions as in most of the literature on the Hahn problem (first raised by Hahn 1966; cf. Hahn 1987b for an introduction and a bibliography; cf. also Kuga 1977 and Burmeister 1980: Ch. 6): analysis in continuous time, instantaneous flow production, durable heterogeneous capital with radioactive depreciation.

In these models, the supply price (i.e. cost of production) of a capital good at time t is determined the moment factor rentals at time t are determined; but, once it is admitted that the value of an asset may be changing over time, then the rate of return on the asset must take that value change into account, so the determination of the rates of return also requires knowledge of the rates of change of the relative values of the several capital goods over time; there are therefore $n-1$ extra variables (if there are n capital goods), the rates of change of the prices of capital goods, which depend not only on the loss of efficiency (or the shorter remaining economic life) of the capital good but also on the current and subsequent rates of production of the several capital goods (because these rates of production influence factor rentals and hence costs of production, through their influence on the composition of demand and on the changes in relative stocks). As a result, given the propensities to save, a continuum of different compositions of investment at time t are compatible with a given vector of endowments and with 'myopic' URRSP[20] at the initial moment (even when no multiplicity of equilibria arises owing to other causes, such as those highlighted by the literature on the two-sector neoclassical growth model). This is because, given the composition of investment, and assuming the associated full-employment factor rentals are unique, these factor rentals will not in general entail equal rates of return on supply prices *if* changes of relative prices over time (and the connected asset revaluations) are neglected; but an equality of rates of return (URRSP) may nonetheless obtain if asset appreciation or depreciation compensates the deviations of the several capital rental/price ratios from the constant-relative-prices levels.

For instance, let us for simplicity assume that all capital goods are indestructible and of constant efficiency. Then, if there were constant relative prices, the rate of return on the supply price of a capital good would be given by the ratio of its rental *m* to its cost of production *p*. In a situation of changing relative prices, the rate of return is given by that ratio plus the rate of price change (which may be negative) relative to the chosen numéraire *(dp/dt)/p*, i.e. by *m/p+(dp/dt)/p*.

So, assuming that, given the composition of output and hence of investment, both the rentals and the costs of production of the several capital goods are given, and that the resulting *m/p* ratios for the several capital goods are different, it is possible that these differences may be compensated by opportune differences in the rates of change *(dp/dt)/p* of the values of the several capital goods. The necessary rates of asset appreciation or depreciation may be brought about by changes over time in the supply prices of the several capital goods, changes brought about by opportune changes over time in factor rentals, in turn brought about by opportune changes in the composition of investment. If economic agents expect precisely those rates of asset appreciation or depreciation, then such an evolution of the economy confirms their expectations, which are therefore warranted in Harrod's sense.

Then, if the initial vector of capital endowments is given, it is possible that URRSP be obtainable with a *range* of compositions of investment, differing in the initial relative rentals and supply prices of the several capital goods, and associated with such subsequent changes in the composition of production, as to have rates of change of the several relative prices which establish and maintain myopic URRSP.

Why is this also relevant to the determination of a long-period equilibrium? Because if *many* compositions of investment may be associated with *the same* vector of initial capital endowments, then this means that *the same* composition of investment may be associated with *many* vectors of initial capital endowments; which might be taken to mean that long-period equilibria are not uniquely determined, in that capital endowments and hence capital rentals are not uniquely determined by the URRSP assumption once tastes, technology and the endowments of non-capital factors are given, even when the composition of investment is taken as given. It might therefore be thought that a long-period equilibrium is not a well-defined notion, even apart from the problem with determining the endowment of 'capital'.[21]

But, as argued above, the non-uniqueness of paths *converging to the steady state* is no reason for worry for the traditional marginalist economist. It is only non-convergent paths that need cause worry. Now, it has been shown that non-convergent paths do exist; indeed, in most cases (at least when all capital gains are reinvested), when the initial capital vector is given all the myopic URRSP paths but one will not converge to the (by assumption unique) steady-growth path, which will be a saddle-point; and it has also been shown that the non-convergent paths will sooner or later become non-feasible, i.e. will no longer be able to guarantee URRSP. What I want to add to these results is the suggestion that the fact that these paths will sooner or later contradict the URRSP assumption, does not require perfect foresight in order to be grasped by economic agents, and that therefore the economy will not settle on any of these paths.

I assume that the importance in the economy of the output of any single capital good is not great (a plausible assumption when there are many capital goods), so that one may reason in Marshallian *ceteris paribus* fashion and take the rest of the economy as little

affected by changes in the production of a capital good, except for the rentals of the factors very specific to its production. In particular, let us assume that the rate of return elsewhere is independent of the level of production of our capital good and is constant at the level *r*.

Let us accept a neo-Walrasian framework (i.e. given initial capital endowments and full employment of resources); let us assume that capital goods do not deteriorate and last for ever; let us assume that the supply of labour is fixed at each moment and grows at a constant rate, and that there is no reservation demand for the stocks of capital goods; and let us initially assume that the economy starts with the capital endowments appropriate to steady growth, the latter being positive. Let us try to understand the behaviour of divergent paths by assuming uniqueness of the momentary equilibrium,[22] and that for only one capital good the proportion of its output at time zero relative to other outputs of capital goods is different from the steady-growth one. To fix ideas, let us assume that the initial output of our capital good is *less* than the steady-growth one, while the composition of the remaining investment is the steady-growth one.[23] One may choose as numéraire the single consumption good.

If one leaves aside the possibility of self-intensive capital goods (i.e. of capital goods which utilize themselves in their direct production so intensively that an expansion—in comparative statics terms—of their own rate of production increases the relative demand for their stock and hence increases their rentals: a case which may be argued to be improbable when the capital goods are numerous), then the effect of the lower production of this capital good will be to decrease—relative to the steady state, in comparative statics terms—its cost of production at time zero more than its rental, so that its *m/p* ratio will be higher, and hence greater than *r*. Then for URRSP the capital good must have a negative *(dp/dt)/p* at time zero, i.e. its (relative) price must decrease over time. For the capital good to become relatively cheaper it will be necessary that its relative production decreases over time: this will further lower the relative rentals of the factors very intensively utilized in its production, and thus its relative cost of production.[24] *So the production of the capital good must deviate further from the steady-growth one*. The effect of this on the (relative) rental *m* of the capital good will be that it will increase over time (the stock of the capital good will grow at a lower rate than the other ones, and so will become scarcer, relative to the other capital goods); so *m/p* will increase, and this will entail an increase of the difference between *m/p* and *r*, what will require the price of the capital good to decrease even faster. A point will soon be reached when the price of the capital good, required for URRSP, will become inferior to the minimum possible supply price (associated with zero production of that capital good), and production of the capital good will stop.[25] URRSP will then require that its demand price continues to decrease faster and faster, because its rental continues to increase (because the economy keeps growing and so the capital good, even under the assumption that it does not deteriorate, becomes relatively scarcer and scarcer).

So, if this reasoning can be generalized, we reach a first conclusion: URRSP entails that *along a divergent path a capital good which decreases in price over time will have a rental which increases over time*. It is true that a more general analysis would have to admit the possibility that a capital good may decrease in relative output and endowment and in supply price while its rental decreases too, because the relative output of other capital goods, which utilize it very intensively, is decreasing even more; but then our

reasoning must be true for those other capital goods, unless they too are utilized for the production of capital goods whose output is decreasing even more: it seems therefore clear that, if there is at least one capital good decreasing in price, then there must be at least one capital good for which the italicized conclusion is valid.[26]

Now, would not most of us feel that it is impossible that a capital good decreases in value over time in spite of a continuous increase of its rental (and with no reason to expect that that increase will be reversed later, however far into the future one tries to peer)? The spontaneous expectation of economists, and of economic agents in general, is, I would suggest, that an indestructible asset whose rental increases over time will itself rise in value (if the rate of discount does not rise, of course). Such an expectation appears well grounded. A decreasing supply price for an indestructible capital good requires that the demand price be decreasing over time too. If the rental earned by the capital good does not decrease over time, the only way to obtain a demand price for the capital good decreasing over time is that the value—i.e. the demand price—of the capital good be expected to go on decreasing (at a sufficient rate to more than compensate the increasing rental, if the rental increases over time). So the only way to obtain a decreasing demand price is that the decrease of the demand price be expected to continue. But there is a limit to the possible fall in the demand price of a capital good: a zero price. If the price of the capital good becomes zero, then—at least if free disposal is assumed, but this is a reasonable assumption in most cases—it cannot go on decreasing, and URRSP can no longer be maintained.[27] Now, if the rental of the capital good does not decrease, then its price must reach zero in finite time. The demonstration is easy. We assume r, the common rate of return elsewhere in the economy, is constant, while m, the rental of our capital good, is nondecreasing. URRSP implies $m/p+(dp/dt)/p=r$ which implies $dp/dt=rp-m$. We start from a situation where $p>0$ and $m/p>r$, so URRSP implies $dp/dt<0$. So $rp-m$ is negative and decreasing over time, i.e. $|rp-m|$ increases over time. So, as p approaches zero, $|dp/dt|$ does not decrease, on the contrary, it increases over time, which means that p reaches zero in finite time.

So URRSP cannot be valid forever, because the capital good's price cannot go on decreasing indefinitely. This conclusion does not require that agents be endowed with perfect foresight for them to be able to reach it. It seems to be within the reach of all reasonable economic agents: we did not require perfect foresight to arrive at it! But, since the possibility of an indefinite decrease of the price of a capital good with increasing rental was the only thing making such a decrease of the demand price possible from the very start, then the demand price cannot even start to decrease. Common sense is thereby shown to be reasonable: capital goods with rentals increasing over time must be expected to increase in value over time, not decrease. The 'myopic' expectations validating a divergent path cannot therefore come into being in this case: a high number of agents would never entertain them.

In the opposite case of a capital good with too high an initial production level and hence a higher p and lower m than in steady growth, its price must be increasing over time, and its rental decreasing. So $m/p<r$, and URRSP implies $dp/dt>0$. So $rp-m$ is positive and increasing over time. The increase of the supply price will soon require that this capital good remains the only one to be produced, besides the consumption good. In this case, therefore, we cannot adopt Marshallian *ceteris paribus* modes of reasoning for *this* capital good; but we can for the aggregate of all other capital goods, when the

production of this aggregate has shrunk almost to zero and therefore has become irrelevant for the determination of prices elsewhere. To this aggregate we can apply the reasoning previously applied to the single capital good whose production was shrinking. The rate of return *r* will be determined on the single capital good still produced, which we can now take as numéraire. The capital goods, whose production has been shrinking, in a neighbourhood of zero production must exhibit a decreasing supply price, which requires, for URRSP, an increasing rental. After their production has stopped, their rentals will keep increasing because their stocks remain unaltered while the stock of the single capital good still produced, and the supply of labour, keep increasing. Therefore we can apply the same reasoning as previously to reach the conclusion that the price of this aggregate must reach zero in finite time, at which point URRSP is no longer maintainable.

The above reasoning was based, for expository purposes, on the supposition that the economy's initial endowments were exactly those appropriate to steady growth, but it seems clear that it can also be applied to any situation, by replacing the steady growth with the unique path, or with one of the paths, on the convergent manifold. All that is required is that in place of the deviations from the steady-state outputs, rentals and prices, one substitutes the deviations from the converging-path outputs, rentals and prices. Sooner or later these increasing deviations become increasing deviations from the steady-state values too, and then the above reasoning becomes fully applicable.

It may therefore be concluded that neo-Walrasian equilibrium growth paths à la Hahn deviating from, rather than converging to, constant relative prices require implausible expectations.[28]

If now we turn to non-steady-growth *long-period* equilibria, the conclusion can only be reinforced by the requirement that the expectations in long-period equilibrium must be correct because resulting from a process of revision of expectations in the face of realized results. Even if by an extraordinary fluke at a certain moment all agents entertained the expectations required for a divergent path and the economy in fact were on such a path, soon some agents would realize the unsustainability of such a path and would modify their expectations and actions, causing disequilibrium. Therefore the only compositions of the capital stock compatible with a long-period equilibrium would appear to be the ones associated with the paths converging to steady growth, in particular, converging to constant relative prices.

These considerations appear sufficient to exclude divergent paths as possible centres of gravitation of actual paths. If market prices converge to anything as a result of trial and error, the convergence, it would seem, must be to constant relative prices as long as distribution is given, even in a neoclassical framework.

This reasoning appears to me sufficient to confirm the soundness of the traditional marginalist approach, if their conception of 'capital' as somehow a single factor embodied in the several capital goods is granted.

If then, always within the same general approach, one wanted to improve the approximation of the theory and take into consideration also the effects of the slow changes over time in income distribution, it would appear that that would not be impossible: one way to do it would be to conceive a non- stationary long-period equilibrium as the situation the economy would be in now, if it had been foreseen sufficiently in advance, and accordingly to imagine the period from date 0 to date 1 (in

discrete-time analysis) to be an intermediate period of an intertemporal equilibrium established many periods before and extending into the future, and such that the amount of 'capital' at date 0 is equal to the given endowment of 'capital' of the given economy. In this way the composition of capital at date 0 would be endogenously determined as the one which would result from all adjustments having had sufficient time to operate; and the influence on economic decisions at date 0 of accumulation and of the slow change in distribution would be captured.[29] But this confirms the legitimacy of the simplifying assumption of constant relative prices in long-period equilibria. Since intertemporal equilibria with constant exogenous data asymptotically tend to constant relative prices,[30] the equilibrium thus defined, by assuming it to have been established a sufficient number of periods before date 0, could be made to have nearly constant relative prices from date 0 to date 1. Therefore it could be legitimately approximated by neglecting the markets before date 0 and by assuming that, from date 0 to date 1, relative prices do not change (this would be the form taken now by the URRSP assumption for the initial period). In other words, one formulates an intertemporal Arrow-Debreu equilibrium where, in place of the given vector of initial capital endowments, one treats the initial endowments of the several capital goods as endogenously determined variables, one takes as given the initial 'quantity of capital' K, and one imposes $n-1$ conditions of initially constant relative prices.[31] In this simplified formulation, since, relative to an Arrow-Debreu equilibrium starting on date 0, one is turning into unknowns the n initial endowments of the n produced goods, while the URRSP assumption as here formulated supplies $n-1$ additional conditions, the abandonment of the stationary-state assumption still leaves one and only one degree of freedom, to be 'closed' through a condition of equality between the demand for and the given supply of 'capital'. Taking the initial endowments of the several capital goods as given while maintaining the URRSP conditions would on the contrary introduce $n-1$ additional equations into an already fully determinate intertemporal equilibrium, thus causing overdetermination.

2.5

The only author to assume URRSP and also to take as given the initial endowments of the several capital goods was Walras (followed by Pareto). In his analysis the overdetermination is made less visible by not having the composition of investment determined by the need to maintain equilibrium also in the following periods.

Let us take the vector X as given, but let us drop not only equation (F) but also the stationary-state conditions (E), and let us admit that savings are determined by consumer choices. We must then add an equation establishing the equality between total gross savings and the value of gross investment. Since we have dropped $n+1$ equations and n unknowns, this extra equation takes us back to equality between number of equations and of unknowns. This is what Walras did. He saw the composition of investment as determined in the following way: if a capital good yields a higher rate of return than the others, in the tâtonnement with provisional 'tickets' the amount of it which firms intend to produce will increase, bringing about an increase in its cost of production which will tend to lower the ratio of its rental to its cost of production, on which its rate of return depends.

This analysis is unconvincing even conceding to Walras the instantaneity of the adjustment to equilibrium, because it keeps neglecting changes in relative prices over time when the justification for such neglect—the slowness of changes in the data—is no longer there. This is because the composition of investment, determined in this way, is bound quickly to change the composition of the capital stock and thus the relative rentals of the several capital goods; but it is then implausible that economic agents will not try to take those changes into account in determining their investments. So Walras's determination of the composition of investment, totally independent as it is of its subsequent expectable effects, is clearly implausible.

Anyway, as Walras himself admits, this mechanism will generally be unable to bring about URRSP (the reason is not difficult to see: the changes in the relative costs of production of the different capital goods, obtainable by varying the composition of investment, will generally be insufficient to guarantee a uniform rate of return; e.g. the rental of a capital good might be and stay at zero, if the capital good is present in such abundance that its marginal product is zero whatever the composition of production, in which case the rate of return on that capital good cannot be positive). Had Walras admitted the need to determine investment by looking at its subsequent effects, the overdetermination of his analysis would have been patent.[32]

2.6

Let us now show that Hahn's discussion of a miniature general equilibrium model on pp. 362–9 of his article—when correctly interpreted—confirms the basic results reached by the critics' research on the logic of long-period equilibria: namely, that unless the initial endowments of the several capital goods are treated as endogenously determined variables, a URRSP assumption cannot be satisfied, and that if they are endogenous variables, then there is only one degree of freedom, which would be 'closed' if it were legitimate to take the total value of capital, or any other measure of the total endowment of 'capital', as given.

Hahn imagines an economy where wheat and barley are the only two goods produced, and used both as consumption goods and as (circulating) capital goods. He assumes that the economy ends in the period following the one under consideration (or, more precisely, that the economy has market days once a year, that we are in the 1976 market day, and that the economy ends on the 1977 market day), and assumes that all prices are determined at the beginning (the 1977 output prices are therefore discounted prices). This he does, of course, because he wants to determine the intertemporal Arrow-Debreu equilibrium of this economy. But it is possible to interpret the assumption that the economy ends in 1977 in a way which makes it compatible with a long-period equilibrium. A long-period equilibrium depicts a trend—a tranquil situation where either no change is going on, or this change is slow and smooth and so is predictable—so there must be gross investment going on; then, in order to conceive of a long-period equilibrium of Hahn's economy, one must accept that part of the 1977 production of wheat and barley is bought for investment, rather than consumption, purposes. But an interpretation of the assumption that Hahn's economy ends in 1977 appears possible, which allows for investment, namely, that in fact there is investment but that, for

simplicity, the amount and composition of investment are arbitrarily fixed, or determined in a way analogous to consumption demand.

With this interpretation, the assumption that the economy ends in 1977 does not prevent the determination of a long-period equilibrium. Clearly, an investment determined in this way means that the economy will not in general be stationary, but as argued above the stationary-state assumption is not a necessary part of a long-period equilibrium.

Another aspect of Hahn's model which makes the connection with traditional long-period analyses difficult to grasp is that its assumptions make it very difficult to perceive the justification for the assumption of constant relative prices. Two difficulties in this respect arise in Hahn's model. The second difficulty will be illustrated in the following paragraph. The first difficulty is due to the dating of commodities, i.e. to the adoption of a discrete-time model, where goods are distinguished by their dates of sale and these dates are separated by finite time intervals or periods, and where the analysis starts with the situation at date *t*. If it is assumed, as Hahn does, that production is of the point-input point-output type and requires one period, then the cost of production of a capital good at time $t+1$ requires the determination of the factor rentals at time *t*, so the determination of a long-period equilibrium requires the determination of outputs at time $t+1$ simultaneously with the determination of the composition of the capital endowment at time *t*. In order to determine the latter composition, one must assume that the capital goods constituting the endowment are themselves earning a URRSP; but the cost of production of the capital goods at the initial date *t* is not defined, because it would require consideration of factor rentals at time $t-1$, which by construction are not included in the analysis. But this problem only arises because of the simplifying and unrealistic assumptions about the timing of inputs and outputs (e.g. it would not arise if production were assumed to be instantaneous flow production, as in continuous-time neoclassical growth models: then the cost of production of capital goods would be well defined from the first instant). As explained above, the secondary importance of the changes of relative prices over time, once the composition of capital has had time to adjust to the composition of demand, makes it possible to surmount this problem by requiring that from the first to the second period relative prices do not change.[33] This is exactly what Hahn does for his model when he decides to study the implications of the assumption of a uniform rate of profits: he assumes that the own-rates of return on wheat and barley are the same, i.e. that the relative price of wheat and barley is the same in 1976 and 1977. But without explanations it is very difficult for the reader not well versed in the logic of long-period analyses to realize that this assumption is the necessary form taken in Hahn's model by the traditional assumption of a uniform rate of profit, or of return, on *cost of production*.

Now, when Hahn (p. 365) adds to his model (with given endowments W_{76}, B_{76}) the two equations:

$$P_{w^{76}}/P_{w^{77}} = P_{B^{76}}/P_{B^{77}} = 1 + R,$$

Hahn finds a strict overdetermination: he now has 1 more equation than variables (R is an extra variable). This is as announced in paragraph 2.5: it was said there that Walras relied on the free variability of the composition of investment to bring URRSP about; but Walras's mechanism cannot operate at all, with a resulting strict overdetermination ($n-1$

equations more than unknowns, where n is the number of capital goods, here 2), if the investment vector is fixed, or determined by other forces, or—as in Hahn's model if we follow his own interpretation—totally absent.

And when later (p. 369) Hahn considers an aggregate measure of capital C ('For instance, C may be the value of the endowment calculated at the Sraffa prices for a given R'), he does see that, if one assumes that the endowments W_{76}, B_{76} are not given and that relative prices are constant, then the model has only one degree of freedom, which might be closed by adding the condition that the existing endowments must have a value equal to a given C, a condition which Hahn writes (p. 369) as $C=P_W(R)W_{76}+P_B(R)B_{76}$.

2.7

But for anyone not already well acquainted with the logic of long-period equilibria, the description of the economy as actually ending with the second period, coupled with the hypothesis of yearly production cycles and of a single market at the beginning of each production cycle, makes it all but impossible to understand what the role of that given C was traditionally intended to be. Leaving the composition of the capital endowment to be determined endogenously makes little sense without the possibility of repetition of production and transaction flows, and such repetition is impossible in the economy as described by Hahn, which is to go through only one production cycle before closing down (and will therefore produce only consumption goods). The reason for the assumption of a uniform rate of return on cost of production (i.e., in Hahn's model, of constant relative prices) is analogously obscured (this is the second difficulty announced in the previous paragraph). For the same reason—the absence of repetitions in real time—the traditional role of equilibrium as indicating the trend around which the economy gravitates is simply impossible to conceive.

In other words, the chosen example makes the assumption of constant relative prices appear a very strange one. It also gives maximum plausibility to Hahn's suggestion that, either the given capital endowments are compatible with an equilibrium with uniform-profit-rate prices, or Sraffa's equations have no relevance: after showing that a uniform rate of profits can only obtain if the endowments of wheat and barley are in a certain set, he writes that 'If Mr Sraffa lands on an island whose history does not belong to this set, he will be out of luck' (p. 366), the implication obviously being that only by a fluke will Sraffa not be 'out of luck', given the scarce plausibility of a situation where given endowments happened to be in exactly the proportions required for a uniform rate of profits.

But Sraffa's prices, being long-period prices, need not be compatible with the existing relative capital endowments in order to yield useful indications. We find here an apparent inability on Hahn's part to conceive of any other role for equilibrium prices except the neo-Walrasian one: equilibrium prices must be the prices which would allow the economy to come into equilibrium at the given instant. Since Hahn is conscious of the possibility to interpret Sraffa's prices 'as the state to which the system tends…as "normal" or long-run prices' (p. 359),[34] it is all the more surprising that he should be apparently unaware of the role traditionally assigned in the marginalist tradition to equilibrium prices: to be indicators only of the average or trend of market prices.

With that sentence, 'If Mr Sraffa lands…', Hahn also implicitly suggests that distribution cannot but be determined by relative factor endowments in the way indicated by Arrow-Debreu theory:[35] in fact, in each situation, in which—according to Hahn—Sraffa were not 'out of luck', there would be only one level of the uniform rate of profits and one associated vector of relative prices allowing the economy to come into equilibrium at the given instant: the ones corresponding to the Arrow-Debreu equilibrium generated by the given endowments. On this apparent inability to conceive of other possible forces determining distribution, the reply to Hahn is in Garegnani (1990b:115–17).

3 Capital as an amount of value

3.1

It is then not surprising that some misunderstanding should also be present in Hahn's interpretation of the critique of the traditional conception of capital as an amount of value. As remembered above, Hahn considers the possibility of closing the uniform-rate-of-profits formulation (with variable endowments) of his model by adding the equation $C=P_W(R)W_{76}+P_B(R)B_{76}$; but he denies that this equation would entail arguing in a circle. He writes (p. 369): '… "arguing in a circle" is not the problem. The problem is the sense to be made of *C* being given from outside'.

The problem thus raised is not examined by Hahn, though; he dismisses it, by immediately arguing that anyway the capital aggregation issue is misconceived by the Sraffians. Before commenting on this (in paragraph 3.4), let us stop and ask whether sense *might* be made 'of *C* being given from outside', since taking the value of capital as 'given from outside' was precisely the generally adopted procedure[36] (with the sole exception of Walras and his follower Pareto) from the rise to dominance of the neoclassical approach to recent decades, and is still common practice in applied economics. When this question is examined, the 'arguing in a circle' accusation indeed turns out to be justified. The economic meaning of the equation requiring that the value of the capital goods employed in the economy be equal to a given number *C* can only be, it would seem, the following: for any real economy, let us assume that one might in principle collect data, as to its technology and tastes, its endowment of labour,[37] and the value *C* of its capital stock, sufficient to build a long-period general equilibrium model including that equation; then one might (assuming existence and uniqueness) determine the long-period equilibrium, by treating these observations as data. But since, in the real economy, the value of the existing capital stock depends on income distribution and on the numeraire,[38] and would have been different—and by different amounts depending on the numéraire chosen—had income distribution been different even if neither technology nor the composition of production had been different, the equilibrium one obtains comes to depend on what the observed income distribution is. An explanation or prediction of the trend of the observed income distribution on the basis of the one thus theoretically determined would indeed be arguing in a circle, as Hahn himself appears to admit a few pages earlier.[39]

3.2

One did not need Sraffa's equations to see this point, and in fact the problem had been admitted before, e.g. by Wicksell, Hayek, Lindahl, and had indeed been an important reason behind the shift to neo-Walrasian equilibria (cf. Milgate 1979; Wicksell 1934:202).

But Sraffa's contribution on this issue[40] has been nonetheless important. It has consisted, firstly, in finding the analytical instruments which have made it possible to see with the utmost clarity that the normal value of a given vector of capital goods may change—even very significantly—when nothing but distribution changes; secondly, in showing with the help of those instruments that there is no logically satisfactory way to reconcile the long-period behaviour of prices and technical choices with a description of production with heterogeneous capital goods as if with 'capital', a single factor. This he achieves by showing the possibility of inversion of the direction of the movement of relative long-period prices as the rate of profits rises. If it were possible to determine, independently of distribution, the 'capital'-labour intensity of the production methods of two products, with the rate of profit (interest) the price of 'capital', then the movement of relative long-period prices of the two products should be monotonic: as the interest rate rises, the more capital-intensive good should become relatively more expensive. The possibility that, as the interest rate rises, a good may first become more and then less expensive relative to a second good, shows that there is no way to conceive the two goods as produced with 'capital'-labour ratios independent of distribution. Thus no way can be found to establish, independently of distribution, how much 'capital' the production of a good employs.

This has of course negative implications for the determinability of a well-behaved demand curve for 'capital', but here I will concentrate on the implications for the determinability of the *endowment* of 'capital'. The implication is that it is also impossible to hope to be able to ascertain how much 'capital' the entire economy is employing from a knowledge of the net product and of the production methods employed.[41] Thus Sraffa confirms beyond any possible doubt that not only the value measurement of the given endowment of 'capital' is illegitimate, but that any other measurement of the given endowment of 'capital' would be equally illegitimate. But then it is the notion itself of a given endowment of 'capital' which turns out to be inconsistent. Long-period equilibria cannot be determined, because the datum relative to the endowment of 'capital' is logically indeterminable.

3.3

Getting a possible misunderstanding out of the way now will be useful later. The logical inconsistency justifying expressions such as 'arguing in a circle' is not an inconsistency of the formal model as such; rather, it is an inconsistency between the specification of the model, and the logic of economic explanation which should be based on the equilibrium determined by the model. The introduction of equation (F) into the long-period equilibrium system of equations of paragraph 2.2, or of the equation $C=P_W(R)W_{76}+P_B(R)B_{76}$ with a given number C in it into Hahn's model with variable initial endowments and constant relative prices, introduces no formal contradiction into the system of equations: if this is what Hahn meant by denying the right to speak of

'arguing in a circle', he was correct; but clearly then he was misunderstanding the critics. Of course it had not escaped the critics that no formal contradiction was introduced by such equations. The thing was obvious e.g. from a study of Wicksell. So clearly the critics were pointing to something else—to the inconsistency indicated.[42]

3.4

Hahn's views on the issue of capital aggregation again confirm an inability to perceive the role of 'capital' in traditional analyses; they also help one understand why the neoclassical side has not been greatly worried by the impossibility of aggregation.

The relevant passage is the following, which comes immediately after the quotation given in paragraph 3.1:

> All of this has nothing to do with Sraffa's rather special (8′) [the equation expressing long-period prices in terms of dated quantities of labour—F.P.] or indeed with the circumstance that the relative prices are complicated functions of *R*…. The point is much simpler. In general, there does not exist a function from the vector of endowments to the scalars such that knowledge of the scalar (and of preferences and of technology) is sufficient to allow one to determine a neoclassical equilibrium. If you put it the other way round, it is even more obvious. In general, the neoclassical equilibrium can be found given the vector of endowment[s] which may have, say, 10^8 components. It would be surprising if there were a single number which gives the same information as the 10^8 dimensional vector. In fact, sometimes and in very special cases, this surprising property holds. But neoclassical economists have shown these special cases to be without interest.
>
> (p. 369)

Hahn here clearly means by 'neoclassical equilibrium' an equilibrium with *given* endowments of the several capital goods ('the neoclassical equilibrium can be found given the vector of endowment[s]'), so the aggregation he is looking for can only exist if a single scalar can *replace*[43] the full vector of *given* capital goods endowments in the equilibrium's data, and yet determine the *same* equilibrium.

It is important to notice that the equilibrium Hahn has in mind is defined independently of whether such an aggregation is possible; which also makes it legitimate to be content, for certain purposes, with approximate aggregation only.

This is a very different problem from the one arising in the formulation of long-period equilibria. In these, the endowments of the several capital goods are not *replaced* by the given quantity of 'capital', but co-exist with the latter, being variables to be determined endogenously on the basis of the latter and of the URRSP condition.[44] The theoretically exact determinability of the 'quantity of capital' is not simply a convenient simplifying device, it is essential to the theory of long-period equilibria: without it, it would be impossible to determine the equilibrium and the whole theory would crumble down. Which is, of course, exactly what it does do.

The inability to get out of neo-Walrasian equilibrium conceptions also explains the frequent view that there is nothing special about the problem of capital aggregation. The problem of capital aggregation is seen as just one instance of the general problem of aggregating some inputs into an 'aggregate input index' in the formulation of the production function of a product. The basic result here is that Leontiefs so-called weak separability condition (the rates of substitution between the factors one wishes to aggregate must be independent of the quantities employed of the other factors) is necessary and sufficient for the derivation of a production function:

$y=f(x_1,\ldots, x_n, x_{n+1},\ldots, x_n+m)$

to be represented in the form:

$y=F(\psi(x_1,\ldots, x_n), x_{n+1},\ldots, x_n+m)$

i.e. to be able technically to aggregate a number of production factors into a single 'factor' in a production function. Then it is as if an intermediate good $k=\psi(x_1,\ldots, x_n)$ were produced by the factors $x_1,\ldots, x_n$ and then it were used together with the remaining factors to produce the final product. Solow, who first introduced this Leontief aggregation condition into the Cambridge controversy, used it to answer the question:

> When if ever can the various capital inputs be summed up in a single index-figure, so that the production function can be 'collapsed' to give output as a function of inputs of labour and 'capital-in-general'?
>
> (Solow 1955–6:102)

But it is clear from the formal statement of the problem that there is no reason why $x_1,\ldots, x_n$ should be (services of) capital goods; they might stand for amounts of services of any factors measured in physical (technical) units. The problem might as well be posed for, e.g., heterogeneous labour, or heterogeneous land. This is why Bliss (1975), having accepted Solow's framework, concludes that there is:

> no support whatsoever for the idea that the aggregation of capital is relatively difficult. The conditions for general capital aggregation are identical to the conditions for the aggregation of labour, or of output. We may thus conclude that the widespread belief that there is a notable, particular and distinct problem posed by capital aggregation is at best an ill-formulated idea, and at worst is based simply on ignorance.
>
> (p. 162)

What Bliss does not understand here is that the 'particular and distinct problem posed by capital aggregation' on which the critics were insisting arises in the determination of a *long-period* equilibrium: then, as said above, the conception of the several capital goods as embodiments of a single factor 'capital' is *indispensable* to the determination of the data of the equilibrium,[45] what is not the case for labour or land: the several kinds of these factors need not be aggregated, because the endowment of each one of them can be assumed to change slowly enough relative to the tendency of prices to costs of production, so as to justify including it in the data. Therefore the particular problem

posed by capital 'aggregation' (in long-period equilibria) is not that it is 'relatively difficult' but simply that, differently from the case with heterogeneous non-produced factors, it cannot be avoided.

4 The neo-Walrasian notions of equilibrium

4.1

It has been seen that Hahn's arguments (a) rest on a definition of marginalist, or neoclassical, theory as including only the neo-Walrasian versions of it—in fact, in this article, essentially Arrow-Debreu equilibrium theory—and (b) show an inability fully to grasp the existence and motivations of other versions incorporating the assumption of a uniform rate of profits.[46]

Clarity on these matters might have resulted in a much shorter article on Hahn's part, containing little more than the claim that the neo-Walrasian versions of marginalist theory are the only ones which can be defended, and discarding as indefensible the traditional versions resting on 'capital' conceived as a homogeneous factor embodied in the several capital goods.

But are the neo-Walrasian versions of marginalist theory any more defensible?

Here I shall initially insist on one reason to answer in the negative: the existence, in the neo-Walrasian versions as well, of a logical inconsistency in the specification of the capital endowment, an inconsistency which is strictly analogous to the one relative to the value measurement of the endowment of 'capital'. I shall then rebut the attempt to surmount this inconsistency by assuming instantaneous equilibration. In the course of this rebuttal some other important criticisms of neo-Walrasian analyses, already present in Hicks's writings (Petri 1991) but neglected until they were brought to the attention of the profession by Garegnani (1976, 1990a), will be briefly recalled. The conclusion will be that neo-Walrasian equilibria are unable to teach us anything as to the behaviour of real economies.

4.2

It was said above (paragraph 2.1) that it would be contradictory to admit that adjustments take time, and to take as given the vector of capital endowments.

I wish to argue that because of this contradiction, the inconsistency relative to the specification of the capital endowment has not disappeared with the shift from long-period to neo-Walrasian equilibria, it has only taken a different form. The basic inconsistency, characterizing the marginalist approach in all its versions, is between (a) the requirement of given endowments of factors measured in technical units, and (b) the essentially endogenous nature of the proportions between the amounts of the several capital goods. The traditional, long-period versions (apart from Walras) admitted (b), and were then unable to satisfy (a). The neo-Walrasian versions, in order to satisfy (a), take as given the endowment of each capital good, and in so doing cannot make room for (b). The logical inconsistency arising in the latter versions is analogous to the one arising in long-period equilibria in connection with the measurement of the endowment of 'capital'

as a given amount of value, in that, as in the latter case, no formal inconsistency of the model arises (cf. above, paragraph 3.3): the inconsistency is between the data relative to the endowment of capital, and the logic of economic explanation to be based on the equilibrium determined by the model.

As already explained, in long-period equilibria mathematically there is no contradiction caused by the introduction of a given (e.g. the observed) value of capital into the model; the logical inconsistency arises when one wants to argue that prices and distribution will tend to (and their trend or average is, because of this, explained by) those determined by the model: this cannot be argued if some of the data of the model will not in fact remain constant as prices and distribution change, and this is precisely what will happen to any observed value of capital. In neo-Walrasian equilibria, the inconsistency is, analogously, not a formal contradiction of the model; it is an inconsistency between the logic of economic explanation, which requires that the equilibrium determines the situation the economy tends to, and the given (the observed) vector of endowments of capital goods, which would not remain unaltered during any adjustment process (except fairy-tale ones). The moment it is admitted that adjustments take time, it would be logically contradictory to assume that economic agents, under the impulse to maximize their utility or extraprofits, will take the actions which—assuming the stability of adjustment processes—will cause markets to tend to equilibrium, and yet that during these adjustment processes the agents will not alter the existing quantities of the several capital goods even when such alterations would increase their utility or extraprofit; one would then be assuming at the same time that economic agents are rational, and irrational. So if agents are rational, then whatever state the economy tends to, this state will not have capital endowments equal to the initially observed ones; so, if the neo-Walrasian equilibrium aims at determining what the economy tends to, then it cannot be based on a capital endowment vector equal to the initially observed one, nor does one know what capital endowment vector to put in its place. Conclusion: the capital endowment is as indeterminable when measured as a vector of physical capital goods (as in neo-Walrasian equilibria), as when measured as an amount of value (as in long-period equilibria).

Only two replies to this criticism appear possible. The first one is that such a criticism is only legitimate if the adjustment processes are admitted to take time, during which time production and consumption activities go on, so it does not apply if one assumes that the adjustment is in ‘logical time’, i.e. instantaneous. The problem with such a reply has already been indicated in paragraph 2.1: one would have to demonstrate that the assumption of instantaneous adjustment is legitimate, i.e. that it makes no significant difference (otherwise one might make any assumption whatsoever, however absurd, even that there is some God guaranteeing through his omnipotence that the amounts of capital goods will always change in such a way that the value of capital in terms of a chosen numéraire will remain unaltered). But before illustrating the obstacles in the way to such a demonstration, let us briefly stop on the second possible reply, which is, I infer from his other writings, the one to which Hahn would have recourse: that neo-Walrasian equilibria are important for reasons independent of the conception of equilibrium as the situation towards which the economy tends.

4.3

Hahn, in *The Notion of Equilibrium in Economics* (1973), argues that Arrow-Debreu equilibria have a negative usefulness, because they help us understand what the world would have to look like in order for certain contentions to be acceptable, e.g. that real economies are Pareto-efficient: he argues that Arrow-Debreu theory shows that in order to obtain Paretian efficiency there ought to exist complete contingent intertemporal markets, and thus—since these markets do not exist—the claim that real economies are Pareto-efficient is falsified. This argument is far from fully convincing;[47] but even conceding to Arrow-Debreu theory some negative usefulness of this kind, the really important question remains totally unanswered: how do real economies work? can neo-Walrasian equilibria tell us something positive on this issue?

It cannot reasonably be denied that the neoclassical general equilibrium was and is judged a fundamental notion not for the reason cited by Hahn, but instead because it was and is viewed as a guide to the behaviour of real economies, in that it was and is assumed to describe the state to which these tend and are therefore most of the time, or at least on an average, sufficiently close to. It is in this role that it is used as the basis for the application of neoclassical theory to concrete problems, both micro (welfare, taxation, public goods, antitrust etc.) and macro. If the economy were not believed to tend to a neoclassical equilibrium, all these applications would never have been developed—and the enormous energies dedicated to the analysis of general equilibrium theory itself would have been directed elsewhere.

4.4

We are therefore back to the question encountered by the first possible reply, i.e. the question whether neo-Walrasian equilibria can be taken to approximate with reasonable accuracy the behaviour of real economies where adjustments are not instantaneous.[48]

Here we find what may be named the *impermanence problem* (Garegnani 1976; Petri 1991). This problem is widely admitted in one form or another,[49] although its implications are perhaps not always appreciated. Some of the data of a neo-Walrasian equilibrium (the endowments of the several capital goods and, in temporary equilibria, expectation functions) lack sufficient persistence: they are susceptible quickly to change during any time-consuming process of adjustment, with the result that, before the economy has had time to approach, through trial and error, the equilibrium, the latter may itself have significantly changed (and in largely unpredictable ways, given the accidental nature of the details of disequilibrium). The initial equilibrium prices and quantities cannot therefore be established, nor can they be seen as the values that actual prices and quantities will tend towards. What will happen in the second period is then unpredictable for two reasons: the economy will find itself in the second period with data relative to the endowments of capital goods (and to expectation functions, in temporary equilibria), which are unpredictable, depending on the accidents of disequilibrium; furthermore, for the same reason as for the first period (the non-instantaneity of adjustment) the equilibrium, corresponding to these new data, will not be reached either. And the same holds true for all subsequent periods. Therefore we cannot know toward which values will disequilibrium adjustments cause prices and quantities to converge, if they converge at all.

4.5

The absence of any clear connection between neo-Walrasian equilibria and reality is reinforced by two considerations.

The first derives from what may be called the *substitutability problem* (Garegnani 1990:57–8; Petri 1991:270–2). When what is taken as given is no longer an amount of 'capital' capable of adapting its 'form' to demand, but instead the endowments of each distinct capital good, then there will not generally be enough substitutability to obtain plausible prices: a high number of capital goods are specific to a product and the proportions in which they must be combined are fixed, so if their endowments are arbitrary the probability is extremely high that a very high proportion of their equilibrium rentals will be zero, a result radically at variance with the evidence. Also, for similar reasons the elasticity of the very-short-run demand for labour might easily be very low, with a considerable risk of a zero, or implausibly low, equilibrium real wage. And small changes in the relative capital endowments may easily result in enormous changes in many equilibrium prices, including the equilibrium wage. These possible theoretical outcomes show how little claim neo-Walrasian equilibrium prices can have to be a guide to actual prices.

A second consideration is connected with the full employment of resources. No one can reasonably deny that one often observes what *prima facie* appears to be involuntary unemployment in excess of the presumable frictional level. Traditionally, marginalist economists had no difficulty in admitting it, although explaining it as cyclical only. Therefore the full employment characterizing neo-Walrasian equilibria does not clearly correspond to observed events, even neglecting frictional unemployment. Nor can one argue *on the basis of neo-Walrasian equilibrium theory* that observed unemployment must be voluntary. Such an argument must in fact necessarily rely on the thesis that the unemployment of a factor is due to the rigidity of the factor price, and thus must necessarily assume that factor price flexibility would ensure a tendency to full employment. But such a tendency must be argued to exist for real economies, and thus cannot be based on the study of the stability of the instantaneous, or timeless, adjustment processes which are the only ones compatible with the neo-Walrasian framework.

Let me insist on this last point. Within neo-Walrasian equilibria, when one abandons the realm of pure exchange and admits production and capital goods, then stability cannot be studied except for fairy-tale adjustment processes involving no implementation of disequilibrium decisions; no conclusion derived from the study of these adjustment processes can be applied to economies where disequilibrium production decisions are implemented and can e.g. result in all sorts of multiplier-accelerator interactions; so even if further research were to conclude e.g. that the tâtonnement with 'tickets'—contrary to what we now believe to be the case—is unstable only in situations that are very unlikely to occur, one would have no right to conclude that we can assume stability for the behaviour of real economies where disequilibrium decisions are actually implemented; in particular, no conclusion could be derived as to whether actual economies do tend to the full employment of resources at least on an average over the cycle.

But then it cannot be excluded that, over a sequence of periods, there may be an accumulation of deviations of the actual path followed by the economy from the one initially determined by the original intertemporal equilibrium or sequence of temporary equilibria: e.g. there is no way of excluding that an economy, whose full-employment

equilibrium path would determine a doubling of productive capacity in, say, 20 years, may instead find itself, after 20 years, with a smaller productive capacity than initially (something like this happened to many nations in the 1920s and 1930s!).

Thus neither the initial-period neo-Walrasian equilibrium nor the equilibrium path (if it can be determined)[50] based on the initial data can tell us *anything at all* on the actual evolution of an actual economy, because no force exists in the theory, capable of limiting the initial deviation from equilibrium, or of preventing a cumulation of deviations over a number of periods, in real economies.[51]

5 The real microfoundation of neoclassical applied economics

5.1

But how can it be that, now that the neo-Walrasian versions are generally admitted to be the sole rigorous microfoundation of applied neoclassical economics, the faith is still so widespread that distribution and growth are determined in the way suggested by neoclassical theory?

The answer is probably to be found in two facts. The first is that the neoclassical approach initially was born, and accepted, in versions where the equilibrium, being a long-period equilibrium, was endowed with sufficient persistence and could therefore be seen as the centre of gravitation of realistic, time-consuming adjustment processes. So the substitutability problem did not arise, and the demand curve for labour could be thought to be sufficiently elastic, because the 'form' of capital was given time to adapt to the varying numbers of labourers to be combined with a given 'quantity of capital'; and expectations were given time to be corrected on the basis of experience. Thus over the cycle the adjustment mechanisms pushing toward full employment, on which the plausibility of the theory relied, could be seen as the dominant force and therefore the equilibrium could be seen as indicating the trend around which the economy fluctuated.

5.2

The second is that the shift to neo-Walrasian equilibria does not seem to have been accompanied by a sufficient clarity as to its implications.[52] It would seem that a majority of economists did not realize that the main reason for the shift was precisely the difficulties of the traditional conception of capital as a single factor (cf. Garegnani 1976; Milgate 1979), and that therefore they no longer had the right to assume that things work out *as if* capital could be treated in the traditional way.

This confusion still persists. Neoclassical macroeconomics, applied international trade theory, applied growth theory, etc. continue to rely on notions which require the validity of the traditional conception of 'capital'.

Let us for instance ask: what is taken as given when drawing the standard aggregate labour demand curve? This curve must show, for each level of the real wage, the labour employment implied by the corresponding solution of a general equilibrium model where the equation 'demand for labour=supply of labour' has been eliminated and in its place the real wage is treated as a parameter.[53] What are we to take as the fully employed

endowment of capital in this exercise in general equilibrium comparative statics? The use to which the curve is put—to exhibit the effects of persistent changes in the real wage on labour employment—shows that what is taken as given cannot be the endowments of each different capital good, including nails, screws, component parts of final goods only waiting to be assembled, etc.: those endowments would have no persistence, being susceptible of drastic changes in even only a few hours, so the labour demand curve based on them would have no validity for assessing the effects of changes in the real wage on labour demand. No, what is actually, more or less explicitly, taken as given when drawing that curve is the amount of 'capital' of which the economy is endowed.[54] The validity of the traditional conception of 'capital' is taken for granted. Indeed, if that conception were not in the background, it would be unclear why the change in the composition of capital associated, over any reasonable time period, with a changed real wage, should always entail a change of the demand for labo ur of opposite sign to the change in real wage. If the several capital goods were not seen as elements of a single factor 'capital' employed in a given quantity, and whose optimal ratio to labour increases with the real wage (i.e. decreases when the rate of interest increases), it would be unclear why, as the real wage changed, the disappearance of some kinds of capital goods and the appearance of different ones associated with the new cost-minimizing techniques should always entail a change in the demand for labour of opposite sign to the change in real wage. Also, for the reasons giving rise to the substitutability problem, the assumption of any significant elasticity of the labour demand curve would be totally arbitrary if what was taken as given were not only the quantity, but also the 'form', of capital.

Thus implicit in the standard labour demand curve of most macroeconomic textbooks and articles there are two beliefs, both resting on an assumed validity of the traditional conception of 'capital': first, that one can take as given the economy's endowment of 'capital'; and second, that the 'capital'-labour ratio is an increasing function of the real wage. Here only the first one of these beliefs has been subjected to criticism; but this is enough to destroy the legitimacy of the labour demand curve, because, if one cannot determine the amount of 'capital' which remains fixed while labour demand varies, one cannot define the labour demand curve. (The second belief is undermined by reverse capital deepening.)

5.3

The faith in the traditional conception of 'capital' is even clearer in the treatment of aggregate investment. The latest *JEL* survey on investment theory captures the general approach to investment theory when it states:

> The Benchmark Model is based on a demand for capital and, with the addition of dynamics, a demand for investment. The demand for capital is derived from elementary economic principles, and is determined by the equality between the expected marginal benefits and costs from an additional unit of capital….
>
> As discussed throughout this survey, a fundamental issue in investment research is the translation of the demand for the stock of capital into a demand for the flow of investment.

(Chirinko 1993:1877, 1905)

The traditional notion of a demand curve for 'capital', negatively elastic with respect to the rate of interest, is here uncritically accepted, and admitted to be the starting point of the contemporary theories of aggregate investment. In the years of hottest debate on the theory of capital it was at least occasion-ally admitted that there were some problems with this approach, e.g. Junankar in his 1972 survey of investment theory was very candid: 'There are several problems involved in measuring aggregate capital stock… Cambridge economists have argued very strongly that it is impossible to measure capital in value terms in a way that is independent of the rate of interest and wages. For the purposes of this survey I shall side-step this controversy and *assume* that we can measure capital in value terms' (Junankar 1972:12–13, my italics). Since then, even such limited admissions seem to have disappeared, in spite of the growing recognition of the inconsistency of any notion of aggregate capital. In this way the younger generations of economists are kept ignorant of these problems, and bad science breeds bad science.

Investment theory is a field where confusion and theoretical approximation are nowadays particularly evident, but reasons of space prevent a discussion of the many issues involved. The interested reader can read Garegnani (1978, 1990a) and Petri (1996) for more detailed arguments. Here I can only state without proof that without reference to a 'well-behaved' demand for 'capital' the value factor, it is impossible to derive the negative elasticity of investment with respect to the interest rate, which is the foundation of the neoclassical belief that the interest rate can act as the price bringing investment into line with full-employment savings—a belief without which the assumption of full employment would be indefensible. The demonstration, based on Sraffa's discovery of reswitching, of the possibility of 'reverse capital deepening', shows that there is no reason why the 'capital'-labour ratio should be a 'well-behaved' function of the rate of interest,[55] and destroys therefore the traditional demand curve for 'capital', and thus the traditional investment function too. The modern derivations of a negative elasticity of investment with respect to the interest rate all rest on unacceptable premises: Jorgenson (1967) and the adjustment-cost approach need the assumption of a given number of firms, and the assumption that the net returns to investment are independent of the level of the interest rate, i.e. that product prices do not decrease when a decrease of the interest rate decreases costs of production: assumptions which contradict all tradition in value theory; Tobin's *q* rests either on adjustment costs, or on the increasing-supply-price approach of Keynes, Lerner and Ackley, which is empirically doubtful, and anyway needing the traditional notion of capital-labour substitution to explain why a lower interest rate makes the economy desire an increase of the capital stock. Thus, without the validity of the traditional notion of 'capital', the presumption that the rate of interest can act as the price bringing investment into equality with full-employment savings is without foundation.[56]

5.4

Given the earlier conclusion that, by themselves, neo-Walrasian equilibria and their sequences tell us *nothing at all* about the actual path a market economy will follow, it would seem that only a more or less conscious belief that things work out *as if* capital could be treated in the traditional marginalist way (cf. above, paragraph 5.2) can justify to

some extent the belief that sequences of neo-Walrasian equilibria describe with acceptable approximation the behaviour of market economies. In fact then the choice between the traditional marginalist treatment of capital, and the neo-Walrasian one, would be of little consequence. The path traced by a sequence of neo-Walrasian equilibria would exhibit the same general characteristics, as to distribution and growth, as predicted by traditional analyses based on 'capital' the value factor. The assumption of instantaneous adjustment to equilibrium would not be crucial to the results, since the actual economy would anyway gravitate toward a situation of full employment growth, and with distribution determined essentially in the way indicated by traditional analyses. But then—the reasoning might continue—for many purposes one might as well derive the qualitatively correct results from the simplest possible models: one-good neoclassical models. Such a line of reasoning can however only rest on an implicit faith in the traditional notion of 'capital'.

It would seem therefore that those neoclassical macroeconomists, who claim that their one-good models are only simplifications and refer to neo-Walrasian analyses as the rigorous microfoundation of their macro theories, have got it the wrong way round. Hahn himself, who has elsewhere been so critical of modern mainstream macroeconomics, appears to fall into the same mistake when, in the article under discussion, he doubts that 'the simple (essentially one capital good) models are useless' and adds:

> we use simple models (e.g. macroeconomics) to gain insights of a certain kind. Simplification is never without cost and the cost is sometimes loss of rigour. It remains to be shown that the cost is too high in this instance.
>
> (p. 370)

Neoclassical analyses based on one-good models are *not* 'simplifications' of neo-Walrasian disaggregated analyses, on the contrary, they embody a 'vision' which is prior to, and the only possible foundation of, the belief that neo-Walrasian analyses may have any connection with reality. (It is then easier to understand why neoclassical macroeconomics has great difficulty with dropping the traditional notion of capital.)[57]

It is rather the neoclassical who must prove that one-good neoclassical models may have any claim at all to represent the tendencies of real economies. For the reasons indicated, neo-Walrasian equilibria will be of no help to them in this endeavour.

5.5

Two implications of the above arguments may now be stressed.

The first is, that Hahn had no right to write that 'neoclassical economics can study the economy for an arbitrary history; Sraffa cannot' (p. 368), nor as a consequence to claim that Sraffa's analysis is concerned with a 'very special state' (p. 363) while neoclassical (i.e. neo-Walrasian) analyses can deal with 'more general situations' (p. 364), and thus to depict Sraffa's analysis as a special case of Arrow-Debreu theory. It is true that Arrow-Debreu equilibria yielding constant relative prices are a special case of Arrow-Debreu equilibria. But Sraffa's analysis does not in the least aim at determining the prices of an Arrow-Debreu equilibrium, and the difference can easily be pointed out at the level of theory, and at the level of method.

First, at the level of theory, long-period prices need no assumption of full employment of resources in order to be determined, and are compatible with different theories of distribution; in these respects, it is rather Arrow-Debreu analysis that is a special case, embodying as it does the theory that distribution is determined by the tendency to an equilibrium between supply of and demand for factors of production.

Second, at the level of method, Arrow-Debreu theory or more generally neo-Walrasian equilibrium theory determines very-short-period equilibria which can indicate the behaviour of the economy only under the extremely special assumption, which Hahn himself rejects as implausible (Hahn 1987a), of not only stable but also infinitely fast adjustments to equilibrium; the traditional method, shared by the classical economists and also by marginalism before the recent decades, which asks what the normal or long-period position of an economy is, and argues that the economy gravitates around and toward it, only needs the assumption of a tendency—at finite speed—toward a uniform rate of return on supply price, operating through changes in the composition of capital. It should be obvious which assumption is less special.

Thus Hahn can only claim that Sraffa's analysis is a special case of Arrow-Debreu equilibrium theory because he is apparently unable to conceive of any other approach to the explanation of value. Which is a pity, given his numerous expressions of dissatisfaction with the assumption of instantaneous equilibration. Perhaps after the present paper he too will come to see that the way forward toward a return of value theory to relevance is a return to the traditional method.

But the only versions of neoclassical theory compatible with the method of long-period positions are the ones resting on 'capital', the single-value factor. And applied neoclassical economics, e.g. macroeconomics, *de facto* continues to this day to rely on adjustment mechanisms (resting, basically, on the decreasing demand curve for labour, and the decreasing aggregate investment schedule) that can be justified only on the basis of that conception of capital which Sraffa has shown to be indefensible. So Sraffa has faulted the only versions of neoclassical theory capable of application. Thus—second implication—he has undermined the whole of the neoclassical approach.

Final conclusion: since both groups of versions of marginalist equilibrium theory—the long-period versions and the neo-Walrasian versions—encounter what appear to be radical and insurmountable difficulties, one must conclude that at present there is no defensible neoclassical theory (in the sense of explanation) of prices and distribution. The onus is on the neoclassicals to show that this is not so. Unless and until they succeed, it seems reasonable to turn to different, non-neoclassical approaches to value and distribution (and employment and growth).

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Notes

1 Cf. Harcourt (1969, 1972) for a survey of the debate in the 1950s and 1960s; and Ahmad (1991) and the entries on capital theory in the *New Palgrave*, later collected in Eatwell *et al.* (1990), for more recent surveys. But the clearest assessment so far of the issues at stake is, in my opinion, Garegnani (1990a), to which the present paper owes a great deal. The use of the terms 'marginalist' and 'neoclassical' as synonymous, to refer to the approach which explains income distribution as resulting from an equilibrium between supply of, and demand for, factors of production, grudgingly bows to the current fashion of the potentially misleading term 'neoclassical', which may suggest a continuity with the 'classical' or 'surplus' approach of Smith, Ricardo and Marx which is on the contrary non-existent.

2 In spite of the importance of its author, this article has so far received only one extensive published reply, Duménil and Lévy (1985), which is misleading in some important respects (cf. note 49 below). Briefer comments are in Garegnani (1990a, 1990b) and Kurz (1987). (A long unpublished and provisional comment by Garegnani came to my notice too late to be taken into account; the overlap appears anyway to be minimal.) Unless otherwise indicated, all page references in the sequel will be to Hahn's article. For the sake of argument, the term 'neo-Ricardians' will be accepted in this essay; but a double warning is in order: first, some of the authors generally so labelled have expressed views different from those which are presented here; second, the 'neo-Ricardians' are far from accepting Ricardo's view on all issues; none of them accepts Say's Law, and many of them—e.g. myself—are closer to Marx than to Ricardo on the forces determining income distribution.

3 'Profit' is used in different senses in economic writing. Marginalist authors tend to mean by it what is left to the entrepreneur after paying all costs, including interest on capital (and a normal risk allowance): profit in this sense tends to zero in the long period in competitive product markets. Classical authors, who saw interest payments as that part of surplus value which is appropriated by the lender, meant by 'profit' what is left after paying all costs but not interest: the rate of profits is therefore, in this terminology, the same thing as the rate of return on investment. The latter usage is maintained by the authors who, like Sraffa, propose a return to the classical approach, and will also be adopted here; the marginalist/neoclassical concept will be referred to as 'extraprofit'.

4 By 'neo-Walrasian equilibria' I mean the notions of general equilibrium which follow Walras in including among the equilibrium's data the vector of initial endowments of the several capital goods and inventories, but, contrary to Walras, do not assume a uniform rate of return on supply price nor stationary prices, and must then explicitly consider the influence of future price changes on current equilibrium conditions, via expectation functions or futures markets. These notions include the intertemporal (Arrow-Debreu or continuous-time), as well as the temporary and the 'fixprice' general equilibria (Hahn, to the best of my knowledge, does not seem to have for the latter two kinds of equilibria the same high consideration as for the former). On the meaning of long period and short period, cf. Panico and Petri (1987).

5 Hahn's article cites in its References the 1976 volume containing Garegnani (1976) but does not discuss or cite Garegnani's article, and contains no reference to any of the subsequent critical writings mentioned in the text. I am not aware of subsequent discussions of these critical contributions by neoclassical authors. Hennings (1990:118) cites Garegnani (1976) but appears unable to grasp the latter's argument.

6 Cf. e.g. Wicksell (1893) or its summary in Garegnani (1990a); also cf. Hansen (1970: Ch. 17).

7 Walras postulates the equality between the rate of interest and the rates of net return on the supply price of capital goods, i.e., for each capital good i, $(v_i - d_i p_i)/p_i = r$, with v_i rental, p_i supply price i.e. cost of production, d_i rate of radioactive depreciation, and r rate of interest. (For simplicity I am leaving aside here the insurance charges which in Walras's analysis take care of risk.) If one assumes circulating capital goods, i.e. $d_i=1$, this becomes $v_i=(1+r)p_i$. Now, $p_i=\sum_j a_{ji}v_j$ where a_{ji} is the technical coefficient of factor j in the production of good i. It

suffices to replace in this expression, for all *j*'s, v_j with $(1+r)p_j$ and one obtains Sraffa's circulating-capital price equations (with the rate of interest coinciding with the rate of profits because I have neglected risk). As to Wicksell's *Lectures*, his equations are *derived from* Sraffa-type equations by substituting, for the capital goods' inputs in the direct production of a good, the indirect amounts of labour and land employed one, two, three etc. periods before, i.e. by resolving the cost of production of each good into a sum of dated wages and rents, each multiplied by an appropriate power of $(1+r)$; the minimization of costs of production then yields the efficient dated factor employment conditions (equality of value marginal product and unit cost inclusive of interest, for each dated factor) which Wicksell explicitly postulates. Thus the classical and the traditional marginalist approaches do not differ on the issue: how are normal or long-period prices determined, once either the real wage or the rate of profits are determined? They differ on the forces determining the *distribution of income* between wages and profits (interest) (cf. e.g. Garegnani 1987, 1990b; Bharadwaj 1991). The absence, in the classical authors, of a conception of distribution as resulting from an equilibrium between the forces acting on the demand and on the supply side suggests as inappropriate the use of the term 'equilibrium' for the normal positions which they studied. Thus in the present paper by long-period equilibrium it will always be meant the marginalist, or neoclassical, notion.

8 This is what Garegnani (1976) has christened the 'method of long-period positions'.

9 Apart from differences on how precisely to conceive this factor 'capital', whether as saved-up services of original factors as in Jevons, Böhm-Bawerk, Wicksell or as 'real capital' as in Marshall, J.B.Clark, Knight, etc., this conception was universally accepted by marginalist authors: it even emerges in Walras, cf. Garegnani (1990:56).

10 The total amount of 'capital', the homogeneous factor, would on the contrary be only slowly altered by net savings, i.e. would change with a speed comparable to e.g. that of changes in labour supply due to population growth: taking its endowment as given was therefore as legitimate as for the labour endowment; the speed of adaptation of the relative proportions of the several capital endowments could be plausibly argued to be generally much higher than the speed of change of total 'capital'.

11 Cf. e.g. Kompas (1992:160); Donzelli (1986: Ch. 8). This line of argument opposes itself to the interpretation advanced by Garegnani (1976) and Milgate (1979,1982), who argue that the main reason for the shift to the neo-Walrasian versions of general equilibrium theory was the perception of some problems with the notion of 'capital' in Hayek, Lindahl, and Hicks. I find the Garegnani-Milgate interpretation more convincing.

12 Barring of course those quick changes in data, attributable to technical progress, or to plagues or wars or analogous catastrophes, changes whose effects were to be studied via comparative statics, i.e. by assuming a disequilibrium transition toward the new equilibrium associated with the new data.

13 'Both logically and for purposes of exposition, it would seem right to begin by examining the effects of a given supply of capital already accumulated, and *then* to inquire the causes which influence, and eventually alter, this supply' (Wicksell 1934:154–5).

14 I leave aside here joint production.

15 Solow's one-good growth model gives the picture (the momentary equilibrium of Solow's model is in fact a long-period equilibrium, only slowly altered by changes in the overall capital-labour ratio). The assumption of constant prices is even more justified in a classical approach where, owing to the absence of the full employment assumption and to the different explanation of distribution, the absence of stationarity does not generally imply a need to change production methods or distribution in the economy as time goes on; one can then also more easily make room for the need for a predictable environment (without which the division of labour cannot easily prosper), a need which in all likelihood makes firms reluctant to change prices for fear of losing custom and thus makes relative prices even more

persistent than they would be in a Sraffian approach. Therefore the ‘Hahn problem’ (cf. pp. 30–7) need worry a non-marginalist economist even less than a traditional marginalist one.

16 Changes in technology will in general entail, not a different proportion between labour and the same capital goods as before, but the use of different capital goods.

17 If the economy is not stationary, equations (E) are to be replaced by $n-1$ equations establishing that the growth rate of all capital stocks must be the same, and a new equation must be added establishing that the aggregate value of gross investment must equal the value of gross savings, determined by consumer choices.

18 Cf. e.g. Wicksell (1934:164), for an attempt at studying the possibility that during such a transition, due to an innovation making long-term investment more profitable, the real wage may initially fall. The basis for this study is the determination of the long-period stationary demand for, and structure of, ‘capital’.

19 Neither Lindahl nor Hicks ever states that the (static) long-period equilibrium becomes indeterminate if the assumption of constant relative prices is dropped. They both express doubts about the usefulness of the stationary state assumption; but both misinterpret it as the assumption of a *secular* stationary state. This is well known for Hicks (cf. Garegnani 1976, who also notices that Hicks had expressed no qualms about the traditional approach to non-stationary economies before starting to nurture doubts about the conception of ‘capital’ as a single factor); it has been less noticed that the same misunderstanding appears to characterize Lindahl, cf. Lindahl (1939:286, fn. †, 292); but Lindahl then proceeds to indicate, as an important reason to shift to the method of sequences of temporary equilibria, the difficulty with conceiving the quantity of ‘capital’ as measurable independently of relative prices (Lindahl 1939:316–17), a difficulty totally independent of whether the economy is stationary or not, and in fact making it impossible to determine the data only of the static, not of the secular, stationary equilibrium.

20 ‘Myopic’ URRSP obtains when the rates of return thus obtained at the initial moment are all equal and coincide with the expected ones; it is not excluded that they may stop being equal some time in the future. Perfect foresight over the distant future is thus not postulated.

21 It might even be thought that the same indefiniteness affects more generally the notion of long-period positions, even in a classical approach. But in a classical approach there is no presumption of continuous full employment of resources, so the mechanism remembered in the text, based on changes in the composition of investment, which might ensure the ‘compensating’ variation over time of the supply prices of the several capital goods, could not operate. (The indeterminacies of equilibrium growth paths in overlapping-generations models—cf. Woodford, 1984—have different causes, and will not be discussed here, except to notice that they would seem to be strictly connected with the marginalist elements of the analysis, and therefore no reason for worry for the non-neoclassical economist.)

22 Multiple locally isolated equilibria are a basic problem of neoclassical theory both in its long-period and in its neo-Walrasian versions. Here the question under examination is whether long-period equilibria based on an assumed legitimacy of the notion of’capital’ are a well-defined notion *if one leaves aside this problem.* For this reason, the example by Medio (1988) which shows that the convergent paths may converge to two different steady state equilibria is not relevant for present purposes, being another aspect of the possible multiplicity of equilibria.

23 This assumption excludes the case of no technical choice (fixed coefficients).

24 I here exclude by assumption the possibility of negatively sloped supply curves of factors, which might imply that an increase of the production of a good is associated with a lower rental of some of the factors utilized intensively in its production; then it would be impossible to exclude the possibility of a negative association between rate of production and cost of production of a good.

25 In most plausible situations, the maximum percentage decrease of the relative price of a capital good relative to the constant-relative-prices situation, compatible with a positive output of that capital good, will generally be very narrow.
26 Of course, under the assumption that capital goods are not self-intensive.
27 For a less intuitive demonstration that the reaching of a zero price for a capital good violates URRSP, cf. Burmeister (1980:227).
28 That the economy may *converge to* a diverging path is also highly implausible, for the following reason. Consider the case of the URRSP path in which a capital good is decreasing in price through time, i.e. whose relative production is decreasing through time. If by accident its production were to decrease less than required for URRSP, its price would decrease less than required for URRSP, and therefore its rate of return would be higher than elsewhere, which would stimulate an increase, not a decrease, in the demand for it. The economy would move away from the path, not closer to it.
29 The implicit assumption of correct foresight would here be justified by the long-period nature of the analysis, as resulting from the possibility to correct mistaken expectations, together with the slowness of the changes in the data; this would make the convergence of expectations, as to the trend of relative prices, toward the correct ones a plausible occurrence, in the absence of other causes of instability of the equilibrium.
30 Cf. Yano (1984), Epstein (1987), Dana *et al.* (1989).
31 In continuous-time formulations, the URRSP assumption would take the form of assuming the time derivatives of relative prices to be equal to zero at time zero.
32 This summary of Walras's theory of capital is based on Garegnani (1962, 1990a), where it is also explained that Walras too intended—at least originally—to determine a long-period equilibrium, as shown not only by his neglect of price changes in the definition of the rates of return on capital goods, but also by the fact that up to the third edition of his *Eléments d'Économie Politique* the tâtonnement was conceived as going on in real time and involving at each step the actual production and sale of disequilibrium quantities of products; he simply did not initially realize the illegitimacy of the given composition of capital if the groping toward equilibrium was admitted to take time; when he finally did, he tried as he could to find some way out, and in the fourth edition (1900) he introduced the imaginary device of a tâtonnement based on provisional offers, written on 'tickets' or 'pledges' which would become binding only in equilibrium, and carried on in what appears to be conceived (although Walras does not explicitly say so) as a 'suspended activity' situation, with production, exchanges etc. not happening until equilibrium is reached. This device made the implementation of disequilibrium decisions unnecessary for the reaching of equilibrium; but no discussion is offered by Walras of the connection between the equilibrium thus established, and a reality of which he admits that:

> the continuous market…is perpetually tending towards equilibrium without ever actually attaining it, because the market has no other way of approaching equilibrium except by groping, and, before the goal is reached, it has to renew its efforts and start again, all the basic data of the problem, e.g. the initial quantities possessed, the utilities of goods and services, the technical coefficients, the excess of income over consumption, the working capital requirements, etc., having changed in the meantime…. There never is a day when the effective demand for products and services equals their effective supply and when the selling price of products equals the cost of the productive services used in making them… just as a lake is, at times, stirred to its very depths by a storm, so also the market is sometimes thrown into violent confusion by crises, which are sudden and general disturbances of equilibrium.
>
> (Walras 1954:381)

If the equilibrium depends on such flimsy data that one must assume a suspended-time adjustment in order to imagine that the equilibrium is actually approached, then what guarantee is there that the groping toward equilibrium in real time will bring the economy reasonably close to the theoretical equilibrium path? It is therefore interesting that a fairly similar version of these passages appears already in the first edition of the *Eléments*, where the conception of equilibrium is clearly the traditional one of a persistent state, since it is approached by time-consuming processes involving the actual implementation of production decisions: this means that this passage was originally written having in mind simply those changes in data that the method of long-period positions and of long-period equilibria can study through comparative statics: technical progress, accumulation, population growth, etc.; and that none of these was responsible for Walras's modification of his conception of the tâtonnement; the reason for the latter modification was clearly his discovery of problems with his treatment of capital, because it is in that same fourth edition that Walras introduces the argument explained in the text, on the mechanism tending to establish a uniform rate of return and determining the composition of investment; in the earlier editions, in order to reach a uniform rate of return on supply price he had contradictorily relied on the belief that an increase in the production of a capital good would decrease the rate of return on its supply price because it would decrease its rental (cf. Walras 1954:594, Jaffé's collation note [n]; Garegnani 1962:23): an idea clearly deriving from the traditional reasoning which allowed the production of new capital goods to affect their rentals by affecting their endowments, i.e. an idea expressing the traditional argument which saw the equality of rates of return come about because of variations in the relative endowments of different capital goods. In the fourth edition Walras drastically changed the argument, admitting that the rentals would be little affected, and relying on variations of costs of production as explained in the text. This may be the place to dispel a frequent misconception. It is nowadays often thought that there is a further group of data of a general equilibrium, besides the composition of the capital stock, which cannot be taken as given unless one assumes a tâtonnement with 'tickets' (or some equivalently instantaneous adjustment entailing no implementation of disequilibrium decisions): the given distribution among consumers of the 'initial quantities possessed'; on this basis, it might be argued that the notion of a long-period general equilibrium would be criticizable even if one left aside the problems with the given endowment of 'capital', because the data relative to the consumers' endowments would not remain unchanged during the gravitation towards it. But in a production economy 'the initial quantities possessed' by consumers and taken as data of a long-period equilibrium are amounts of factors, so the problem can only arise owing to disequilibrium redistributions of the property of land or of 'capital', i.e. of wealth. The traditional neglect of this problem appears to have been due to an implicit (and reasonable) opinion that the endogenous changes in the distribution of wealth attributable to disequilibrium transactions could be safely assumed to be generally negligible in their economy-wide effects; and that they might anyway be dealt with at a second stage of the analysis, through comparative statics, if the specific case so required (e.g. in hyperinflations).

33 For continuous-time models such as the usual neoclassical multisector growth models used to study the Hahn problem, the URRSP assumption is satisfied by the model's growth path from the very start even if all initial endowments are assumed given, as long as all capital goods are produced from the first moment (an unlikely event, if the initial endowments are arbitrary, but not an impossibility, if there is enough substitutability). The URRSP condition is therefore insufficient in these models to characterize a long-period equilibrium as resulting from a previous adjustment of the composition of capital; the condition, equivalent to the condition of relative prices unchanging from date 0 to date 1 in the discrete-time models, can be that the time derivatives of relative prices are all zero at time 0.

34 Later in the same page Hahn shows awareness of the fact that long-period prices require time to be established: 'If there is enough time for equal rates of profit to be established…' (p. 359).

35 This misconception extends to the issue of labour employment: Hahn interprets Sraffa's analysis as presupposing the full employment of labour: 'the Sraffa special island' (p. 364) is described as differing from 'the neoclassical general case' only in that there is a uniform rate of profits. On the contrary, one important implication of Sraffa's book is that all that is required for prices to tend to long-period prices is the tendency to a uniform rate of profits, a tendency which does not imply anything as to the employment of labour (and is in fact coupled e.g. in Marx with a view of capitalism as needing persistent unemployment for its functioning).

36 There is a reason for this. In equilibrium the total rentals earned by different amounts of the same factor must be proportional to the factor amounts; e.g. if A and B are two fields of land of the same quality, and A earns 20 as total rent while B earns 10, we can conclude that A's surface must be double the surface of B. Now let A and B be two different capital goods, and assume that their rentals (net of depreciation), respectively 20 and 10, reflect the productive contribution of a common factor 'capital' embodied in them: then we must conclude that A embodies twice as much 'capital' as B. But in equilibrium the value of A will also be twice the value of B, e.g. if the rate of interest is 10% the value of A will be 200 and the value of B 100. Conclusion: as a logical necessity, the amount of 'capital' embodied in different capital goods must be proportional to their value.

37 Endowments of labour, if labour is heterogeneous; and endowments of land too, if we do not wish to assume for simplicity that land is overabundant and hence free.

38 This will not be true for the normal value of the existing capital stock only if relative prices do not change with distribution—the strict labour theory of value case—or if the numéraire is a composite commodity with the same composition as the existing capital stock. But in this second case, since the reaching of equilibrium takes time and during the disequilibrium adjustments the composition of capital will change, after a little time the numéraire will no longer have the same composition as the capital stock and the dependence of the value of the capital stock on distribution will reassert itself. Furthermore, the observable value of the existing stock of capital goods will also depend on the deviations of market prices from long-period prices.

39 He writes: 'the value (in numéraire) of the means of production (capital) used in the production of one unit of Standard commodity…depends, in general in a complicated way, on *r*. Therefore it cannot be used to determine *r* without circular reasoning' (p. 358). The same would obviously remain true whatever the goods being produced.

40 I.e. on the issue of the determinability of the *endowment* of 'capital'. For the implications of Sraffa's results for the *demand* for 'capital', and hence for the stability of the savings-investment market, cf. below, paragraph 5.3.

41 If production were with labour and land, the knowledge of (1) the quantities produced, (2) the land intensity of production (i.e. the output/land ratio) in each industry, would make it possible to derive the total quantity of land employed; if the full employment of land were assumed, one would then also know the land endowment. Sraffa shows that the same procedure is not possible with 'capital'.

42 Hahn too uses the expression 'circular reasoning' in this sense (cf. note 39 above).

43 Cf. also Bliss (1975:147), who makes it clear that his study of the problem of aggregation tries to elucidate 'what is involved in replacing a heterogeneous collection of inputs by an aggregate'.

44 Hahn appears to overlook the fact that, in his own model of the wheat-and-barley economy, if the endowments are both treated as variables and the model is 'closed' by the uniform-profit-rate assumption plus a given amount of value capital *C*, the scalar *C* does not replace the vector of endowments of wheat and barley, it only makes it possible to determine them

endogenously. Some misunderstanding of traditional marginalist capital theory also appears to surface when Hahn adds: 'After all, there have been many attempts to find a scalar representation of the endowment vector, e.g. the period of production' (1982:369). But in Böhm-Bawerk and the early Wicksell, the main authors to base their theories of capital on the average period of production, the period of production was not a scalar representation of the capital *endowment*, it was a scalar representation of the average capital *intensity* of production processes, necessary to determine the *demand* for 'capital' (the left-hand side of equation (F)), given the full employment of other factors and the composition of production; the given supply (the endowment) of 'capital' K^* was measured by Böhm-Bawerk and Wicksell as an amount of value.

45 Here I am again only mentioning the problems concerning the determination of the endowment of 'capital', not because I consider the problems arising on the demand side, and affecting the stability of the savings-investment market, less important, but only because the supply-side problems appear to have received so far less attention.

46 It does not totally escape Hahn that the 'neoclassical theory' he believes he must defend against Sraffa is not in fact the one Sraffa was *directly* attacking (Sraffa's results also imply an indirect criticism of neo-Walrasian theory, cf. section 5 below): 'Mr Sraffa and his followers are much concerned with the history of thought and with economists long since deceased. …These earlier economists had no rigorously formulated model to help them and they got into trouble. But neoclassical economics is alive and kicking and has not got stuck in Böhm-Bawerkian arithmetic or even in Wicksellian puzzles' (pp. 369–70). But it is difficult to see in what sense one can judge Wicksell, for instance, to have 'no rigorously formulated model'; and above all, Hahn is clearly wrong in suggesting that the traditional marginalist recourse to 'capital', the homogeneous factor, was an initial simplification due to the primitive stage of analytical development of marginalist theory at the time. It was, on the contrary, motivated by the need to reconcile an approach to distribution based on the tendency to equilibrium between supply of and demand for factors, with the treatment of the composition of capital as a variable to be endogenously determined by the equilibrium.

47 E.g. if the 'inefficiencies' relative to a Pareto optimum were only due to the non-instantaneity of adjustment (e.g. frictional unemployment) or to imperfect forecast, but there existed the tendency to a marginalist full-employment equilibrium embodying reasonable—even if not fully exact—expectations, then the 'inefficiencies' would only be such in comparison with a Utopian, unrealizable state of perfection, so one would have every right to disregard them in discussing concrete problems.

48 To the problems to be discussed in this paragraph one must then add the difficulties freely admitted by general equilibrium specialists: the non-uniqueness of equilibrium, the general instability of the tâtonnement, the implausibility (if not logical difficulty, cf. Kurz 1987) of the assumption of complete futures markets or perfect foresight, the possible indeterminacy of intertemporal equilibria over infinite horizons, the conceptual problems which arise in temporary equilibria with the hypothesis of price-taking and with determining the firms' expectations, the possible non-existence of temporary equilibria owing to bankruptcies, etc.

49 Cf. note 51 below for an explicit admission by Franklin Fisher. Hahn (1984:4) indirectly admits it when he admits an inability of Arrow-Debreu theory to make room for the 'actual working of the invisible hand'. Duménil and Lévy (1985:341) notice this problem of neo-Walrasian equilibria, but their criticism on this score runs the risk of being ineffectual because they describe a classical long-period position—to which, they argue, one should accept that actual economies do tend—as if the latter implied Say's Law, the full employment of labour and the same income distribution as a neo-Walrasian model: 'Under the unrealistic assumption that all agents develop perfect foresight and anticipation of the future, classical dynamics would unfold along a very particular line… *Walrasian intertemporal equilibrium*' (Duménil and Lévy 1985:342). This is very misleading: in a classical approach even with correct foresight the real wage will be exogenously given;

Say's Law might hold or not (the classical authors did not agree on this issue), and even if it did, it would not rule out structural unemployment. The flexibility of capacity utilization in real economies also implies that the full employment of labour does not entail a specific income distribution (cf. Ciccone 1990; Garegnani 1992). Duménil and Lévy also fail to notice that the 'gravitation' method which they incorrectly ascribe exclusively to classical economics was in fact shared by neoclassical value theory before the shift to neo-Walrasian equilibria; thus they incorrectly concede to Hahn that 'neoclassical theory' only means the Arrow-Debreu model or more generally neo-Walrasian equilibria.

50 If the absurdity of the assumption of complete futures markets is admitted and the equilibrium path is determined as a sequence of temporary equilibria, then, besides the difficulties due to the non-uniqueness and possible non-existence of temporary equilibria, a grave danger of indeterminateness of the path arises, due to the arbitrariness of the assumptions as to how the expectation functions of agents will change over time, cf. Garegnani (1990a:53), and Petri (1991:274) who shows that Hicks had seen this danger already in 1936. Indeed, as shown in the same article, Hicks had seen the impermanence problem and the substitutability problem too, and this is why he finally ended up by rejecting the method of temporary general equilibria.

51 Thus Franklin Fisher has conceded that the alteration induced in the data of a neo-Walrasian equilibrium by any time-consuming adjustment process 'makes the calculation of equilibria corresponding to the initial state of the system essentially irrelevant' (Fisher 1983:14; also cf. Zaghini 1990), and has tried to investigate whether disequilibrium processes admitting disequilibrium transactions and productions might converge; but his results confirm the difficulties of neo-Walrasian theory: he can only prove convergence under the extremely restrictive hypothesis of No Favourable Surprise which in a discrete-time formulation would essentially amount to assuming rational expectations (cf. Madden 1984); and the convergence may be to situations which have nothing to do with the equilibria of neoclassical theory,] situations of unemployment, of rigid prices, or even of no attempt to exchange. The indeterminateness of the results shows that, without persistent forces making themselves felt through the vagaries of disequilibrium, economic theory can have little hope to reach definite conclusions.

52 Indeed, as argued earlier, the differences between neo-Walrasian and traditional treatments of equilibrium and of capital remained and still are generally unclear to the profession. Thus e.g. Milton Friedman felt no need to distinguish Wicksell from Walras (or, more probably, from neo-Walrasian theories) when writing: 'Thanks to Wicksell, we are all acquainted with the concept of a "natural" rate of interest and the possibility of a discrepancy between the "natural" and the "market" rate…. This analysis has its close counterpart in the employment market…. The "natural rate of unemployment", in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations' (Friedman 1968:7–8).

53 In addition, one must assume that the income from which the demand for final goods comes is the income of the employed factors only.

54 If one were to try and confine the analysis to a short-but-not-so-short period where only the *durable* capital stocks are given in physical terms, then, not only serious problems would arise in delimiting the kinds of capital goods whose stocks could be treated as given; but also, as is well known, increases in employment would often be associated with more-than-proportional, rather than less-than-proportional, increases in output, implying an increasing marginal product of labour up to a seldom reached full-utilization point where the marginal product of labour would quickly fall to zero; the resulting 'labour demand' curve, being often increasing at the observed employment levels, would be as unable to explain the observed wage and/or employment levels as the curve derived from neo-Walrasian equilibria. Furthermore, any short-period result would be bound to be only temporary, and dominated over longer periods by long-period technical choices. Thus it is only the belief in the positive elasticity of the long-period K/L ratio to the real wage which may motivate a

belief that even in the short period the demand for labour will be downward-sloping; what is then implicitly assumed is that long-period technical choices are going on even in the short period and are sufficiently important to dominate the irregularities and accidents of the short period: the short-period labour demand curve is then downward-sloping *in spite of* the short-period nature of the analysis, not *because* of it.

55 An analogous result has been recently demonstrated by Mas-Colell (1989): the long-period capital-output ratio can be nearly any function of the interest rate.

56 This presumption is also present in any claim that neo-Walrasian equilibria—which are full-employment equilibria—or their sequences indicate the tendencies of real economies. To the criticism advanced against this presumption in paragraph 4.5, one may add here the following one: according to Garegnani (1990a:60–1) and Schefold (1997), the adjustment processes admissible within the neo-Walrasian framework, implausible as they are owing to the need to assume that they go on in a 'suspended activity' situation, cannot anyway ensure the stability of the savings-investment markets, because there is no reason why reverse capital deepening should not also happen, and undermine the stability of the savings-investment markets, in intertemporal neo-Walrasian general equilibria, since in the intermediate periods of those equilibria the values of intermediate products will depend on distribution as much as in the traditional long-period version

57 The general abandonment of one-good models, at least by leading neoclassical theoreticians, would appear to have been a reluctant and recent move, essentially prompted by the Cambridge controversies. As admitted e.g. by Dougherty, the results on reswitching, reverse capital deepening, and the illegitimacy of aggregate or surrogate production functions were decisive: 'Since [the mid-1960s] the general equilibrium model has been the undisputed core of neoclassical capital theory' (Dougherty 1980:3).

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3
Classical and neoclassical short-run prices

A comparative analysis of their intended empirical content

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The present work is intended to be a comparative analysis of the concepts of short-run price currently found in the literature: the market price referred to by the classical authors, both the Marshallian price of temporary equilibrium and short-period normal price, the prices of either temporary or intertemporal general equilibrium. In particular, the paper tries to assess what is the intended empirical content, if any, of each of these price notions, i.e. its supposed relation with actual prices. Whether that content is or is not made explicit in the related literature, we will look for it by investigating those analytical features of the various prices that are relevant to our question, with special attention to the kinds of circumstances that in the respective contexts are allowed to affect them. Within these limits we will be concerned with the different theoretical frameworks to which the notions of price here considered belong.

For each price notion we will thus be able to assess the consistency of its analytical characteristics with some definite meaning in terms of actual prices, and obviously with the meaning usually assigned to it whenever there is any. In view of the relevant differences that in this respect will emerge, the term 'short-run price', which in our title is referred to any of the prices in question, is to be intended as expressing nothing more than the fact that in the respective analytical frameworks these prices constitute magnitudes which are bound to change with comparative rapidity over sequences of trades of some length. In other words, their short-run label merely counterparts the 'long-run' character of concepts such as natural price, long-period normal price or long-run equilibrium price, which in the different approaches share the feature of not being inherently subject to such rapid variations.

Starting from the classical market price (section I), our discussion will then extend to Marshall's notions of temporary and short-period equilibrium prices (section II) and to the prices that appear in modern formulations of general equilibrium, either of temporary or of intertemporal species (section III). The procedure followed will be to compare the price notion considered at each step of the analysis with the notions previously examined. The paper concludes (section IV) by noting that while the analytical characteristics of the classical market price and of Marshall's short-run prices show quite clearly the relations these prices are supposed to have with actual prices, the same does not hold for the prices of either temporary or intertemporal general equilibrium, which apparently cannot be assigned any definite empirical content.

I Market prices in the classical analysis

1 Our discussion begins from the notion of market price we find in the analyses of the classical authors. Adam Smith conceives the market price as 'the actual price at which any commodity is commonly sold' (Smith [1776], Bk. I, Ch. VII, p. 73), that is to say, the price observable in the day-by-day working of the market. The character of actual magnitude of the market price shows up even more clearly in comparison with the *abstract* nature of the notion of natural price, which Smith puts forward side by side with that of market price. The natural price is characterized by the condition that its value allows all incomes arising (directly and indirectly) out of it to be paid at neither more nor less than their natural rates, i.e. at their 'ordinary' or 'average' rates (*ibid.*, p. 72). Market and natural price can therefore be seen as different representations of the same phenomenon—the exchange value of the commodity: the market price corresponds to the form taken by the phenomenon in any concrete situation, whereas the natural price is an abstract representation of that phenomenon, in which only some of the influencing factors are considered. In particular, while the market price takes into account whatever circumstance possibly acting on the price, the natural price exclusively admits the influence of the circumstances which either determine the relevant conditions of production (both direct and indirect) of the commodity, or rule the natural rates of wage, profit and rent. More specifically, the concept of natural price leaves out of consideration any factor that causes mere deviations of the actual rates of income from their natural levels.

What has just been said allows us to better understand some features of Smith's treatment of the market price. Smith does not provide any general *determination* of the market price, limiting himself to state that it will exceed (fall short of) the natural price when the quantity of the commodity 'actually brought to market' is smaller (larger) than the 'effectual demand', i.e. than the quantity that buyers are willing to buy at the natural price (*ibid.*, p. 73). No theory is therefore put forward by Smith about the *value* that the market price assumes in any particular situation. This appears to be consistent with the nature of actual magnitude that, as has been noted above, is proper to that price. Like any concrete event, the price which prevails at any particular moment may be influenced by an unbounded and varying multitude of circumstances. Accordingly, its magnitude cannot be the object of scientific theory, as the character of generality of the explanation which any such theory aims to provide entails an abstract representation of the phenomenon investigated, in which the causes regarded as systematic are isolated from all other influencing factors.[1] In conjunction with what has been argued above as to the abstract nature of the natural price, this kind of consideration helps us to see why in the classical authors we find theories of natural, and not of market, prices.[2]

2 In Smith's view the market price, though generally different from the natural price, constantly tends to adjust to the latter, which acts as its 'centre of gravity' (*ibid.*, p. 75). This conception implies that the causes of divergence between quantity brought to market and effectual demand are viewed as merely temporary—though at each moment there will be some of them at work. In view of the further course of our discussion, we can conveniently distinguish these circumstances in two categories.

On the one hand, an excess or deficiency of supply with respect to the effectual demand can be induced, in Smith's conception, by a corresponding excess or shortage of

what he calls the 'quantity of industry annually employed in order to bring any commodity to market' *(ibid.),* and which we can refer to as the *productive capacity* of the industry concerned. More particularly, the source of the discrepancy between market and natural price is to be ultimately singled out, in cases of that kind, in the fact that the industry in question is either over- or under-equipped with capital. The competitive tendency of profits to adjust to their natural values will thus entail capital transfers from or to that industry, with corresponding changes in outputs.[3]

On the other hand, in Smith's analysis the divergence of market from natural prices can also depend on temporary circumstances that are destined to expire with the mere passage of time, without involving any necessary movement of capital. Smith provides an example of circumstance pertaining to this second category when he points out the variability that in some industries (such as those of corn, wine, etc.) characterizes the quantity of produce obtainable by a given number of workers. Referring to any such industry, he observes that:

> It is only the average produce of the one species of industry which can be suited in any respect to the effectual demand; and as its actual produce is frequently much greater and frequently much less than its average produce, the quantity of the commodities brought to market will sometimes exceed a good deal, and sometimes fall short a good deal of the effectual demand. Even though that demand should therefore continue always the same, their market price will be liable to great fluctuations, will sometimes fall a good deal below, and sometimes rise a good deal above their natural price.
>
> (*ibid.*, pp. 75–6)

It is evident that, in such cases, the deviation of the quantity produced from the effectual demand, and therefore of the market price from the natural price, depends on 'external' circumstances (such as weather), the influence of which does not imply any necessary over- or under-investment of capital in the industry concerned.

A further source of deviation from the natural price to be included in the second category is constituted by temporary changes in the level of the effectual demand.[4] Besides being possibly subjected to forces of persistent character, the quantity that would be bought at the natural price can itself be influenced by transient circumstances. Analogously to the quantity supplied, the effectual demand must consequently be regarded as liable to temporary variations, which give place to an additional cause of divergence of the market price from the natural price. This is exemplified by Smith's case of the rise in the price of black cloth in occasion of a public mourning, in which a transitory increase in the effectual demand for that cloth is clearly implied (*ibid.*, p. 76).[5]

3 Once the possibility of temporary and accidental changes in the effectual demand is acknowledged, it is useful to make an explicit distinction between the *actual* effectual demand which may happen to exist in any particular situation, and the *normal* effectual demand. As the term suggests, the latter is to be intended as the effectual demand under normal conditions, accordingly regulated by the most persistent circumstances only. Then, on account of the transitory nature of the other circumstances that at each moment may affect the actual effectual demand, the latter can be thought of as fluctuating around

the normal effectual demand. It follows that the tendency of the quantity brought to market, and ultimately of the productive capacity of the industry, to adjust to the effectual demand should be interpreted as referring to the normal level of the latter. Smith himself seems to confirm this interpretation when he says that:

> the quantity of industry annually employed is necessarily regulated by the annual demand, in such a manner that the average produce may, as nearly as possible, be equal to the *average annual consumption*.
>
> (*ibid.*, Ch. X, p. 132, emphasis added; see also Ch. XI, p. 206)[6]

And an analogous concept is expressed by Ricardo in the following passage:

> the price of corn will fall from the effects of a glut, and much agricultural distress will be produced, till the average supply is brought to a level with the *average demand*.
>
> (Ricardo [1821], Ch. XIX, p. 272, emphasis added)[7]

Bearing in mind our classification of the circumstances that can affect market prices, it follows from the above considerations that the first category must be conceived as constituted by discrepancies between productive capacities and *normal* effectual demands. When, on the contrary, the cause of the excess or shortage of capacity with respect to the effectual demand lies in a temporary deviation of the latter from its normal level, we would face a circumstance which belongs to the second category.

The inclusion of the deviations of actual from normal effectual demand in our second category is subject, however, to an important exception. The difference between actual and normal effectual demand for a certain commodity might be caused by divergences from their natural values of market prices and outputs of *other* commodities. To the extent that those divergences are due to discrepancies between productive capacities and normal effectual demands, the return of the market price of the first commodity towards the natural price would depend on changes in the productive capacities of other industries. Thus, an influence which in the market for a certain commodity appears to belong to the second category would in turn be an effect of the first category of influences on market prices (and outputs) of other commodities. For the purposes of our discussion it is convenient to include such cases in the first category,[8] so as to leave in the second just those influences on market prices whose elimination does not require changes in the productive capacity of *any* industry in the economy. The second category of circumstances will therefore be referred to as exclusively consisting of transitory factors whose influence either on the quantity brought to market, or on the actual effectual demand, disappears with the mere passage of time.[9]

4 The divergences of market from natural prices caused by differences between productive capacities and normal effectual demands are obviously of greater analytical interest than those determined by other transitory circumstances that may affect either supply or demand conditions. Indeed, while the latter circumstances are bound to expire with the simple passage of time, in the presence of the former source of divergence the tendency to natural prices entails the action of competition in transferring capital from

some industries to others, and therefore involves the very process of capital accumulation.

Smith's analysis already shows this prevailing interest. Chapter VII of the *Wealth of Nations,* dedicated to the natural and market price of commodities, deals first of all with those divergences between the two prices which would be eliminated by the adjustment of the 'quantity of industry annually employed in order to bring any commodity to market' to the effectual demand (Smith [1776], Bk. I, Ch. VII, p. 75)—where, on the basis of what has been argued in the previous section, the effectual demand which the 'quantity of industry' tends to adjust to is to be intended as the normal effectual demand. Only at a second stage does Smith mention deviations from the natural price caused by other possible influences on the quantity supplied, as well as by temporary alterations in the effectual demand itself.

The greater importance attributed to what we have classified as the first category of circumstances is even more evident in Ricardo and Marx. Both these authors relate the divergence of market from natural prices almost exclusively to disproportions in the relative sizes of different sectors, thus neglecting all those occasional influences on market prices that need not induce capital transfers between industries. The abstraction from the influences just mentioned may obviously be viewed as a deliberate disregard for something which is not of primary concern to the analysis. However, that abstraction seems also to be supported by the higher degree of 'persistence' that these authors attribute to the effects of capacity maladjustments in comparison to other temporary influences on market prices.

Ricardo and Marx share the view that capital responds only slowly to differences in profitability between sectors, owing in part to the losses that would be entailed by rapid disinvestments, particularly in respect to fixed capital.[10] More importantly from our present point of view, they seem to hold that what further helps to determine that slowness is the awareness of capitalists that market prices and profit rates can be influenced by transitory circumstances that do not warrant capital movements. In other words, capitalists themselves would take into account the influence on market prices of occasional factors that are bound to expire with the simple passage of time. They would therefore take their decisions of investment and disinvestment only after observing the behaviour of market prices long enough to become confident that existing differences in profitability are not merely due to ephemeral circumstances.[11]

Thus for both Ricardo and Marx the effect on market prices of the inappropriateness of existing capacity to normal effectual demands tends to be more lasting than the influence of other transitory circumstances. We can then infer that in imputing uniquely to such capacity maladjustments the deviations of market from natural prices, and consequently taking these deviations as a motive for investment decisions, these authors are concerned with the relation that market prices bear to their natural counterparts for some length of time, rather than at any single moment. This seems to be confirmed by passages in Ricardo like the following:

> the desire, which every capitalist has, of diverting his funds from a less to a more profitable employment, prevents the market price of commodities *from continuing for any length of time* either much above, or much below the natural price.

(Ricardo [1821], Ch. IV, p. 91, emphasis added)

or, even more neatly, by Marx when stating:

> The competition between capitalists…consists here of their gradually withdrawing capital from spheres in which profit is *for an appreciable length of time* below average, and gradually investing capital into spheres in which profit is above average.
>
> (Marx [1894], Ch. XXII, p. 366, emphasis added)

> *persistent deviations* of the market price from the cost-price…will bring about new migrations and a new distribution of social capital.
>
> (Marx [1862–3], Ch. X, p. 209, emphasis added)[12]

In sum, Ricardo's and Marx's concern with market prices refers to *averages* over time of those prices, on which the influence of the relations between existing capacities and (normal) effectual demands can be viewed as prevailing with respect to the effects of other, more transitory circumstances.[13] Nevertheless, the average market prices just referred to would still be deduced by producers from observable prices, and like the latter would therefore represent *actual* magnitudes. The relevance of this consideration will become clearer later on, when we compare the market price of Ricardo and Marx with Marshall's short-period normal price.

II Marshall's temporary equilibrium price and short-period normal price

5 We now turn to consider the short-run price concepts put forward by Marshall in his *Principles of Economics:* the price of 'temporary equilibrium of demand and supply' and the 'short-period normal price'.

The price of temporary equilibrium is intended by Marshall as the price actually ruling at a given moment of time, in strict analogy, in this respect, with Smith's market price. Besides the fact that Marshall often refers to this price with the expression 'market price',[14] more substantial evidence of this analogy is provided by the kinds of circumstances that are supposed to be relevant to it.

Marshall regards the temporary equilibrium price as governed by the relation between demand and supply, where the latter 'is taken to mean the stock of the commodity in question which is on hand, or at all events "in sight"' (Marshall [1890], Bk. V, Ch. IV, pp. 378–9)—a concept of supply, then, which bears a close resemblance to Smith's 'quantity brought to market'. Moreover, Marshall conceives the current supply and demand conditions, which the temporary equilibrium price depends on, as possibly influenced by any sort of transitory events. This can be found more explicitly in respect to supply, as in the case of the 'uncertanties of the weather' in Marshall's example of the fish market (*ibid.*, p. 369).[15] That demand can be affected by transient factors is also implied, however, by Marshall's reference to the notions of *normal* demand and *normal* supply as distinct from the notions of demand and supply relevant to the temporary

equilibrium price. At any rate he stresses that the price of temporary equilibrium crucially depends on the expectations, of sellers but also of buyers, about what the price will be at future dates (*ibid.*, Ch. II, pp. 332–3, 337). We can thus infer that the slope and position of what we can call the 'market' demand function (as distinct from the normal demand function) depends on present expectations, which by their own nature are subject to change very rapidly and under the influence of a variety of subjective and objective factors.[16]

A crucial difference between Smith's market price and Marshall's temporary equilibrium price lies however in the very conception of the latter as an equilibrium price, i.e. as a price which makes the amount buyers are willing to purchase just equal to the amount which sellers are willing to sell *ibid.*, (Ch. II, p. 333). This diversity is relevant to our present concern in that it helps us to see a possible contradiction in the meaning of actual magnitude Marshall attributes to this price. Indeed, it may be easily argued that in general such an equalizing price would prevail, if ever, only after a sufficient number of exchanges has taken place at different prices; or even that it would not effectively prevail at any particular moment, being rather a central value around which the actual prices agreed in successive transactions would dispose themselves. In any case it could be objected that the time required for the temporary equilibirum price to emerge could be longer than the very short one which is implied by the relevant conditions of supply and demand.

Marshall seems to be so much aware of this problem that, in fact, he eliminates it *by assumption*. Thus, while admitting, on the one hand, that during the market period:

> the price may be tossed hither and thither like a shuttlecock, as one side or the other [i.e., sellers or buyers] gets the best in the 'higgling and bargaining' of the market

he asserts, on the other hand, that:

> the price is likely to be never very far from [the temporary equilibrium value]; and it is nearly sure to be pretty close to [that value] at the end of the market.
>
> *(ibid.)*[17]

The above claims about such a rapid convergence to the equilibrium price sound quite arbitrary, though they are supported by the assumption (in turn, however, not indisputable) that the dealings which occur at other prices have no appreciable effects on the 'marginal utility of money' of agents (*ibid.*, pp. 334–5). However, the very fact that Marshall resolves to introduce what appears to be an *ad hoc* postulate shows how much he wants to place the meaning of his temporary-equilibrium price as close as he can to that of an actually ruling price.[18]

6 The short-period normal price is conceived by Marshall as the value 'about which the price fluctuates from day to day' (*ibid.*, Ch. V, p. 369) for the length of time in which the material, personal and organizational elements of the stock of plant of the industry concerned cannot be appreciably modified. This role of 'centre of gravity' is precisely associated to the comparative persistence of existing plant,[19] which, though subject to

vary in the long period, is viewed as unchanging while the transitory factors that affect the day-by-day behaviour of the price have time to offset each other.[20]

The link between the short-period normal price and existing plant is provided by the 'expenses of production' (*ibid.*, Ch. III, p. 339 and Ch. V, p. 372) that have to be incurred to obtain any given level of output with that plant (and for given prices of other inputs, as proper to partial equilibrium analysis). The schedule of those expenses constitutes a circumstance as much persistent as the stock of plant it relates to, and lends itself to be used by Marshall to specify the supply price that producers ask for the regular production of a given output with the given stock of plant (see, in this respect, para. 8 below). Once it is referred to the level of output whose demand price (under the relevant normal conditions) is just equal, that supply price provides the value which, according to Marshall, competition will tend to establish in the market during the period taken into consideration.

7 Marshall's short-period normal price leaves aside the influence of any temporary circumstance other than existing plant. As the latter bears a strict relation to the productive capacity of the industry, a similarity might be thought to exist with the kind of influence on the market price that, as has been argued above, Ricardo and Marx exclusively take into account in their analyses.[21] However, the analogy between the two concepts of price can only be partial, as the notion of market price found in Ricardo and Marx can in no way be conceived as a centre of gravity of the actual price. As we noted, it can be interpreted as a time average of observed prices, reckoned over the interval in which the size of capacity cannot change appreciably. This average, however, would merely amount to an *ex-post* result of the values taken by the actual price, whilst Marshall's price is intended to provide the magnitude to which that average tends to conform. What appears to be at the origin of this different status is the fact that Ricardo's and Marx's market price is not supposed to fulfil any definite relation with the cost of production. Therefore it lacks an indispensable requisite to function as a centre of gravitation, as there is no reason to expect any competitive pressure upon the actual price to adjust to it. In effect in the classical analysis one can find a definite price: cost relation only with respect to the natural price, while no such relation is ever supposed to hold as the market price diverges from the latter—even when, as in Ricardo and Marx, that divergence is entirely imputed to the maladjustment of capacity in the industry concerned.

8 It can be noted, in connection with what has just been pointed out, that a general difficulty seems to stand against the possibility of specifying price: cost relations that can be supposed to prevail in situations in which the quantities produced are not those consistent with prices yielding a uniform rate of profit.[22] This difficulty is generated by the indeterminateness that is bound to characterize the price: cost relation if the latter is not constrained by some condition about the return on invested capital. As it relates to the 'non-long-period' character of the prices under consideration, that difficulty is not specific to the classical analysis only. In fact it also manifests itself in the context of Marshall's short-period analysis, as will now be argued.

In that analysis a definite relation between price and unit cost is demanded by the very specification of a (short-period) supply price for each level of output obtainable with existing plant. Marshall attempts to satisfy this requirement by relating the short-period supply price of a given output to the marginal cost of the latter (*ibid.*, pp. 373–5), on the

basis of the schedule of the 'expenses of production' associated to the existing stock of plant. On close examination, however, one finds that this short-period relation between supply price and marginal cost—which would obviously entail a corresponding relation of the supply price with the average short-period cost—turns out to be precisely defined only for sufficiently high (relative to plant) levels of output, at which the relation itself amounts to an equality. For comparatively low levels of output, instead, Marshall believes that the fear of 'spoiling the market' prevents producers from accepting the low price that would be implied by that equality.[23] The relation of the short-period supply price with the marginal cost thus loosens, as at those levels of output the behaviour of producers would be such as to keep the supply price somewhat higher than the marginal cost. As Marshall puts it, this short-period supply price:

> is nearly always above, and generally very much above the special or prime cost for raw materials, labour and wear-and-tear of plant, which is immediately and directly involved by getting a little further use out of appliances that are not fully employed.
>
> (*ibid.*, Ch. V, pp. 374–5)

Marshall is thus led to remark that 'if trade is slack', the excess of the short-period supply price above the prime cost (which in the short period amounts to the same thing as the marginal cost) does not lend itself to any generalization, as:

> *here there is no definite law*, the chief operative force is the fear of spoiling the market; and that acts in different ways and different strength on different individuals and different industrial groups.
>
> (*ibid.*, Ch. XV, p. 498, emphasis added)

Marshall himself thus acknowledges that at low levels of price a good deal of indeterminateness characterizes the short-period relation of price to cost. In respect to such situations, therefore, he says nothing more precise than that that relation will not be adequate to yield the normal rate of return on capital—i.e., nothing more precise, we may note, than what can be found in respect to a 'low' market price (relative to input prices) in the analyses of Ricardo and Marx.

III Prices of temporary and intertemporal general equilibrium

9 We now turn to the prices that form the object of modern theories of temporary general equilibrium (TGE) and intertemporal general equilibrium (IGE). The investigation about the contents of these prices can conveniently start from the prices of TGE theory. As the latter theory is not based on such special assumptions as IGE theory is, prices therein lend themselves to more immediate comparisons with the classical and Marshallian concepts of price dealt with above. Moreover, precisely those comparisons provide a useful prelude to the consideration of IGE prices.

In TGE theory[24] prices ultimately depend on: (a) preferences; (b) feasible technical possibilities; (c) functions, or at any rate rules, according to which expectations are

formed; (d) physical endowments.[25] The temporary nature of the equilibria considered by the theory derives from the *necessary* variability from one 'date' to another of the set of data under (d), and particularly of the individual stocks of capital and consumer goods. The amounts of these stocks are bound to change endogenously, through production as well as exchange activities, as a result of the maximizing behaviour of agents. Instead, changes in the other determinants do not spring as necessary outcomes of agents' actions, and from the analytical point of view the theory is free to abstain from taking such changes into account. The question is of special importance to our discussion, and we will come back to it in the next paragraph.

Given the character of the present work, in what follows we will refer to the general framework of TGE theory as outlined above, though it has been acknowledged that 'the subject has not yet reached a degree of maturation which permits the statement of a theory in a general and concise way', and that it rather consists of 'a bewildering variety of models' (Grandmont, 1977, p. 537, reprinted in Grandmont, 1988, p. 5). For the same reason we will abstract from the analytical difficulties that this approach meets in dealing with production, and which seem to be responsible for the fact that a large amount of TGE models restrict their scope to pure exchange economies (see *ibid.*, respectively pp. 555–6 and pp. 22–3).

10 We may begin by comparing the price of TGE with Marshall's price of *partial* temporary equilibrium, and ask ourselves whether the former can be regarded as the general equilibrium counterpart of the latter.

Some analogies exist between these two concepts of price, as is suggested by the fact that the same term has been adopted to define the kind of equilibrium to which they refer. At each 'date', TGE prices are determined by the equilibrium of demand and supply, where the latter is regarded as the outcome of decisions mostly, though not exclusively, taken in the past.[26] Thus, apart from the slight difference in respect to the latter point—Marshall admitting no influence at all of current decisions on current supply—either TGE prices or Marshall's temporary equilibrium price are taken to represent values which form in the market during a very short period of time, in which supply is scarcely modifiable or even fixed. Nevertheless, whilst Marshall's notion is clearly intended as the actual price at any given moment, the same cannot be said with regard to the content of TGE prices.

We can first observe that, even more than in the case of Marshall's temporary equilibrium price, the interpretation of TGE prices as actual magnitudes would be in conflict with their determination as the values which equalize the quantities demanded and supplied.[27] Actually, in the TGE framework the presumption that the equilibrium price is reached very rapidly sounds weaker than in Marshall's partial equilibrium, where the assumption that all other markets are in equilibrium makes it easier to neglect the effects of trades at 'false' prices in the particular market under consideration.

But another feature of TGE theory also prevents the prices therein from being comparable to actual prices. To be consistent with a meaning like that just mentioned, TGE prices should be determined while taking into account the influence of a variety of transitory and accidental factors, as in fact Marshall assumes for his temporary equilibrium price. Accordingly, one should conceive the four groups of circumstances, which the theory takes as the determinants of prices, as those which at a given point in time result from any sort of influence, however fortuituous and short-lived—such as the

influence of atmospherical conditions, which moment by moment may affect production relations; of social or biological accidents, which may transitorily alter individuals' preferences (as in this framework would be the case of the public mourning mentioned by Smith); and so on. In the formulations of the theory that can commonly be found, however, the determinants of prices do not receive such treatment. What forms the object of the theory is, in general, a *sequence* of temporary equilibria which develops from given initial conditions, and in which the data relevant to each subsequent temporary equilibrium either do not change or change endogenously. Thus, in respect to the formation of expectations, Grandmont explicitly declares that:

> if one wishes to represent the dynamic evolution of an economy as a sequence of temporary equilibria, one must make explicit how at each date traders forecast the future on the basis of past observations, and only on that basis, by *prespecifying* their learning processes or expectations functions.
>
> (1988, p. xx, emphasis added)[28]

The 'prespecification' mentioned in this passage obviously implies the invariance of the rules by which at each 'date' expected values are determined, though one could hardly conceive anything more subject to changing exogenous influences than the process by which individuals form, at any distinct moment, their own expectations—as Hicks freely admitted when mentioning the dependence of price expectations on 'the weather, the political news, people's state of health, their "psychology"' (Hicks, 1946, p. 204).

The usual formalization of the theory is therefore inhospitable to exogenous and uneven influences on the data like those we have previously referred to. This restrictive attitude presumably responds to the need to preserve the ability of the theory to explain how the system of prices evolves along the sequence of temporary equilibria. Indeed, if at each 'date' a variety of transient exogenous influences were allowed to act on the determinants of prices, the changes in prices from one temporary equilibrium to another would largely elude the domain of the theory, with consequent impairment of the meaningfulness of the latter—in line, we might say, with our argument about actual prices not being subduable to theory.[29] In sum, for the sake of its own relevance the theory must not lose control, so to speak, of the sequence of temporary equilibria. Witness of this concern can be found in the effort the analysis has devoted to detecting the conditions under which the sequence converges to some particular state, often defined as 'long-run equilibrium'.[30]

11 It has been argued in the previous paragraph that, as the object of TGE theory generally consists in a whole sequence of temporary equilibria, this theory cannot freely allow for the transitory influences on prices which instead are admitted in Marshall's temporary equilibrium. Then it can be natural to ask why TGE theory is so much concerned with pursuing the succession of temporary equilibria, whereas Marshall does not feel this need and just refers to the temporary equilibrium as one of the 'species' of equilibria considered in his analysis. The answer may be found in that, differently from Marshall's price theory, TGE theory does not contemplate any notion of 'normal' price determined independently of the prices of temporary equilibrium and conceived as the value the latter gravitate around. Therefore in this theory the analysis of the sequence of

temporary equilibria is the only means by which the movement of prices over time can be studied, as the sequence itself is not replaceable by any assumed tendency of the price system to predeterminable configurations.

12 As has been remarked above, the existing stocks of products, and particularly of capital goods, are the data which TGE theory must typically treat as changing from one 'date' to another. Moving from this premise we can investigate whether an analogy can be drawn either with the market price as referred to by Ricardo and Marx, or with Marshall's short-period normal price. We have previously argued that both these prices are conceived as affected by the influence of just one kind of temporary circumstance, namely the amount of productive capacity installed in the industry concerned; the obvious relation between productive capacity and capital stock might then suggest the analogy already mentioned. It will be maintained below, however, that the price of TGE cannot be assimilated to either of those concepts of price, and that this impossibility definitely enlightens the difficulty one meets in attempting to specify the nature and meaning of the prices of TGE theory.

Comparing TGE prices first with Marshall's short-period normal price, it must be considered that what is assumed as given in the determination of the latter is not the *whole* stock of capital employed in the industry, but only some relatively durable part of it, included in Marshall's notion of 'plant'. As we already noticed, this is consistent with the fact that the short-period normal price is presumed to be exempt from the transitory influences that may affect the price at any moment, the length of the short period being regarded as sufficient to cancel them out. During such period several production cycles will therefore be started, with each of them possibly being characterized by a different level of intended output, and consequently by the employment of different quantities of some capital goods, such as circulating capital items. It follows that for the quantities of these capital goods no assumption of invariance could be made within Marshall's short period.

In TGE theory, instead, prices are determined on the basis of given endowments of *all* capital goods, as is required by the general equilibrium character of the analysis. Differently from Marshall's *partial* analysis, in which the price of the service of any input (not included in plant) is taken as given, in TGE theory the price of any productive service must find an endogenous determination in terms of supply and demand equilibria. Hence the need to specify the available quantity of any capital good, however short its duration, in order to define the supply conditions for its productive services.

It follows that the capital endowment taken as given in TGE theory need vary in a time interval much shorter than Marshall's short period,[31] with the consequence that TGE prices cannot be assigned with the same intended content as Marshall's short-period normal price.[32] In particular, there can be no grounds to regard these prices as (short-run) centres of gravitation of actual prices, since some of the data on which they depend need not be more persistent than the varied kinds of circumstances that at any moment may influence actual prices.[33]

A similar line of argument applies to the possibility of likening the TGE price to the market price as seemingly understood by Ricardo and Marx, that is to say as a time average of observed prices, which in its divergence from the natural price would only reflect the relation between existing productive capacity and normal effectual demand.[34] As we argued, this content rests on the presumption that capacity maladjustments are

more lasting than other transient influences on actual prices, and it has just been pointed out that no such presumption can hold for at least some of the stocks of capital goods on which TGE prices depend.

13 The discussion of the previous paragraphs has brought to light the difficulties which are met in trying to specify the empirical content of the prices of TGE. It can be of some interest to note that these difficulties involve not only the meaning of the magnitudes contemplated by TGE theory, and therefore the very relevance of the latter, but even the analytical soundness of the whole framework. In this theory it is generally assumed that at any 'date' the expected values of future prices depend, according to specified functions, on the past values of prices. It follows that at least at the starting 'date' of the sequence of temporary equilibria those past values consist of exogenous magnitudes, which the theory assumes to be observable from the actual history of the economy. Since the prices which enter as arguments into the expectations functions must obviously bear some definite relation with the prices to be forecasted, at least for that initial situation TGE theory needs to postulate a precise correspondence between observable prices and theoretical prices, which on the contrary has been denied in our investigation. In other words, the indefinite content of TGE prices makes it difficult to specify what are the 'past' prices which at the opening of the sequence of temporary equilibria have to be included among the data of the theory.

14 We shall finally make some brief remarks on the nature of the prices of *intertemporal* general equilibrium (hereafter, IGE).

The IGE framework differs from TGE theory in that it postulates that for any commodity there exist, at the starting moment, forward markets for all future dates of delivery.[35] This counterfactual assumption[36] introduces a further source of uncertainty about the meaning of IGE prices, as it implies leaving no room for incorrect expectations. While appropriate to the analysis of long-run values, in the present context the sterilization of forecasting errors merely adds to the indefmiteness of the nature of the 'dated' magnitudes, which by that reason depart even more than in the TGE setting from the content of actual magnitudes.[37]

The difficulty of assessing the content of IGE prices is far from becoming lesser in the formulations of the theory in which the future markets are assumed to be complete *contingent* markets. Each market is then distinguished by the date at which the commodity should be delivered and by the delivery being conditional on the occurrence of one particular set of events—including 'atmospheric conditions, natural disasters, technical possibilities…' (Debreu, 1959, p. 98)–among all the sets which can possibly take place at the date of delivery. The supposed completeness of these markets implies that, for any commodity and date of delivery, there exists a market for any possible 'state of the world' at that date.[38] In principle these versions of the theory take into account all kinds of influences that may affect prices at any moment of time, and therefore it might seem that in this respect the content of the prices that appear therein approaches that of actual magnitudes. Just a little reflection is needed, however, to understand that the introduction of contingent markets in the IGE framework does not mark any real progress towards a theory of actual prices.

We have already argued in the present paper that a theory which attempted to deal with any conceivable influence on prices would inevitably be condemned to a condition of indefmiteness. In the case of IGE theory this consequence is only formally prevented

by the device of assuming that, for any commodity and date of delivery, each state of the world, i.e. each combination of possible events, defines a specific contingent market. Since there is no way of constraining within any *finite* list the events which may occur at one particular moment, and therefore their combinations, that device merely resolves into an endless multiplication of markets and prices,[39] with the collapse of the theory as such.[40] Any question about what may be the content of the prices in IGE theory with complete contingent markets seems therefore to be overcome by the fact that apparently that formulation leaves us with no theory at all.

IV Concluding remarks

15 A result of our comparative analysis is that while the intended empirical content of the classical market price and of both Marshall's short-run notions of price is easily seen, it is unclear what meaning should be attributed to the prices found in modern theories of temporary and intertemporal general equilibrium.

The classical authors conceive the market price as an actually observed magnitude. In Smith it is intended as the price which forms in the market at each single moment under the influence of any sort of circumstance, however transitory. Ricardo and Marx attribute to the market price a content different from Smith's only in that their analyses deal almost exclusively with those deviations from the natural price which are sufficiently persistent as to induce capital transfers between industries. This suggests that, rather than to the actual price at any moment, both those authors implicitly refer to some average of the values which that price assumes over time. Nonetheless such average price would share the nature of actual magnitude of the values it is obtained from.

The nature of actual magnitude is also that which Marshall attributes to his temporary equilibrium price, with an attempted analogy with Smith's market price. No less clear, in the author's intentions, is the meaning of the short-period normal price, conceived as the 'centre of gravity' of the actual price for the stretch of time in which the productive capacity of the industry concerned does not change appreciably. As has been argued, some characteristics of these price notions conflict, however, with the contents they are respectively assigned with. In the case of the temporary equilibrium price, the condition of equilibrium between supply and demand which that price is supposed to satisfy can hardly be appropriate to the price actually ruling at any given moment. With regard to the short-period normal price, the attraction that through the pressure of competition it should exert on the actual price contrasts with the incomplete definiteness of its relation to unit cost.

The way in which the theory of temporary general equilibrium is framed, which reflects its concern of the latter with sequences of equilibria, excludes on the one hand the possibility of comparing the prices in this theory to the classical market price or to Marshall's temporary equilibrium price. On the other hand, on account of the characteristics of their determinants, no analogy can be safely established between these prices and either Marshall's short-period normal price or Ricardo's and Marx's market price. The failure of any attempt at assimilation to those older concepts of price reveals that the prices in this version of general equilibrium theory can be interpreted neither as actual magnitudes nor as (short-run) centres of gravity of actual prices. And, besides its

relevance, even the soundness of the analytical framework seems to be undermined by the difficulty of assessing the relation in which its prices stand with actual prices—a definite correspondence of the former with the latter being in fact required by the presence of 'past' observed prices among the initial data which enter the expectations functions contemplated by the theory.

Conclusions partly analogous to those we have reached for the prices of general temporary equilibrium apply to the prices in the theory of general intertemporal equilibrium. The theory just mentioned shares the analytical characteristics which in the temporary equilibrium framework prevent the attribution of a precise meaning to the prices which appear therein. In addition, a specific source of indefiniteness is provided, in this theory, by the substitution of individual price expectations with prices observable on supposedly complete forward markets, with consequent elimination from agents' decisions of the influence of incorrect expectations. And the vanishing of the theory, rather than a better specification of the content of the magnitudes that appear in it, is what seems to arise when the assumed forward markets are further distinguished according to all possible 'states of the world' which may occur at the date of delivery. The infinitude of such 'states' in fact implies an indefinite multiplication of the prices contemplated by the theory, and therefore the dissolution of its very object.

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Notes

1 See e.g. Nagel, 1961, p. 11; Machlup, 1978, pp. 109–10, 116.

2 However, the analysis of these authors, and particularly of Smith, does provide a theory of the *direction* in which the market price diverges from the natural price, that direction being strictly determined by the size of the quantity brought to market relative to that of the effectual demand.

3 Initially, the difference between market and natural price could obviously result in a divergence of wages or rents, rather than profits, from their natural levels. However, the competition among, respectively, workers or landlords would bring those incomes back in line with their natural rates, thus transferring to profits the discrepancy between market and natural price and inducing changes in output which push the market price towards the natural price. In Smith's exposition, however, the tendential mobility of labour and land from one employment to another seems to be conceived of as something which can *directly* affect the outputs of the different commodities (see Smith [1776], Bk. I, Ch. VII, pp. 74–5). But such direct influence would contrast with the fact that in a capitalist economy the decisions about what and how much to produce are taken by the owners of the means of production. Even the case in which labour or land move away from a particular employment may only occur if profit earners are not disposed to pay wages or rent at competitive rates, which implies they have already decided to withdraw from that production.

4 Our second category of circumstances partially coincides with the 'accidental variations in effective demand and in the quantities brought to market' dealt with in Vianello (1989, pp. 93–7). A difference between Vianello's classification and ours is referred to in note 8 below.

5 See also Ch. X, p. 132, where this change in the demand for black cloth is mentioned as an instance of 'accidental variation in the demand'.

6 The distinction between normal and actual effectual demand allows us to enlighten some aspects of Smith's explanation of the deviations of the market price from the natural price. When imputing the influence on the market price to the quantity supplied, Smith implicitly compares the latter with a level of effectual demand which is supposed not to be affected by temporary or accidental circumstances, i.e. with the *normal* effectual demand: for instance, in the passage concerning agricultural products quoted above in the text, Smith remarks that it is only the *average* produce, as opposed to the actual produce, that adjusts to the effectual demand—thus implicitly attaching the latter with a character of normality. This appears as a quite sensible procedure, for in those cases the emphasis is placed upon transitory influences on supply, and non-normal influences on effectual demand can be conveniently left aside. Correspondingly, when the concern is with the effects of temporary changes in the effectual demand, the *actual* level of the latter is implicitly compared to the quantity normally supplied, equal to the normal effectual demand. This is the case of the public mourning, which according to Smith raises, besides the price of black cloth, the wages of journeymen tailors, as in respect to these workers there is 'an effectual demand for more labour, for more work to be done than can be had' (*ibid.,* Ch. VII, p. 76). Clearly, what is here referred to is a non-normal level of the effectual demand for that kind of labour, a level that exceeds the quantity of it that is normally supplied. In sum, Smith deals with temporary variations of supply separately from temporary variations of effectual demand; obviously, this analytical device by no means denies that at any moment both kinds of variations can be simultaneously at work.

7 It is interesting to note that the glut here referred to depicts what could be called a case of 'overshooting', since it is supposed to derive from an initial high price of corn which, Ricardo observes on the same page, 'will probably cause more capital to be employed, and more raw produce to be brought to market than the demands of the country require'.

8 The source of deviation of actual from normal effectual demand we are referring to is on the contrary included by Vianello among 'accidental variations' in the effectual demand, together with any other transitory influence on the latter (Vianello, 1989, p. 93).

9 This does not rule out the possibility that capital transfers take place, and can help to push the market price toward the natural price, under circumstances belonging to the second category. What is meant in the text is that in these cases the market price would tend to come back to the natural price even in the absence of capital movements.

10 Ricardo observes, for instance, that in consequence of changes in the composition of demand, and more generally in the profitability of the production of certain commodities, 'considerable distress, and no doubt some loss, will be experienced by those who are engaged in the manufacture of such commodities; and it will be felt not only at the time of the change, but through the whole interval during which they are removing their capitals, and the labour which they command, from one employment to another' (Ricardo [1821], p. 263). That the losses and delays with which capital is transferred are mainly due to the existence of fixed capital, emerges from passages like the following: 'and during the interval…much fixed capital is underployed, perhaps wholly lost' *(ibid.).* Marx too is quite clear about this kind of obstacle to the movement of capital. Thus, with regard to 'actual production-industry, agriculture, mining, etc.', as opposed to merchant activity, he underlines that 'the transfer of capital from one sphere to another offers considerable difficulties, particularly on account of the existing fixed capital' (Marx [1894] Ch. XII, p. 208).

11 Such behaviour is recognized by Ricardo in the following argument:

> When the market prices of goods fall from an abundant supply, from a diminished demand, or from a rise in the value of money, a manufacturer naturally accumulates an unusual quantity of finished goods, being unwilling to sell them at very depressed prices…. This, however, is but of temporary duration; for either the manufacturer's expectations were well grounded, and the market price of commodities rises, or he discovers that there is a permanently diminished demand, and he no longer resists the course of affairs.
>
> (Ricardo [1821], p. 298)

Marx, similarly, refers to the cautionary attitude of capitalists in the face of changes in market prices. Just below the passage concerning fixed capital quoted in note 10 above, he reinforces the argument by appealing to a further factor which restrains capitalists from reacting rapidly to differences in profitability:

> Experience shows, moreover, that if a branch of industry…yields unusually high profits at one period, it makes very little profit, or even suffers losses, at another, so that in a certain cycle of years the average profit is much the same as in other branches. *And capital soon learns to take this experience into account.*
>
> (Marx [1894], Ch. XII, p. 208, emphasis added)

12 As is clear from the context, and at any rate is explicitly indicated by Marx a few lines below, the expression 'cost-price' has the same meaning as Ricardo's natural price.

13 Marx seems to mean something similar when, precisely with regard to the time average of market prices, he remarks that 'this average is not merely of theoretical, but also of practical importance to capital, whose investment is calculated on the fluctuations and compensations of a more or less fixed period' (Marx [1894], Ch. X, p. 190).

14 See, e,g., Marshall [1890], Bk. V, Ch. II, p. 334, n. 1, or Ch. III, p. 348.

15 In general Marshall's distinction between temporary equilibrium (or market) price, short-period normal price and long-period normal price concentrates on the conditions of supply, and pays less attention to the different circumstances that may be relevant to demand according to the length of the period considered (see, e.g., the synopsis at Bk. V, Ch. V, pp. 378–9, where the distinction is exclusively drawn in respect to supply). In fact Marshall, though acknowledging that the relation between price and demand may depend on time (see Bk. III, Ch. IV, pp. 110–12), drastically limits the relevance of this dependence when he states that 'those demands that show high elasticity in the long run, show a high elasticity almost at once; so that, subject to a few exceptions, we may speak of the demand for a commodity as being of high or low elasticity without specifying how far we are looking ahead' (Bk. V, Ch. XII, p. 456; see also Ch. III, p. 342). In this respect Whitaker has suggested that '[Marshall's] rather perfunctory treatment of the time aspect of demand is probably to be explained by the greater doctrinal importance he attributed to disentangling the time aspect of supply' (Whitaker, 1982, p. 47; the footnote on the same page provides the reference pages of the relevant points of the *Principles*, and in particular of the passage by Marshall just quoted). See, however, note 17 below.

16 Marshall's acknowledgement of the influence that at any particular moment expectations may exert on buyers' behaviour contrasts with his general statement, reported in note 15 above, about the substantial independence from time of the price elasticity of demand. For instance, to the extent that a rise in price generates the expectation of further rises, the 'market' function of demand for a commodity might show an upward slope, and therefore a price elasticity whose algebraic sign would be opposite to that assumed for the normal demand curve.

17 This statement refers to a situation in which both buyers and sellers have an accurate knowledge of market conditions. Marshall admits that if, on the contrary, one side overestimates the strength of the other, the price may initially be quite different from the equilibrium one; even for these cases, however, he concludes that the market will close on a price very near the equilibrium value, and with a quantity totally sold equal to that which would have been sold if the equilibrium price had been set from the beginning (p. 334).

18 Marshall's interest in giving the temporary equilibrium price the same content as that of the classical market price may be explained by his tendency to present his own theory of prices as a refinement of the classical one. As is suggested in Bharadwaj (1978), pp. 264–5, and Garegnani (1983), pp. 312–13, once the notion of equilibrium of supply and demand was applied to the market price, Marshall was able to extend it to the normal price by merely lengthening the period of time taken into account. By this generalization of the supply and demand principle, however, he was in fact moving away from the classical theory of prices.

19 Marshall explicitly distinguishes market and normal price in respect to the degree of persistence of the circumstances that influence them:

> It is to the persistence of the influences considered, and the time allowed for them to work out their effects that we refer when contrasting Market and Normal price.
>
> (Marshall [1890], Bk. V, Ch. III, p. 348)

20 'both the material capital of machinery and other business plant, and the immaterial capital of business skill and ability and organization, are of slow growth and slow decay' (ibid., p. 342).

21 This apparent similarity is what presumably leads to statements like the following: 'Marshall…devoted considerable attention to the specification of short-period *normal* prices and long-period *normal* prices, the concepts he substituted for the market prices and natural prices of Smith and Ricardo' (Eatwell, 1987, p. 599). Here the mention of Smith seems to be misplaced, since it is the market price as referred to by Ricardo (and Marx), rather than by Smith, that may appear as comparable to Marshall's short-period normal price. The closest Marshallian counterpart of the market price, if the latter is taken in Smith's sense of price ruling at any moment, is obviously found (as Marshall himself seems to suggest) in the price of temporary equilibrium, rather than in the short-period normal price.

22 Or, obviously, a definite series of profit rates if free competition were assumed away.

23 It need not be recalled that Marshall regards the short-period marginal cost, and therefore the corresponding supply price, as varying directly with output (see e.g., Marshall [1890], Bk. V, Ch. V, p. 370). A marginal cost which increases (or at least does not decrease) with output is on the other hand a necessary condition for the supply price to coincide with that cost. More generally, under increasing returns the very meaningfulness of 'marginal' magnitudes becomes doubtful (see, in this regard, *ibid.*, App. H, p. 805).

24 As is well known, the first influential work on TGE theory was Hicks (1946; first edition 1939). For an overview of the basic features of the theory, see Grandmont (1987), pp. 620–3, (1977), pp. 536–72, reprinted in Grandmont (1988), pp. 3–40.

25 See Grandmont 1987, p. 622. This author also mentions circumstances like the institutional set up and government policies. However, it seems legitimate to leave out of consideration those kinds of circumstances when one studies the theory in its purest form.

26 Some influence of current output decisions on current supplies appears to be generally admitted by the theory (Grandmont 1977, p. 555). It seems, however, that the essence of the theory, with the central role played by the endowments (including stocks of produced goods) that in each period the system 'inherits' from the past, strongly restricts the extent to which the supplies of any period can be supposed to depend on production decisions taken in the same period. See, in this regard, Hicks (1946), pp. 122, 130, where he refers, respectively, to

'some small variability of output into our shortest period', and to the determination of the price system at a particular 'Monday' as based on 'material equipment of the community…including the finished goods now ready for sale, the half-finished goods and raw materials, the fixed plant of all sort and the durable consumers' goods, [which] must be taken as given'.

27 On the more general implications of this difficulty for TGE theory see Garegnani (1976), p. 38, (1990), pp. 56–7; Petri (1988), pp. 8–13, (1991), esp. pp. 280–3, where it is argued that precisely that difficulty leads Hicks later to disavow his own construction.

28 The concern of the theory with keeping the expectations functions safe from exogenous changes is witnessed by another passage in the work just quoted in the text, where it is maintained that the assumed constancy of those functions 'is compatible with changes of the agents' views about the world, provided that the dynamic rules governing these changes are themselves constant'(Grandmont, 1988, p. xix). As an instance of such compatibility the work makes the case that at any moment the agent's estimation of the 'structural parameters' of the economy is in turn an unvarying function of the past and current values of the variables, and can therefore be embodied in the given expectations function of the agent. As is evident, under this assumption—the arbitrariness of which need not be pointed out—changes in that estimation are rendered entirely endogenous.

29 This loss of meaningfulness is tangible in the versions of the theory in which the equilibrium at each 'date' is supposed to be affected by random shocks, represented by the values assumed by exogenous stochastic variables (see Grandmont, 1977, pp. 565–7). With these formulations, which are those in which TGE prices come in fact nearest to actual prices, the theory actually gives up the task of *determining* the values of the prices at any distinct 'date', for those values become themselves stochastic variables; in turn, the sequence of temporary equilibria is transformed into a stochastic process, the 'dynamics' of which constitutes a problem the analysis is admittedly unable to solve (see *ibid.*, p. 567). In the language of the TGE literature this drastic change in the scope of the theory corresponds to (and is somewhat softened by) the distinction between 'deterministic' models and 'stochastic' models.

30 The search for such conditions is among the questions that, in Grandmont's words, 'have attracted the attention of modern economic theorists working in temporary equilibrium over the last 15 years or so' (Grandmont, 1987, p. 622).

31 See, in this regard, Hicks's observation, referring to temporary equilibrium theory, that 'Our [Lindahl's and his own] single period (or "week") was shorter than Marshall's "short period"' (Hicks, 1965, p. 74).

32 This conclusion denies the possibility of interpreting the prices of TGE, as well as of IGE (see the next paragraph in the text), as the *general* equilibrium counterparts of Marshall's *partial* equilibrium notion of short-period normal price. An example of this kind of interpretation is provided by Novshek and Sonnenschein (1986), pp. 333–60, who up to section 4 refer to IGE, and from section 5 on to TGE (see p. 357); see also Novshek and Sonnenschein (1987). These authors abstract from capital (1986, p. 338), and enrole 'entrepreneurship' as 'the factor that is fixed in the short run' (*ibid.*, p. 353). Therefore the argument about the lack of persistence of the data of temporary and intertemporal equilibria, which precisely refers to the stocks of capital goods, would not be strictly applicable to their analysis—though one might then say that such an abstraction is hardly consistent with the search for 'Marshallian-like' foundations of general equilibrium theory, which is the object of Novshek and Sonnenschein's work. It is quite obvious, however, that that restrictive hypothesis plays, in the authors' intention, a merely simplifying role, and that their contention is believed to hold also under more general conditions, in which our point would regain its relevance.

33 See, in this respect, Garegnani (1976), p. 38 and Garegnani (1990), pp. 55–7.

34 This assimilation is put forward by Zaghini (1987), who contends that TGE theory provides that rigorous theory of market prices which cannot be found in the analyses of the classical authors. Various reasons to reject this view have been provided in Ciccone (1991).
35 Debreu (1959), Ch. 2; Bliss (1975), pp. 47–8.
36 The fact that in reality forward markets are very limited, especially in respect to dates of delivery, should not be regarded merely as an institutional accident, subject to be modified. As noted by Hicks (1946, p. 137), it rather appears as a consequence of people's unwillingness to assume forward obligations—at least besides the more immediate future—which in turn derives from the uncertainty which for each individual surrounds the further course of her/his own life. In principle that uncertainty would not be an obstacle to forward contracts if future markets were contingent to all possible states of the world, as IGE theory is also ready to assume (see below in the text). But in turn it is not accidental that in the actual world contingent markets are relatively rare. As is argued by Arrow, a reason for this is that in most cases the occurrence of the events to which contingent contracts would be conditional would not be equally verifiable for both parties, and the awareness of this asymmetry in fact prevents the emergence of such markets (Arrow, 1974a, pp. 9–10).
37 As is evident, incorrect expectations are likely to have relevant effects on the prices which actually rule at any particular moment through the influence that moment by moment they exert on individuals' behaviour.
38 In the face of the macroscopic unrealism of complete contingent markets, general equilibrium theorists could hardly omit to discuss the question of the empirical relevance of IGE theory. Their position in this respect oscillates between a normative function and an explanatory function of the theory, with a mixture of the two whose methodological soundness need not be undoubtful. For instance, while admitting that 'the contingent commodities called for do not exist to the extent required', Arrow maintains that, however, 'the variety of securities available on modern markets serves as a partial substitute', and adds that 'the model of general equilibrium under uncertainty [i.e., with markets contingent to uncertain states of the world] is as much a normative as an empirical description. It is the way the actual world differs from the criteria of the model which suggests social policy to improve the efficiency with which risk bearing is allocated' (Arrow, 1974b, p. 268). Somewhat similarly, after acknowledging that the assumption of complete contingent markets is unrealistic, Hahn notes that 'at least some of the disorders of a capitalist society which Keynes considered can be traced to the absence of these Arrow-Debreu markets' (Hahn, 1981, p. 124).
39 Since altering the specification of even one single element of a state of the world defines a different state, and this procedure may in principle be repeated at will for any element, the number of possible states of the world is clearly infinite, as for instance is acknowledged in Laffont (1989), p. 55. Therefore it sounds quite arbitrary that, in their presentation of the subject, Arrow and Hahn start with the clause: 'If there are finitely many states of the world…' (Arrow and Hahn, 1971, p. 122).
40 In the substance this indeterminacy appears to be analogous to that of the versions of TGE theory in which at each 'date' the temporary equilibrium is assumed to be influenced by stochastic variables (see above, note 29). The only difference seems to be that in those formulations of TGE theory the inability to determine the values of the equilibrium prices is freely admitted—though under the guise of a switch of the analysis from 'deterministic' to 'stochastic' models—whereas in IGE with contingent markets this feature is hidden behind the formal correspondence between states of the world and future markets. As is argued in the text, the question reemerges, however, in the indefiniteness of such states, and therefore of the markets and prices which the theory refers to.

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4
Some deficiencies of Walrasian intertemporal general equilibrium

John Eatwell and Murray Milgate

Two issues have obscured the failure of neoclassical analysis to provide a coherent theory of the determination of the normal rate of profit in a competitive economy. *First*, the erroneous belief that the failure derived from an inability to 'aggregate' capital. It was shown by Pierangelo Garegnani in his 1958 Cambridge PhD dissertation (Garegnani, 1960) that in fact the failure derives from the impossibility (other than in single commodity models) of expressing the endowment of reproducible means of production in a manner which is compatible with the solution of the equations for the determination of long-period positions and the normal rate of profit. His exposure of the deficiencies of Walras's theory of capital is the starting point of this essay. *Second*, the failure has been further obscured by a fundamental change in the notion of equilibrium (again first explored by Garegnani, in this instance in his contribution to the Buffalo conference on capital theory, 1976). The notion of equilibrium has been changed from the traditional concept of normal or long-run equilibrium to the relatively novel concept of intertemporal equilibrium[1] (Milgate, 1979). Instead of providing the starting point for an empirical analysis of the workings of a market economy, the concept of equilibrium has been reduced to a name for the solution of any set of equations, divorced from the systematic workings of a competitive economy.

These two issues are not unrelated. The spurious legitimacy bestowed on 'disaggregated' models has been reinforced by the change in the notion of competitive equilibrium within those models. This essay explores this linkage by means of a simple intertemporal general equilibrium model.

Competition is the force regulating the systematic operation of a market economy. Competition endows economic variables with the necessary consistency and continuity that permits statements of broad generality to be made about them. The regulating force of competition makes itself felt both *empirically* in the prices and quantities that emerge in actual competitive markets in which resources are mobile between uses; and *analytically* in that it is the hypothesis which ensures that prices and quantities gravitate around and towards their 'normal' levels, which are therefore the appropriate objects of formal enquiry. It is the process of competition which gives the concept of equilibrium its economic meaning. A competitive equilibrium is not merely a position from which, once it has been established, no agent who has the power to do so will wish to move. It is also

a position which represents the main forces defining the operation of the economy. By the operation of competition those forces, will, on average, determine the actual configuration of prices and quantities in the economy. In other words, the concept of a normal position of the economy, an equilibrium regulated by competition, is not only the foundation of analytical economics, it is the foundation of applied economics too.

It is this dual character of competition that was first captured by Adam Smith in the distinction between natural and market prices (Smith, 1776, Ch. 7). Natural prices are the competitive 'centre of gravitation' for fluctuations of market (i.e. actual) prices. By creating these categories Smith defined what the theory of value, the core of any analysis of a market economy, was to be about. The determination of natural prices (later called prices of production, long-period prices, or normal prices) is the legitimate object of economic enquiry because such prices are both:

(a) the *theoretical* solution of a model which consciously abstracts from the multiplicity of factors affecting any economic variable to concentrate on what are believed to be the predominant causes; and
(b) the *empirical* manifestation of the prices that would tend to be established by the persistent force of competition, surmounting the disruptive and obstructive events of day-to-day economic life.

In other words, searching for the determinants of natural prices *makes sense* because the reality of competition, of the persistent mobility of resources in search of maximum return, provides the consistency in economic affairs and the persistence in observed relationships which it is the task of the economist to identify and interpret.

Overdetermination in neoclassical capital theory

In a neoclassical model of pure exchange equilibrium prices are determined by the condition that excess demands for all endowments are equal to or less than zero. When excess demand is less than zero the price of that good is zero.

In a neoclassical model of non-capitalist production (production by non-reproducible means of production) equilibrium factor rentals are such as to clear markets for endowments, whilst the prices of produced commodities are equal to the sum of the factor rentals expended in their production (i.e. are equal to their costs of production). In the case in which the demand price of a commodity is less than its cost of production at all positive levels of output, the commodity is not produced. In effect, it never exists.

In this model of non-capitalistic production commodities may be classified into one of two distinct categories: *first*, non-producible factors, the rentals of which are determined by the condition that the market for fixed endowment clears, and *second*, produced commodities, whose demand price in equilibrium is equal to their cost of production. This latter equality is secured by adjusting the quantity of the producible commodity produced to the demand for it (with consequent changes in demand price and factor rentals).

Reproducible means of production (capital goods) violate this simple dichotomy. As elements of the given endowment their equilibrium rental must clear that market (the *first* condition). As producible commodities their price, in equilibrium, must equal their cost

of production (the *second* condition). So two quite separate conditions are brought to bear on the determination of the price of each reproducible means of production. The model is over-determined up to degree $k-1$, where k is the number of reproducible means of production.[2]

The condition that the demand price of reproducible means of production should equal their cost of production is one and the same as the condition that there should be a uniform rate of profit. Suppose a circulating capital good has a gross rental r. Then its demand price is equal to the net rental, $r-C$, (where C is the cost of production), discounted by the general rate of profit. Since a net rental defines a (potentially) infinite stream of returns, the demand price$=(r-C)/\pi$ where π is the general rate of profit. In equilibrium demand price must equal cost for all reproducible means of production, that is $(r-C)/\pi=C$ for all capital goods. Rearranging, $r=(1+\pi)C$. The rental is such as to yield a uniform rate of profit over the cost of production. If there is only one capital good then the ratio of the net rental, r, to the cost of production, C, *determines* π. This is the reason why the maximum degree of over-determination is $k-1$.

Other than in the trivial case of a one-commodity world the problem of overdetermination is typically solved by relaxing one of the two conditions, namely the condition that in equilibrium the demand price of produced commodities should equal their cost of production.[3] This results in the odd condition that 'state of the art' capital goods that are used in current production processes are not reproduced in what purports to be an equilibrium. In other words, the inequality has a quite different significance when applied to capital goods than when used in the analysis of consumer good pricing in non-capitalistic production. In the latter case the presence of the inequality suggest that in equilibrium the good whose price is lower than its cost of production will simply not exist. However, in models of capitalistic production the presence of the inequality indicates that a capital good that is currently used is not reproduced in equilibrium; i.e. the available stock of capital goods is such that market clearing rental yields a rate of return over cost which is below the general rate of profit.[4] This is not a long-run equilibrium, but the familiar condition of the Marshallian short run. Yet the determined equilibrium is supposed to be a centre of gravitation. A short run is a position from which the economy has a tendency, by the workings of competition, to move away. Moreover, as Garegnani (1976, 1990) has pointed out, the resultant equilibrium is a peculiar hybrid. Markets for non-reproducible factors display all the characteristics of the long run, whilst the market for capital goods displays the characteristics of the short run.

These propositions may be illustrated by means of a simple version of the Arrow-Debreu intertemporal general equilibrium model (Arrow and Debreu, 1951; Debreu, 1954). This simple model is adapted from Hahn (1982); see also Eatwell (1978). The model covers just two time periods, time 0 and time 1. There are two qualitatively distinct commodities S and Q, endowments of which, X_s^0 and X_q^0, are given at time 0, and are available with the endowment of labour, X_ℓ, to produce S and Q at time 1. S and Q are therefore both reproducible means of production and final goods. It is assumed that consumers' preferences and producers' technologies are suitably well-behaved, and hence that all excess demand functions are continuous, homogeneous of degree zero and obey Walras's Law. Commodities are distinguished by their physical characteristics and their location in time. There are therefore five commodities in the economy S^0, S^1, Q^0,

Q^1, and labour, L, with which are associated five prices, P_s^0, P_q^0, P_s^1, P_q^1, and *w*. Labour is paid at time 0. There is perfect certainty and all markets clear simultaneously at time 0.

The markets for the five commodities determine five excess demands Z_i^t and Z_ℓ; (*i*=*s*, *q; t*=0, 1) by Walras's Law

$$p_s^0 Z_s^0 + p_s^1 Z_s^1 + p_q^0 Z_q^0 + p_q^1 Z_q^1 + wZ_\ell \equiv 0 \tag{1}$$

As is well known, for this economy there will exist a competitive equilibrium, $Z_i^t \leq 0$ and $Z_\ell \leq 0$ and associated equilibrium prices. The ratios between the prices of each of the qualitatively identical commodities at times 0 and 1 may be interpreted as the own rates of return on commodity S and commodity Q. There is no reason to suppose that the own rates of return are equal to one another:

$$p_s^0/p_s^1 = 1 + \pi_s$$

In this model one of the two sets of conditions which govern the prices of reproducible means of production is relaxed to avoid the problem of over-determination. It is the 'price equals cost of production' condition which is relaxed. So the relationships between prices at time 0 and time 1 are defined by the inequalities:

$$p_s^1 \leq a_{ss} p_s^0 + a_{qs} p_q^0 + a_{\ell s} w \tag{2a}$$

$$p_q^1 \leq a_{sq} p_s^0 + a_{qq} p_q^0 + a_{\ell q} w, \tag{2b}$$

where the a_{ij} are the input coefficients associated with cost-minimising choice of technique.

The origins of the overdetermination that is characteristic of neoclassical models which include reproducible means of production can now be examined by imposing on the Arrow-Debreu model the second condition for normal equilibrium, the condition price equals cost of production. In that case the inequalities (2) become the equations:

$$p_s^1 = a_{ss} p_s^0 + a_{qs} p_q^0 + a_{\ell s} w \tag{3a}$$

$$p_q^1 = a_{sq} p_s^0 + a_{qq} p_q^0 + a_{\ell q} w \tag{3b}$$

As is well known the replacement of the inequalities by equalities will undermine the proof of existence of an economically meaningful competitive equilibrium (Wald, 1951). This is because it may be the case that the equalities are satisfied only in circumstances in which negative quantities are produced.

Exactly what is happening can be revealed most clearly by imposing the condition that price ratios should be the same at time 0 and time 1, i.e. that the price system is

stationary: $p_s^0/p_q^0 = p_s^1/p_q^1$. (This is a strong assumption which will be discussed further below.) In this case the own rates of return on the two commodities will be the same:

$$p_s^0/p_s^1 = 1 + \pi \tag{4a}$$

$$p_q^0/p_q^1 = 1 + \pi \tag{4b}$$

The single own rate of return defined by expressions (4) may be used to simplify the equations (3), by replacing the prices at time 1, $(p_i^1;\ i = s, q)$, with prices at time 0 divided by the common rate of return $(p_i^0/(1+\pi))$. The equations then become the familiar price of production equations

$$p_s^0 = (1+\pi)(a_{ss}\,p_s^0 + a_{qs}p_q^0 + a_{\ell s}w) \tag{5a}$$

$$p_q^0 = (1+\pi)(a_{sq}\,p_s^0 + a_{qq}\,p_q^0 + a_{\ell q}w) \tag{5b}$$

The system is completed by adding the numeraire equation (the unit simplex):

$$\Sigma_i\Sigma_t\,p_i^t + w = 1 \qquad i = s, q;\ t = 0, 1 \tag{6}$$

The equations (4), (5) and (6) constitute the set of relationships defining the 'price equals cost of production' conditions. They comprise 5 equations in 6 unknowns: 4 prices, 1 wage rate, and 1 rate of profit. It is therefore possible to express five of the unknowns, the prices and the wage rate, as functions of the sixth, the rate of profit:

$$p_i^t = p_i^t(\pi) \quad i = s, q;\ t = 0, 1 \tag{7a}$$

$$w = w(\pi) \tag{7b}$$

The equation (7b) is the familiar wage-profit line (Kurz, 1987).

The cost-of-production conditions thus determine the set of prices as functions of the rate of profit. There is no reason to suppose that these prices are compatible with the excess demands in the markets for endowments being less than or equal to zero. There are five excess demands (Z_i^t, i=s, q; t=0, 1 and Z_ℓ) and only one unknown, π. Of course only four excess demands are independent, so suppose that the labour market clears (Z_ℓ=0). That leaves four independent excess demands and only one unknown. However, having imposed the condition that price equals cost of production on a linear system it must be the case that the quantities of goods produced at time 1 are equal to the demand for them, so $Z_s^1 = 0$ and $Z_q^1 = 0$. There remain the two independent excess demands

for the endowments of reproducible means of production, Z_s^0 and Z_q^0, and only one unknown. The system is overdetermined by degree one. If there had been *k* reproducible means of production it would have been overdetermined by degree *k*−1.

The question arises, to what extent is this result dependent on the assumption (4) of a stationary price system? Clearly this assumption was valuable in simplifying the argument, and in clarifying the character of the overdetermination. But does the entire result depend upon it?

The mathematical role of the assumption is to create a relationship between prices at time 1 and prices at time 0 which, so to speak, restricts the independence of the prices. Part of the restriction is imposed simply by replacing inequalities (2) with equations (3) and so eliminating the general possibility of the existence of an economically meaningful solution.[5] The imposition of conditions (4) clearly eliminates any independence in prices and leads to equations (7).

But is the assumption of stationary prices so unreasonable? In a competitive economy the individual agent can know current prices, but typically (apart from the few commodities for which futures markets exist) cannot know future prices. In particular the individual entrepreneur cannot possibly know the general equilibrium implications of price, quantity or technique changes. So, for example, an entrepreneur considering whether to introduce a new technique must compare that technique to current practice at *current* prices, even though the introduction of the technique would result in all prices in the economy changing. In the absence of such general equilibrium information the individual agent in a competitive economy makes decisions on the presumption that current prices will persist, i.e. that the price vector is stationary. It is therefore reasonable to characterise the stationary price system as a centre of gravitation, whilst recognising that through time that centre of gravitation will change.

Agents in the economy may, of course, possess some generally available information about how relative prices are expected to change in the future. It may be known or generally expected, for example, that the price of S will fall by a factor of α over the price of Q. If this is the case then the condition of stationarity, $p_s^0/p_q^0 = p_s^1/p_q^1$ is replaced by $p_s^0/p_q^0 = \alpha p_s^1/p_q^1$.

It is obvious that use of this latter relationship will in no way change the above argument so long as α is an independent variable, i.e. α is determined by factors additional to the data of general equilibrium. Of course, in intertemporal general equilibrium theory α is not an independent variable, but is instead determined in futures markets over which there is perfect knowledge. This latter assumption ensures, as Malinvaud (1961) has argued, that intertemporal analysis is reduced to the exact equivalent of atemporal analysis. Steel at time 0 is defined as a different commodity from steel at time 1, or indeed at any other time. Moreover, the steel that is made available at different times is associated with different processes of production. From the perspective of time 0, the production programme is different for steel at 1 than it is, say, for steel at 8. Just as apples and bread are produced by the application of different techniques to the original endowments of land and labour within an atemporal model, so in the intertemporal model steel at different times is produced by the application of different

techniques to the original endowment of factors (even if the difference in technique is only the input of resources into storage).

The intertemporal technique recreates the atemporal model. Yet whereas in the case of the land and labour model some sense might be made of the idea of fluctuations around the equilibrium point and of adjustment to the centre of gravitation through time, no such interpretation is possible in the intertemporal model *because adjustment through time is already incorporated in the definition of equilibrium.* In this model the concepts of short-run and long-run therefore have no meaning. All the information about the economy is already incorporated in the definition of equilibrium. The notion of fluctuation around that equilibrium, or of the equilibrium as a centre of gravitation makes no sense. This is why the concepts of short-run and long-run have disappeared from general equilibrium analysis, to be replaced by catalogues of models each of which determines an 'equilibrium' embodying specific characteristics of products or markets, or specific characterisations of agent behaviour. Each model is specific to the problem under consideration, and each definition of equilibrium is *sui generis*. All generality is lost.

The assumption of stationary prices[6] is therefore *more* general than the proposition that prices are determined to satisfy the conditions of intertemporal equilibrium. Stationary prices and the associated general rate of profit may be conceived as centres of gravitation around which the actual economy fluctuates.

Intertemporal equilibrium and the competitive process

The overdetermination inherent in neoclassical capital theory arises because the endowment of factors is, and must be, arbitrary. Rentals for the arbitrary stocks of the various capital goods define demand prices which need bear no relationship whatsoever to the cost of reproduction of the capital goods. The question therefore arises: why is an arbitrary stock of capital goods included as part of the data of an equilibrium, when the very essence of that stock is that it can be changed, and will be changed by profit maximising agents? Garegnani gave the answer in his PhD dissertation. It is because the logical structure of neoclassical theory demands that quantity of any endowment be expressed (a) independently of prices (since the endowment is one of the data for the determination of prices), and (b) in a manner appropriate to cost-minimising choice of technique. The latter condition is vital, since choice of technique defines the demand functions for factors of production. The quantity of capital in the economy cannot be specified in terms of value since that violates condition (a). But measures which satisfy (a) but violate (b) are excluded too. For example, measuring the number of workers in the economy by their weight would satisfy (a) but would hardly be appropriate for choice of technique (b). Worker hours of a given quality is the appropriate measure. Similarly, measuring the capital stock by its weight, or even by Böhm-Bawerk's average period of production, is inappropriate for cost minimising choice of technique. The rental paid for capital goods is not related to their weight, and minimising the average period of production does not minimise cost in a competitive economy, in which cost includes compound interest (Garegnani, 1960, 1990).

Specifying each element of the capital stock in terms of it own 'technical units' satisfies both (a) and (b). But a new difficulty then arises. Specifying the endowment in

this manner is incompatible with determining an equilibrium which can be meaningfully interpreted as a centre of gravitation for the economy. This is the case even if the endowment happens by chance to be such that the inequalities (2) were satisfied in equilibrium with equality, as in (3).

The intertemporal equilibrium will define a point on a production possibility curve. That production possibility curve specifies the possible combinations of S^1 and Q^1 which may be produced given the available technology and the endowments, X_s^0, X_q^0, and X_ℓ. In Figure 4.1 this is the curve labelled A.

In the position of equilibrium, with prices determined, the value of the endowment of capital goods held by each household is:

$$k_h = p_s^0 x_s^0 + p_q^0 x_q^0 \tag{8}$$

The value of capital in the economy as a whole is:

$$\mathbf{K} = \Sigma_h k_h \tag{9}$$

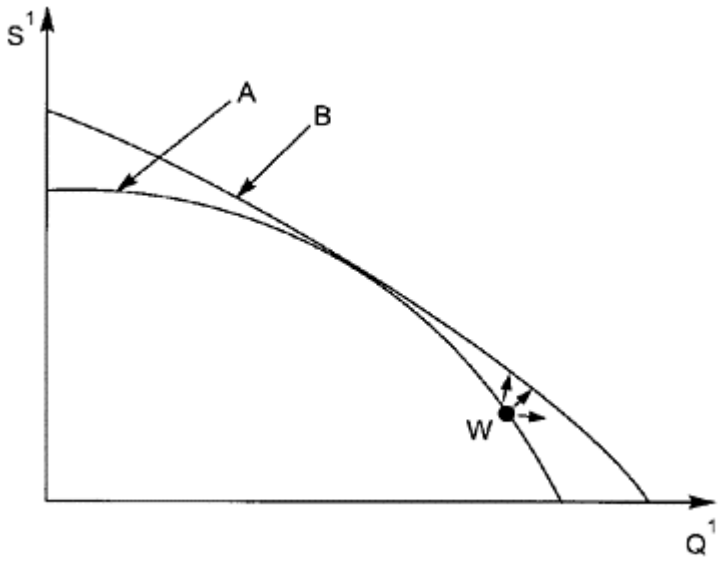

Figure 4.1 The Arrow-Debreu frontier and the preferred frontier

Now conduct the following 'thought experiment'. The agents in the economy evaluate the capital stock of the economy as K. Suppose that they were allowed to choose any composition of endowment, X_s^0, $\bar{X}_q^0$, which had the value K. In other words, suppose K is taken as the endowment of 'capital' and the equilibrium outputs of goods determined with respect to K and X_ℓ. The amounts of S and Q used as inputs in the production

process (the commodity 'endowment') will be determined endogenously, subject to the constraint that in equilibrium their total value is equal to K.[7] In that equilibrium the 'endowment' endogenously chosen would either be the same as the original endowment $X_s^0, \bar{X}_q^0$, (if, by a fluke, that endowment happened to be optimal) or would be different because a different 'endowment' is preferred. In terms of the diagram, the production possibility surface labelled B is that associated with the endogenously determined 'endowment'. At those points at which A and B coincide, the endowment $X_s^0, \bar{X}_q^0$, is (as a fluke) 'efficient' in the sense that it would be chosen endogenously. At other points the original endowment is 'inefficient'.

Of course, there is no presumption that B is 'efficient' in the general Paretian sense. That would require B to be a part of a general equilibrium defined with respect to a given value of capital. Movement away from W will result in price changes and hence changes in households' evaluation of their endowments (i.e. K would change with changing prices). The point is, that other than where A and B coincide, B is more efficient than A. This exercise is valuable in that it suggests that should any random shock tend to cause the economy to diverge from a point of Arrow-Debreu equilibrium (W in Figure 4.1) then competitive pressures will tend to push the economy away from W toward the outer production possibility curve B. In other words, by specifying as a given the endowment of capital goods which is subject to competitive change, the Arrow-Debreu model determines an *inferior* position of the economy, a position from which, given the opportunity, the economy would move away.[8]

Note that this says far more than that the equilibrium is unstable. An equilibrium which is formally unstable might nonetheless represent the long-run optimum of the economy. But short-run positions are not optimal and hence are *always* unsustainable, except in the chance case in which the short-run happens to coincide with the long-run.

It might be argued that in fact agents have no opportunity to 'move away' and W is the best they can do, and therefore this point is Pareto Optimal. But this is only credible if the intertemporal equilibrium model is defined as a complete description of the economy. In other words, this is not a model of the economy, it is the economy. This is to abandon the power of the very concept of a model as an abstraction which captures the dominant elements in the behaviour of an economy. No one imagines that a model is a complete description. It is simply meant to determine the competitive centre of gravitation. Abandoning this conception of economic modelling is to abandon the method of economic theory and empirical analysis laid down by Adam Smith and used by economists ever since. There may be good reasons for making such a change in economic method. But none of the authors of intertemporal models appear to have put forward a case for change. Indeed, they seem generally not to realise that a change has taken place (see, however, Milgate, 1979).

Summing-up

The fundamental and inseparable concepts of competition and equilibrium have been distorted in the development of neoclassical theory (see Eatwell, 1983). First, the

classical characterisation of competition as a process of resource reallocation in the search for maximum profits has been transformed into 'perfect competition', i.e. price taking by an infinity of infinitesimally small agents (Aumann, 1964). Second, equilibrium has been redefined as simply the 'solution' of formal models, rather than a centre of gravitation which is defined by the process of competition, and which is independent of the model which is designed to explain it. If equilibrium is just another name for 'a solution' then its character as a centre of gravitation is lost.

These mutations have culminated in an intertemporal general equilibrium analysis which embodies a characterisation of 'equilibrium' that cannot be conceived of as the centre of gravitation of a competitive process. Indeed, the 'general competitive equilibrium' is a position from which competitive pressures would tend to push the economy *away*. The degeneration of the concept of equilibrium into a 'solution concept' has resulted in a proliferation of 'equilibria': every model has its own equilibrium. Every equilibrium is *sui generis*.

Neoclassical theory has been forced into this dead-end by the overdetermination which is characteristic of models which include reproducible means of production. If the model is to determine a long-run equilibrium then the endowment of capital must be specified as a value of capital, an obvious contradiction. If the endowment is specified as a list of specific capital goods, then it is not possible to determine a long-run equilibrium. Unable to answer the question: 'What determines the long-run equilibrium of a competitive economy, including the rate of profit and associated prices', neoclassical economists changed the question. The theory was kept alive providing an answer to the question: 'What determines prices and quantities in an intertemporal equilibrium?' Unfortunately, no one has bothered to ask what is the relevance of this question to the analysis of a competitive economy.

Notes

1 The canonical notion of intertemporal equilibrium is the Arrow-Debreu model of full futures markets and perfect certainty. However, there are a variety of intertemporal models with a wide range of specifications for the presence or absence of futures markets and for the formation of expectations.

2 Those approaches to capital theory which culminate in the endowment of capital being specified as a quantity of value, as in Wicksell's theory of capital (Wicksell, 1901; see also Pivetti, 1987) or Samuelson's surrogate production function (Samuelson, 1962) maintain the cost of production condition *and at the same time* attempt to derive a coherent analysis of the market clearing condition for stocks of reproducible factors. The search for a solution to the latter problem is manifest in the attempt to derive a well-behaved demand function for capital. This attempt, as is now well known, fails (Garegnani, 1970).

3 Walras himself attempted to avoid the problem of overdetermination by failing to specify what determined the quantities of individual capital goods produced, requiring only that the total value of capital goods produced should equal the total value of savings (Walras, 1874–7). This added $k-1$ degrees of freedom to the model. Unfortunately, as Garegnani (1960) first demonstrated, the range of variation in the quantities of individual capital goods produced (from zero to the total value of savings) is insufficient to ensure that market clearing rentals yield a uniform rate of profit on all capital goods (see also Garegnani, 1990). Morishima modified Walras's theory of capital by replacing the condition that demand prices equal costs of production with inequalities. Eatwell (1987) has shown this ensures a

consistent solution by implicitly allowing the model to be reduced to a one capital good world; i.e. a solution to Walras's equations always exists if the inequality holds for $k-1$ capital goods.

4 In due course this stock would be run down until demand price is equal to cost of production and accordingly production of the particular capital good yields the general rate of profit.

5 Although the use of the inequality appears to be similar to its use in non-capitalistic production, it should be remembered that in the case of reproducible means of production an inequality indicates a short-run position from which the economy will tend to move away.

6 Or the assumption that a is an independent variable.

7 It should be clear that this is a 'thought experiment', for there is no meaningful way in which the endowment can be expressed as the value, K. However, in the face of any random deviation from W the agents in a competitive economy would evaluate the options open to them in terms of the value of their endowment, k_h, even though, in the process of moving toward a new equilibrium that value would change.

8 This would have to be the case if the assumption of perfect certainty were replaced by the assumption of rational expectations. Since a rational expectations equilibrium is subject to random shocks, it is virtually certain that competition would drive the conomy away from an 'equilibrium' determined in markets at time zero.

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Part II
Classical political economy and its relation to marginalism

5
From utilitarianism to marginal utility

Alessandro Roncaglia

1 Introduction

The so-called marginalist revolution is founded on a functional connection between value in use and value in exchange. One of the fathers of the marginalist revolution, Jevons, traces this connection back to utilitarianism and particularly to Bentham's version of it.[1] This paper discusses this widely held view. This issue is also connected to other important issues, such as the differences, commonly overlooked, between the notions of 'economic man' in classical and marginalist analysis (as well as within each of them).

We will first consider, in section 2, Bentham's 'felicific calculus', and the purpose for which it was developed. Then, in section 3, we will recall John Stuart Mill's criticism of Bentham's utilitarianism, and his own proposal.

Both Bentham and Mill admitted, indeed relied on, interpersonal comparisons of pleasures and pains. As for infrapersonal quantitative comparability of different pleasures and pains, while Bentham admits it in his 'felicific calculus', Mill emphatically opposes it.

The opposition between Bentham and Mill has been represented as that between eighteenth century and nineteenth century culture: Enlightenment rationalism versus Romanticism. However, other important roots of Mill's ideas may also be found in Adam Smith and the Scottish school. This point will be briefly discussed in section 4.

This hint at the roots of Mill's views is useful for stressing that the idea of infrapersonal comparability of different pleasures and pains is not a necessary part of the classical notion of economic man. On the contrary, as we may most clearly see by considering Jevons, the subjective theory of value, which derives value in exchange from value in use, relies on such infrapersonal comparisons, while interpersonal comparisons are explicitly rejected or, at most, relegated to a separate field[2]. Jevons's ideas on the subject will be briefly illustrated in section 5.

We will thus be able to draw some conclusions on the different notions of economic man in classical and marginalist thinking. Our thesis is that Mill's criticisms of Bentham apply to the marginalist notion of 'rational economic man' as well.[3] A basic element of the marginalist conceptual framework was therefore already rejected, because of its narrowness, in well-known debates within the classical school.

2 Bentham's utilitarianism

The 'Benthamite revolution' is to be understood in the context of a crucial centuries-long debate on ethics: that between 'deontology' and 'consequentialism'. The deontological approach maintains that actions are 'good' or 'bad' in themselves; the moral quality of any action is a characteristic intrinsic to it. Consequentialism maintains that any action is to be judged within the specific context in which it takes place, that is, by looking at its consequences.[4]

Deontological ethics is typically based on the principle of authority, and is traditionally connected with religious 'commandments'. It dominates in societies oriented towards respect of traditions. Consequentialist ethics came to the fore with the new rationalistic orientation of the Enlightenment age. In different ways, many philosophers and social reformers (such as Beccaria in Italy or Voltaire in France) contributed to the success of this approach; among them, undoubtedly, Bentham played a crucial role.

As part of his consequentialist ethics—summarized in the motto 'the greatest happiness principle'[5]—Bentham proposes the 'felicific calculus', namely the quantitative evaluation and algebraic summation of pleasures and pains stemming as consequences from any given course of action. 'Good' is whatever gives as its result an algebraically positive felicific magnitude, and hence increases the 'amount of happiness' within human societies; 'bad' is whatever gives as its result a negative quantity, and as a consequence decreases the amount of social happiness.[6]

The 'felicific calculus' thus evaluates the *social* impact of both individual actions and public policy choices; Bentham, however, concentrates attention on the latter. In fact, he does not appear to be a consistent supporter of what has been called 'the thesis of the natural identity of interests' (Halévy 1972:89) according to which an optimal situation is reached when individuals are fully free to pursue their preferred courses of action. Bentham shares with French Enlightenment the faith in Reason, and hence displays both the most extreme liberalism,[7] when all individuals in society are considered as fully endowed with benevolent Reason, and a tendency to a sort of centralized planning, when benevolent Reason is considered as the attribute of 'the Legislator'.

We should recall that Bentham's 'central, overall project' is 'the production of a complete, rational code of law' (Harrison 1987:226). In this context, the felicific calculus is the Legislator's main tool. Through it, the Legislator takes into account the behaviour of individuals motivated by their own self-interest, and intervenes setting—through laws—rewards and punishments so as to modify individual behaviour[8] in the direction of the optimal situation corresponding to the 'greatest happiness principle'. Here, of course, the greater or lesser amounts of happiness stemming from different courses of actions are computed for society as a whole, and are assessed by the Legislator himself.

This procedure involves three prerequisites. First, the different pleasures and pains of each individual are assumed to be reducible to quantitative measurement along a unidimensional scale. Second, felicific magnitudes referring to different individuals may be algebraically added up. Specifically, all individuals are assumed to be identical in their capability of experiencing pleasures and pains. Third, the Legislator knows these magnitudes.

Bentham is in many respects a 'true believer' in the powers of Reason and in the applicability of the felicific calculus to a homogeneous one-dimensional human nature. However, in practice in his impressive output of manuscripts no example has been found, at least to my knowledge, of factual computations of this kind, with numerical estimations of pleasures and pains. Bentham systematically limits himself to illustrating the elements which have an influence on the 'quantity' of pleasure and pain.[9] This is sufficient for Bentham's purposes when dealing with specific issues, for instance for establishing criteria which laws (especially those relating to punishments, as in the debate on the death penalty) should follow. We may add that the idea of *well-specified and complete* individual 'preference maps' on which to rely for a factual quantitative evaluation of 'utilities' and 'disutilities' is even remoter from Bentham's mind when considering the behaviour of economic agents. Assessing social and individual preferences is the Legislator's task; the felicific calculus is introduced by Bentham in this context (and more generally in the ethical field), not in the context of an analysis of consumers' behaviour.[10]

Furthermore, between Bentham's analysis and marginalist economics there is a difference in perspective. While Bentham evaluates different courses of *actions* (and especially different legal rules[11]) by analyzing their consequences, marginalist economics aims at evaluating *commodities* through the connection of exchange value to use value.[12] The notion of marginal utility, on which this connection relies, requires that the consumption of each successive dose of each commodity be considered as a different action. This is unnecessary from the perspective of Bentham's Legislator, and it is likely that Bentham would have considered it as stretching too much the application of the felicific calculus.[13]

Let us also notice that Bentham's economic writings do not offer 'a systematic analysis of value and price'.[14] We can find in his writings some emphatic statement to the effect that 'all value is founded on utility', but this simply means that 'where there is no use, there cannot be any value'.[15] That is, exactly as in Smith or Ricardo, utility is a prerequisite for exchange value. However, this does not necessarily imply attributing to utility a quantitatively measurable dimension, and relying on it for the determination of exchange values. True, Bentham follows a tradition external to the classical analysis of Smith and Ricardo when relying on plenty or scarcity of supply as an explanation of prices, specifically in dealing with the water-diamond paradox; but from here ('the tradition of Galiani, Pufendorf and the Schoolmen', as Hutchison 1956:291, recalls) to marginal price theory there is a large step, requiring something more than some knowledge of differential calculus.[16]

3 John Stuart Mill and Goethe's 'many-sidedness'[17]

Let us now consider how Bentham's doctrines were 'modified' by his main disciple, John Stuart Mill.

In his famous pamphlet on *Utilitarianism*, John Stuart Mill defends consequentialism as opposed to deontological morals.[18] However, he attacks the idea that human feelings can be reduced to different quantities of a one-dimensional measuring rod, 'pleasure' or—in the negative—'pain'.

Abandoning sensism, the view of human nature which underlies Bentham's doctrines, Mill is led to separate much more clearly utilitarianism as a moral criterion from utilitarianism as an interpretation of individuals' behaviour. There are two aspects in this distinction. First, habit rather than conscious 'felicific calculus' accounts for a large part of human actions:

> Many indifferent things, which men originally did for a motive of some sort, they continue to do from habit. Sometimes this is done unconsciously, the consciousness coming only after the action: at other times with conscious volition, but volition which has become habitual, and is put into operation by the force of habit, in opposition perhaps to the deliberate preference…will, like all other parts of our constitution, is amenable to habit, and…we may will from habit what we no longer desire from itself…in feeling and in conduct, habit is the only thing which imparts certainty.
>
> (Mill 1987c:312–13)

Second, when we come to those aspects of human behaviour on which we want to pass a judgement of right or wrong, the utilitarian criterion is not applied to immediate unidimensional 'pleasure' and 'pain', but to a more complex and higher level mixture of reasoned feelings:

> Human beings…differ from other animals in two particulars. First, in being capable of sympathizing…with all human, and even with all sentient, beings. Secondly, in having a more developed intelligence, which gives a wider range to the whole of their sentiments, whether self-regarding or sympathetic.
>
> (Mill 1987c:324)

The idea of a complex mixture of feelings is connected to Mill's recognition that there are qualitative differences among different kinds of pleasures which cannot be reduced to quantitative differences. Mill stresses the personal inability of Bentham to recognize this aspect, due to

> the incompleteness of his own mind as a representative of universal human nature. In many of the most natural and strongest feelings of human nature he had no sympathy; from many of its graver experiences he was altogether cut off; and the faculty by which one mind understands a mind different from itself, and throws itself into the feelings of that other mind, was denied him by his deficiency of imagination.
>
> (Mill 1987a:148)

A test-case is the attitude to poetry, but Mill's point is more general than that:

> [T]he being whose capacities for enjoyment are low has the greatest chance of having them fully satisfied; and a highly endowed being will

> always feel that any happiness he can look for, as the world is constituted, is imperfect. But he can learn to bear its imperfections, if they are at all bearable; and they will not make him envy the being who is unconscious of the imperfections. It is better to be a human being dissatisfied than a pig satisfied; better to be Socrates dissatisfied than a fool satisfied. And if the fool, or the pig, are of a different opinion, it is because they only know their own side of the question. The other party to the comparison knows both sides.
>
> (Mill 1987c:281)[19]

It is in this context, and recalling the strength of habit, that Mill (1987c:313) stresses that 'the will to do right ought to be cultivated'. Analogously, in the context of a Smithian-type distinction between selfishness and morally acceptable pursuit of happiness, Mill (1987 c:289) stresses 'that education and opinion, which have so vast a power over human character, should so use that power as to establish in the mind of every individual an indissoluble association between his own happiness and the good of the whole'. Another reason for education, meant in a slightly different way as the development of an intelligent understanding of human nature and its 'many-sidedness', is that the application of the utilitarian criterion for moral judgement is not a mechanical matter, easy and univocal: 'so many things appear either just or unjust, according to the light in which they are regarded…. Utility is an uncertain standard, which every different person interprets differently', and even 'in the mind of one and the same individual, justice is not some one rule, principle, or maxim, but many' (Mill 1987c:328).

As an example of different opinions, Mill recalls the issue of egalitarianism, where 'the equal claim of everybody to happiness in the estimation of the moralist and the legislator, involves an equal claim to all the means of happiness', immediately adding however a qualification which opens the way to differences in judgement, 'except in so far as the inevitable conditions of human life, and the general interest, in which that of every individual is included, set limits to the maxim' (Mill 1987c:336).

It is clear, then, that the image of an all-embracing, peacefully univocal, felicific calculus as a criterion for moral judgement is rejected by Mill, in the name of the multisidedness of human nature. Conflicts (even dramatic ones, such as those which constitute the structure of Greek tragedies) are unavoidable.[20] This 'modified utilitarianism' does not renounce consequentialism, as opposed to deontological *a priori*, as the foundation of ethics. However, it is even remoter than Bentham's views from Jevons's idea—constituting the basis for his 'marginalist revolution'—of a set of preferences related to a one-dimensional notion of utility and sufficiently stable to be used in the analysis of economic agents' behaviour. Even in Bentham, consequentialist ethics did not imply the notion of 'rational economic agents' maximizing a one-dimensional utility; in Mill, the cautions and qualifications with which the 'felicific calculus' is surrounded definitely differentiate from the Jevonian notion the classical one of the 'economic man', profit-maximizer whenever possible, but with more flexible 'social' characterization.[21]

4 The Smithian roots of mild rationalism

If there is an intellectual field where the utilitarian attitude—namely, looking at the consequences of human actions—dominates, to the point of being identified with the scientific attitude tout court, this is economics. The analysis of consequences drives 'economic science', especially when the aggregate outcome of a set of individual actions differs from the (intended or unintended) outcome of each individual action considered in itself. From Mandeville's motto, 'private vices, public virtues', to Adam Smith's defence of the pursuit of self-interest as conducive to society's economic welfare, up to Keynes's stress on the social risks of thriftiness, consequentialism dominates economics.

However, there are different versions of consequentialism: as we saw in the previous sections, Bentham's 'monodimensional' utilitarianism underwent deep modifications in the hands of John Stuart Mill.

The difference between Bentham and Mill has been interpreted (Viner 1991:160) as a counterposition of eighteenth-century Rationalism and nineteenth-century Romanticism. There is, of course, a large element of truth in this representation: the role of Coleridge's poetry in the formation of Mill's thought, for instance, has often been recalled in this context.[22] However, this counterposition should not be stretched to the point of creating a gap between eighteenth- (and early nineteenth-) century 'rationalistic' political economy and a new 'romantic' trend whose point of arrival would be the German historical school or its English equivalent (Cliffe Leslie, for instance), with a final return to 'rationalism' with marginalist choice-theoretic economics based on the notion of the 'rational economic man'.

A clear echo of Smith's 'impartial spectator' in the *Theory of Moral Sentiments* may in fact be found in Mill's formulation of the 'greatest happiness principle' in his essay on *Utilitarianism* (Mill 1987c:288):

> [T]he happiness which forms the utilitarian standard of what is right in conduct, is not the agent's own happiness, but that of all concerned. As between his own happiness and that of others, utilitarianism requires him to be as strictly impartial as a disinterested and benevolent spectator.

The Smithian (and Scottish Enlightenment) view of men as essentially 'social animals' is shared by Mill.[23] Thus, he maintains that civilized citizens of contemporary societies share a communal interest which overcomes sheer selfishness:

> [A]lready a person in whom the social feeling is at all developed, cannot bring himself to think of the rest of his fellow creatures as struggling rivals with him for the means of happiness, whom he must desire to see defeated in their object in order that he may succeed in his. The deeply rooted conception which every individual even now has of himself as a social being, tends to make him feel it one of his natural wants that there should be harmony between his feelings and aims and those of his fellow creatures.
>
> (Mill 1987c:306)

The eighteenth-century roots of Mill's position are apparent here if we keep the Scottish Enlightenment distinct from the French Cartesian tradition and the extreme exalting of

the Goddess Reason in the French Revolution.[24] Within the Scottish 'Sociological School', in fact, the seventeenth- and eighteenth-century debate on human 'passions and interests'[25] is resolved in a recognition of the essential coexistence of different aspects in human nature.

This is evident in Smith's thought: self-interest, which dominates the analysis in the *Wealth of Nations*, is distinct from selfishness, and provides a solid foundation for the working of a market economy precisely because it is grounded in a morally sound society, where 'sympathy' (which dominates Smith's analysis in the *Theory of Moral Sentiments*) constitutes a check avoiding purely selfish actions.[26]

It is thus a multifaceted individual who is at the centre of attention for classical economists, especially those among them who had a solid humanistic education, like Smith and Mill (but not Ricardo). Rationality of behaviour is certainly assumed in their economic analyses, but this does not imply accepting sensism as the correct view of man's nature. In the context of classical economics, rational behaviour simply consists in assuming away contradictions and in the idea that where, as in the 'competition of capitals', there is a specific unidimensional magnitude measuring the outcome of different choices—namely profits—more is preferred to less. But this possibility is certainly not generalized to the whole of human behaviour; specifically, it is absent in the analysis of consumption, where choices are rather considered as the outcome of habits and customs, continuously modified by the appearance of new goods, so that producers are the *primum movens* in the determination of consumption structures.[27]

5 Jevons's utility

In direct opposition to the classical school of Ricardo and Mill, Jevons builds a'utilitarian' economics by reducing economic science to a theory of rational choice, under the postulate that each individual is able to compute in a one-dimensional space all consequences of any action, at least within the economic sphere. Thus Jevons explicitly assumes the possibility of a felicific calculus for each individual: 'It is…to the tracing out of the mechanism of self interest and utility, that this essay has been devoted' (Jevons 1970:50). 'The mind of an individual is the balance which makes its own comparisons, and is the final judge of quantities of feeling' (*ibid.*:84). On the contrary, in his main contribution to economic theory he explicitly and emphatically denies the possibility of interpersonal comparisons: 'there is never, in any single instance, an attempt made to compare the amount of feeling in one mind with that in another. I see no means by which such comparison can be accomplished' (*ibid.*:85).

'Consequentialist ethics' as a social theory, requiring interpersonal comparisons, is thus made to disappear. Each individual may identify 'good' in whatever increases his or her utility, once costs and benefits are considered; but this is completely different from the Bentham-Mill utilitarian ethics where social, not individual, consequences are what matter for the moral assessment of any action.

Jevons's definition of economics is also different from Mill's specification of political economy (see note 27) as limited to a specific aspect of human nature, the desire to possess wealth. After recalling a characteristically Millian point—'the feelings of which a

man is capable are of various grades' (*ibid.*:92)—Jevons limits economics to a specific subset of feelings:

> My present purpose is accomplished in pointing out this hierarchy of feeling, and assigning a proper place to the pleasures and pains with which the economist deals. It is the lowest rank of feelings which we here treat. The calculus of utility aims at supplying the ordinary wants of man at the least cost of labour.
>
> (*ibid.*:93)

Let us notice that this definition is only apparently an obvious and unproblematic one. Thus, for instance, according to it my demand for Bach recordings belongs to the lowest rank of feelings, exactly on the same level as my demand for chocolate—both being part of my (historically determined) subsistence needs. In fact, the reason behind this reformulation of Benthamite utilitarianism is that it is conducive to Jevons's crucial aim, the formulation of economics as a mathematical science:[28] 'It is clear that economics, if it is to be a science at all, must be a mathematical science…*our theory must be mathematical simply because it deals with quantities'* (*ibid.*:78; italics in the original).

It is this crucial aim which leads Jevons to assume feelings as a monodimensional quantitative variable:

> There can be no doubt that pleasure, pain, labour, utility, value, wealth, money, capital, etc., are all notions admitting of quantity; nay, the whole of our actions in industry and trade certainly depend upon comparing quantities of advantage and disadvantage.
>
> (*ibid.*:82)

The point is stressed again and again: 'The future progress of economics as a strict science must greatly depend upon our acquiring more accurate notions of the variable quantities concerned in the theory…[and we should] express the laws of the variation of utility numerically' (*ibid.*:174). Of course, utility is not measured directly, but through its manifestation in individual choices: 'I hesitate to say that men will ever have the means of measuring directly the feelings of the human heart…*it is from the quantitative effects of the feelings that we must estimate their comparative amounts'* (*ibid.*:83; italics in the original).

All this involves both explicit and implicit shifts in the way the economy is viewed and in the conception of human nature. First of all, methodological individualism is a necessary requisite for this procedure. The core of the theory consists in the analysis of individual choices between different pleasures (consumption) and pains (labour);[29] the feelings (preferences) of each individual must be assumed as an independent datum of the problem. Only under these conditions will the 'summing-up' of individual behaviour constitute a theory of the whole economy. '[T]hough the theory presumes to investigate the condition of a mind, and bases upon this investigation the whole of economics, practically it is an aggregate of individuals which will be treated' (*ibid.*:86). 'Methodological individualism' is not justified by Jevons: it is simply assumed, as implicit in the structure of his theory.

Second, 'Jevons viewed "the problem of economics" not as the growth or distribution of the wealth of nations but essentially as the problem of allocating given resources to obtain maximum satisfaction' (Black 1970:11). In Jevons's own words:

> The problem of economics may…be stated thus: *Given, a certain population, with various needs and powers of production, in possession of certain hands and other sources of material: required, the mode of employing their labour which will maximize the utility of the produce.*
> (1970:254; italics in the original)[30]

This constitutes a sharp cleavage with classical political economy, which assumes as its central object the conditions for economic reproduction and development of societies based on the division of labour.

Third, Jevons's economics applies perfect rationality to an aspect of individual behaviour (which he unwarrantedly assumes to be identifiable)—'the lowest rank of feelings'. Not only is each individual isolated from all others, in that interdependence of preferences is ruled out; this specific aspect is also isolated from all other aspects of human nature, and in particular from what is essential in civilized human beings, their very nature of social beings. Jevons (1970:102) remarks that 'In the science of economics we treat men not as they ought to be, but as they are'. However, this is precisely the crucial point of difference. The Scottish Enlightenment, namely the tradition within which Adam Smith builds his political economy, considers 'men as they are' as something more complex than mere 'sensistic machines', and certainly endowed with essential intrinsic social proclivities; it is because of this, for instance, that Smith is able to introduce the very subtle and useful distinction between selfishness and self-interest.

Thus we may conclude that Jevons's notion of the rational economic agent is much less rich than the corresponding classical notion, relies on shaky foundations, and because of its one-sidedness is much more prone to lead to gross misunderstanding of the working of human societies. In a sense, in so far as it relies on conceptual foundations similar to those adopted by Jevons and discussed above, the marginalist episode may be considered as an aberration in the history of economic thought—a deviation from the difficult path of a social science recognizing the complexities of human beings and human societies—which oversimplifies the real world by substituting for it a one-dimensional fiction.

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Notes

1 ‘Bentham’s ideas…are adopted as the starting point of the theory given in this work’ (Jevons 1970:55; cf. also pp. 44, 91–102).

2 Such as Edgeworth’s Utilitarian Calculus, explicitly distinguished from the Economical Calculus: see Ranchetti 1996.

3 By ‘marginalists’ we refer to Jevons and the founding fathers of the so-called Marginalist Revolution: we are not considering here present-day ‘choice theorists’. For a criticism of the latters’ approach based on revealed preferences, see Roncaglia 1978:108–9.

4 This simplistic dichotomy hides many important theoretical and interpretative problems. As Sen (1991) shows, deontological approaches commonly recognize, at least indirectly, the importance of consequences of actions, while consequentialist approaches commonly retain some elements of *a priori* judgements. Overall, however, the distinction retains its validity. A different but connected dichotomy is that between transcendentalist ethics and ethical hedonism: whether the end of moral action does not belong to this earth, or it ought to consist in individual well-being, with the latter view characterizing ‘philosophical utilitarianism’.

5 In Bentham’s own words, ‘the greatest happiness principle’ (also called by him ‘the principle of utility’), which constitutes his ‘fundamental axiom’ since his first important work, the *Fragment on Government*, is that ‘it is the greatest happiness of the greatest number that is the measure of right and wrong’ (Bentham 1977:393, quoted by Harrison 1987:226). This principle derives from Francis Hutcheson’s *Inquiry Concerning Moral Good and Evil*, and from Helvetius, through Beccaria (Halévy 1972:13, 21). Literally taken, it implies two elements (‘greatest happiness’ and ‘greatest number’) to be simultaneously maximized—like considering national income and its distribution as two separate elements in evaluating the well-being of a nation. This is a crucial element to be kept in mind when interpreting Hutcheson or Beccaria. However, ‘the greatest happiness of the greatest number’ can be (and has been, particularly in Bentham’s felicific calculus) interpreted as implying a unique maximand, either total social happiness or average per capita happiness: see the following note.

6 Benthamand other utilitarians like Sidgwick and Edgeworth (cf. Bonner 1995:132–87 for a discussion of their views) appear to choose total social happiness as their criterion; others—like John Stuart Mill—appear to prefer some sort of per capita average (following in this Adam Smith’s leaning for per capita income as the main standard for the wealth of nations, in opposition to the mercantilists’s choice of national wealth). When population is assumed as given (an assumption we may consider implicit in many utilitarian writings dealing with other issues) there is no difference between the two criteria; they differ when the population issue comes in. Recalling the assumption of decreasing returns to land, Mill’s strong neo-Malthusian attitude (up to the point of risking prison for distributing birth control leaflets in his youth) is fully consistent with his utilitarianism. Neo-Malthusian views are instead difficult to reconcile with the choice of total social happiness as the utilitarian criterion.

7 It is from this point of view that he criticizes Smith for admitting State intervention against usury, interpreted as the setting of predatory interest rates; cf. Bentham 1952. Over time Bentham deviated more and more from the liberal idea that ‘Every man is, no doubt, by nature, first and principally recommended to his own care; and as he is fitter to take care of himself than of any other person, it is fit and right that it should be so’ (Smith 1976a:82) and from the connected ideal of laissez-faire: cf. Viner 1991, Hutchison 1956, Harrison 1987.

8 Let us notice that this does not necessarily imply attributing to all individuals the capability of rationally assessing the consequences of each action, with a selfish ‘felicific calculus’; it is

only necessary to assume that the Legislator knows how to drive individual behaviour, even if this is mainly determined by customs and habits.

9 Such as 'intensity, duration, certainty, propinquity, fecundity, purity and extent', quotedby Harrison (1987:227); or the 'memoriter verses'quoted by Welch (1987:770):

> *Intense, long, certain, speedy, fruitful, pure—*
> Such marks in *pleasures* and *pains* endure.
> Such pleasures seek if *private* be thy end;
> if it be *public,* wide let them *extend.*
> *Such pains* avoid, whichever be thy view;
> If pains *must* come, let them *extend* to few.

10 As Guidi(1991:153; my translation) stresses, Bentham 'is very far from assuming a rigorous rationality of behaviour, the hypothesis that the pursuit of maximum satisfaction constantly drives each human being, and that each human being has a coherent "utility function"'.

11 The modern distinction between 'rule utilitarianism' and 'act utilitarianism' proposed by Harrod 1936; see Harsanyi 1982:41) is not relevant here. We may notice however that the distinction was already clearly recognized by Mill (in a letter to Grote, quoted by Bonner 1995:110): 'Human happiness, even one's own, is in general more successfully pursued by acting on general rules, than by measuring the consequences of each act'.

12 What follows also applies to Lancaster's reformulation of consumer theory in terms of 'demand for characteristics' (cf. Lancaster 1991; for a critique of this approach, cf. Roncaglia 1978:109–10).

13 Money, more precisely the amount of money which each economic agent is ready to give in exchange for an incremental quantity of a good, has been proposed (by Jevons 1970:174–5, for instance) as the measure of the utility of such a good. This however is not possible when the Legislator's system of preferences is superimposed on individual agents' evaluations of their own pleasures and pains. Furthermore, unless we assume that the utility of money be the same for all individuals, interpersonal comparisons are not legitimate.

14 As is stressed by Hutchison (1956:290) who, notwithstanding this fact, maintains that 'Bentham's development of, and emphasis on, the two concepts of maximization and utility make him above all the ancestor of neoclassical economic theorising, and especially of Jevons and Edgeworth'.

Stark, the editor of *Jeremy Bentham's Economic Writings,* in his introductions to the three volumes discusses at length Bentham's ideas on monetary, fiscal and commercial issues; value theory is conspicuously absent in his treatment—as, indeed, in Bentham's writings collected in the three volumes—except for a cursory and bombast statement at the end of the introduction to vol. III, according to which Bentham 'anticipated not only Menger and Jevons and Marshall: we find in his books even the germs of such a detailed doctrine as Boehm-Bawerk's explanation of the rate of interest' (Stark 1952–54:III, 59). All this is only substantiated by referring to Bentham's vague hints in the direction of an assumption of decreasing marginal utility of money and, more generally, of'all gratifications' (*ibid.*:58).

15 Quoted by Hutchison (1956:290). Perhaps the main connection between a 'forerunner' like Bentham and the Jevonian theory of value lies in the adhesion to sensism in their view of human nature. It is interesting in this context to recall that Jevons (1970:57) attributes 'to Condillac's work, *Le commerce et le gouvernement* [1776]…the earliest distinct statement of the true connexion between value and utility'.

16 Cf. Roncaglia 1997, especially section 3.

17 'Goethe's device, "many-sidedness"', is recalled by Mill in his *Autobiography* (Mill 1971:98). Cf. also the essay on *Coleridge* (Mill 1987b:201); and Ryan (1987:36).

18 On similar lines, Mill (1971:275) criticizes Kant, who 'lay[s] down a universal first principle as the origin and ground of moral obligation', but 'when he begins to deduce from this precept any of the actual duties of morality, he fails, almost grotesquely, to show that there would be any contradiction…in the adoption by all rational beings of the most outrageously immoral rules of conduct. All he shows is that the *consequences* of their universal adoption would be such as no one would choose to incur'.

19 Mill (1987c:173–4) quotes a striking passage by Bentham: 'Quantity of pleasure being equal, push-pin is as good as poetry', and also recalls 'another aphorism …attributed to him…: "All poetry is misrepresentation"'; Mill's comment is harsh: 'This trait of character seems to us a curious example of what Mr Carlyle strikingly calls "the completeness of limited men"'.

The passage in the text and that on push-pin are quoted by Bronfenbrenner (1988a:294), who then tries to assimilate Mill's 'quality' in a straightforward marginalist analysis of consumer behaviour. However, Bronfenbrenner himself later (1988b:333) recognizes the fallaciousness of his attempt, since 'a given individual before and after exposure to the higher pleasures should be treated for purposes of microeconomic analysis as two different individuals altogether'. As Bronfenbrenner (1988a:307) recalls, Mill's views were defended, after the marginalist revolution, by economist-philosophers such as Leslie Stephen (1900:304–16). Bronfenbrenner's (1988b) reappraisal of the issue suggests, in a sense, relying on discontinuous changes in preference maps, assumed to be stable in the intervals between two subsequent changes. In fact, the stability of preference maps is essential for attributing an 'empirical content' to modern marginalist theory (cf. Roncaglia 1978:109, 116). Yet, in the Millian context under discussion here a gradual adaptation of tastes and behaviour seems much more likely, while 'crucial events' provoking sudden changes in established habits are sufficiently infrequent and appear as a *deus ex machina*. 'Ethology, or the Science of Character' which Mill advocates in many of his writings, precisely aimed at studying these aspects (cf. Becattini 1983; Oakley 1994:175ff).

20 Recognition of this fact—namely, the legitimacy of deep differences in opinions—plays a crucial role in Mill's essay *On Liberty* (Mill 1947).

21 Commenting on this paper at the Lisbon European Conference on the History of Economic Thought (February 1996), Richard Sturn remarked that Mill, in proposing a 'more reasonable' notion of utilitarianism, bypasses all the most difficult issues arising within this approach. Perhaps we should rather say that Mill cleverly escapes what really are insoluble issues, even if at the price of depriving utilitarianism of the capability of providing—at least in principle—direct and easy answers to all sorts of ethical issues. From a slightly different perspective, we might say that confronted with the complexities of human nature the theorist either abstracts from them, building theories apparently endowed of generality but with shaky foundations, or leaves the door open to such complexities but renouncing to the construction of a unified, general theoretical building and to the possibility of providing clear-cut, univocal answers. Why should we not sympathize with Mill for choosing the second alternative?

22 Mill himself, in his *Autobiography* (Mill 1971:81–90), points in this direction.

23 Oakley 1994 illustrates at length this point.

24 On the one side, Bentham was very near in spirit to these elements of the French Revolution. As a consequence of this affinity, he was made an honorary citizen of Republican France (Harrison 1987:226). On the other side, though John Stuart 'lived…in England through his formative and most active years', both 'the Mills are typically Scots' (Macfie 1990:10–11).

25 As indicated in the title of Hirshman 1977.

26 Cf. Roncaglia 1995:6–7.

27 All this is not contradicted, but rather confirmed, by Mill's definition of political economy (Mill 1968) as limited to a specific aspect of human nature, the desire to possess wealth. This definition is equivalent to assuming 'rationality' in the sense that *ceteris paribus* individuals prefer more (income, profits, wages) to less. However it has nothing to do with consumer choices or with reliance on the assumption of *measurable* use values for explaining exchange values. In fact, consumer choice is a topic conspicuously absent from Mill's monumental *Principles* (Mill 1929); in general, Mill appears to consider customs and habits as the main element explaining the structure of consumption and its evolution over time. Let us also recall that while producers not caring about profit maximization risk being left behind by the competitive process (since classical economists consider profits as the source of investment expenditure, necessary for keeping up with the pace of technical progress), 'irrational' consumers do not risk similar 'punishments'.

28 On this interpretation, see Shabas 1990.

29 We may notice here that Jevons conceived of costs as 'real costs' rather than as 'opportunity costs'. Cf. Black 1970:26–7.

30 Cf. also p. 103: 'the theory of economics must begin with a correct theory of consumption'.

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6
Use value and the ‘commercial knowledge of commodities’

Reflections on Aristotle, Savary and the Classics

Bertram Schefold

I

The analysis of use value, i.e. the systematic exposition of what the commercial uses of commodities consist of, seems to have remained entirely outside the sphere of traditional political economy, but I shall argue that some understanding of it represented a precondition of the formation of the concept of value in exchange and of value itself. Value in use plays no significant visible role in the works of the classical political economists. The only major exception is Marx’s application of the concept to the so-called factors of production: it is the use value of the commodity labour power to generate more value than its reproduction costs and it is the use value of capital to generate profits according to a general rate so that money capital, having that property, can be lent, and the price for borrowing it is interest. As is well known, capital in its monetary form is the object of this exchange while a price is the expression of the value of a commodity in terms of money so that interest, as a monetary price of money, is an ‘irrational form’ in Marx (Schefold 1998a). But we shall here not be concerned with these almost metaphorical applications of the concept of value in use but rather with its original meaning in the application to ordinary commodities.

Classical political economy is primarily concerned with value and distribution. The knowledge of what constituted value in use therefore was a precondition of economic inquiry rather than its object. The *New Palgrave Dictionary*—in which classical political economy is well represented—contains only two passing references to value in use. R.D.Collison Black (1987:777) speaks of a ‘change from the classical concept of value in use, or total utility, as a necessary but not sufficient condition to explain the normal values of freely reproducible commodities, to the concept of what Jevons called “the degree of utility”…’. Black aptly characterises value in use as the precondition for commodities to have value, but is it synonymous with ‘total utility’? The original *Palgrave* dictionary [Flux 1899:608–9] stated bluntly: ‘Value in use is what is commonly designated by utility’. Montani, again in the *New Palgrave* [Montani 1987:254] refers to Marx’s definition: ‘exchange value presupposes use value’. Something can have use value, without having been produced by labour, like air, minerals etc. On the other hand,

one can produce use value without producing exchange value within the family or within primitive tribes in which products do not assume the form of commodities. Is the use value of commodities really adequately interpreted as 'total utility', its only economic function being a necessary condition for the existence of value in exchange? A first doubt arises as soon as we recall that the use value of a commodity is a set of socially relevant characteristics of a commodity in classical thought—therefore multidimensional—whereas utility is a one-dimensional, possibly ordinal measure of a basket of commodities, as perceived by a consumer, in modern neoclassical usage of the term.

The Marxian habit of applying the concept of value in use not only to the concrete properties of commodities but also to economic functions, using it for further conceptual distinctions, goes right back to Aristotle. He said that there are two uses of each object of riches. Both uses refer to the object but in different manners; one is peculiar to the object but not the other. For instance, there are two ways of using a shoe: to wear it and for exchange (μεταβλητική). The exchange may be against money or nourishment. But the shoe is made to be worn, not for the purpose for exchange (οὐ γὰρ ἀλλαγῆς ἕνεκεν γέγονεν), Aristotle says in *Politics* 1257a13. This means, translated as literally as I can make it in English: 'for it [the shoe—BS] has not come to be for the sake of exchange'. This refers to the peculiar use of the object. The other use is for exchange. It is a mistaken use of a shoe to treat it as an instrument of exchange, according to Aristotle. An analogy is found in Marx's theory of interest as an 'irrational' form (Schefold 1998a).

Aristotle's amazing distinction is not quite the same as that between use value and exchange value. There seems to be more emphasis on the individual characteristics of a specific article than in the early modern period with its considerations of classes of homogeneous commodities. At any rate, the distinction is made in order to differentiate between natural and unnatural forms of acquisition. The acquisition is natural if it is based on traditional activities to support the household like hunting and farming, and Aristotle does not regard it as a significant break of the principle of autarky if households swap some products. But the shoe must be made to be worn, not as a means to acquire wealth. Acquisition becomes unnatural if wealth is acquired for its own sake, not in order to support some higher form of activity. It is natural to acquire the means of subsistence for a household, and these must be sufficiently ample to support some higher form of life, like the life of an active citizen of the city state or a life of contemplation. But wealth-getting for its own sake (often called chrematistics) is a 'constrained' form of life, and the one who leads it fails to pursue the 'Good Life'. The shoemaker who produces shoes in order to make money fails in the pursuit of the Good Life like the academic who publishes to gain fame instead of seeking the truth.

Aristotle's denunciation of chrematistics raises curious problems regarding the interpretation of Athenian society. He ascribes a low rank to wage labour and to usury, as has often been emphasised. But how are we to interpret his shoemakers who are artisans in their own households, who live on what they are able to sell and who are nevertheless not supposed to produce for exchange? The solution is that they are expected not to develop a commercial mentality but to remain faithful to their craft. The shepherd shall mind his sheep when he is attending his herd and shall not think of how he might slaughter and eat or sell them, the Greeks used to say. To do things well (εὐπραξία)

was a Socratic ideal (Xenophon, *Memorabilia* III. 9. 14–15). In a like way, the artisan is expected to mind his craft, to produce shoes which are comfortable to wear or, in an example provided by Xenophon in his *Memorabilia,* to manufacture an armour which fits the body and not one which results in swellings when the warrior is wearing it (Xenophon, *Memorabilia* III. 10. 9–15). This means that the artisan is expected to mind his individual task at hand. The emphasis is not on serial production for exchange but on individual production for personal use. It is natural to relate this stress on individual dedication and perfection to the Greek achievements in art which have elicited so much admiration since Roman times. A peculiar Greek mentality which—successfully or not—demands to subordinate the economic aspect of life to higher pursuits permeates not only philosophical writings but the entire literary tradition from Homeric times onwards (Schefold 1992b).

With the Christian tradition of an ascetic life as the basis for salvation in mind, one might think that the Greek ideals of a dedication to higher pursuits implied a disdain for life on earth and a transcendental religious orientation, but that would be wrong—at least, if the conception was applied to classical Greece. The Good Life, from Homer to Aristotle, takes place in the community, formerly among the royal household, the aristocrats and their dependants, later in the Polis. It is intensely communal, generosity, friendship and patriotic courage counting among the highest virtues (Schefold 1998). This value orientation goes along with a disregard for commercial activities that limit the freedom of the citizen, like labouring for a wage, that foster greed (like trade) where liberality is called for, and that threaten communal bonds, like lending at interest instead of, as was traditional, reciprocal lending for friendship (so-called Eranos loans, see Millett 1991).

The artisan, though not a high-ranking figure in Greek society (Austin and Vidal-Naquet 1972:23), was integrated into it through the quality of his work. The products of handicraft were—as in probably all preindustrial societies—characterised by local traditions; Xenophon again provides examples, e.g. the makers of jackets at Megara (Xenophon, *Memorabilia,* II. 7.6). The surprising fact is the uncontested high quality of handicraft. The artists concerned were not the élite of a rich, large monarchy, nor did they produce for wealthy princes but they were fairly poor artisans in small shops, dependent on the market.

Now, it is true that the red-figured Athenian pottery was admired in the entire Mediterranean. Customers were found and pottery became an export trade. Some of Virgil's most celebrated verses recall the fame of Greek poets and artisans in later Antiquity, contrasting their gift (to create) to that of the Romans (to rule):

> excudent alii spirantia mollius aera
> (credo equidem), vivos ducent de marmore vultus
> …
> tu regere imperio populos, Romane, memento!
>
> Virgil, *Aeneis VI,* 847–8, 851

['Others will sculpt more softly breathing bronzes, and—I believe—carve living faces out of marble…you, Roman, remember to rule the peoples by order!' my trans.]. This

historical victory of the Greek artisan who was so modest a figure in the classical period seems to lend some credibility to the curious Aristotelian account of how a shoe was to be produced.

II

The meaning of use value must have changed by the time we reach Adam Smith and classical political economy since commercial society does not stigmatise production for the sake of making profit. The Aristotelian emphasis on production for individual use has disappeared. Instead we find distinctions among commodities according to life styles in consumption which are associated with different classes: commodities are 'luxuries' or 'necessaries'. This distinction does not reflect the intensity of desire which is expressed directly as marginal utility in the cardinal version of utility theory or, indirectly, in the theory of preferences associated with the ordinal approach. In the Hobbesian tradition Smith regarded riches partly as power, without reducing them to utility. The diamond, a frivolous object for the moralist Smith, is of value because labour is required to find it. Its use value is to reflect the power of its owner by impressing the observer. Its utility remains to be discovered, says Smith in the *Lectures* (Smith 1978:487), but it can be used to display wealth, therefore the ability to *command* labour. In the *Wealth of Nations*, he states: 'With the greater part of rich people, the chief enjoyment of riches consists in the parade of riches' (Smith 1976a:190). Smith takes up a similar image when he discusses the transition from feudalism to capitalism. The old aristocracy once used its revenues to maintain an army of warriors and other dependants which gave them real power and prestige. The aristocrats later converted their revenues into luxury commodities which were sold to them by the emerging class of traders. The luxuries flattered their vanity but their real power got lost in the transition. 'To gratify the most childish vanity was the sole motive of the great proprietors. The merchants and artificers, much less ridiculous, acted merely from a view to their own interest, and in pursuit of their own pedlar principle of turning a penny wherever a penny was to be got' (Smith 1976a:422).

Smith shared a traditional disregard for luxuries which he considered as frivolous, but he was far from advocating laws against luxury, as in medieval times or in antiquity, for the very example of the commercial revolution showed to him that trade and industry rose with luxury consumption.

The use values of necessaries are of a different character since the necessaries are what the subsistence wage of labourers consists of. Their consumption therefore rises with employment; its volume is dependent on the general level of effectual demand. The chain running from effectual demand to subsistence wages and employment, and from there to necessaries and their production, represents a strong and reliable causal nexus, whereas the demand for luxuries and its consequent effect upon employment is more volatile.

That the Smithian perspective on use value is somewhat different from that of classical antiquity can be seen in several ways. One concerns the description of market processes. To repeat the Aristotelian theory of the just price would be beyond the scope of this article but it is clear that the consideration of the problem in the context of justice in distribution and reciprocity in *Nicomachean Ethics* is primarily applicable to exchanges

of individual articles between individual persons (Schefold 1994a). A vague reference to uniformity of price is implicit when Plato asks that traders should not charge different prices for the same commody in the same market (δ πωλῶν . . . ἐν ἀγορᾶ μηδέποτε δύο εἴπῃ τιμάς) (Plato, *Laws*, 917b) and demands that the selling of an adulterated good (κίβδηλόν τι) be punished, hence some quality standard exists (Plato, *Laws*, 917c). The Smithian convergence of market prices to natural prices presupposes a movement of quantities. If, for whatever reason, be it speculation, the mood of customers or an exterior reason like a bad harvest, there is a shortage of a commodity in a particular market, the market price of that commodity will in general be high relative to the natural price, and the corresponding extra profits will induce producers to increase the supply. The objects of such an analysis, in rigorous form, can only be commodities which are homogeneous and reproducible. The use value of those commodities must be defined in terms of qualities for which there are social standards known and accepted in the market.

The perspective was also different with regard to the division of labour. As is well known, Xenophon had already observed that labour is divided to a greater extent in large cities where the bigger market allows more specialisation, but he concluded that this led to a higher *quality* of the product. Similarly, the main advantage of the division of labour in Plato is that it raises the quality of what is produced, while the advantage of the division of labour in Smith is that it raises *quantity*, i.e. productivity (Schefold 1994a).

Finally, the use values of commodities are different in regard to what is called 'useful'. Aristotle considers a good as useful (συμφέρον) if it is not good in itself but a means for another good. The means of production and of consumption of a household—let us think of an agricultural estate—are useful in this sense: goods needed to achieve the Good Life. According to this philosophy, the ultimate measure of the adequacy of production and consumption of the household cannot be utility—which is only intermediate—it must be virtue. It is virtuous to display riches, to be hospitable, to invite friends, to be generous and artful in spending. Although a life of contemplation ranks higher, Aristotle accepts the traditional ideal of liberality and generosity which may result in a squandering of the fortune rather than in its accumulation.

It would be hard to find a similar affirmative attitude to the display of wealth in Smith. It may have the advantage of creating incomes and employment, also satisfaction to the observers, according to the *Theory of Moral Sentiments* where the image of the Invisible Hand is invoked in this context (Smith 1976b:184). But, at least in the *Wealth of Nations*, the primary emphasis is on accumulation, and in this work, use values fall into the categories of necessaries and luxuries already mentioned. To see wealth as power and utility in its display is a tradition which Smith takes up but which he does not fully integrate into his system of economic thought.

Ricardo, who inherited and developed this system, also inherited the challenge of integrating individual or social evaluations of goods and of analysing their effect, if any, on value and price. The moral considerations surrounding the notion of value recede into the background. He treats utility as the foundation, not as the measure of value. According to Sraffa's analysis of Ricardo's terminology, at least as reflected in the *Index* to the *Works and Correspondence of David Ricardo*, no clear distinction emerges

between ‘value in use’ and ‘utility’ (Ricardo 1951–73, XI:106). Ricardo writes, in his criticism of Say:

> If by an improved machine I can, with the same quantity of labour, make two pairs of stockings instead of one, I in no way impair the *utility* of one pair of stockings though I diminish their value. If then I had precisely the same quantity of coats, shoes, stockings, and all other things, as before, I should have the same quantity of useful things, and should therefore be equally rich, if utility were the measure of riches; but I should have a less amount of value…. Utility then is not the measure of exchangeable value.
>
> (Ricardo 1951–73, I:280, note)

Use values are therefore givens: stockings are stockings and coats are coats, and they carry utility, in that people can make use of them in certain quantities, but no reflection seems necessary on the social process which leads to this classification of objects—it is presupposed—and no effect results for the theory—utility has no effect on price. Ricardo knew, of course, that usually more can be sold in a market if the selling price can be lowered but, in his analysis of the determination of natural prices, the normal quantities to be sold in each market were regarded as given. A few further quotes may illustrate these neat assumptions:

> I like the distinction which Adam Smith makes between value in use and value in exchange. According to that opinion utility is not the measure of value.
>
> (Ricardo 1951–73, Notes on Bentham, III:284)

> The degree of utility can never be the measure by which to estimate value.
>
> (*ibid.*, Letter to Say, VI:247)

> The difficulty of the doctrine of expediency or utility is to know how to balance one object of utility against another—there being no standard in nature, it must vary with the tastes, the passions and the habits of mankind.
>
> (*ibid.*, Letter to James Mill, VII:242)

Utility for Ricardo seems to have been like a rival god who existed but in whom you were not supposed to believe.

III

The task of stating how Jevons might have analysed the change of the marginal utility of stockings in consequence of the introduction of machinery, with the implied increase of disposable income, is left to the reader. We turn to Marx.

Marx knew Galiani and other eighteenth-century authors who were groping towards a utility-based theory of value. He observed the debate among more theoretically oriented

economists and members of the Historical School in Germany who were paving the way for Marshall and for the Austrian variant of the neoclassical 'revolution', according to Streißler (1990). But he does not seem to have reacted to the later mature forms of marginal utility theory, as encountered in Gossen or Jevons, whose writings he seems not to have noticed. There are many places where we see him challenged by different forms of utilitarianism, trying to defend his transformed variant of the classical system. We here only use his *Notes on Wagner* and scattered remarks of the first volume of *Das Kapital*.

He was more radical than Wagner in asserting the historical point of view. Where Wagner insisted on a general theory of value, assuming a capitalist form of production, and rejected the abstraction of simple commodity production as a foundation of the labour theory of value, Marx denied the perennial nature of capitalism. More precisely, he here treated the existence of pre-capitalist forms of production as a *fact*, and the thesis of its eventual disappearance as a *hypothesis*. Hence he thought that Wagner could at most deny the hypothesis and therefore should have said: '… Der Charakter der kapitalistischen Produktion, wie Marx ihn darstellt, ist richtig, aber er irrt sich darin, daß er diese Wirtschaft als transitorisch betrachtet, während sich Aristoteles umgekehrt darin irrte, daß er die *Sklavenwirtschaft* als *nicht* transitorisch betrachtete' ['The character of capitalist production, as represented by Marx, is true, but he errs in regarding this economy as transitory, whereas Aristotle, conversely, erred in regarding the *slave economy* as *not* transitory': MEW, 19:359 my trans.]. In fact, capitalism has not been overturned in the way Marx expected but economic forms do change as economic anthropology confirms.

Wagner then proposes to found the analysis of value on the evaluation of goods; Marx objects that this foundation should not start from an abstract individual but from the definite character of a social individual, therefore from the definite character of the community within which he lives (p. 362). This leads to a restatement of Marx's own views. The commodity is not value in use and value in exchange but it *is* value in use—or a useful object—and *value*. And it *is* this as soon as the value of the commodity *appears* in a form which is different from the natural form of the commodity itself, that is, as soon as value *appears* as exchange value. The aim of the analysis (the merits or demerits of which cannot be discussed here) is to show that the forms which value can take must result in the existence of a general equivalent and hence of money. We only note that the theory of forms of value assumes the concept of value in use as given; it does not elucidate it.

Much earlier, Marx had said in *Zur Kritik* (MEW, 13:3–160) that value in use as such was beyond the scope of political economy, and that it played a role within it only for the analysis of forms. He had added the footnote that this analysis of forms was the reason why 'deutsche Kompilatoren den unter dem Namen "Gut fixierten Gebrauchswert" con amore abhandeln…. "Verständiges über Güter" muß man suchen in "Anweisungen zur Warenkunde"' ['…German compilators lovingly treat value in use, "as fixed in a good"…. Reasoned arguments about goods must be sought in directions regarding the commercial knowledge of commodities':—my trans. MEW, 13:16]. But Marx believes nevertheless to have said the essential on value in use. He quotes himself: 'Ein Ding kann nützlich und Produkt menschlicher Arbeit sein, ohne Ware zu sein. Wer durch sein Produkt sein eigenes Bedürfnis befriedigt, schafft zwar Gebrauchswert, aber nicht Ware. Um Ware zu produzieren, *muß er nicht nur Gebrauchswert produzieren*, sondern

Gebrauchswert für andere, gesellschaftlichen Gebrauchswert' ['A thing may be useful and the product of human work, without being a commodity. He who satisfies his own need by means of his produce creates value in use but not a commodity. In order to produce a commodity, *he must not only produce value in use* but *value for others, social value in use*': MEW, 19:370—my trans., quoted by Marx from the second edition of *Das Kapital*].

This was an important reminder. In the theory of commodity production simple or capitalist—value in use is not what Robinson Crusoe or a modern farmer produce for themselves: it is something to be sold to others, according to the prevailing rules of standardisation in commodity productions. Hence we must ask: what is *social* value in use, in its *historical* specificity? There is little on this in Marx and in the writings of the classical economists but there were the discussions on value in use of the historical school. Now it is disappointing to see that Marx seems more intent to criticise Wagner than to isolate what might be regarded his valuable and positive contribution. In essence, Wagner at least added some constructive ideas to the discussion about use values by differentiating between different needs, by introducing the distinction between individual and social needs in particular and by assessing the respective contributions of the private sector, of charity and of the state to the satisfaction of each. His 'law' of the tendency of the share of the state to increase and his appreciation of this tendency as a measure of progress (Schefold 1991:37) must here be left aside. Obviously, Marx did not recognise the significance of Wagner's analysis for the beginning of the welfare state because he was politically opposed to the conceptions of the 'socialists of the chair'. Yet their conception of social policy is, at least implicitly, present in every modern state.

It may be objected that the modern theory of finance builds more on the theory of public goods in the tradition of Smith, Wicksell, Samuelson than on that of social needs in the German tradition, but Marx did not analyse public goods (the 'light house' of Adam Smith) either. He rejected the very distinction between use values as produced by private capitalists and by the state in his radical opposition to Wagner:

> Es wäre also, wie aus dem obigen hervorgeht, reine Faselei, bei Analyse der Ware—weil sie sich einerseits als Gebrauchswert oder Gut, andererseits als 'Wert' darstellt—nun bei dieser Gelegenheit allerlei banale Reflexionen über Gebrauchswerte oder Güter 'anzuknüpfen', die nicht in den Bereich der Warenwelt fallen, wie 'Staatsgüter', 'Gemeindegüter' etc., wie es Wagner und der deutsche Professor in general tut, oder über das Gut 'Gesundheit' etc. Wo der Staat selbst kapitalistischer Produzent, wie bei Exploitation von Minen, Waldungen, etc., ist sein Produkt 'Ware' und besitzt daher den spezifischen Charakter jeder anderen Ware.
>
> [It would be just twaddle to 'continue' on this occasion in the analysis of the commodity—because it is value in use or good on the one hand, and value on the other—with various banal reflections on values in use or goods which do not pertain to the world of commodities like 'state goods', 'communal goods' etc., as Wagner and the German professors in general are wont to do, or about the good 'health'.]
>
> (MEW, 19:370—my trans.)

It true that the commodities produced by state-owned enterprises may have use values of the same character as those produced by private enterprises, but it does not follow that it is futile to discuss the use value of goods which fulfil social needs or which are public. Marx here missed the opportunity to differentiate between types of use value; his text ends with etymological reflections on the origin of the related words *'Wert'* and *'Würde'* ('value' and 'dignity').

After this negative result, we return to commodities produced in capitalist firms and to Marx's discussion of value in use in *Das Kapital*. Here we find the famous passage: 'Die Gebrauchswerte der Waren liefern das Material einer eigenen Disziplin, der Warenkunde' ['The values in use of commodities yield the material for an own discipline: the commercial knowledge of commod-ities': MEW, 23:50—my trans.). A note is added: 'In der bürgerlichen Gesellschaft herrscht die fictio juris, daß jeder Mensch als Warenkäufer eine enzyklopädische Warenkenntnis besitzt' ['A *fictio juris* prevails in bourgeois society according to which each human buyer of commodities possesses an encyclopedic knowledge of commodities': MEW, 23:50—my trans.]. He tells us that the discovery of values in use is a historical achievement; the measures of commodities derive partly from nature, partly from convention.

These brief indications set a number of tasks which have not been fulfilled, neither by Marx nor by his immediate followers. To begin with, the rendering of *Warenkunde* as 'commercial knowledge of commodities' (Marx 1977:44) represents one of those hopelessly inadequate translations of which the English version of *Das Kapital* contains quite a few—'mercelogia', the Italian form is, as usual, much better. A good translation remains to be found. More substantially: what is this 'commercial knowledge of commodities'—how did it arise and how did it develop? Has the 'commercial knowledge of commodities' not undergone significant changes, for instance recently in consequence of the perception of environmental threats like dangerous wastes of consumer goods? Has the legal fiction not been replaced by a certain degree of protection of the consumer against adulterations of commodities? Who defines the standards in the interplay between producers, the state, consumers and their organisations? Marx mentions wastes ('excretions of production') and adulterations of commodities (e.g. of bread) critically, but his denunciation of private production does not allow him to perceive historical reformist tendencies in this domain. He does not pursue the history of the *institutions* associated with the evolution of the character of use values. Instead, his critical impetus induces him primarily to attack that theoretical strand which abstracts from the historical and institutional aspect in the development of use value, i.e. he discerns and rejects the utility theory of value. As a result, classical theory missed the opportunity to unite with historicism and institutionalism in order to provide a positive account of what happens 'on the demand side', while the critique of utility theory, attempted before that theory had reached its mature stage, could not but fail.

Warenkunde used to be an established term of the German science of business administration. A dictionary would define it as the discipline concerned with traded commodities: their origins, denominations, compositions, manufacturing processes, properties, kinds, trading marks, indications of genuineness and adulteration and the methods to recognise them. Further, this *Warenkunde* would describe the different markets, domestic, foreign, world markets with specific trading practices (Gabler 1959–62, IV:1687; Rettenmaier and Vatter 1955). An influential handbook of business

administration of 1956 (Seischab and Schwantag 1956) still mentions the pursuit of this discipline as an important task (vol. I:991). For its origin, as far as Germany and the nineteenth century is concerned, the reader is referred to the work of J.M.Leuchs and his *System des Handels* (1804). Even if those descriptive, unsophisticated common sense 'compilations' are only remembered with disdain in a modern, theoretically oriented science of business administration (Schneider 1981:91), Marx could take the existence of such a *Warenkunde* for granted.

But the mere reference to the discipline *Warenkunde* as a somewhat trivial subject—and he does not even say that, with his respect for empirical research—could not exempt him from the task of analysing the social character of use value and its origin. Among the scattered remarks on use value (of commodities, not of 'factors of production'), the following seem to me the most important.

The chapter on the division of labour provided Marx with the opportunity to insert some footnotes on the difference between antiquity and the modern world, as regards the quality of production. He states that the 'politische Ökonomie, die als eigene Wissenschaft erst in der Manufakturperiode aufkommt', is only intent, 'die Waren zu verwohlfeilern'. ['Political economy, which surfaces as a science on its own only during the manufacturing period, is only intent to render commodities cheap', MEW, 23:386—my trans.] Although he does not say in conceptual terms what this onesideness of political economy means for use values, he provides some indications, using quotations from the ancients. He mentions Margites who, according to a lost poem (allegedly by Homer) attempted to do all kinds of work himself and therefore did them all badly, while the Greek ideal was to concentrate on one work, to be executed according to the requirements of the task and at the right time (MEW, 23:387). One might mention in this context that there existed also the opposite Homeric ideal of the universally gifted hero, who was a warrior, a king and a craftsman, like the cunning and versatile Odysseus—on the contrast between Margites and Odysseus in the Homeric tradition see (Schefold 1992b). In this way, a kind of indirect characterisation of modern forms of the production of use values is provided by describing its ancient opposite, but no attempt is made to explain the inner logic of the modern formation of use values, let alone of the Greek 'system'. An explanation of the Greek mode of production as a slave holding society would not contribute much for the problem at hand where primarily the work of free artisans is to be considered, while an explanation based on a prevailing ethic proves difficult for a materialist interpretation of history (cf. also Schefold 1994b).

Then there is Marx's polemic against Bentham:

> 'Jeremias Bentham ist ein rein englisches Phänomen. Selbst unseren Philosophen Christian Wolff nicht ausgenommen, hat zu keiner Zeit und in keinem Land der hausbackene Gemeinplatz sich jemals so selbstgefällig breitgemacht. Das Nützlichkeitsprinzip war keine Erfmdung Benthams. Er reproduzierte nur geistlos, was Helvétius und andere Franzosen des 18. Jahrhunderts geistreich gesagt hatten'. ['Bentham is a purely English phenomenon. Not even excepting our philosopher, Christian Wolff, in no time and in no country has the most homespun commonplace ever strutted about in so self-satisfied a way. The principle of utility was no discovery of Bentham. He simply reproduced in his dull

> way what Helvétius and other Frenchmen had said with esprit in the 18th century'.
>
> (MEW, 23:636, note—trans, in Marx 1977:571)

What we get here, is a critique of utilitarianism, not of utility theory. 'Wenn man z.B.wissen will, was ist einem Hunde nützlich?, so muß man die Hundenatur ergründen. Diese Natur selbst ist nicht aus dem "Nützlichkeitsprinzip" zu konstruieren'. ['To know what is useful for a dog, one must study dog-nature. This nature itself is not to be deduced from the principle of utility': MEW, 23:636—trans in Marx 1977:571.] Should the economist conclude that the 'demand' of dogs is to be derived from the fact that they are predacious animals so that they need water and meat? What then of humans who are more variable in their desires? Marx continues: 'Auf den Menschen angewandt, wenn man alle menschliche Tat, Bewegung, Verhältnisse usw. nach dem Nützlichkeitsprinzip beurteilen will, handelt es sich erst um die menschliche Natur im allgemeinen und dann um die in jeder Epoche historisch modifizierte menschliche Natur' ['Applying that to man, he that would criticise all human acts, movements, relations, etc., by the principle of utility, must first deal with human nature in general, and then with human nature as modified in each historical epoch': MEW, 23:636—trans, in Marx 1977:571]. We can only *describe* and possibly *understand* how the historical transformations of needs and of demand take place, as the historical school later was to emphasise; we cannot *predict* demand over the longer run and should not *impose* needs, except in very special circumstances, e.g. we try to prevent drug addiction. It was the mistake of the old utilitarianism to believe that the philosopher could say what was useful for others. Marx did not sufficiently dissociate himself from such endeavours by only pointing to the historical and social determination of needs—an interpretation which was to become the basis for authorities which arrogated the power to determine needs. The utility theory of value, at any rate, is not concerned by Marx's criticism of Bentham since it only assumes that consumers have preferences, without postulating to be able to say what their contents are.

In a more modest and less deterministic interpretation, however, Marx is right. Firms produce use values not for themselves, but for others. They produce not according to individual needs but in standardised forms which appeal to groups of consumers. This is a 'social' and 'historical' determination. The structure of classical theory—it is tedious to repeat it—presupposes that the use values are classified accordingly, but where is the description of how the classification takes place?

IV

Since we have reached a historical juncture of classical theory, utilitarianism and utility theory, it may be useful to remind the reader at this point that a somewhat trivial but common misunderstanding must be avoided. When the classical economist assumed that the quantities demanded and to be produced were given, they did of course not ignore the fact that, in most cases, more can be sold on any market if the producers are able to lower their price. This elementary fact must have been known ever since markets existed, but

the concepts were not there for a long time to express it in a scientific language—not even for one market, let alone in the context of general equilibrium.

Basic insights can be there and be used without finding a scientific expression. As an example, we may consider the architecture of gothic churches. Medieval gothic churches are regarded as more beautiful than their nineteenth century imitations, in spite of the fact that medieval architects were not able to undertake the static calculations scientifically which were invented later and, eventually, prescribed. Their intuition was, by and large, sufficient to construct buildings which have stood the test of time.

It would be ridiculous to assume that Ricardo did not know that quantities and prices were interdependent. His method of assuming quantities as given in the derivation of long-run prices made abstraction from this interdependence; clearly, he must have thought that the drawbacks of the assumption were sufficiently compensated by other advantages—not to be had by assuming the interdependence—which justified the procedure. His analysis of mechanisation is a case in point.

If 'interdependence' is to be assumed, a theory of demand is needed which is more than the intuitive statement of an inverse relation between prices and quantities to be sold. Demands are expressed by individuals, but individuals and the various things they demand are shaped by social and historical circumstances. A formal account of how this conditioning takes place has never been provided while it has turned out that an elegant theory of demand is possible on the assumption that preferences are simply given. The structure of the theory therefore has led to suppressing the obvious, i.e. the influence of the social and historical conditions which, of course, were also once created in the interaction of individuals but which are now regarded as being among the data in any historical period. By contrast, if quantities are given in long-period analysis, there is no theoretical obstacle to the recognition of the historical and social determination of demand, although there is no logical necessity for the theory to provide such an account.

Petty, often regarded as the earliest classical economist, made not only the first move towards a quantitative use of the labour theory of value as the foundation of a theory of what was later called 'natural' or 'normal' price, but he also gave an example of how use values were standardised in a particular market (Roncaglia 1977:108–10). Two physically different commodities, for instance two alloys, are regarded equal as commodities within the subjective theory of value if all consumers regard them as perfect substitutes. The classical theory of value must start from the 'objective' properties of commodities but, strictly speaking, only elementary particles are indistinguishable, and, as a consequence, molecules of exactly the same form and composition. Such a definition of homogeneity obviously is too strong within economics where two sacks of rice may be regarded as equivalent for all practical economic purposes although the individual grains retain a certain individuality and although their numbers are only approximately equal. A 'social' definition of homogeneity is needed, but where does it originate?

Petty's answer to this conundrum is to be found in his *Dialogue of Diamonds* (Petty 1986:624–32). His answer is really simple: the trade in diamonds is undertaken by specialist traders who are in communication among themselves all over the world—he gives examples how changes in the prices of diamonds in Persia (e.g. because a royal celebration causes a rise of prices of jewels there) influence prices in the London market. Communication, however, does not only concern the prices—a communication and interdependence known to every economist—but, and first of all, the definition of the

quality of the diamonds. It is necessary to consider weight, ground surfaces, polish, colours, etc. Petty proceeds rapidly to the formulation of certain rules of how secondary properties (e.g. colourings) modify a base price which was first defined by quality and weight. However, in order to be able to speak of such rules for pricing, the commodity must have been described together with its qualities. This, according to Petty, is the achievement of a communication among the specialised traders who form a community with its own structure of organisation. Order is created spontaneously.

Practices similar to those described by Petty were old, of course. Medieval guilds used trading marks and held inspections of the products of their members in order to guarantee quality. Modern neoclassical theory would explain the existence of such structures by means of savings of transaction costs, which is, broadly speaking, correct, but not historically specific. The history of institutions such as trading bodies is long. Measures, in particular the gauging of scales and the definition of qualities are all preconditions for the negotiation of prices on the basis of a defined value in use. As a result, changes in demand and supply result in changes of prices. Earlier, in the Middle Ages, one often chose to regulate—i.e. to fix—the price, and to allow for changes in demand and supply by admitting changes in the weight of bread or the composition of flour, according to the results of the harvest and the interplay of supply and demand. By charging a price corresponding to a coin of given denomination, one saved the transaction cost of having to use smaller coins, and the unpleasant consequences of bad harvests seemed less visible (Kula 1986:72, 74).

V

It may be worthwhile to take a longer look at the author who may be regarded as the most representative in the field of historical descriptions of business practices. The scope of Savary—who really was no theorist at all—was much broader, as far as our subject is concerned. Since his name is hardly ever mentioned in economics, an introduction to his work is needed (see Schefold 1993, for a more detailed account).

Savary's *Parfait Négotiant* (1993 [1675]) was not the first treatise on the business of trade, nor did it exist in isolation. Paciolo was the author of the oldest printed treatise on double accounting. Cotrugli wrote his *Della Mercatura et del Mercante Perfetto* in 1458 for the archive of his trading firm; the book was printed in Venice in 1573. A kindred work, *Il Negotiante* by Peri, appeared in 1683. It contained most elements of the early science of the business of trade. These books describe the practices of trade, especially by comparing the trading business in different cities, they explain the exchange of bills and the trade between fairs. A link with the late medieval literature on ethical behaviour, on the condemnation of usury and the legal taking of interest and on the correct application of these norms in business was retained. An important representative of the writers of this orientation was Gerald Malynes in England who defended the practice of the clearing of bills against doctrinaire legal prescriptions.

Savary's book was regarded as the most comprehensive and thorough in this tradition; there were many new additions, reprints and translations so that Savary dominated the teaching of what we call business administration for more than a century. He was especially influential because he had inspired French legislation on trade, trading

companies and bills of exchange. Some advised young traders to read his book down to the beginning of this century.

The contents are not structured according to some abstract system of business administration but the author follows the simple and harmonious rule of describing what a young trader has to learn, beginning with the family of the master in which he is to live as an apprentice, down to the larger tasks which await him when the business grows, when a society is to be founded, when the trade transcends local bounds, becomes national and, eventually, global.

Savary owed much to Colbert; his considerations of how to create institutions, i.e. on how a society is to be founded or which trading policy is to be pursued in a nation, are immensely interesting because, although he is quite naive in his language, he stands at the watershed between the self-organisation of the merchants and the regulation of their activity by the State so that he displays a remarkable insight into that conscious creation of order which Hayek calls spontaneous but which here appears as a result of much deliberation, first on the part of the merchants who create their system of communication and trade, then on the part of the State, the leaders of which wish to exploit the new wealth created and gradually come to understand that they must tend the hen whose golden eggs they want to take for themselves.

There results that curious mentality of the merchant, well expressed by Savary: devotion to the King and the aristocracy and yet contempt for their frivolous way of living, pride of own achievements and yet self-deprecating modesty when he advises to observe rules, to be loyal to one's master—especially within the shop—and, most importantly, to maintain order in the business. Conventional morals coexist with an abject defence of slavery. Savary had no illusions regarding the goals of the upper class. Trade had, first of all, to help itself. But it was useful that the State now proceeded to fix and stabilise the customs which gradually had evolved in trade—Savary knew this—since commerce recovered in Italy in the late Middle Ages. It was from the Italians that the merchants had learned that 'marvellous' system of double accounting and of using bills of exchange. All this was clearly seen and formulated by a man who neither partook in the humanistic culture of his age nor was aware of the emergence of the natural sciences—there is no mentioning of names like Decartes, Leibniz and Newton; all is said in plain terms, using common sense, with moralistic and nationalistic overtones. The merit of the book is in the mass of the material presented, in the zealous effort to transmit the experience of a lifetime to future traders and, in particular, in the political design to coordinate the order of the merchants and that of the king at all levels: from instruction and commercial law to trading companies and colonial policy. Savary dedicated his work to Colbert who had solicited it: 'Mon travail n'est fondé que sur la justice de ces Ordonnances que nous devons à vostre application, & à l'amour que vous avez pour le Commerce; & et c'est dans ce trésor que j'ai puisé toutes les maximes que j'ai cruës nécessaires pour rendre le Negoce heureux, & fidelle' (Savary 1993 [1675]:iii).

There are hundreds of pages on the commercial knowledge of commodities if one counts the descriptions of national and foreign trading possibilities as *Warenkunde*. In some places, one might speak of Savary's loving descriptions of raw materials and finished products, typified according to places, regions, countries, and characterising all the principle features of each commodity, especially textiles. The modern reader, and possibly the contemporary apprentice, are bored all the same. An example, chosen for its

pedantic accuracy, may suffice. In the description of ‘draperie d’or, d’argent et de soye’, he refers to statutes confirmed by royal decree of July 1667:

> Il y a de quatre sortes de velours. La première s’appelle velours à quatre poils, vulgairement appelez six lisses; ils se font en un peigne de vingt portées, qui font soixante portées de chesne, de quatre-vingts portées de poil, chacune portée de quatre-vingts filets à huit fils de poil par chacune dent de peigne, les poils & chesnes doivent estre d’organsin filé, tordu au moulin & tramé de trame doublée & montée au moulin, le tout cuit, & de pure & fine soye, sans qu’il puisse y avoir aucun fleuret, & le velours doit avoir de largeur onze vingt-quatrièmes d’aune entre les deux lisières, les quelles doivent estre marquées par quatre chesnettes: c’est la raison pour la quelle ont les appelle velours à quatre poils.
>
> (Savary 1993 [1675]:99)

And so on. The text illustrates the degree of royal regulations in luxury good production. He mentions official controls (p. 106). But he also advises to control oneself in person and indicates e. how the qualities of dyes may be tested by simple chemical means (p. 112).

The apprentice must know how to measure correctly. There is very little about pricing. Discrimination is permissible but it must be used by the master himself only. It seems more important to know how to stock commodities, which localisation is favourable for the shop—we obtain a vision of the conditions of life and work among the artisans of Paris in the seventeenth century. The streets are narrow and sinister. One is reminded of Dutch still lifes, of the interior of houses painted by Pieter de Hooch or Vermeer, and one understands why it seems so very important to Savary to explain how each commodity is to be *shown*. Some textiles look most beautiful in the morning, others at noon, others in the evening. Even beautiful ladies obscure their faces by means of veils, he observes.

This is the commercial knowledge of commodities in the perspective of the trader. The more interesting descriptions obviously concern luxury items—sufficiently precious to be resold—Savary warns the young tradesmen of those ladies who buy beautiful clothes, using the credit of their husbands, and who then go and sell them in order to participate in games of chance, with the husbands failing to pay up.

A wider horizon opens with international trade. The young merchant now has to learn where and what to buy, which conventions are to be observed in other nations—Savary is suspicious of the British because of their formal and informal protectionism.

It is hardly necessary for us to dwell on the geographical aspect of the commercial knowledge of commodities. A more interesting aspect is production. Savary professes that his experiences as a manufacturer are only limited but he has some advice to give. His point of view is that of the merchant who wants to take up production. The first, characteristic question is whether foreign methods of production are to be imitated or whether one should try to test new inventions. Imitation turns out to be more difficult than it appears. Savary indicates that foreign producers may have the advantage of what we would call external effects which may then not be available to the single imitator. He therefore develops what we would call the theory of ‘industrial districts’. Knowledge is locally bound and is transferred if several firms in the same industry rival in one place,

trying to improve quality and to extend their individual markets. They also compete for the best workers—their switching between different firms is regarded as the main transfer of knowledge. Ultimately, the manufacturer remains dependent on the secrets of the good artisan.

There thus emerges—mixed in with endless technical details, regarding measures, weights and individual commodities—a commercial knowledge of commodities which is characteristic of modern capitalism in the pre-industrial age. It is problematic to speak of commodities—and there is no basis for capitalist forms of organisation—where earlier forms of production (Aristotle's ideal shoemaker) lack that characteristic. An increased degree of homogeneity of manufactured commodities results from conventions. They guide the hands of producers and educate the eyes of the consumer, the trader being the intermediary who controls and sees to it that there is neither arbitrary and excessive individuality nor violation of the principle of producing within prescribed patterns.

We know that the picture had started to change a century later. It is not clear whether the role of authorities in defining standards had increased further as it has today. Serial production, based on the use of machines, did not exactly replicate old standards so that the industrial revolution also implied the freedom to transform given aesthetic standards. The main result, however, was that the repetitive pattern of machine production resulted in nearly identical commodities. Marx spoke of the 'formal' and the 'real' subsumption of labour under capital when he said that, prior to the introduction of machines and the factory, the labourer formally had to follow the directions of the capitalist-entrepreneur although he was not technically constrained to adapt his movements to those directions. The introduction of the machine then led to 'real' subsumption: the rhythm of work now depended on the rhythm of operation of the machine—an image of production which later culminated in the assembly line. In a like way, according to the commercial knowledge of commodities in Savary, conventions first were established and systematised by traders. Producers learned to adopt given patterns, consumers learned to accept them. Hence a transition occured towards a standardised production of use value *prior* to the introduction of the machine; full standardisation took place when the machine replaced the tool. And, in fact, according to the theory of mechanical technical progress proposed by Babbage and taken up by Marx, the invention and introduction of the machine were much facilitated by the degree of the division of labour achieved prior to industrialisation which was such that, because of the standardisation of the commodities ('formal standardisation'), the manipulation of the object had become so simple that the hand with its tool could be replaced by the machine ('real standardisation'), with a reduced role of the worker in its operation.

VI

It is time to summarise and to draw some conclusions. We begin with the structure of classical theory. It assumes use values as given, as the precondition for the saleability of a commodity. Effective demand determines the quantity to be sold. Costs—including normal profits—determine normal price. Costs are usually scale dependent, because of advantages of mass production on the one hand and elements of rent on the other.

Monetary influences then determine monetary price, but they may also affect the normal price by affecting effective demand and distribution.

The determination of effective demand is clearly the most difficult step in this analysis. The neoclassical shortcut to solve the problem of demand runs as follows: population consists of individual agents, agents obtain factor incomes in a general equilibrium, preferences determine demand for present and, with foresight, future commodities, i.e. they also determine savings. The solution is elegant but does not easily leave room for the explanation of unemployment and the introduction of money. It is true, on the other hand, that classical theorists tell long stories about accumulation, employment, interest and money, also about population and its stratification, but, at the level of formal analysis, normal effective demand is simply treated as a point in the diagram of prices and quantities.

The discussion of use values of commodities (of the 'commercial knowledge of commodities') does not help to enhance or transform this analytical structure which is already more than what Garegnani has called the 'core' of the theory, but *Warenkunde* helps to characterise what theory regards as given, the use value of commodities, and how that changes in different conditions of accumulation.

Warenkunde has been an academic discipline in recent times (reference was made above to Rettenmaier and Vatter 1955, as an example) but the universe of commodities has become so vast that comprehensive accounts are impossible and specialisation (e.g. on environmental aspects) becomes unavoidable. Rettenmaier and Vatter informed about elementary concepts of physics and chemistry, metals, glasses, foodstuffs etc., but there were also special chapters on fertilisers (with some digression into biology), on textiles, leather, paper, and on dyes. What once was summarised in one discipline now inevitably appears in different disguises.

Some commercial knowledge of commodities exists, first of all, on the part of consumers. Marx speaks of the juridical fiction that consumers possess an 'encyclopaedic' knowledge. There may be truth in this at an abstract level but, in more concrete and modern circumstances, the consumer benefits from a certain degree of protection against fraud while he is not free from obligations, e.g. regarding the treatment of wastes. Babbage pointed out that the task of the consumers was facilitated by the build-up of reputation on the part of sellers who are, through the mechanism of reputation, induced to forgo single possibilities for deceiving consumers in order to gain a larger market by remaining honest regularly (Schefold 1996). The knowledge on the part of consumers is structured according to their own stratification. Social demarcations are increasingly blurred and give way to pluralism in more recent times, however.

The commercial knowledge of commodities on the part of sellers must be much more extensive because it is their business not only to know more details about consumer goods but also about raw materials and their origins, intermediate products, standards of production and the like. The aspiration to develop *Warenkunde* scientifically arose among the community of traders. Entrepreneurs try to go beyond the establishment of a certain individual reputation by establishing the identity of a firm and of specific products. They may thus succeed to create quite artificial standards, according to which an article with the appropriate brand name (jeans produced in a developing country, say) can acquire a value in the market which is much higher than its normal technical cost of production. When this point is reached, we cannot say anymore that the value in use is given and that

the normal price only depends on cost of production. And if Veblen effects generalise, it is part of the use value of a commodity visibly to have been expensive, hence there is then some analogy here with the diamond example of Adam Smith: the use value of the commodity is not reduced to its being an object of immediate consumption or of domestic production but it is used to impress others. With a Veblen effect, the value in use of a commodity depends on its value in exchange.

From an abstract point of view, the commercial knowledge of commodities is concerned with qualities. If these are regarded as given and if individuals maximise the satisfaction of their needs, not much need be said because needs become, as it were, one-dimensional through the maximisation; the term utility is the appropriate expression of this reductionist approach. But if needs are heterogeneous, socially stratified, and if the development of qualities has a history, demand patterns may be interpreted in a different light. Goods reflect the stratification (necessaries vs luxuries, basic needs vs higher needs according to Maslow, etc.). The corresponding social vision obviously was present in the classical writers, Ricardo included, but only Smith went to some length to explain it.

The formal concept of value in use, but no further specification of its content, is necessary if one wants to work with classical theory in the abstract. Value in use becomes really interesting only in a concrete historical perspective which attempts to characterise different economic styles in which values in use have different structures. According to Greek economic ethics and our interpretation of the archaeological remains, the production of use values by artisans in the classical period of Antiquity was oriented towards individual clients or, what is more, aimed at creating an immanent individuality of the product. In a sense, this individualism is self-effacing in that it is the individuality of the object which counts primarily, not that of its maker, even though the successful artist eventually may have been celebrated. Generally, Greek society required a very high degree of spontaneous conformity since such a degree of dedication to good work cannot be enforced through coercion—it was remarked that slaves often worked badly.

The socialised form of production in modern capitalism ranges at another extreme: persuasion is used to induce consumers to accept standardised products. Consumers can seek individuality by trying to find original combinations of mass products, but there is little individuality in the products themselves. Conventions are reproduced in bureaucratic organisations and controlled by a differentiated legal system. Less spontaneous conformity is required where formal rules are imposed.

The accounts provided by Petty and Savary represent steps in a transition, in this perspective; the individuality of the products disappears slowly. Melancholy about this loss is expressed in art, but there is compensation ahead: in the fascination derived from the expansion of production and of the availability of products.

The consideration of the commercial knowledge of commodities therefore seems to result in—among other things—a kind of economic aesthetics—perhaps a potential complement to the economic ethics which have come back into fashion some years ago. Needless to say that we here only provide a primitive sketch. The history of art provides rich descriptions of the artefacts of Antiquity, of the France of Savary or even of modern mass production but nobody seems to have tried so far to link the aesthetic description with the economic style of the period and country under consideration by means of an examination of the texts on the commercial knowledge of commodities. The difficulty in the aesthetic description of commodities as an expression of their social character derives

from the necessity to have an understanding of the interrelatedness of the economic and social phenomena in a given economic style. One might speak of a ‘totality’ if this term was not so very loaded.

Consider, for instance, that silver dagger from Sanaa in the Yemen on the wall across from my desk: the handle and the curved sheath are beautifully engraved but the short hidden blade is of bad iron and jagged. One is curious to know in what kind of society men like to carry weapons of this kind and who are the artisans capable of fulfilling their needs. Is this like the European Middle Ages, a society waiting to get modernised, or is it a development which one should not try to see as one of the stages in the European evolution?

There is a risk in moving from the analysis of value in use to the commercial knowledge of commodities, and from there to an attempt to integrate some kind of economic aesthetics with the economics of development: one risks falling between two stools: goal-oriented development economists will smile at such deviations and pass on, while the art historian prefers to see art interpreted as art and hates to see it reduced to materialist determinations.

I might defend myself against the one by trying to convince him of an increased possibility to understand development and by pointing out to the other that I was, contrary to his suspicion, trying to use an understanding of ideas for the understanding of a material object and the conditions of its creation, not—or not exclusively or not primarily—the other way round. But they might not listen.

The space allotted to me is exhausted anyway. So let me conclude this time with a more conventional observation. We have spoken of the transformation of use values as a consequence but also as a precondition of the industrial revolution at the end of the last section. This was one of the reasons why the discussion of the value in use of commodities, however reduced in scope, has never been completely absent from classical theory. Today, the development of technology still rests on changes of values in use—often even if only processes seem to get innovated. The production of new goods—the innovation of products—requires a more obvious modification of values of use, usually both on the output and on the input side. This qualitative change—also considered in modern growth theory—requires a constantly repeated change of routines and signifies a permanent revision of the commercial knowledge of commodities. It forces the creation of new standards and is, in its massive application, certainly a characteristic trait of modern industrial capitalism. The composition of output evolved in the seventeenth century and to some extent even in Antiquity. But the modern phenomenon is unprecedented and not well captured in any of the modern theories.

In one domain—the development of software—standardisation is of utmost importance right now. The power to define standards visibly creates a tremendous competitive advantage, and compatibility among computer programs is a dimension of their value in use (Gleick 1995).

Therefore, independently of whether one takes an interest in the specific orientation of research which I have indicated in the last section of this article, the discussion of how to grasp the direction in the change of values in use is bound to be an important subject for economic theory in the years to come.

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7
From classical rent theory to marginal productivity theory

The works of F.B.W.Hermann and J.H.von Thünen

Heinz D.Kurz

I Introduction

It is not much of an overstatement to maintain that the 'marginalist revolution' in the last quarter of the nineteenth century consisted essentially of a generalisation of the principle of *intensive* diminishing returns to the treatment of all sorts of economic phenomena. It was felt that on the basis of this principle it would be possible to develop 'a unified general theory to determine the prices of all productive services in the same way' (Walras 1954 [1874]:416). In this perspective, marginalism is an offspring of the theory of differential rent as it had been developed by authors such as Thomas Robert Malthus (cf. Garegnani 1970:407; Bharadwaj 1978). If this interpretation is accepted then the path leading from that theory to the marginalist doctrine ought to be studied carefully.

Obviously, the idea of the universal applicability of that principle did not emerge suddenly in the early 1870s but was elaborated in the course of a process stretching over some five decades from the 1820s onwards. Broadly speaking, the formulation of the theory of production in the image of the classical theory of rent came somewhat earlier, the formulation of the theory of consumption in the same image somewhat later. On the one hand the principle of intensive diminishing returns was carried over from agriculture and homogeneous land to the *sphere of production* in general and to all factors of production alike. In this way the concept of intensive rent gradually became the unique principle determining income distribution: rent, wages and profits were indiscriminately explained in terms of the relative scarcities of the respective factors of production, land, labour and 'capital'. The upshot of these attempts was the marginal productivity theory of income distribution. On the other hand the principle of intensive diminishing returns was applied to the *sphere of consumption*. Knut Wicksell noticed that the classical theory of rent 'shows a marked analogy with the modern concept of marginal utility' (Wicksell 1954 [1893]:40). The analogy between diminishing marginal utility in consumption and diminishing marginal productivity in production was emphasised also by Piero Sraffa in his 1925 paper 'Sulle relazioni fra costo e quantità prodotta'. In the section on decreasing returns Sraffa pointed out:

> The same argument may be repeated for the case of diminishing utility (and therefore for the demand curves derived from it) which is a special case of diminishing productivity, when we consider utility as product, the commodities consumed as the variable factor of production, and the 'sensitive organism' as the constant factor. It is not any allegedly psycho-physical law which endows diminishing utility with generality, but the possibility of using different doses of a commodity to satisfy different needs and the desire to utilise the first doses to satisfy the most urgent needs.
>
> (Sraffa 1925:295)[1]

Thus, in utility theory the 'sensitive organism' plays a similar role as a given quantity of homogeneous land in production theory. Hence the works of William Stanley Jevons, Carl Menger and Léon Walras can hardly be said to have ushered in a new age in economics .Most of what they had to say had already been said by some earlier writers. There was no such thing as a proper 'revolution'.

This paper goes back to the beginnings of the gradual development of the marginalist theory focusing attention on two German authors: Friedrich Benedikt Wilhelm Hermann (1795–1868) and Johann Heinrich von Thünen (1785–1850). Both can be said to have played an important part in the establishment of the new doctrine. While starting from a 'classical' point of view, they prepared the ground for its abandonment and replacement with supply and demand theory. Since I have attempted to assess the achievements of Hermann's contribution in some detail in another paper (cf. Kurz 1998), a summary statement of the relevant aspects of his contribution must suffice. This is provided in section II. The attention focuses on Hermann's short-period analysis and his attempt to generalise the classical principle of extensive diminishing returns and the related concept of the scarcity of a factor of production from the explanation of the rent of land to the explanation of all distributive variables, including wages and profits. As regards his treatment of capital goods, Hermann thus anticipates important concepts elaborated several decades later by Alfred Marshall and Knut Wicksell. The following three sections are dedicated to Thünen's contribution. Section III deals with his objectivist point of view and method of analysis, which is essentially the same long-period method adopted by the classical economists from Adam Smith to David Ricardo. Section IV summarises his theory of rent in the case in which production is carried out without any means of production that are worth mentioning: this is the case which was later called 'noncapitalistic' production by Eugen von Böhm-Bawerk and Knut Wicksell. Section V turns to Thünen's analysis of 'capitalistic' production and his theory of capital and interest. The question is whether the theory of intensive diminishing returns, as it was developed by the classical economists, can be applied to the determination of the rate of interest in terms of the marginal product of a factor 'capital'. It will be shown that this is indeed possible, although in exceedingly special circumstances only: there must be a single wage alias capital good which is identical with the product in the production of which it is employed. Thünen had contemplated this case in what may be called his 'rye model', which bears a close resemblance to the 'corn model' ascribed to Ricardo by Sraffa. However, Thünen was wrong in assuming that the simple relationships holding in

this fictitious economy carry over to the 'real world' with heterogeneous capital goods. Section VI draws some conclusions.

It should be stressed that important aspects of Thünen's work can only be mentioned in passing but will not be dealt with in any detail in what follows. This concerns especially Thünen's particular concept of the 'natural' wage rate. We shall thus also set aside his ethical and social reformist views and their impact on his economic analysis. For a treatment of some of these issues, see Samuelson (1983, 1986), Dorfman (1986) and the contributions in Rieter (1995).

II Hermann's contribution to the theory of capital and interest

In 1832 Friedrich Benedikt Wilhelm Hermann published his *Staatswirthschaftliche Untersuchungen* (Hermann 1832) which quickly earned him the reputation of one of the leading economic theorists in Germany. According to Joseph.A.Schumpeter, Hermann was 'miles above' his contemporaries in Germany in terms of 'the sharpness of his eye, analytical talent and originality' (Schumpeter 1914:56): his work is said to represent 'the culminating point of the highroad of German economists of his time' (*ibid.*:55). In a later work Schumpeter expressed the fear that 'we might feel inclined to discount the reputation' of our author 'on the ground that he stands out for lack of competition' (Schumpeter 1954:503). Hermann's contribution is indeed remarkable and deserves careful attention, not least because of the judgement passed on it by our second main author. Thünen called Hermann's treatment of profits 'the most profound and valuable disquisition on the issue I ever encountered' (Thünen 1990 [1850]:334, fn.)—and apparently benefited from Hermann's analysis in his own attempt to come to grips with the problem of capital and interest in the second part of *Der isolierte Staat*, published in 1850, entitled *Der naturgemäße Arbeitslohn und dessen Verhältniß zum Zinsfuß und zur Landrente* ['The natural wage rate and its relationship to the rate of interest and the rent of land'].

In his analysis of capital and interest Hermann starts from Smith's definition of capital as comprising those valuable things which, while they exist, yield their proprietors an income. However, Smith is accused of not consequently applying this definition: 'In particular it is astonishing that he does not reckon land amongst the capitals, although it is a good which continues to exist while it yields an income' (Hermann 1832:48). To this Hermann adds the observation that in civilised nations most plots of land have been modified by capital investments and therefore have gradually assumed the nature of capital. Hence, in Hermann's analysis, land and natural resources are subsumed under 'capital' and are thus defined away as a separate factor of production. However, this does not make Hermann abandon the principles developed by earlier authors, most notably Malthus and Ricardo, to explain the income obtained by the proprietors of this kind of resources: the principles of extensive and intensive rent. On the contrary, the gist of his argument consists of a generalisation of these principles to the explanation of *all* kinds of property incomes, in particular profits. Hence, properly speaking it is not land that is subsumed under capital, but rather (fixed) capital is subsumed under land. Profits on fixed capital items are accordingly conceived of as scarcity rents in complete analogy with the rents obtained on different qualities of land that are, or are not, in short supply.

Hermann treats long-lived capital goods as rent-bearing assets on a par with different qualities of land, and thus anticipates Marshall's concept of 'Quasi-Rent' (cf. Marshall 1977 [1890]:341, 516–22) and Wicksell's concept of 'Rent-Goods' (cf. Wicksell 1954 [1893]:99, 115–19).

In terms of *method* of analysis, Hermann's approach to the theory of distribution implies a shift away from the long-period method of Smith and Ricardo to some short-period method. As is well known, Smith and Ricardo focused attention on positions of the economic system characterised by a full reciprocal adjustment of productive capacity in the different lines of production and 'effectual demand' so that a uniform rate of profit obtains.[2] These positions were seen to act as 'centres of gravitation', or attractors, given the actions of profit-seeking producers who allocate their capital in search of the highest rate of return. By increasing (decreasing) the production of those capital goods which pay high (low) rates of profit, discrepancies between productive capacity and demand would be abolished and a tendency toward a uniform rate of profit manifest itself. As we shall see, Hermann does not abandon this notion. He rather relegates it to the status of a benchmark and in much of what he writes rather concentrates on the short and medium run in which the capital stock has not yet had enough time fully to adjust to the other data of the economic system in order for a competitive long-run 'equilibrium', with a uniform rate of profit, to get established. This shift away from the long period is justified in terms of the observation that the economic system is continuously exposed to changes of a more or less exogenous nature, so that the system will hardly ever be in a long-period position. This becomes clear when Hermann turns to the theory of price.

In 'civil exchange', he argues, 'the price is the result of the struggle between two parties with opposed interests and under the influence of competition'. The 'market price' is defined as that price at which the two parties are 'in equilibrium', that is, 'when the same amount of the commodity is wanted and offered' (*ibid.:*67). This definition conveys the impression that Hermann is exclusively concerned with the actual price, whereas the 'natural' price of the classical economists plays no role in his argument. However, throughout his work the classical notion lingers in the background and frequently comes to the fore. This is the case, for example, when the exchange value of a commodity is said 'to cover in addition to the value of circulating capital contained in it the exchange value of all the capital services foregone in its production, or the *ordinary profit'* (*ibid.:*79; emphasis added). The reference is to that amount of profits which could be obtained in alternative employments of capital (*ibid.:* 81–2), that is, Hermann has recourse to a principle of *opportunity benefit* (or *cost*). He also mentions the classical concepts of 'cost price', 'natural' and 'necessary' price (*ibid.:*94, fn.).

In the sequel, Hermann moves freely between the long-run and the short-run notion of price. He makes it clear that for the most part of the argument he does not follow Smith and Ricardo but rather J.B.Say and especially Malthus (*ibid.:*96, fn.). Accordingly, both actual and normal price are taken to be determined by 'demand and supply' *(Ausgebot und Nachfrage)*.[3] As is well known, Ricardo in a letter to Malthus dated 9 October 1820 objected: 'You say demand and supply regulates value—this, I think, is saying nothing' (Ricardo 1951–73:vol. VIII, p. 279). Hermann could not know this objection, but he was aware of the necessity to render the two words *analytical categories*. To this effect he studied the determinants of demand and supply. He saw three factors at work on each

side. It should be noted that the factors mentioned on the two sides are not fully symmetrical.

From the point of view of *demand*, the price of a commodity is said to depend on (i) the use value of the good, that is, the position of the respective want that is satisfied by means of the good in a hierarchy of wants;[4] (ii) the purchasing power of those who desire the good, that is, what matters is their 'effectual' *(wirksame)* demand; and (iii) the additional costs of purchasing the commodity, that is, 'natural' and 'social' factors that constrain competition and prevent the price from falling to cost of production (inclusive of ordinary profits) (cf. *ibid.*:66–76). While the consumer is assumed to be predominantly interested in the use value of a commodity, the producer is said to be exclusively interested in its exchange value or, more precisely, the difference between the exchange value and total unit costs. The three factors at work on the *supply* side contemplated by Hermann are (i) the cost of production of the commodity; (ii) the 'natural' and 'social' factors that constrain competition and thus exert an influence on its price; and (iii) the 'exchange value of price goods', by which Hermann means the terms of trade between the commodity under consideration and all the other commodities or, broadly speaking, the purchasing power of the proceeds from selling one unit of the commodity (cf. *ibid.*:76–96).

As regards the supply side, emphasis is on (i) (*ibid.*:76–88). Hermann defines, in modern parlance, the long-run supply price of a commodity as unit costs plus profit at the ordinary rate on the capital advanced at the beginning of the production period:

> Calling *A* the circulating capital, which passes over to the product, and *B* the fixed capital, which is employed in production, and assuming that the value of the capital service is on average *p*/100 of the capital, then costs equal: $A+(A+B)p/100$.
>
> (*ibid.*:79–80)

This is a price=cost equation. The uniformity of the rate of profit is expressly tied to the condition of 'freedom of trade' *(Freiheit des Verkehrs)*, that is, free entry and exit in all industries (*ibid.*:82). Hermann also addresses the problem of the choice of technique in a long-period framework and suggests a solution to this problem in terms of *inequalities*.[5]

As regards the determination of price in the short period, Hermann anticipates the concept of a *rising supply curve* derived from increasing marginal costs as the output of a commodity is increased, given the stock of fixed capital goods (cf. also Streissler 1994, 1995). This conceptualisation provides him with a platform to attack Ricardo's long-period method and the corresponding price concept which is said to set aside the impact of demand:

> The price of those commodities which are regularly brought to the market in any desired quantity is not exclusively determined by cost, as Ricardo and his pupils teach. In any case the first and most important factor of price is rather demand, which has its main roots in the use value of the good and in the purchasing power of the buyers. From demand and from what those who want the good are willing to abstain from derives the cost

> of the least efficient production that may be undertaken to satisfy the demand.
>
> (Hermann 1832:95)[6]

While Hermann placed a lot of emphasis on the factors affecting the demand for commodities and, deriving from that, the demand for factor services, he failed to develop the concept of a 'demand function'. The reason for this is that he did not have a clear notion of *substitution* in consumption or production, indeed any notion of substitutability at all. While he showed some awareness that demand and supply are responsive to changes in relative prices and thus in income distribution, he failed to provide a theoretical expression of these interdependences.[7] Therefore Hermann's explanation of income distribution in terms of demand and supply is somewhat left hanging in the air and is at best a quarter-way house between classical and marginalist theory. In this context it deserves to be mentioned that Hermann was a dyed-in-the-wool objectivist, who distrusted all arguments that had recourse to psychological factors, feelings, etc. Hence it would be totally inappropriate to take Hermann's emphasis on 'demand' as an indication of some sort of subjectivism on his part. Nothing would be further from the truth as his detailed critique of Senior's abstinence theory shows (cf. Hermann 1836).[8] To Senior's inclusion of the feelings of those providing productive services in his investigation of the causes of wealth, Hermann objects that what counts are only the results of the mental and emotional forces at work, that is, the usefulness of the goods generated, and not the forces themselves.

Interestingly, in the latter regard a similar position was advocated by Johann Heinrich von Thünen The reader of *Der isolierte Staat* (Thünen 1990 [1826, 1850]) will in vain look for significant subjective elements. We begin with a brief account of Thünen's general perspective on economic phenomena and his method of analysis.

III Thünen's objectivist point of view and his long-period method

Thünen was concerned with an investigation which is 'entirely based on reality' (Thünen 1990 [1826, 1850]:28). His objectivist point of view is reflected in his meticulous description of the physical properties of production processes which is more reminiscent of William Petty and the Physiocrats than Adam Smith or David Ricardo. Being a landowner himself, his attention focused on primary production in general and agriculture in particular. In a letter to John Neville Keynes, Alfred Marshall observed in 1899: 'you know von Thünen's *métier* was that of agricultural reformer. His abstract economics came in by the way. He was up to his eyes in facts about rye and manure and so on'.[9] Wherever Thünen looked he saw joint production, nowhere single production. Each cause has several, physically discernible effects, some of which can be measured with sufficient precision. However, Thünen was an objectivist not only in regard to a description of the real physical obstacles which had to be overcome in the production of different commodities in terms of well specified quantities of means of production. He was also an objectivist in describing the costs of production due to the presence of a particular kind of labour performed: the labour of men as opposed to the labour of animals or machines. In his view at a given time and place these costs consisted of fixed

quantities of certain means of subsistence. In this regard he followed the classical economists and conceived of the wages of labour as 'the sum of the necessaries of the worker', that is, those amounts of the different wage goods 'which allow the worker to subsist and reproduce his race' Thünen 1990 [1826, 1850]:316). Like Smith, Malthus and Ricardo he envisaged the gravitation of actual wages around a subsistence level as the result of the working of a law of population which was taken to be responsible for a tendency towards an excess supply of labour. His programme of social reform, steps of which he realised on his estate in Tellow, Mecklenburg, was designed to break this tendency.

While joint production played an important role in Thünen's famous theory of rings of specialisation (cf. Kurz 1986), his theory of distribution was essentially elaborated within a single-products framework. As regards the analytical method adopted, Thünen was a close follower of Smith and Ricardo. His main concern was with *long-period* positions of the economic system, characterised by a uniform rate of interest and uniform rates of remuneration of all primary factors of production. While he did not turn a blind eye to the short run, in contradistinction to Hermann his main interest was the long run. Each long-period position was considered the result of an adjustment of the economic system to the persistent and systematic factors at work, whereas all temporary and accidental factors were set aside. In a long-period position the dominant factors are consistent among themselves, that is, mutually equilibrating. A change in one of the factors was seen to trigger a process of adjustment which would lead to a new long-period position. Thünen was convinced that this process was too complex to be studied. He therefore contented himself with studying the impact of a change in one of the dominant factors in terms of a comparison of the respective long-period positions. His analysis was thus based on *isolating abstractions* and *comparative statics*. His attention focused on *stationary* conditions of the economic system, an investigation of which was taken to entail important insights into economic dynamics. He explained:

> In reality all phenomena are but a transitional step to some yet unattained distant goal.—In the isolated state we instead focused attention always on the final success, that is, the attained goal. When the goal is attained, tranquility and thus a state of persistence will obtain—and it is here that we can see the laws at work, whereas in the period of transition many a thing will appear to us as an inextricable chaos…. The insight gained with this method may contribute in an important way to shedding light on the confusing phenomena during the development and transition.
>
> (Thünen 1990 [1826, 1850]:303–4)

Thünen employed both a *partial* and a *general* method. The First Part of the *Isolated State* contains mostly partial, the Second Part mostly general analysis. In the Introduction to the latter he wrote: 'In order to construct the isolated state we had to assume the price of corn as known. However, this price can neither be arbitrary nor accidental.' The task of the Second Part is said to consist of 'removing these assumptions and put economic laws in their place' (*ibid.:* 299). In his attempt to establish these laws Thünen was convinced that algebra would be of invaluable help. 'Absolute correctness' is required.

'Happily, we find the proof of it in the science that does not err—mathematics' (*ibid.*:289). Thünen was indeed one of the first German mathematical economists.

IV Thünen's approach to rent theory

Thünen investigated both the case of extensive and intensive diminishing returns in agriculture. Given the aim of this paper, we need to deal with his theory of rent only to the extent to which this is necessary in order to understand his theory of capital and interest.[10]

Thünen's main concern in the first part of *Der isolierte Staat*, entitled 'Untersuchungen über den Einfluß, den die Getreidepreise, der Reichthum des Bodens und die Abgaben auf den Ackerbau ausüben' ['Investigations on the impact of corn prices, the fertility of land and duties on agriculture'] was the spatial allocation of productive activity. Thünen's basic model assumes land as being differentiated only in terms of the distance of its location from a central town which is also the marketplace where the produce of land is sold. With freight costs proportional to distance and with output per acre depending on the amount of labour employed per acre, each producer chooses his method of production in such a way that the marginal net product of labour equals the given and uniform real wage in terms of rye. Thünen is able to show that land rent from rye production is a diminishing function of distance. Essentially the same argument is then applied to other agricultural commodities like milk and dairy products, vegetables, or lumber. Comparing the rentability of the different uses to which land can be put at each distance, the proprietor of land then decides to raise the product promising the highest rent. This leads to Thünen's scheme of 'rings' of specialisation around the marketplace. It is shown that the lower the transportation costs and the more rapidly returns are diminishing, the larger will be the distance from the centre at which a commodity will be produced.

The differential rent Thünen discusses in this context is essentially rent due to differences in location of cultivable land. This is a special case of extensive rent in which the 'quality' of land is continuously decreasing as the distance from the town increases. Returns can be said to diminish as production is extended to areas farther away from the town, because costs of transportation rise proportionally with distance. The special case contemplated by Thünen's model may also be cast in the following way (cf. Kurz and Salvadori 1995:287): in it the *order of fertility* and the *order of rentability* coincide. By the former we mean the order in which land of different location is taken into cultivation: with the level of output(s) rising, cultivation will gradually expand in concentric circles from the town. By the latter we mean the rent per acre yielded on land of different location. It can be shown that contrary to a widspread view to be found in the literature, the coincidence of the two orders does not generally hold, but requires special assumptions which are met in Thünen's case.

However, Thünen also investigates the case of pure intensive rent. While the case of differently fertile (or distant) plots of land is congenial to Thünen's objectivist point of view, things are different in the case of intensive diminishing returns. Focusing attention on stationary states of the economy, Thünen could find out everything about the yield of qualitatively different plots of land, because these yields do coexist at a given moment of

time. He could not observe, however, the 'marginal product' on land of uniform quality (where quality includes the aspect of location) for the simple reason that it does not exist and therefore cannot be observed. For the concept of marginal product requires the comparison of two constellations, one which is actually realised whereas the other one is purely hypothetical. The reference is thus to returns which do not hold simultaneously, but consecutively. Whenever one of the returns is realised and can be observed, the other isn't and can't. It is only the *experimenting* Thünen who could find out the marginal product by comparing the yields of two different but qualitatively homogeneous plots of land cultivated at different intensities, that is, applying different amounts of labour (or labour-cum-capital) per acre. By means of the experiment Thünen not only determines the marginal product: he actually puts it into existence.

For obvious reasons Thünen was able to carry out only a limited number of experiments on his estate in Tellow. The tables he produced summarising his findings therefore contain information about discrete steps in the intensification of the cultivation of homogeneous land.[11] He nevertheless thought that he could combine the results to something like a smooth production function with first derivatives that are positive, at least within limits. This required that the gaps between his observations be bridged. Hence, both the production function and the marginal product functions of labour and capital are constructions based on Thünen's intellectual or agricultural experiments.

We now come to Thünen's theory of capital and interest. He seemed to have been convinced that decreasing returns to a factor whose quantity is increased, given the quantities of any other factors that collaborate in production, holds also with regard to a factor called 'capital'. Moreover, in conditions of free competition the remuneration of each factor will tend to equality with the factor's marginal product. This led him to interpret the rate of interest as reflecting the marginal product of 'capital'.

V Thünen on capital and interest

Thünen develops his theory of capital and interest in a sequence of logical steps garbed in a tale of economic and social progress starting with a primitive society in the tropics. Production is originally carried out without any produced means of production, that is, 'uncapitalistically'. Yet, because of a favourable climate and an abundance of fertile land, and on the assumption that people are prepared to work more hours per day than is needed for mere subsistence, a surplus product will be generated. This surplus allows people to subsist for a period of time in which they can produce primitive means of production which enhance labour productivity.[12] This is Thünen's view of primitive accumulation and the process of social and economic development triggered by it. He then leaves the tropical world and turns to Europe, where 'capitalistic' forms of production prevail. The most simple form of 'capitalistic' production analysed by him is the production of rye by means of rye. In it rye is the only capital good which is physically identical with the consumption good. Thünen appears to have been convinced that the results derived within such a framework essentially carry over to the real world in which heterogeneous capital goods are used. In particular, he was of the opinion that the rate of interest equals the marginal product of capital.

1 Thünen's 'rye model'

The idea of a sort of 'rye model' is first alluded to in paragraph 8 of the first section of part II of *Der isolierte Staat*, 'Formation of capital by labour'. Thünen refers to the case of an independent worker in a tropical country who can produce an amount of the means of subsistence that is greater than the amount he requires for consumption:

> Here we have to take the means of subsistence, which the worker needs during a year, as the unit and measure of the size of the product.—These means of subsistence I call S and the hundredth part of it *c*, so that $S = 100c$.—Assume now that the worker, provided he is industrious and parsimonious, is able to produce with his hands 10 per cent more than he needs for his necessary subsistence, that is, 1.1 *S* or 110*c* per year. After having subtracted what he must consume in order to subsist there remains then a surplus of $110c - 100c = 10c$.
>
> (Thünen 1990 [1826, 1850]:341)

Transplanted into a capitalist economy with wage labour, and assuming that the real wage rate equals the subsistence level referred to, we have for the rate of interest:

$$r = \frac{110c - 100c}{100c} = 0.1$$

or 10 per cent. The two distributive variables are thus treated *asymmetrically* as in the classical approaches to the theory of distribution from Smith to Ricardo; and as in these conceptualisations the wage rate is the *exogenous* (or independent) variable and the rate of interest the *endogenous* (or dependent) variable.

In his discussion of an advanced state of the economy the asymmetric treatment of the two distributive variables is preserved, but in the course of the argument he interchanges their character as dependent or independent variables: the rate of interest is given from outside and the wage rate is determined from within the model. This is meant to reflect the fact that with the progress of the economy, that is, due to the accumulation of capital, wages tend to rise as the marginal product of labour rises. In the introductory passage of paragraph 13, 'Reduction of the effectiveness of capital to labour', Thünen writes:

> In our investigation we now leave the tropical world and turn to the European circumstances in which man cannot produce anything without the assistance of capital and cannot even subsist without the help of capital.—Here each product is the collective work of labour and capital and the question arises whether the share each of these factors *[Potenzen]* has in the common product can be discerned and separated.
>
> (*ibid.*:361)

This is the famous *imputation* problem which was to absorb the energies of generations of economists. Thünen proceeds as follows. Initially he takes the real wage rate *w* as given, $w = a + y$, where *a* denotes a minimum of subsistence and *y* a surplus component over and above that minimum. In addition he assumes that land of the best quality is

abundant, that is, a free good. He then compares stationary states of the economy characterised by different quantities of capital per unit of labour employed. On capital he writes:

> Capital is the accumulated product of labour, that is, labour already performed; it originates together with living labour from a single source: human activity; capital and labour are thus essentially the same, only in the sequence of time they are different like present and past.
>
> (*ibid.*:297)

And:

> By capital I understand the product brought about by labour with the assistance of natural forces, which serves to improve the effectiveness of human labour and is applied for this purpose, and which can be separated from land.
>
> (*ibid.*:333)

Let k designate the amount of capital other than wage capital per unit of wage capital, measured in bushels of rye, and x the net product of rye per unit of labour. (The notation is mine.)[13] Hence, taking k as given involves assuming that a particular technique is in use. With regard to this technique we then have, according to Thünen:

> *The rent* [i.e. the agricultural surplus product distributed in the form of interest] *divided by the capital employed gives the rate of interest…*
>
> Hence $$r = \ldots = \frac{x - (a + y)}{k(a + y)} \quad \left[= \frac{x - w}{kw} \right].$$
>
> This expression for the rate of interest (given the concepts we associate with the symbols x, k and $a+y$) is of general, absolute validity. Equally valid must be the consequences which can mathematically be derived from this equation.
>
> (*ibid.*:362)

One of these consequences is the *inverse* relationship between the real wage rate w and the rate of interest r. Solved for w we get the following expression:

$$w = \frac{x}{1 + rk}$$

In Thünen's words: 'In each moment w depends on r, so that we must always take r as known in order to determine w' (*ibid.*:371). Conversely, if the real wage rate is given, the equation determines the rate of interest on the basis of a comparison of two quantities of rye: the surplus product of rye distributed as interest divided by the amount of capital including wages in terms of rye. In the simple 'rye model' the capital advanced consists

in fact exclusively of rye, whilst in models with heterogeneous capital goods it is only the *value* of capital that Thünen expresses in units of rye.

Thünen thus arrives basically at the same result as Ricardo in his *Essay on the Influence of a low Price of Corn on the Profits of Stock*, published in 1815, and, following Sraffa's interpretation (cf. Ricardo, 1951–73: vol. I, pp. xxxi– ii), in his lost manuscript on profits of capital of 1814, which in all probability contained a pure corn model.[14] Yet while Ricardo, in the *Essay on Profits*, was mainly concerned with the effects of the accumulation of capital on the rate of profits *vis-à-vis* diminishing returns in agriculture, Thünen sets aside altogether the problem of the scarcity of land and its impact on the distribution of income. He instead treats 'capital' as a scarce factor of production and attempts to determine the net rate of interest in analogy with the determination of the rate of intensive rent in the model with homogeneous labour and homogeneous land. The 'quantity of capital' has therefore replaced the amount of homogeneous land in given supply, and the principle of intensive rent has been employed to explain interest.

It should also be mentioned that Thünen came close to seeing that all distributive variables ought to and in fact can be determined simultaneously. We have seen that for the most part he treated the different distributive variables *asymmetrically*. This asymmetric treatment was a characteristic feature of the classical theory of distribution: the classical authors took the wage rate as given from outside the system of production and conceived of the rent rates and the general rate of profit as residuals. Thünen adopted this approach with a single difference: in some of his analysis he took the rate of interest as given and determined the wage rate (more precisely: the surplus component of wages) endogenously. This procedure implied that there was a degree of freedom in the distribution of income. With given technical alternatives of production, described in terms of different capital-labour ratios, the wage rate and the interest rate are uniquely determined once the economy's endowment of labour and 'capital' is given. This idea was to form the cornerstone of the marginal productivity theory of income distribution, and Thünen is therefore rightly regarded as one of its most important precursors.

2 The real economy

According to Thünen the analogy between the land-labour and the capital-labour model is perfect. In the same way as an increase in the amount of labour, given the amount of land, decreases the marginal product of labour and increases the marginal product of land, an increases in the amount of 'capital', given the amount of labour, decreases the marginal product of 'capital' and increases the marginal product of labour. Thünen concludes that one is confronted with 'the need [!] to find a series [for the marginal productivity of capital] whose elements are progressively getting smaller, and to this requirement [!] there corresponds the geometrical series, whose first term is a fraction, such as 9/10, $(9/10)^2$, $(9/10)^3$, $(9/10)^4$…' (*ibid.*:346). Whilst Thünen found decreasing returns in agriculture empirically during his experiments on his farm, as regards 'capitalistic production' he relies exclusively on an analogy. The decreasing marginal productivity of capital or of 'the last invested particle of capital *[Kapitalteilchen]*' is said to reflect 'the cause of the phenomenon which is most important for the rest of our investigation, that is, each additional capital invested in a firm or an industry will yield a lower rent than the

one invested earlier' (*ibid.*:345). On the other hand an increase in the amount of capital employed per labourer increases the real wage rate: '*The reduction of the rent as a consequence of the growth of capital is thus beneficial to the worker and increases the wage of his labour*' (*ibid.*:348).

Appearances can be deceptive. A closer examination of Thünen's argument shows that his jump from the land-labour model to the capital-labour model landed him right in the middle of the capital problem. This problem was specified by Knut Wicksell as follows:

> Whereas labour and land are measured each in terms of its own *technical* unit (e.g. working days or months, acre per annum) capital, on the other hand…is reckoned in common parlance, as a sum of *exchange*…. In other words, each particular capital-good is measured by a unit extraneous to itself. [This]…is a theoretical anomaly which disturbs the correspondence which would otherwise exist between all the factors of production…. If capital also were to be measured in technical units, the defect would be remedied and the correspondence would be complete. But, in that case, productive capital would have to be distributed into as many categories as there are kinds of tools, machinery, and materials, etc., and a unified treatment of the rôle of capital in production would be impossible. Even then we should only know the *yield* of the various objects at a particular moment, but nothing at all about the value of the goods themselves, which it is necessary to know in order to calculate the rate of interest, which in equilibrium is the same on all capital. Again, it is futile to attempt—with Walras and his followers—to derive the value of capital-goods from their own cost of production or reproduction; for in fact these costs of production include *capital* and interest…. We should, therefore, be arguing in a circle.
>
> (Wicksell 1934 [1901]:149)[15]

The difficulty encountered in the case of *heterogeneous* capital goods is put into sharp relief when we turn to Thünen's discussion of the commodity composition of 'capital'—its physical texture, so to speak. Fully in line with his objectivist point of view Thünen stresses the heterogeneity of capital goods. Right at the beginning of his attempt to deal with 'capital' on a par with homogeneous land, he invokes the figure of a kind of Robinson Crusoe who produces his own instruments and tools. 'The worker making the capital', he writes,

> recognizing and pursuing his own interest, will at first direct his labour to the production of those tools and machines, which increase his force *[Kraft]* most and render the highest success to his labour. Once these are available in sufficient quantity, he will direct his labour to the production of instruments and machines which, although also useful, are less effective and less beneficial to the productivity of his labour than the previous ones—and which, if loaned to others, yield him a smaller rent.
>
> (*ibid.*:345)

What Thünen expresses here is that the *marginal* rats of interest tends to fall. If capital goods of different 'efficiency' are employed simultaneously then the rates of interest cannot be uniform—in the same way as in the case of extensive diminishing returns the rents paid per acre of different qualities of land will generally be different.[16] However, while the latter constellation is perfectly compatible with a long-period position of the economy and its characteristic feature, that is, a uniform rate of interest, the former is definitely *short-period* in character: profit-seeking entrepreneurs will invest and disinvest in such a way that there will be a tendency towards a uniform rate of interest. It is this long-period constellation Thünen is most interested in.

This becomes clear shortly after, when Thünen turns to the *long period*. Remarkably enough, he implies without any further discussion that the above short-period findings have a bearing on long-period theory. In fact, he draws the conclusion that an increase in the 'quantity of capital' leads to a decrease in the *general* rate of interest and not just the *marginal* rate: '*The rent which capital as a whole yields when loaned out, is determined by the last invested particle of capital*. This is one of the most important propositions in the doctrine of interest' (*ibid.:*348). Thünen's translation of a finding in a short-period framework to the long period implies a stunning *non sequitur*. Had he properly taken into consideration the heterogeneity of capital goods in the context of a long-period framework of the analysis he could not have failed to see that the 'quantity of capital' cannot be given independently of, and prior to, the rate of interest and relative prices.[17]

VI Concluding remarks

Hermann and Thünen are two of the most remarkable German economists of the last century. Beginning with a thoroughly 'classical' view, both authors eventually contributed to the abandonment of the classical analysis and the development of marginalism. Ironically, the main building block of the alternative scheme of economic thought was inherited from the classical economists: the theory of rent due to extensive and intensive diminishing returns. It was the assumed general applicability of the principle of scarcity rent to the explanation of all distributive variables which informed the development of the new doctrine. A major concern of Hermann's was the short run. In this regard the classical theory of extensive diminishing returns was taken to provide the appropriate approach to tackle the problem of differential profitability of heterogeneous capital goods in terms of their relative scarcities. Prices were assumed to be determined by 'demand' and 'supply', with the quantity supplied conceived of as a rising function of the price, thus reflecting diminishing returns due to the heterogeneity and relative scarcities of the capital goods in existence. Hermann's emphasis on the role of 'demand' must not be mistaken as foreshadowing the subjectivist point of view. There is nothing resembling the concept of 'marginal utility' or any related concept to be found in Hermann's analysis.

Thünen shared Hermann's 'objectivist' point of view. However, in contradistinction to Hermann he was mainly interested in analysing and comparing the properties of different long-period positions of the economic system, characterised by a uniform rate of interest and uniform rates of remuneration of all primary factors of production. His respective analysis therefore focused attention on constellations, in which the capital stock in

existence was fully adjusted to the other data of the system, that is, the technical alternatives of production and the amounts of the agricultural products to be produced (and, in some of his examples, the real wage rate). It seems that his theory of capital and interest essentially derived from his analysis of the properties of a simple 'rye model', in which there is a single capital good, rye, which is identical with the product. In the rye model the rate of interest turns out to be equal to the marginal net product of capital. This is best seen in the case of intensive diminishing returns, in which the amount of labour-cum-capital (in terms of rye) is increased, given the available amount of homogeneous land. With changing proportions of rye advanced (wages plus seed) per acre the marginal net product of rye capital will fall. However, Thünen was wrong in assuming that the properties of the rye model carry over to the real world with heterogeneous capital goods. As was pointed out already by Wicksell, in the case of heterogeneous capital goods the different items of 'capital' cannot generally be aggregated prior to and independently of the determination of relative prices and the rate of interest. Therefore, it is impossible to ascertain the rate of interest as the scarcity price of a factor 'capital', the 'quantity' of which is in given supply. Thünen thus had erred in an important respect. The proximate source of his error may be said to have consisted in abandoning his otherwise objectivist perspective in regard to the problem of capital.

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Notes

1 The English version of the passage quoted from the Italian original is taken from a translation of Sraffa's paper by John Eatwell and Alessandro Roncaglia.

2 Alternatively, a relatively stable structure of differential rates of profit, reflecting persistent causes affecting profitability in different employments of capital, was contemplated by these authors; see, for example, Smith (1976 [1776]:I.x.b).

3 It has been widely acknowledged that the major novelty in Mountifort Longfield's approach to the problem of value and distribution in his *Lectures on Political Economy* (Longfield 1971 [1834]) consisted in his attempt to determine the price of a product as well as the price of a factor service by the opposing forces of 'demand' and 'supply'. It may be said that in this regard Longfield was anticipated two years by Hermann. Longfield has also been credited with building up the notion of a demand schedule on an argument that can be interpreted as an early statement of marginal utility theory (cf. Schumpeter 1954:465). In this regard Hermann cannot claim priority, whereas another German economist, Karl Heinrich Rau, could (see Streissler 1995).

4 In modern terminology, Hermann's view of needs and wants comes close to the concept of lexicographic preferences.

5 The solution suggested by Hermann resembles that of William Whewell published only one year earlier. On the role of inequalities in the classical approach to the problem of the choice of technique, see Kurz and Salvadori (1995:400–3).

6 There is a close resemblance between Hermann's and Malthus's position. In a letter dated 26 October 1820 Malthus had answered Ricardo's earlier letter:

> No wealth can exist unless the demand, or the estimation in which the commodity is held exceeds the cost of production: and with regard to a vast mass of commodities does not the demand actually determine the cost? How is the price of corn, and the quality of the last land taken into cultivation determined but by the state of the population and the demand. How is the price of metals determined?
>
> (in Ricardo 1951–73: vol. VIII, p. 286)

Ricardo replied in a letter dated 24 November 1820, saying:

> I shall not dispute another proposition in your letter 'No wealth[']' you say 'can exist unless the demand, or the estimation in which the commodity is held exceeds the cost of production.' I have never disputed this. I do not dispute either the influence of demand on the price of corn and on the price of all other things, but supply follows close at its heels, and soon takes the power of regulating price in his own hands, and in regulating it he is determined by cost of production. I acknowledge the intervals on which you so exclusively dwell, but still they are only intervals.
>
> (*ibid.*:302)

This shows that the dispute between Ricardo and Malthus was to a considerable extent a dispute about method, that is, whether the theory of value should be short or long-period: while Ricardo was in favour of the latter, Malthus opted for the former. Hermann can be said to have sided more with Malthus.

7 As regards production, Hermann's discussion of the choice of technique problem contains of course the germs of a concept of substitution. Yet, Hermann does not appear to have been aware of the wider implications of his respective argument.

8 For a summary statement of this critique, see Kurz (1995c: section 8).

9 The letter is to be found in the Marshall Archive; it is also quoted by Donoghue (1995).

10 For a more detailed discussion of Thünen's approach to rent theory, see Kurz (1995a, 1995b) and Helmstädter (1995).

11 See the enlarged and newly calculated tables of Thünen in Helmstadter (1995:77–80).

12 There is a close resemblance between Thünen's speculation and the Austrian idea of the 'superiority of more roundabout processes of production'; see Böhm-Bawerk (1921 [1884]:145 et seq).

13 Thünen's k bears some resemblance to Marx's 'organic composition of capital'. As regards x, Thünen assumes that the net product 'comprises what is exclusively distributed between capitalist and worker, since all other expences of industry have already been deducted' (*ibid.*:362). This implies that contrary to his usual approach in which wages are taken to be

paid *ante factum* and thus belong to the capital advances at the beginning of the period of production, they are now reckoned as a part of net income.

14 To the best of my knowledge there is no evidence that Thünen knew Ricardo's *Essay on Profits*.

15 Wicksell applied his considerations directly to Thünen's 'well-thought-out and "motivated" productivity theory' (Wicksell 1954 [1893]:111, fn.); see Wicksell 1934 [1901]:177.

16 In this regard Thünen simply reiterates Hermann's finding.

17 It should be mentioned that Samuelson in the section 'Vindicating Thünen's Logic on Capital' of his 1983 paper assumes a single capital good which he dubs 'leet', using a variant of Joan Robinson's term 'leets' (which derives from 'steel'); cf. Samuelson (1983, p. 1485). His argument therefore cannot vindicate Thünen's treatment of the case with heterogeneous capital goods.

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8
Social accounting with Adam Smith

Fernando Vianello

'The gross revenue of all the inhabitants of a great country', we read in the *Wealth of Nations*, 'comprehends the whole annual produce of their land and labour; the neat revenue, what remains free to them after deducting the expence of maintaining; first, their fixed; and secondly, their circulating capital; or what, without encroaching upon their capital, they can place in their stock reserved for immediate consumption' (*WN*, II. ii. 5).

Prima facie this clear-cut distinction between the 'gross revenue' (or 'the whole annual produce') of a country and its 'neat revenue' (or what its inhabitants can consume 'without encroaching upon their capital') seems to contradict a well-known allegation made by Marx: namely, that Adam Smith's view of the price of every commodity as resolving itself entirely into wages, profits and rents causes him to see the replacement of non-wage capital as a charge on the output of each branch of production taken separately, but not on that of the economy as a whole. The purpose of ascertaining to what extent Smith lays himself open to the above criticism represented the original mainspring for this paper, which progressively developed into a laborious attempt at unravelling the tangled skein of his social accounting. As a part of this attempt, some attention has been paid to Smith's distinction between productive and unproductive labour, the essentials of which are spelled out in section 3, while section 6 (which is something of an appendix) is concerned with an ambiguity, pointed out by Marx, in his treatment of the matter.

1 Adam Smith's view that price resolves itself entirely into wages, profits and rents

Let us begin with Smith's contention that the price of every commodity resolves itself entirely into three 'component parts' (*WN*, I. vi. 9)—wages, profits and rents. With reference to corn-growing, the grounds for this contention are spelled out as follows:

> A fourth part, it may perhaps be thought, is necessary for replacing the stock of the farmer, or for compensating the wear and tear of his labouring cattle, and other instruments of husbandry. But it must be considered that the price of any instrument of husbandry, such as a labouring horse, is itself made up of the same three parts; the rent of the land upon which he

> is reared, the [wages of the] labour of tending and rearing him and the profits of the farmer who advances both the rent of this land and the wages of this labour. Though the price of corn, therefore, may pay the price as well as the maintenance of the horse, the whole price still resolves itself either immediately or ultimately into the same three parts of rent, labour [read wage], and profit.
>
> (*WN*, I. vi. 11)

As against this Marx observes that the rearing of horses and manufacture of agricultural implements require the employment of other products as means of production. It follows, he argues, that what Smith concedes in the case of the corn-grower—i.e. that 'the price of his corn includes, besides the wages, profit and rent paid by him to himself and others, *a fourth component part*'—must also 'hold good for the horse breeder and the manufacturer of agricultural implements; and it is of no avail for Adam Smith to send us from pillar to post' (Marx 1905–10:1, 99).

The assumption behind Smith's reasoning is, in fact, that in moving back from a commodity to its means of production, from these to their own means of production, and so on, one eventually comes to an 'initial' stage of production, in which the means of production of the following stage are produced without the aid of any other means of production apart from natural resources.[1] Let us suppose that the means of production each stage receives from the preceding one be totally consumed in the annual cycle of production. Only the value of the output in the initial stage of production resolves itself immediately into revenues. Nevertheless, the output of each stage of production—the value of which is equal to the sum of the revenues obtained in that and all the preceding stages—supplies the means of production to the stage following, so that the price of every commodity resolves itself into the revenues received in a series of stages, long or short as it may be.[2]

If, however, the production of all commodities requires the employment of some products as means of production (as indeed it does, except in the case of such primordial activities as gathering firewood or picking wild fruits), then, moving back along the chain of the stages of production of any commodity, one never comes to an initial stage of production. Sooner or later one will in fact encounter commodities that enter directly or indirectly into their own production, and cannot therefore be got rid of, no matter how far back one moves. There seems, therefore, to be no way of getting round Marx's objection that the price of commodities cannot resolve itself entirely ('that is to say', as P.Sraffa puts it, 'without leaving any commodity residue'; Sraffa 1960:94) into the revenues obtained in a finite series of stages of production. (For the purpose of illustrating the 'resolution' argument, Marx incidentally points out, the example of corn 'is peculiarly unhappily chosen' for the products employed in corn growing 'include one that does not at all need be bought from somebody else, namely the seed; and can this component part of the value possibly resolve itself into wages, profit or rent for anybody?'; Marx 1905–10:I, 99.)

To the view of a 'linear' structure of production—with each stage receiving means of production from the stage immediately preceding and supplying means of production to the stage immediately following—Marx opposes the view of means of production being replaced through *reciprocal* purchases by the various branches of production (as also

through part of the production being directly set aside, as in the example of corn growing).[3] Of course, also in Marx's opinion the value of every commodity is equal to the sum of the revenues obtained in its direct and indirect production. But this equality can be arrived at by constructing, as Marx in fact does, a vertically integrated industry (see Marx 1905–10:1, 107–50 and 187–98; see also Vianello 1973:75–9), and not by the alternative method of tracing back the revenues obtained in all the various stages of the production of every commodity.

2 The value of the annual produce resolving itself into revenues

To this criticism Marx adds a second one, which is in fact conceptually quite distinct, although the two criticisms are often treated by him as if they were one and the same. Here we are referring to the criticism mentioned in the introduction to this paper, which runs as follows: the thesis of complete 'resolution' of the price of every commodity into revenues leads Smith astray, causing him to see the value of the means of production as nothing but 'an apparent element of commodity value, which disappears in the total pattern' (Marx 1894:984) and to develop his argument *as if for the economy as a whole capital was formed solely by the necessaries advanced to the productive labourers* (on productive and unproductive labour see section 3 below).

The nearest that Smith comes to overlooking the existence of non-wage capital is perhaps where he remarks that:

> [a]s the price or exchangeable value of every particular commodity, taken separately, resolves itself into some one or other, or all those three parts; so that of all the commodities which compose the whole annual produce of the labour of every country, taken complexly, must resolve itself into the same three parts, and be parcelled out among different inhabitants of the country, either as the wages of their labour, the profits of their stock, or the rent of their land.
>
> (*WN*, I. vi. 17)

However, referring back to this assertion later in the *Wealth of Nations* (II. ii. 1–2), he adds that:

> though the whole value of the annual produce of the land and labour of every country is thus divided among and constitutes a revenue to its different inhabitants; yet as in the rent of a private estate we distinguish among the gross rent and the neat rent, so we may likewise in the revenue of all the inhabitants of a great country. The gross rent of a private estate comprehends whatever is paid by the farmer; the neat rent, what remains free to the landlord, after deducting the expence of management, of repairs, and all other necessary charges; or what, without hurting his estate, he can afford to place in his stock reserved for immediate consumption, or to spend upon his table, equipage, the ornaments of his house and furniture, his private enjoyments and amusements.[4]

(*WN*, II. ii. 3–4)

In the light of this statement (and of that quoted at the opening of this paper, which comes a few lines later in Smith's text), a comprehensive evaluation of Marx's second criticism appears to require a detailed examination of what exactly Smith finds necessary to deduct from the gross in order to arrive at the net revenue. This examination will be tackled in sections 4 and 5 below.

3 Productive and unproductive labour

If we are to take our argument forward we must now pause to consider the distinction Smith makes between the sort of labour which contributes to the creation of the annual produce ('productive labour') and the sort of labour which does not ('unproductive labour'). Smith sees as productive the labourers engaged in agriculture, mining and manufacturing, as also in the transport and sale of commodities (which we here disregard for the sake of simplicity); unproductive labourers are, in his opinion, menial servants, civil servants and, more generally, labourers supplying services not related to the transport or sale of commodities. 'The labour of some of the most respectable orders in the society', he writes in a famous passage:

> is, like that of menial servants, unproductive of any value…. The sovereign, for example, with all the officers both of justice and war, who serve under him, the whole army and navy, are unproductive labourers. …In the same class must be ranked, some both of the gravest and most important, and some of the most frivolous professions: churchmen, lawyers, physicians, men of letters of all kinds; players, buffoons, musicians, opera-singers, opera-dancers, &c.
>
> (*WN*, II. iii. 2)

The annual produce comes, in Smith's words, 'either from the ground or from the hands of the productive labourers' (*WN*, II. iii. 4).[5] None of it emerges from the hands of the unproductive labourers. What Smith says of the 'servants of the public', that they 'are maintained by a part of the annual produce of the industry of other people' (*WN*, II. iii. 2), does in fact apply to all unproductive labourers.

If the society wants to draw permanently upon the services of a number of unproductive labourers, it must reserve part of its net revenue for the maintenance of these labourers *every year*. ('The protection, security, and defence of the commonwealth, the effect of their labour this year, will not purchase its protection, security, and defence for the year to come'; *WW*, II. iii. 2). On the contrary, the decision to reserve part of a single year's net revenue for the maintenance of some productive labourers, in addition to those previously employed, brings about a *permanent* increase in the number of productive labourers: as Smith puts it, the latter decision 'establishes as it were a perpetual fund for the maintenance of an equal number in all times to come' (*WN*, II. iii. 19). 19).

This fund is replaced, year after year, thanks to the sale of the commodities produced. In fact, by producing a commodity Smith's productive labourer also 'produces a value', thus contributing to the replacement (and augmentation) of the above fund:

> There is one sort of labour which adds to the value of the subject upon which it is bestowed: there is another which has no such effect. The former, *as it produces a value*, may be called productive; the latter, unproductive labour. Thus the labour of a manufacturer adds, generally, to the value of the materials which he works upon, that of his own maintenance, and of his master's profit…the labour of the manufacturer fixes and realizes itself in some particular subject or vendible commodity…. That subject, or what is the same thing, the price of that subject, can afterwards, if necessary, put into motion a quantity of labour equal to that which had originally produced it. The labour of the menial servant, on the contrary, does not fix or realize itself in any particular subject or vendible commodity. His services generally perish in the very instant of their performance, and seldom leave any trace behind them, for which an equal quantity of service could afterwards be procured.
>
> (*WN*, II. iii. 1, italics added)

Smith returns to the subject of productive and unproductive labour when examining the doctrines of the Physiocratic school (see *WN*, IV. ix). As we know, F.Quesnay holds as unproductive the labour of craftsmen on the grounds that their products have no greater value than the raw materials they transform plus the necessaries they consume. Against this position Smith sets his own contention that labour is productive whenever it 'adds to the value of the subject upon which it is bestowed'. Even if the value added to the raw materials by the craftsmen covered no more than their maintenance, as Quesnay has it, this would in no way detract from the productive nature of their labour, Smith argues. The labour of the craftsmen would in fact add to the annual produce, although less than would be the case if a corresponding amount of labour went into agriculture (see *WN*, IV. ix. 30).

However, the differences between Smith and Quesnay do not stop here. Indeed, the very idea that the value produced by the craftsmen might cover no more than their maintenance is incompatible with Smith's view of the natural price as the price sufficient to pay wages, profits and rents at their natural rates (see *WN*, I. vii). It is this view that lies behind his assertion that 'the labour of a manufacturer adds, generally, to the value of the materials which he works upon, that of his own maintenance, and of his master's profit'. (As for the 'independent workman' who 'has stock sufficient both to purchase the materials of his work, and to maintain himself till it be compleated', he—Smith argues—'is both master and workman, and enjoys the whole produce of his own labour, or the whole value which it adds to the materials upon which it is bestowed. It includes what are usually two distinct revenues, belonging to two distinct persons, the profits of stock, and the wages of labour'; *WN*, I. viii. 9.)

4 Net revenue and replacement of capital

In book 2, chapter 1 of the *Wealth of Nations* Smith refers to the 'general stock of any country or society' as made up of three parts: the stock reserved for immediate consumption, the fixed capital and the circulating capital (see *WN*, II. i. 11–22).

The distinctive characteristic of circulating capital is 'that it affords a revenue only by circulating or changing masters' (*WN*, II. i. 18). On the basis of this criterion Smith includes money in the circulating capital of the society (see *WN*, II. ii. 9) and the seed in its fixed capital. ('Though it goes backward and forward between the ground and the granary, it never changes masters, and therefore does not properly circulate'; *WN*, II. i. 10.) Besides money, the circulating capital includes 'the provisions, materials, and finished work of all kinds that are in the hands of their respective dealers' (*WN*, II. i. 22).

In the passage quoted at the opening of this paper the net revenue is defined by Smith as that part of the annual produce which the inhabitants of a country 'can place in their stock reserved for immediate consumption'. This entails that the net additions to the fixed capital and the stock of money do not form part of the net revenue. The reason for this exclusion appears to be that fixed capital and money contribute only indirectly to giving rise to the stock reserved for immediate consumption, the size of which is taken by Smith as the measure of the prosperity of a country. ('To maintain and augment the stock which may be reserved for immediate consumption, is the sole end and purpose both of the fixed and circulating capitals. It is this stock which feeds, clothes, and lodges the people. Their riches or poverty depends upon the abundant or sparing supplies which those two capitals can afford to the stock reserved for immediate consumption'; *WN*, II. i. 26.)

With reference to 'the expence which is properly laid out upon a fixed capital of any kind', Smith observes that:

> [a] certain quantity of materials, and the labour of a certain number of workmen, both of which might have been immediately employed to augment the food, clothing and lodging, the subsistence and convenience of the society, are thus diverted to another employment, highly advantageous indeed, but still different from this one.
>
> (*WN*, II. ii. 7)

The same is true of the outlay for the stock of money:

> A certain quantity of very valuable materials, gold and silver, and of very curious labour, instead of augmenting the stock reserved for immediate consumption, the subsistence, conveniencies and amusements of individuals, is employed in supporting that great but expensive instrument of commerce, by means of which every individual in the society has his subsistence, conveniencies, and amusements, regularly distributed to him in their proper proportions.
>
> (*WN*, II. ii. 13)

Let us go back once more to the passage quoted at the opening of this paper. There the net revenue, or the part of the annual produce that can be placed in the stock reserved for immediate consumption, is identified with what remains free to the inhabitants of a country 'after deducting the expence of maintainig both their fixed and their circulating capital', the latter including the necessaries advanced to the productive labourers. The net revenue of the inhabitants ('*all* the inhabitants of a great country'), however, necessarily includes the revenue of the productive labourers[6] (see Spengler 1959:410). This does indeed give rise to the ambiguity pointed out by Gilibert (1987:171):

> should we consider the subsistence fund of the wage-earners as circulating capital, therefore excluding it from the net revenue, or as final consumption, and then as a part of it?

Smith has, in fact, an answer to this question, though a puzzling one, namely that the necessaries advanced to the productive labourers should be reckoned as part of both capital and net revenue, as they shift during the year from the society's circulating capital to its stock reserved for immediate consumption. What a man employs in maintaining productive labourers, he observes, 'after having served in the function of capital to him,…constitutes a revenue to them'(*WN*, II. iii. 6).

But this is not the whole story. For in Smith's opinion the property of forming part successively of the circulating capital of the society and of its net revenue does not belong only to the necessaries advanced to the productive labourers, but is shared with them by other components of the circulating capital:

> Of the four parts of which [the circulating capital] is composed, money, provisions, materials, and finished work—he writes—the three last…are regularly withdrawn from it, and placed either in the fixed capital of the society, or in their stock reserved for immediate consumption. Whatever portion of those consumable commodities is not employed in maintaining the former, goes all to the latter, and makes a part of the neat revenue of the society. The maintenance of those three parts of circulating capital, therefore, withdraws no portion of the annual produce from the neat revenue of the society, besides what is necessary for maintaining the fixed capital.[7] The circulating capital of a society is in this respect different from that of an individual. That of an individual is totally excluded from making any part of his neat revenue…. But though the circulating capital of every individual makes a part of that of the society to which he belongs, it is not upon that account totally excluded from making a part likewise of their neat revenue. Though the whole goods in a merchant's shop must by no means be placed in his own stock reserved for immediate consumption, they may in that of other people.
>
> (*WN*, II. ii. 9–10)

As far as the materials are concerned, it is obvious that what is actually placed in the stock reserved for immediate consumption, and forms part of the net revenue, are not the materials themselves, but the consumer goods into which they are transformed.

The materials employed in maintaining and augmenting the fixed capital and the stock of money, being transformed into something which is excluded from forming part of the net revenue, do not share the double role—as capital and net revenue—attributed by Smith to the materials employed in the production of consumer goods:

> Neither the materials necessary for supporting their useful machines and instruments of trade, their profitable buildings, &c. nor the produce of the labour necessary for fashioning those materials into the proper form can ever make any part of [the net produce]. The price of that labour may indeed make a part of it; as the workmen so employed may place the whole value of their wages in their stock reserved for immediate consumption.[8]
>
> (*WN*, II. ii. 6)

5 The error in Smith's treatment of circulating capital and investment

Consider now the following statement, contained in book 2, chapter 3 of the *Wealth of Nations,* a few lines above the assertion that the necessaries advanced to the productive labourers are capital for the employer and revenue for the employees:

> Though the whole annual produce of the land and labour of any country, is, no doubt, ultimately destined for supplying the consumption of its inhabitants, and for procuring a revenue to them—Smith writes—yet when it first comes either from the ground or from the hands of the productive labourers, it naturally divides itself into two parts. One of them, and frequently the largest, is, in the first place, destined for replacing a capital, or for renewing the provisions, materials and finished work, which have been withdrawn from a capital; the other for constituting a revenue either to the owner of this capital, as the profit of his stock; or to some other person, as the rent of his land.
>
> (*WN*, II. iii. 4)

This subdivision of the annual produce into two parts—one serving to replace the capital, the other making up the social surplus that goes to the capitalists and landowners—is strongly reminiscent of the Physiocrats' conception of the *produit net* (although the latter goes entirely into rent) as the difference between the *réproduction totale* and the part of it which must be set aside or exchanged for non-agricultural means of production in order to make it possible for the productive process to be repeated on the same scale (see Cannan 1917:59–63).

The view that a part of the annual produce is 'destined for replacing a capital, or for renewing the provisions, materials and finished work, which have been withdrawn from a capital' is clearly at variance with the view that '[t]he maintenance of those three parts of circulating capital…withdraws no portion of the annual produce from the neat revenue of the society, besides what is necessary for maintaining the fixed capital'. In evaluating this

contradiction we must, however, distinguish between the replacement of the goods consumed during the year and that of the materials (let us ignore, for the sake of simplicity, the inventories of finished work).

To include, or not, the wages of the productive labourers in the net revenue of the society is indeed a matter of definition. And, if one chooses to include them, it makes little difference whether what one actually includes are the goods advanced and consumed in the year considered (as Smith has been shown to do) or the newly produced goods required to replace those advanced and consumed. It also makes little difference whether the goods consumed by landowners, capitalists and unproductive labourers are reckoned as part of the net revenue of the year in which they are produced or of the year in which they are consumed (Smith's choice being the latter).

In Smith's opinion, however, not only the replacement of the goods consumed, but also the replacement of the materials used up in their production 'withdraws no portion of the annual produce from the neat revenue of the society'. The key to this erroneous conclusion may possibly be found in Smith's assertion that, while the annual produce '*when it first comes from the ground or from the hands of the productive labourers*…naturally divides into two parts' etc., the materials (except those employed in the maintenance and augmentation of the fixed capital and the stock of money) will sooner or later be transformed into consumer goods—so that the whole annual produce (except the part of it represented by the maintenance and augmentation of the fixed capital and the stock of money) is '*ultimately* destined for supplying the consumption of the inhabitants'.

As we saw in section 2 above, Marx traces back the error in Smith's treatment of (circulating) capital[9] to his view of the price of every commodity as resolving itself entirely into wages, profits and rents. This view, however, implies no further error besides that of assuming the existence of an initial stage in the production of every commodity. If, indeed, one admits the existence of such a stage, there is nothing wrong in equating the price of a commodity to the sum of the revenues received in the n stages of its production.[10] Whether or not the commodity in question forms part of the net revenue of the society, the means of production produced in each of the $(n-1)$ stages of its indirect production form part of the gross revenue of the society, but not of its net revenue.

It is at this point that *a second error* creeps into Smith's reasoning. This second error may be described by saying that a situation characterized by the employment of labour, in the same year, in all the different stages of the production of every commodity (which is tantamount to saying in all the different industries of the economy) is taken as equivalent, for the economy as a whole, to a situation in which every commodity goes through all the different stages of its production in the same year. It is only in the latter situation that the replacement of the materials employed in the production of the commodities forming part of the net revenue can be said not to require any deduction from the annual produce, namely, from the collection of commodities existing at the end of the year (which in the situation considered includes only newly produced consumer goods, machines and coins). An example may be useful to clarify this point. Let us take a commodity, cloth, produced with one single means of production, flax, which in turn is obtained with no other means of production than land. Let us suppose that the quantity of flax produced in a particular year equals the quantity employed in the same year in the cloth industry. The quantity of cloth produced represents the net revenue obtained in the two stages of its production, the

quantity of flax produced being required for replacing the quantity employed in the production of the cloth. To state that no such deduction is necessary does indeed amount to treating the matter as if the cloth were produced in the second half of the year employing the flax produced in the first half—so that no flax existed either at the beginning or at the end of the year.

Let us now consider Smith's view of the accumulation of capital. In book 2, chapter 3 of the *Wealth of Nations* (namely, in the same chapter in which Smith states that the annual produce 'naturally divides itself into two parts') we find the well-known passages where investment is described as consisting entirely of necessaries advanced to productive labourers, and not also of means of production:

> Whatever a person saves from his revenue he adds to his capital, and either employs it himself in maintaining an additional number of productive hands, or enables some other person to do so, by lending it to him for an interest, that is, for a share of the profits.
>
> (*WN*, II. iii. 15)

> What is annually saved is as regularly consumed as what is annually spent, and nearly at the same time too; but it is consumed by a different set of people…. The consumption is the same, but the consumers are different.
>
> (*WN*, II. iii. 18)

In order to throw some light on this peculiar view of capital and investment as differing in composition—the latter consisting entirely of necessaries although the former is made up of both necessaries and means of production—let us suppose that it is decided to increase in a permanent manner the production of cloth, and that in order to do so a prior increase in the production of flax is required (the existing stocks of flax being just sufficient for the old level of cloth production). More labourers must therefore be employed in the production of flax and, one year later, in the production of cloth. It may indeed seem that the investment made in each of the two years consists only in the necessaries advanced to an extra number of labourers. However, this is only true of the first year's investment. Thanks to this investment the society's net revenue is in fact increased by a certain amount of flax, which together with the new wage advances goes to make up the investment required in the second year to increase the production of cloth. And this part of the saved revenue, which exists materially in the form of flax, certainly cannot be said to be consumed by anyone. Indeed, it is only if the cloth goes through both stages of its production in the same year, that the necessaries advanced to the additional labourers employed can be said to represent the only investment required.

(If the stocks of flax kept by the producers of cloth are large enough to allow for an immediate rise of production to the level desired, such a rise can be obtained by employing an additional number of labourers in the cloth industry, while *at the same time* an additional number of labourers are also employed in the production of flax. The increase in the latter production must, however, be such as not only to replace the larger quantity of flax transformed into cloth, but to make the stocks of flax adequate to the new level of cloth production—as they assumedly were to the old at the beginning of the

story. The resulting *increase* in the stocks of flax[11] forms part of both the net revenue and the saving of the society.)

6 Further observations on productive and unproductive labour

There is a certain ambiguity in Smith's statement that productive labour is such that 'it produces a value' (see section 3 above), since it appears to open up the 'productive' qualification not only to the labourers engaged in the production of material goods, but also to those supplying *services intended for sale*. The problem is raised by Marx, who offers as one example an actor hired by a theatrical impresario (see Marx 1905–10:I, 157). The actor's services disappear, just like those of Smith's menial servants, 'in the very instant of their performance'. However, they leave '[a] trace behind them'—the takings—'for which an equal quantity of service could afterwards be procured'. And this, according to Smith, is typical of productive labour.

The conclusion Marx draws is that the criterion according to which labour producing material goods is productive and labour going into the supply of services unproductive, is not the only one to be found in the *Wealth of Nations*. He holds that a second criterion can also be discerned, according to which labour, whether it produces material goods or supplies services, is productive provided that the goods or services in question are intended for sale (see *ibid.:* I, 155–74). If we disregard independent labour, this second criterion can be reformulated, defining labour as productive when it is exchanged for capital and unproductive when it is exchanged for revenue (directly or through the payment of taxes). It is in fact in these terms that Marx states (and adopts) the second criterion. The typical menial servant (as we shall see, there are also atypical ones) is an unproductive labourer according to both the first criterion (since he or she supplies a service) and the second (since the service in question is immediately enjoyed by whoever maintains the menial servant with his or her revenue). The actor referred to by Marx, in contrast, is unproductive according to the first criterion and productive according to the second, the service he supplies being intended for sale (and his labour being exchanged for the impresario's capital).

The case of a cook employed by a family (another example offered by Marx; see *ibid.*:I, 165) reverses the actor's pattern. The cook is a productive labourer according to the first criterion and unproductive according to the second. The dishes she cooks are as tangible as the meals served in an inn but, unlike them, they are not what Smith describes as 'vendible commodities'. Marx suggests that it is in fact the second criterion (whether or not the goods produced or the services supplied are intended for sale) that Smith applies when, without further qualification, he defines the labour of menial servants as unproductive.

Let us first consider labour producing material goods for immediate consumption (not only of those maintaining the labourers, but also of the labourers themselves—the production of foodstuffs as also of yarn, textiles and clothing by a peasant family being a case in point). The fact that Smith makes no mention at all of this type of labour leaves room for various interpretations. He might consider it productive—of wealth, but also of value: as Marx (*ibid:* I, 164–5) points out, an object not intended for sale is not by this token devoid of value, and may eventually be sold should the need arise—without taking

account of (or giving much weight to) the fact that in some cases this productive labour is carried out by labourers belonging to a category (that of menial servants) to which he applies the blanket label of unproductive.[12] Or it may be that this type of labour simply fails to find any place in Smith's taxonomy. (Quite possibly, it is the fact that production for immediate consumption has little relevance to his analysis that leads him to disregard it: in society as conceived in the *Wealth of Nations* the material goods produced are *normally* intended for sale—and services *normally* not.)

However, let us, for the sake of discussion, follow Marx in crediting Smith with the opinion that labourers producing material goods are to be considered unproductive when their products are not to be sold (or when their labour is exchanged for revenue). There would still be no grounds for attributing him with the reverse idea, namely, that labourers supplying services are productive provided their services are intended for sale (or their labour is exchanged for capital).

Moreover, Smith explicitly takes account of the possibility that the services of unproductive labourers might be put on sale, and the case he considers is in fact that of the actors. Taking the case of a man who goes to the theatre, Smith states that he 'contribute[s] his share towards maintaining one set of unproductive labourers' (*WN*, II. iii. 7)—thus making clear beyond any doubt that in his view the actors remain unproductive labourers although their services are put on sale. Smith does not mention whether the takings are collected by the actors themselves or by an impresario, but in the latter case the only opinion one can reasonably attribute him with is that the impresario, exactly like the actors, is maintained 'by a part of the annual produce of the industry of other people' (see section 3 above).

The conclusion we come to is, therefore, that there are in fact no grounds for reading into the *Wealth of Nations* the concept of productive labour as labour exchanged for capital—whether it produces material goods or supplies services. The production of material goods is, in Smith's opinion, a necessary condition for a given type of labour to be considered productive. Nevertheless, attributing him with a twofold concept of productive labour brings out (and derives from) a real ambiguity in his position, and that is precisely the ambiguity we pointed out at the opening of this section and which we shall now attempt to account for.

When Smith states that investment gives rise to a sort of 'perpetual fund' serving for the maintenance of productive labourers (see section 3 above), he is not contemplating a *fund of necessaries*—perpetuated through the reproduction of the commodities it consists of—but a *fund of value*—perpetuated through the sale of the products. Approaching the problem in this way, and stating that a labourer is productive in that 'he produces a value', Smith does not take the viewpoint of society as a whole (as in fact he does when he states that the unproductive labourers are maintained by a part of the annual produce of somebody else's labour), but that of the investor who employs his capital.

He is unable to see that in the case of labourers supplying services intended for sale these two viewpoints come into conflict (as he himself realizes they do, for example, in the case of a house-owner letting a dwelling which brings him in revenue, but from which 'the revenue of the whole body of the people can never be in the smallest degree increased'; *WN*, II. i. 12), since in his opinion the only way society has of procuring wealth—i.e. employing productive labourers—is also the only way for the individual investor to do so: 'Whatever part of his stock a man employs as a capital, he always

expects it to be replaced to him with a profit. He employs it, therefore, in maintaining productive hands only' (*WN*, II. iii. 6).

Clearly, the example of the actor hired by an impresario contradicts the above statement, compelling one to admit that capital may also be used to maintain unproductive labourers, or in other words that it is possible to realize profits without occasioning any increase in the wealth of society. However, the fact that the two viewpoints—of the individual investor and of society as a whole—do not match perfectly is not only of little practical importance (the fact remaining that in Smith's world profits are made *almost* solely by maintaining productive labourers), but has also less momentous conceptual consequences than Marx supposes (for, as we have seen, Smith's opinion that capital is exchanged only for productive labour—i.e. labour producing material goods—is quite a long way from the idea that Marx reads into his work, i.e. that when exchanged for capital, labour is by this very token to be considered productive).

Notes

1 In each stage of production we include all the production processes occurring *at the same distance* from the 'final' stage, i.e. from the direct production of the commodity we are considering. (Both the production of 'labouring cattle' and that of 'other instruments of husbandry' belong to the penultimate stage of the production of corn in Smith's example.) Thus the initial stage of production of any given commodity coincides with the *most distant* among the initial stages of production of its means of production.

2 The profit received in each stage of production, Smith points out, exceeds that received in the preceding one ('every subsequent profit is greater than the foregoing'), the reason being that 'the capital from which it is derived must always be greater. The capital which employs the weavers, for example, must be greater than that which employs the spinners; because it not only replaces that capital with its profits, but pays, besides, the wages of the weavers' (*WN*, I. vi. 11).

3'The actual structure of the present-day economic system', W.Leontief observes, 'is anything but linear. The mutual interrelation of industries is anything but that of simple vertical succession and—what is particularly important—that initial stage characterized by exclusive application of the "original factors of production" is non existent. If Böhm-Bawerk did actually set out in search of this hypothetical first stage, he would find himself now still on the road' (Leontief 1938:4). Where Leontief writes Böhm-Bawerk we can safely read Adam Smith.

4 It is only in 'popular language', Ricardo protests, that 'rent' is taken as 'whatever is annually paid by the farmer to his landlord'. Strictly speaking, 'rent' covers only payment 'for the use of the original and indestructible powers of the soil' (Ricardo 1821:67).

5 The passage is quoted at greater length in section 4 below.

6 Ricardo—who systematically uses the expressions 'net revenue', 'net income' to denote the sum of profits and rents—reproaches Smith with 'constantly magni-f[ying] the advantages which a country derives from a large gross, rather than a large net income', when '[i]ts power of supporting fleets and armies, and all species of unproductive labour, must be in proportion to its net, and not to its gross income' (Ricardo 1821:347, 348). Curiously enough, however, Smith himself points out that the 'real wealth' of the inhabitants of a country 'is in proportion, not to their gross, but to their neat revenue' (*WN*, II. ii. 5). It may well be that Ricardo failed to notice such a clear-cut magnification of net revenue, but it appears far more likely that he chose to overlook it, being fully aware that the 'neat revenue' Smith refers to does not coincide with the sum of profits and rents.

7 Here Smith seems to be forgetting that a part of the circulating capital is employed in augmenting, and not only in maintaining the fixed capital and in maintaining and augmenting the stock of money. ('All useful machines and instruments of trade are originally derived from a circulating capital, which furnishes the materials of which they are made, and the maintenance of the workmen who make them. They require too a capital of the same kind to keep them in constant repair'; *WN*, II. i. 24. This also applies to the stock of money; see *WN*, II. ii. 13.)

8 'But in other sorts of labour'—Smith continues—'both the price and the produce go to this stock, the price to that of the workmen, the produce to that of other people, whose subsistence, conveniencies, and amusements, are augmented by the labour of those workmen' (*WW*, II. ii. 6).

9 How is it possible, Marx wonders, for the net produce, or the sum of wages, profits and rents, to be equal to the value of the commodities produced, which, in addition to these three component parts, contains a fourth part, namely the value of the means of production? 'How can a value of four be bought with a value of three?' (Marx 1894:982). Smith, says Marx, provides no better answer than 'the maxim that what appears as revenue for one person forms capital for another', with which, he seems to believe, '[a]ll further consideration is rendered unnecessary' (*ibid.*:981).

10 The point is admittedly of little intrinsic interest for those who deny the existence of an initial stage in the production of commodities. However, failing, as Marx does, to take account of it in an examination of Smith's position may prove misleading.

11 If the increase in the production of flax were no more than sufficient to replace the quantity actually used up, and the production of cloth were to continue from then on with the new, reduced level of inventories-to-output ratio, this would be properly described as a switch to a new (less flexible) method of production.

12 To be *very* precise, we might in fact question whether Smith declares all the labour of menial servants unproductive *without any exceptions*. Menial services, he points out in a passage we have already seen, '*generally* perish in the very instant of their performance, and *seldom* leave any trace behind them, for which an equal quantity of service could afterwards be procured' (see section 3 above). The adverbs printed here in italics might mean—as Marx takes it—that menial servants are unproductive even when producing material commodities, and that therefore 'neither the special characteristics of the labour employed, nor the external form of its product necessarily make it "productive" or "unproductive"' (Marx 1905–10:1, 165). But they might equally well imply that Smith sees menial servants as being *generally* unproductive labourers, and only *seldom* productive labourers.

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The quotations from the ‘Wealth of Nations’ *(WN)* are drawn from the Glasgow Edition of the Works and Correpondence of Adam Smith.

9
The notion of the subsistence wage in pre-Smithian classical political economy

Some reflections inspired by the surplus approach

Tony Aspromourgos and Peter Groenewegen

1 Introduction

Garegnani (1983; 1984; 1987; 1989) has done much to demonstrate the importance of the classical approach to wage theory as a feature distinguishing it from marginalist economics in its analysis of the problem of value and distribution. Their approach to wage theory, in many respects relying on an exogenously determined wage, nevertheless constitutes part of the core of the basic 'surplus approach' to economic analysis.[1] Given net social product, aggregate wages for the classical economists are taken to be sufficient to determine the surplus product of the economy in the form of shares other than wages, that is, profit, interest and rent. In addition, the classical approach to wages leaves room for the possibility of unemployment in the analysis, even when the natural wage rate rules in their system. Such an approach to wages, Garegnani (1989:118) emphatically points out, stands in strong contrast to subsequent wage theories based, as they generally tend to be, on a form of supply and demand analysis. The classical view amounts to an entirely different relationship between income distribution and relative prices—an element of *independence* of distribution from relative prices ('value through exogenous distribution'—Bharadwaj 1963); and, at the same time, an essential interdependence between wages as a distributional variable and commodity prices. These distinctive features of classical wage theory emphasise the relevance of the first part of our title, *pre-Smithian* classical political economy, since they occurred in preliminary form well before 1776.

Before the relevance of that emphasis can be demonstrated, the notion of classical political economy needs some comment. For many historians of economics, and for those familiar with the run-of-the-mill histories of economics, classical economics is seen as a largely British phenomenon, the dominant form of economics for the first half of the nineteenth century. Classical economics is seen to start with the path-breaking work of Adam Smith, and to conclude with the system of political economy developed by John Stuart Mill in his *Principles of Political Economy* (1848 in the first edition, 1871 for the seventh and last) or, in some cases, with the final defence of the Millian system by J.E.

Cairnes during the late 1870s. This conveniently enables Smith's predecessors to be labelled as non-classical, as mere precursors or pre-Adamites, a type of classification which enables a particular slant to be placed on the interpretation of Smith, and to ignore the many important non-British contributions which Smith, a cosmopolitan and citizen of the world, gratefully absorbed into his system. This view, moreover, glosses over the other meanings which have been ascribed to classical political economy: that by Marx, that by Keynes, and, in the wake of Sraffa (1960), that which bases itself on the surplus approach as the central framework of classical doctrine with respect to distribution (cf. Pivetti 1987: esp. 872). Of these, Marx's approach in particular, and to a lesser extent, the surplus approach to classical political economy, have the quality of embracing the tradition in economic literature prior to Adam Smith, more specifically in the case of Marx, commencing the period of classical political economy with Sir William Petty in England and Boisguilbert in France at the end of the seventeenth century. This gives classical political economy a virtual century of history before one of its great peaks, Adam Smith's *Wealth of Nations* (see Marx 1859:56 and, for a detailed discussion, Groenewegen 1987). For the purposes of this paper, the Marxian perspective on the history of classical political economy is particularly pertinent since it allows a discussion of both the British and the French economic literature on the subject of wage theory before Adam Smith's treatise was published in 1776.

Some further remark needs to be made by way of introduction. Much of the focus in this discussion of pre-Smithian classical wage theory is on the conceptualisation, and application, of the subsistence wage in that literature in both France and England. The first section of the paper looks at the idea of the subsistence wage in the general literature of economics in the century from 1650 and at the limited use which was made of it in these writings. This sets the stage for a more detailed examination in the second section of a number of selected authors (Petty, Cantillon, Steuart) who can be said to have developed the notion of a subsistence wage in the context of an economic system based in essence on the surplus approach. A third section looks at three French post-1650 contributions to the concept of a subsistence wage. A fourth and final section offers some conclusions. The chapter's thrust falls within Garegnani's research questions (see Garegnani 1989:118) which stressed the need for more detailed examination of the more formative stage in the classical theories of wages before Adam Smith.

It may likewise be useful to identify the various stages in which a relationship between subsistence and surplus can be examined. A good starting point is to separate the notion of subsistence from wages. The surplus can then be identified without any reference to wages by the simple subtraction from the product of the necessary consumption (subsistence) of the workers who are required in the production of that product. The analysis is then firmly placed within the sphere of production. An additional step then becomes possible, establishing the proposition that the wages of labour tend to equality with the value of subsistence. This enables emergence of the classical connection between production and distribution, and allocation of the surplus becomes synonymous with the distribution of non-wage income (interest, profits, rent, and in some cases, entrepreneurial income). Principles additional to the identification (or determination) of wages with (by) subsistence are required to explain the distribution of the surplus between profits, entrepreneurial income, interest, rent and taxes. This conceptual framework of the relationship between subsistence and surplus allows a different

explanation of content ordering. Section 2 looks at aspects of the second stage; identification of wages with subsistence, in arguments which are generally independent of the first stage. Sections 3 and 4 discuss authors who had tended to cover the first two stages of the argument in varying degrees, and some of whom, towards the end of the period, had begun to tackle the third stage. Of the latter, Turgot is the leading example.

2 Primitive views on subsistence and wages

The notion of an association between the labourer's wage and cost of living came easily in societies with a long tradition of wage setting in accordance with movements in the price of provisions. In Medieval, Tudor and early Stuart England, 'wage fixing had to be carried out in a manner closely resembling the modern calculations of a rise in the cost of living, by referring to "the prices of all kinds of victuals, full rayment and apparel, both linnen and woollen and also of house rent"' (Heckscher 1955:229; cf. Furniss 1920:43–44, 164–73; Lipson 1956: vol. III, 271–77; and the statutes reprinted in Bland *et al.* 1914:329, 342). France had a similar tradition of wage setting in terms of food prices, and of supplementary, regional controls over the price of bread, which lasted longer than their British counterpart.

The simple subsistence theory of wages rested on the proposition that there existed a straightforward direct relationship between the rate of wages and the prices of provisions. If money wages were high, it was only a result of the high prices workmen paid for the necessities needed for their living; and if these prices fell, then wages would fall as a necessary consequence. Anything that caused the price of provisions to change, whether from tax rises, restraints on trade or natural causes such as harvest failure, subsequently induced a change in wages.

That this simple relationship existed in the period as an explanation of the causes of high or low wages can be seen from the following quotations:

> the hire of Labourers and Servants carrieth with it a resultance of the prices of all things necessary for a man's life.
>
> (Rice Vaughan 1675:108, cf. 105)

> As the food and rayment of the poor is made dear by Excise, so doth the price of their labour rise in proportion.
>
> (Mun 664:102)

> If malt, coals, leather, and other things bear a great price, the wages of servants, workmen, and artificers, will consequently rise.
>
> (Davenant 1696:vol. II, 199)

> We must consider that Wages must bear a rate in all Nations according to the Price of Provisions, when Wheat is sold for one Shilling *per* Bushel, and all things suitably, a labouring Man may work for three Pence *per diem*, as well as can for twelve Pence, when it is sold for four shillings …you cannot fall Wages, unless you fall Products.

(Cary 1695:144–5)

> the different Cheapness or Dearness of Provisions in several Countries, must be allowed to make amends for different Wages.
>
> (Fleetwood 1707:165)

> Where Provisions are dear, Work and Wages will rise in Proportion and…should a *Fishery* make Provisions in *England* but one tenth part cheaper, Wages would fall in proportion.
>
> (Puckle 1707:40, 42, cf. 44)

> Rates of Labour are always settled and constituted of the Price of Victuals and Drink.
>
> (Vanderlint 1734:6)

> all Wages must be proportioned to the Price of the Necessaries of Life.
>
> (Lindsay 1733:36)

> For the *Incomes* of such Families are the *Measure* of their *expences;* and they cannot *eat, drink,* or *wear* more in a Year, than they earn in that Time, so that if the intended *Tax* should be laid, and their *Wages* are to continue at the *same Rates* as heretofore, nothing can be plainer, or more certain than that all Money which such a *Tax* would cause to be taken more than usual out of their *Incomes, must be PINCHED* from the *BELLIES* and *BACKS* of the *Labouring Families,* whose wages, as Matters now stand, do but barely provide them with *Necessary Meat, Drink, Cloathing, Firing, etc*.
>
> (Massie 1760:10)

> Flesh-meat was tolerably cheap, before bread became dear, but now both stand at a pretty high rate, and of consequence must proportionably raise the price of labour.
>
> (Anonymous 1758:23)

Several quotations from the opinions just cited mention the frequent outcries against the dearness of provisions in times of harvest failure, such as those which occurred in 1757–59 and 1766–68. Others referred to the impact on wage rates of an excise on the necessities consumed by the poor. This concern was sometimes on humanitarian grounds, but more generally was inspired by a desire to safeguard the export trade from the uncompetitiveness of high wages.

Real analytical depth embodied in this causal relationship between provision prices and wages was generally missing. There was little awareness of the forces which determined the prices of provision apart from the immediate causes such as tax increases, harvest failure and import prohibitions which induced the complaints. Nor was the relationship analytically used to heighten understanding of the economic system. An exception is Child (1690) who built in a migratory population mechanism to explain

wage levels, as well as a link between population, employment opportunities and wage levels. 'For much want of People would procure greater Wages; and greater Wages if our Laws have encouragement, would procure us a supply of People without the charge of breeding them' (Child 1690:175); or, alternatively:

> Such as our employment is for People, so many will our People be; and if we should imagine we have in England employment but for one hundred People, and have born and bred amongst us one hundred and fifty people, I say, the fifty must away from here, or starved, or be hanged to prevent it, whether we had any foreign Plantations or not.
>
> (Child 1690:174)

However, these remarks were not integrated into a consistent theory of wage determination in terms of subsistence. Another exception can be found in the work of Locke, who used the assumption of a subsistence wage in his argument designed to demonstrate that the ultimate incidence of all taxes was on the landlord who paid it from rent:

> The Poor Labourer and handicraftsman cannot [bear this increase in Taxes]; for he just lives from hand to mouth already, and all his Food, Clothing, and Utensils, costing a quarter more than they did before, either his Wages must rise with the Price of things, to make him live, or else, not being able to maintain himself and his Family by his labour, he comes to the Parish and then the Land bears the burden in a heavier way.
>
> (Locke 1696:92)

If the wages of labour were regulated by the need for subsistence, a tax could not effectively be placed on labourers. They would pass it on; either through wage increases, or else through demands for poor relief, whose burden via the poor rates would fall on landlords. The direct, or indirect, effects of the tax-induced wage increases would likewise impact on landlords' incomes, either through the rise in prices following on a rise in wages for the commodities landlords consumed, or through a rising wage bill for the domestic servants and retainers they hired. The analytical importance of the subsistence wage assumption for this tax incidence result perceived by Locke at the end of the seventeenth century, was grasped equally by the Physiocrats in their analysis of the efficiency of a single, direct tax on net product, and by their contemporary Steuart. Its analytical importance was also implied in the work of Petty and more strongly, Cantillon. This is discussed in the subsequent sections.

Tax incidence analysis, implicitly in the case of Locke, and more explicitly in that of some subsequent writers, raises the issue of surplus in relation to the subsistence wage. A number of British authors of the seventeenth and eighteenth centuries grasped, in varying degrees, the analytical importance of a given subsistence wage for the determination, allocation and distribution of the economic surplus. Their contributions, qualitatively distinctly superior to the simple views looked at in this section, can now be considered.

3 Petty, Cantillon and Steuart

The central conceptual significance of subsistence in early and mature classical economics is that it provides a fundamental link between production on the one hand, and functional income distribution on the other. Subsistence is identified with the necessary consumption of labour employed in production—this consumption per worker per given time period is the means of reproducing the workforce through time. In this sense, the notion of subsistence itself signifies a kind of production process for labour. The economic system's gross outputs net of direct commodity inputs defines 'net product' as commonly understood; net product net of total labour subsistence defines the social surplus. Hence with regard to production, the notion of subsistence is essential to conceptualising the surplus. Then, if a critical supposition can be added—that the purchasing power of the wages of labour is equatable with subsistence—a direct and clear-cut connection between the social surplus and income distribution can be drawn. Assuming that competition of some kind ensures a uniformity of prices and wages of homogeneous commodities and labour through time—and that production costs are at least covered by prices—then the surplus is realised as non-wage income. That is to say, if the production system produces a surplus, and wages are restricted to subsistence, then prices must allow non-wage income—which is just the point Sraffa (1960:3–10) makes concerning the transition from pricing in a subsistence system, to pricing with production of a surplus. The question of the allocation of the surplus then becomes synonymous with the question of the distribution of non-wage income.

It seems evident enough that William Petty's seminal articulation of a notion of economic surplus is closely connected with a selfconscious methodological stance—derived primarily from Hobbes—which is guided by objectivism, economism and a thoroughgoing commitment to mathematics as the model for rational inquiry (See Aspromourgos 1996: Ch. 4). Indeed, the very notion of a set of physical quantities of commodities (subsistence) which may be treated as given, for the purposes of an economic inquiry, is an expression of an objectivist stance—pointing as it does towards a social characterisation of consumption, *contra* the particular methodological individualism of post-classical marginalism which treats consumption as individually idiosyncratic, save for its logical structure. More particularly, in this the earliest account of surplus with analytical significance, subsistence is conceived as a *social* datum not a physiological one: 'sugar, tobacco and pepper, which custom hath now made necessary to all sorts of people'; 'climate disposes men to a necessity of spending more or less'; subsistence understood as 'the easiest-gotten food of the respective countries of the world'—oatmeal (Ireland), rice (India), and so on (Hull 1899:90, 181, 275).[2] Not invisible, and *impossible to observe*, 'preferences', but observable social behaviour, is the point of departure for analysis. In its most abstract form this approach enabled Petty to define the social surplus by deducting from gross product a single physical magnitude. This he could do by assuming (in an engagingly quaint and selfconscious way) that necessary labour consumption is constituted by a single commodity, homogeneous with the output of a particular sector or activity:

> I premise these suppositions: First…suppose there be in a territory a thousand people. Let these people be supposed sufficient to till this whole

> territory as to the husbandry of corn, which we will suppose to contain all necessaries for life, as in the Lord's Prayer we suppose the word 'bread' doth…. Suppose…that a tenth part of this land, and tenth of the people, *viz.* an hundred of them, can produce corn enough for the whole.
>
> (Hull 1899:89; also 30–31, 42–44, 50–51)

This novel construction was noticed by the young Sraffa (1925:324 n; also 279), who noted also that it had caught the attention of Alfred Marshall. It amounts to a production system which employs just one basic commodity.

In Petty, the notion of surplus is deployed for both explanatory and normative purposes. The world Petty's theory and doctrine inhabit is entirely precapitalist. His primitive treatment of the relation between surplus and incomes has ground rents and tax revenues as the income forms in which surplus is realised. Profits on capital advanced are nowhere to be found. The major purpose to which the surplus theory is devoted is analysis of labour allocation in society and extensive proposals for economic reform (i.e., proposals to *re*allocate social labour). In one such discussion Petty notes that the burden of the church on the social product could be substantially reduced by restoring celibacy to the English clergy; making the observation that:

> forasmuch as there be more males than females in England…it were good for the ministers to return to their celibacy…. And then our unmarried parson might live as well with half, as now with the whole, of his benefice.
>
> (Hull 1899:25; also 73, 79–80)

Any doubt that this is intended facetiously is dispelled by a knowledge of Petty's temperament (see Aspromourgos 1996: Ch. 2). Furthermore, in the context of his famous (or infamous) political arithmetic, Petty actually makes some attempts to empirically measure surplus product, surplus labour and surplus land:

> The moderate labour of 12 million, not over…12 hours per diem upon necessary business, will so cultivate 72 million of acres as to be sufficient maintenance for 19 millions of people;…3 acres, 2 thirds [of land] well cultivated, will maintain…at a medium of man, woman and children.[3]
>
> 18,000,000 of acres, 3,500,000 boves, 1,000,000 of sheep and 300,000 people may feed 1,200,000 [in Ireland]; and consequently…there being 1,200,000 in all…900,000 are spare hands and may be employed to luxury, ornament, war sciences, superstitions [i.e., religion] etc.
>
> (Matsukawa 1977:45–47)[4]

With regard to wages and subsistence in particular, the precapitalist character of Petty's thought is manifest in his comments on regulation of wages:

> if it were proclaimed that labourers' wages…should not rise at all upon…[a doubling of money prices], then would this Act be as only a tax upon the said labourers, as forcing them to lose half their wages; which

> would not be only unjust but impossible, unless they could live with the said half (which is not to be supposed). For then the law that appoints such wages were ill made, which should allow the labourer but just wherewithall to live. For if you allow double then he works but half so much as he could have done and otherwise would;[5] which is a loss to the Public of the fruit of so much labour.
>
> (Hull 1899:87)

> It is observed by clothiers and others who employ great numbers of poor people, that when corn is extremely plentiful, that the labour of the poor is proportionably dear and scarce to be had at all (so licentious are they who labour only to eat, or rather to drink[6]). Wherefore, when so many acres sown with corn, as do usually produce a sufficient store for the nation, shall produce perhaps double to what is expected or necessary, it seems not unreasonable that this common blessing of God should be applied to the common good of all people, represented by their sovereign; much rather than the same should be abused by the vile and brutish part of mankind.
>
> (Hull 1899:274–75)

> Now the price of labour must be certain (as we see it made by the Statutes which limit the day-wages of several workmen); the non-observance of which laws, and the not adapting them to the change of times, is by the way very dangerous, and confusive to all endeavours of bettering the trade of the nation.
>
> (Hull 1899:52; also 30–31, 118–19, 220 with 299)

Petty's regulatory views amount to keeping the hourly or daily real wage at a rate which stabilises labour supply at desirable levels—either by targeting the corn price or adjusting the money wage.

Where Petty's corpus of published writings consists of a collection of tracts—albeit with a considerable underlying unity of doctrine and purpose—Cantillon's extant contribution to economics consists of a single work, which is a genuine treatise. Here the treatment of wages and subsistence leaves absolutely no doubt concerning the social and conventional character of necessary labour consumption. For now customary consumption is not only historically and geographically determined, but also *class* determined. That is to say, there are *multiple* customary subsistences at any particular time and place, with a different consumption for different categories of labour. In a striking illustration of this in relation to consumption and human reproduction, Cantillon observes:

> most men desire nothing better than to marry if they are set in a position to keep their Families in the same style as they are content to live themselves. That is, if a Man is satisfied with the produce of an Acre and a half of Land he will marry if he is sure of having enough to keep his Family in the same way. But if he is only satisfied with the produce of 5

> to 10 Acres he will be in no hurry to marry unless he thinks he can bring up his Family in the same manner.
>
> [with regard to the Nobility,] as the largest share of the Property is usually given to the Eldest sons, the younger Sons are in no hurry to marry…
>
> In the lower classes…most…would consider themselves to do an injustice to their Children if they brought them up to fall into a lower class than themselves…. All the lower orders wish to live and bring up Children who can live like themselves.
>
> (Cantillon 1755:77–79)

This notion of multiple subsistence and 'class reproduction' (so to speak) raises the question of *who* is necessary for production in Cantillon's scheme of thinking; that is to say, what categories of labour (and hence also their customary subsistence) constitute necessary input to the production system, and what labour or activities (and hence also their consumption, subsistence or otherwise) are surplus. The issue is complicated by the fact that, unlike in Petty, in Cantillon profits begin to enter the economic picture in a systematic manner. But these profits are not the profits of capital advanced; rather, they are profits of entrepreneurship, and in particular, of risk-bearing. Entrepreneurship for Cantillon is linked with non-wage income other than rents, interest receipts and taxes. The profits of entrepreneurship are linked with self-employment: 'Undertakers[7] of all kinds adjust themselves to risks…[and] live at uncertainty'; 'except the Prince and the proprietors of Land, all the Inhabitants of a State…can be divided into two classes, Undertakers and Hired people;…all the Undertakers are as it were on unfixed wages and the others on wages fixed so long as they receive them' (Cantillon 1755:53–55). Hence farmers are entrepreneurs, as—for example—are chimney-sweeps and water carriers; whereas generals and courtiers are hired labourers (Cantillon 1755:43–55). The precise domain of the surplus and its correspondence with income distribution thereby become somewhat unclear. Are entrepreneurial incomes—in particular, farmers' incomes—to be associated with the social surplus or not? The best judgement one can form on the basis of Cantillon's text is that they are not, with the surplus accruing exclusively as rents, taxes and interest payments (see Aspromourgos 1996: section 7.3).

The conception of subsistence wages as the means of reproduction of a (heterogeneous) labour force is brought into sharp focus in Cantillon's conception of a parity of value between land input and labour input in production. In essence, this equation involves Cantillon determining the quantities of land required to reproduce each category of labour, in the sense of the quantities of land required to produce their customary (subsistence) consumption (see Cantillon 1755:31–43; Aspromourgos 1996:Ch. 6, esp. section 6.2). In other words, it is a reduction of labour (as a reproducible input) to a quantity of land—in Cantillon's system, implicitly the only primary input. This is evident in Cantillon's conception of value as being determined by direct and indirect land input:

> the intrinsic value of any thing may be measured by the quantity of Land used in its production and the quantity of labour which enters into it, in

> other words by the quantity of Land of which the produce is allotted to those who have worked upon it.
>
> (Cantillon 1755:41)

The land value of labour—that is, the land input directly and indirectly required to produce customary labour subsistence—is a measure of the real cost of labour reproduction, with the price of labour (the money wage) equal to cost of production (the money price of customary subsistence) (Cantillon 1755:19–21, 123–25, 177). Cantillon makes this notion of cost-of-labour-reproduction most explicit with respect to slaves, by comparing them to cattle; but analytically, the value of non-slave labour is formulated in exactly the same way as for slave labour.[8] As to the *content* of subsistence, Cantillon generally seems to identify it with the product of a vertically integrated rural sector which includes production of its own manufactured inputs to agricultural output (Aspromourgos 1996:80).

Steuart is a figure contemporaneous with Adam Smith, though the development of Steuart's theory of distribution and value is more really contemporaneous with Quesnay. Here there is what appears to be a departure from the doctrine of subsistence wages; but whether this marks an *advance* upon the achievements of Petty and Cantillon is another matter. The *Inquiry into the Principles of Political Oeconomy* (1767) is often ambivalent and somewhat obscure on the issue of the relation between wages and subsistence (see Aspromourgos 1996: Ch. 8). Certainly Steuart articulates a clear conception of subsistence (with agriculture the primary element), and its social or conventional character. This he does by drawing a distinction between '*physical-necessary*' and '*political-necessary*'. The former is defined as '*ample subsistence where no degree of superfluity is implied*'. On the other hand, political-necessary, which varies according to social rank, is conventional:

> The nature of man furnishes him with some desires relative to his wants, which do not proceed from his animal oeconomy, but which are entirely similar to them in their effects. These proceed from the affections of his mind, are formed by habit and education, and when once *regularly established,* create another kind of necessary.
>
> (Steuart 1767:269–70; cf. 155)

As in Cantillon, there are multiple customary subsistences. Steuart seems to expect the wages of the majority of labourers to be governed by physical subsistence, though by no means all, where physical subsistence is itself divided into three classes:

> it is requisite that the individual of the most puny constitution for labour and industry, and of the most slender genius for works of ingenuity… should be able…to gain the *lowest* degree of the physical-necessary; for in this case, by far the greatest part of the industrious will be found in the second [middle] class, and the strong and healthy all in the first [highest].
>
> The difference between the highest class and the lowest, I do not apprehend to be very great….

> What we mean by *the first class* of the physical-necessary, is…[what] a strong healthy person should be able to gain by the exercise of the lowest denominations of industrious labour, and without a possibility of being deprived of it, by the competition of others of the same profession.
>
> Farther…this *physical-necessary* ought to be the highest degree of ease, which any one should be able to acquire with labour and industry, where no peculiar ingenuity is required…. The *physical-necessary*, therefore, ought to be the reward of *labour* and *industry;* whatever any workman gains above this standard, ought to be in consequence of his superior *ingenuity*.
>
> (Steuart 1767:272–74; cf. 114–16, 269–76, 297, 302, 377–78, 400–1, 681).

It would be possible, in one sense, to perceive this ambivalence concerning the confluence of subsistence and wages as analytical progress: to the extent that wages are being uncoupled, to some extent, from subsistence, labourers are no longer merely being theorised like cattle (or horses—Steuart 1767:401). But what seems more significant concerning the relation between wages and subsistence in Steuart is that the ambivalence is an expression of a deep problem which renders his *magnum opus* qualitatively and decisively inferior to that of Adam Smith in this regard. Steuart draws no clear functional distinction between labour and capital, and hence, nor between wages and profits. Indeed, he really has no theory of capital at all. The 'profits' which appear in the *Principles* are really the profits of artisans, craftsmen, merchants and traders; and so are largely the profits of species *of labour:* 'the price of a manufacture is to be known by the expense of living of the workman, the sum it costs him to bring his work to perfection, and his reasonable profit' (Steuart 1767:340). In this sense, (surplus) wages and profits become interchangeable terms (for example, Steuart 1767:161, 288, 684, 695).

This failure analytically to distinguish wages and profits in an adequate manner manifests itself also in another, and quite striking, line of argument which Steuart pursues concerning distribution and subsistence, and which is worth noting here. Steuart raises the possibility that customary subsistence might itself become a function of above-normal wages (or 'profits' as quasiwages):

> if the scale of demand…keeps profits high…not only the immediate seller of the goods, but also every one who has contributed to the manufacture, will insist upon sharing these new profits…and by such profits subsisting for a long time, they insensibly become *consolidated*…into the intrinsic value[9] of the goods…. [T]hese profits become, by long habit, virtually *consolidated with* the real value[10] of the merchandize.
>
> so soon as…profits become *consolidated* with the intrinsic value, they…cease to have the advantage of profits, and, becoming in a manner necessary to the existence of the goods, will cease to be considered as advantageous.
>
> [One cause of high price is] consolidation of high profits with…real value…. This cause operates in countries where luxury has gained ground, and where domestic competition has called off too many of the hands.

(Steuart 1767:192–93, 194, 246; cf. 204, 240, 248–52, 259, 684, 695)

Profits are metamorphosed, so to speak, into customary necessary consumption and hence production costs of commodities. Garegnani (1984:320 n. 49) raises a similar issue, concerning the possible dependence of subsistence upon market wages—though in his case it is deployed as an implied critique of classical closure (the notion of a 'natural' real wage with respect to which market wages are regulated). In Steuart's case, 'consolidation' leads to no alternative closure—in fact, he is left with a system of value and distribution with no closure or determinacy at all. Marx's (1967: vol. III, 783–84) comment is accurate enough, and applies as well to Steuart: 'Petty, Cantillon, and in general those writers who are closer to feudal times, assume ground-rent to be the normal form of surplus-value in general, whereas profit to them is still amorphously combined with wages'.

4 Boisguilbert, Quesnay and Turgot

In the French writings of the period, the views of Boisguilbert, Quesnay and Turgot deserve particular attention. This is not because there were no other writers who drew relationships between wages and subsistence. An examination of Boisguilbert is interesting because of the particular emphasis he gave to workers' subsistence in the context of profits of agriculture and employment opportunities (cf. Bharadwaj 1987:544). Quesnay developed arguments on the subsistence wage in connection with taxation and the distribution of the total product into net product and necessary expenses; a position which Turgot elaborated on and built into formal propositions about the competitive necessity for a subsistence wage.

In Boisguilbert's economic system, subsistence was associated with the livelihood of the workers, defined as those with nothing to sell but their 'arms' or bodily strength (Boisguilbert 1704:834). Analytically, they are linked via the price of grain and opportunities for employment. A low grain price is condemned by Boisguilbert, even though at first sight it seems an advantageous situation for the poor. Boisguilbert's reasoning in support of a more appropriate, higher grain price is based on two factors: it enables a higher level of agricultural activity from the higher incomes it gives to landlords and farmers which, in addition, raises economic activity levels cumulatively and generally. It thereby provides greater opportunities for work, and work combined with higher grain prices provides better conditions for poor labourers than unemployment combined with low grain prices and relatively cheap bread (Boisguilbert 1704: esp. 828–29, 843–44).

Contrary to the claim of Van Dyke Roberts (1935:289–90), Boisguilbert does not really posit an explicit subsistence wage theory. However, he clearly suggests the necessity of the provision of subsistence for workers before profits can be paid or extracted, using the analogy of a coach horse which must be adequately fed before profits can be drawn from its services. This analogy likewise suggests the fact that subsistence has to be advanced to the workers (human or animal) before the produced output is sold. The necessity of subsistence for Boisguilbert arises not only from physical requirements but from what he calls the 'obligations of religion, humanity, justice and polities'. These

also make it mandatory that the labourer and his family get their subsistence together with the opportunity to earn it from their daily labour (Boisguilbert 1707:1003; cf. Van Dyke Roberts 1935:289). Boisguilbert's comments clearly illustrate the validity of Garegnani's remark that classical economists associated the notion of a subsistence wage with social custom and convention as well as recognition of the possibility of unemployment.

What constitutes customary subsistence in Boisguilbert's writings is something needing further discussion. The starting point is the important role of corn in the food requirements of the ordinary people:

> No one contests that in France corn alone constitutes the food of the ordinary people *[menu peuple]* without any assistance of beverages or vegetables as everywhere else, and even less of meat and fish; by contrast in England, it is bread which holds the least place in the customary daily food of the people. Meat and fish are there quite plentiful and consequently lowly priced, thereby relieving corn of three quarters, and often even all of the functions which it has in France of almost feeding the people by itself.
>
> (Boisguilbert 1704:868)

Earlier, Boisguilbert (1704:864) had discussed the 'necessities for workers' in terms of the abundance of the harvest, and talked of their 'customary subsistence' *(la subsistence ordinaire)* in connection with the need for grain exports to revive and stimulate agriculture. Not surprisingly, therefore, there is a link between wages and corn prices; a high corn price 'justifies raising the price of workers' (Boisguilbert 1704:875).

There are qualifications to the emphasis on the almost exclusive importance of corn in the French labourer's diet. Some workers are able to supplement their corn diet with 'salted meat and a broth made of boiled meat'. During periods of prosperity associated with high corn prices, high employment and high incomes, workers' consumption of meat can be as much as tripled in Boisguilbert's view, hence well above subsistence in leaner times. High surplus is therefore linked with high real wages via the demand for labour it generates (Boisguilbert 1704:868–69). In the context of a discussion of military supplies, including timber frames for fortifications and metallic products for armaments, Boisguilbert (1707:1002) mentioned 'bread, wine, meat and clothing' as essential supplies for the soldiers. Boisguilbert's customary subsistence standards therefore admit of considerable flexibility, not only on the basis of international comparisons with England and Holland, a flexibility many of the classical economists admitted, but in terms of the relative degree of prosperity which existed in a particular region or country at a particular time.

Much of the content of Boisguilbert's subsistence wage views can be found in Quesnay's work. His earlier economic writings simply linked wages to the price of subsistence, especially to that of corn, as the commodity which featured most prominently in workers' budgets. A rise in the price of corn could therefore entail a rise in wages:

> A man consumes three setiers of corn (per annum); if because of the proper price *(ban prix)* of corn he pays four livres more for each setier, this price increases his expenditure by a sou per day, and his wages will rise in this proportion.
>
> (Quesnay 1757:509)

Like Boisguilbert, Quesnay did not advocate low wages, since this was incompatible with his views on the appropriate price of corn. High corn prices were required to stimulate agricultural production, the size of the net product and hence induce economic recovery. Moreover, low corn prices tended to make workers 'less industrious, lazy and presumptuous' so that farmers, as employers of labour, were better off when bread and corn were dear for this reason as well (Quesnay 1757:509).

In later work, Quesnay introduced some additional factors into his discussion of wages. These related to migratory shifts of labour when 'corn is too low and earnings are in proportion'—a situation he, also like Boisguilbert, linked to diminished employment opportunities for labour (Quesnay 1758:635). A competitive labour market was implied which linked the level of prices relative to costs of consumption with the state of employment and the supply of available workers via migratory population changes. If the balance between prices and wages was disturbed, that between prices and costs would also be altered, changing both the employment situation (an increased margin over cost raising, and a reduced one, lowering employment opportunities) and the incentives of workers to immigrate or emigrate according to the attractiveness of the circumstances. High prices and commensurate wages provide incentives to hire labour and induce an influx of workers to meet that demand from neighbouring regions with less favourable conditions. As Bharadwaj put it (1987:544) this constituted a marriage between the ideas of Boisguilbert and Child on the subject.

In one of his last economic papers, Quesnay showed that this mechanism would ultimately lower wages to some minimum:

> The level of wages, and consequently the enjoyments which the wageearners can obtain for themselves, are fixed and reduced to a minimum by the extreme competition which exists between them. If a nation seeks through a tax to force these wage-earners doubly to restrict their enjoyments, they will emigrate in order to settle in other nations where their subsistence is more assured and their industry more protected. Then the small number of them who remain in the country, being less constrained by competition, will lay down the law to the first distributors of the expenditure, and force them to pay the normal wages, plus the tax and the costs of the land into the bargain. The result is that these first proprietors of renascent products bound to the land through their possessions, will necessarily bear the whole burden of this destructive tax. If the wage-earners, whose enjoyments it is sought to restrict by means of the tax, are unable to emigrate in order to get back to their former level, they will become beggars or thieves, a kind of arbitrary and walking tax, which is very burdensome to the first distributors of the expenditure.
>
> (Quesnay 1767:984–85)

Whether there is an implication in this argument that Quesnay saw this subsistence level as a physical minimum is doubtful. His reference to workers' enjoyments as part of that subsistence suggests customary levels and standards, or a normal consumption pattern above the physically necessary which varied slowly over time. At the same time, the tax incidence theory, as in the case of Locke, required the notion of a given subsistence wage in order to reach the desired result that landlords pay all taxes directly and indirectly. A given subsistence wage seems also to be assumed for the intricate analyses of accumulation, input-output relations and the necessary distribution of output which were part and parcel of his *Tableau économique*.

Turgot, the last of the major French economists before Adam Smith, produced the most theoretically satisfying subsistence wage theory. His most famous work, the *Reflections* (Turgot 1766:45–16) enunciated this by the statement that competition limits the wages of workers to subsistence. A letter to Hume written not long thereafter clarified the matter further. Although wages were competitively determined by supply and demand, labour like all commodities also had a 'fundamental value' which, 'for the wages of the artisan…is the cost of his subsistence'. As in the general theory of value, market prices under competitive conditions in the long run adjust to the fundamental value, even when subsistence, the basis for the fundamental price of the worker, contained an element of 'superfluity, which if need be, can be reduced' (Turgot 1767a:211–12).

Turgot (1767b:126–27) explained this more fully by examining the interrelationship between the price of agricultural products, profits, the level of wages and the size of the population. High wages increase the cost of production as part of these costs and lower profits. 'Is there any type of work in which profits are not diminished by the dearness of labour?' Furthermore, higher wages increase population, either by immigration, a fairly rapid effect, or by encouraging marriage and births: 'the increase in people in turn lowers wages through competition'. A similar argument, but in more detail, was presented three years later in Turgot's letters on the grain trade to l'Abbé Terray (Turgot 1770:174–76, 177 and cf. 170). In this argument, the profits of the farmers are directly linked to the demand for labour. In addition, the passage explains the meaning Turgot gave to subsistence in more detail:

> It is certain that competition, by causing wages to be at a lower level, reduce those of the simple unskilled workers to what is necessary to their subsistence. It should not be thought, however, that this necessity is thus reduced to the essentials for avoiding starvation to such an extent, that nothing remains outside it, which these men may have at their command either to obtain some little luxuries, or, if they are thrifty, to create a little movable fund which becomes their resort in unforeseen causes of sickness, or times of high prices, or unemployment. When the objects of their expenditure increase in price, they first begin to cut down on this little superfluity and the enjoyments it can procure for them. But it is of this type of *luxury* especially, that it can be said that it is *a most necessary thing*, it is essential that there is a little of it, just as it is necessary that there is *some play* in every machine. A watch of which all the wheels would work into each other with mathematical precision and without the

> smallest gap, would soon cease to go. If by an unexpected decrease in wages or increase in expenses, the worker can put up with being reduced to strict essentials, the same causes which had forced wages to rise a little above the necessary of yesterday, continue to operate and cause them to rise once more until they attain a higher level, in the same proportion with the necessary of today. If an absence of the ability to pay stands in the way of this return to the natural proportion, if the decrease of the revenue of the proprietors persuaded them to resist this increase in wages, the worker would go elsewhere to look for the competency without which he cannot exist; population would diminish up to the point where the decrease in the number of workers, by curtailing their competition, enables them to lay down the law and to force the proprietors to raise wages.
>
> (Turgot 1770:168)

Once again, the import of the remark is that the notion of subsistence is a flexible one; it allows for the requirements of the workers and their dependents in a progressive manner, that is, relative to the changes in these requirements over time, and enabling variation with the circumstances. The last can be documented from a remark on the high wages paid in Holland. These 'exceed the needs of those who earn them', partly because the advantageous location of Holland favours high labour productivity. This enables saving by workers, an opportunity not available in some of the views on subsistence which have been quoted (for example, that of Massie 1760) as well as the taxation of wages or wage goods (the notorious Dutch excise) to defray public expenditure (Turgot 1767b:131).

5 Concluding Comments

From the modern standpoint, looking at the classical treatment of wages in relation to subsistence in retrospect, we may raise a number of questions, premised upon an observation: it seems obvious that in modern capitalist economies real wages are in general normally above subsistence. (1) What does this 'uncoupling' of wages from subsistence mean for the plausibility of the classical approach to economics today? (2) Does the notion of subsistence labour consumption itself even retain any meaning in the modern context? And if it does not, how can the surplus approach retain any plausibility since, as indicated above, the social surplus cannot be defined in the absence of a concept of necessary labour consumption?

1 The classical surplus approach to distribution and value in particular, proceeded in two steps. First there is the conception of production as a 'circular' system which generates a surplus over and above replacement of used up means of production including necessary labour consumption—a *re*production system, so to speak. Such systems may be growing through time depending upon the uses to which the surplus is put, which may itself be connected with income distribution. Second, in a framework of generalised capitalist competition wherein wages, prices, profits and other returns are arbitraged, some principles for determining the distribution of the surplus must be deployed. In the classical framework, the subsistence theory of wages was one such

principle. (The principle of differential rents was another.) Now Sraffa (1960) has rigorously shown that in a classical framework along these lines, given the real wage and output levels, the technique of production in use will determine relative prices simultaneously with the remaining distributive variables; so that the distribution of the surplus, in terms of 'functional' income distribution, is fully determined. None of these results hinges essentially upon the real wage being equal to necessary labour consumption (and certainly does not hinge upon the real wage being constant). All that is required is that the real wage be determined independently of prices and other distributive variables (see Aspromourgos 1996: section 10.3). The only resulting difference is that wages will share in the social surplus, rather than it resolving exclusively into non-wage income shares—and some alternative principle for determining real wages must be posited. If the real wage is to be maintained as a variable independent of relative prices and other distributive variables, then the most obvious such alternative principle in the modern era is money-wage indexation; but the failure of modern wage indexation systems to endure is noteworthy. In fact, the *lack* of dependence of the surplus approach upon a subsistence wage assumption is evident from the very beginning—in one of Petty's surplus models, in which consumption is allowed to vary above subsistence (Hull 1899: vol. I, 89–90).

It is possible to take a *further* step away from classicism: to propose not only that real wages share in the social surplus, but also that real wages cease to be the independent distributive variable, to be replaced by the general rate of profit on capital. (It is evident that the latter step presupposes the former.) This is overwhelmingly what those who have followed Sraffa's lead in the rehabilitation and reconstruction of the classical surplus approach have suggested—and Sraffa himself. But there has been a division of opinion as to what principles are to be looked to for determining the rate of profit: the rate of accumulation, in the manner of the Cambridge Growth Equation (e.g., Pasi-netti 1977: Ch. VII, esp. 217–18); or a rate of interest determined by monetary forces, together with money-wage bargaining (e.g., Pivetti 1991). Garegnani (1984:320–21) would appear to favour the latter (also Sraffa 1960:33), the position with which the present authors agree. Certainly the latter approach is more consistent with the projection of a 'Sraffa-Keynes synthesis'. The point to emphasise here is that even this two-step departure from classicism retains the surplus approach: all that has altered is the character of the principles deployed for determining the distribution of the surplus.

2 What of the notion of subsistence itself? It has been seen in the above examination of notions of subsistence in pre-Smithian classical economics that subsistence was always conceived as a conventional or socio-historical phenomenon, from the very beginning of the tradition. The possibility that necessary consumption so understood might itself be a function of *above-subsistence* wages—as Steuart recognized, without grasping its full significance—might well do fatal damage to the classical *theory of wages*, in so far as it deprives the 'natural' wage of independence from the market wage (Garegnani 1984:320 n. 49). But it does not seem to do any such damage to the notion of subsistence conventionally conceived itself; and so, neither to the concept of social surplus. This kind of 'hysteresis of subsistence' merely exposes more clearly the fact that subsistence and surplus *really are social phenomena*, not 'natural' phenomena. (It was one of Marx's fundamental criticisms of the classical school, that it mistook historically specific categories for natural phenomena.) In the developed world access to electricity is a

necessity not a luxury, and the telephone is not far off this status as well.[11] It would not seem a wild claim to suppose that at some time in the future, access to computer technologies will acquire similar status as a virtual necessity in large parts of the world. (Of course, there remains a *geographical* element to the notion of subsistence as well: that which is a necessity in one place might simultaneously be a luxury in another—or even quite useless.) If a *tangible* expression of subsistence is to be sought for in the developed world, then it is likely to be found in the character and content of the various social security and related income support systems in the developed economies. These systems, in a very real sense, constitute the various social conceptions of the minimum acceptable standard of life in modern economies. That these systems have themselves evolved as functions of technical progress, labour productivity and real wages, as well as other social forces, in no way vitiates the distinction between necessity and luxury.[12]

This line of argument also points to why the labour movement in particular, and wage earners in general, have a quite direct material interest in the provision of social security and income support, *even if they individually never have recourse to those systems:* if real wages in the modern world are endogenously determined, ultimately by reference to an exogenous profitability of capital, this mechanism would still be constrained by a lower bound for real wages, determined by reference to subsistence. If this socially determined subsistence is constituted by social security, then the preservation and enhancement of such systems is synonymous with the preservation and enhancement of the lower bound of the spectrum of possible distributive outcomes, within which central bank determination of interest, interacting with money-wage bargaining, will determine the actual distributive outcome.

Notes

1 Garegnani defined this specifically in terms of the relation between distribution of the surplus and relative prices.

2 In all quotations from Petty, spelling and punctuation have been modernised.

3 This is from the unpublished *Petty Papers*, vol. i, item 22, p. 4—as catalogued by Slatter (1980). The *Papers* are now held by The British Library.

4 Other illustrations of this empirical conceptualisation are provided in Aspromourgos (1996: Ch. 3; esp. section 3.5).

5 This phenomenon, which was not only observed by Petty, is sometimes described as a'backward bending' labour supply curve. It might better be described as a 'rectangular hyperbola' supply curve: the worker seeks to adjust labour time worked as the real wage (time-) rate varies with the price of 'provisions' or 'corn', in order to maintain a desired or normal consumption level. If S_h is supply of labour hours per week, Wh is the hourly time-rate of money wages, p_c is the money price of corn, and c is normal labour consumption per week; then:

$S_h.w_h=p_c \cdot c$

$S_h(w_h/p_c)=c$

The relation between hours supplied per week and the hourly real wage is a rectangular hyperbola.

6 The notion of 'corn' as a generic for subsistence is generally interpreted in terms of 'bread' as a staple—much like rice in much of Asia. Smith (1976:175–6) makes this point, suggesting

the possibility of potatoes replacing corn in parts of Europe. (If classical economics, and capitalism, had originated in the latter part of the world, we would no doubt speak now of a 'rice model', rather than a 'corn model'.) It is therefore worth noting that corn was the basis for distilling alcohol as well as baking bread. Petty makes this explicit in one characterisation of surplus:

> If we know how many people there are and the faculties of each, we can tell how much corn will make them bread *and beer*, how much wool and skins, clothes; what cattle will afford them flesh, butter and cheese; how many men's labour in nets and boats will find them fish and fowl. By all which, and by knowing how much of all these the intrinsic virtue of the country will produce, and with what labour, we know as followeth, viz:
>
> 1. Whether we can live.
> 2. What we can spare and export.
> 3. How many of our whole number need actually to labour.
>
> (Lansdowne 1927: vol. I, 89–90; emphasis added)

7 This is Higgs's translation of the word *Entrepreneurs.*

8 In initially assuming subsistence labour consumption, Sraffa (1960:9) also likens wages to 'feed for…cattle'. Cantillon's notion of labour being 'worth' its cost of production or consumption appears to have heightened Rousseau's indignation against modernity—and he also explicitly refers to men being evaluated like herds of cattle (see Aspromourgos 1996:200 n.16, with 101). See also Steuart (1767:401).

9 This is an expression for cost of production.

10 This is a synonym for intrinsic value, at least in this context.

11 In recent times in Australia there has been some controversy surrounding provision of telephones to the poor—telephones which can take incoming calls, but cannot make outgoing calls. It is interesting to note that the controversy has not really been over whether the poor should have such access—only over whether they should be required to pay an installation fee. This implies that at least being able to receive phone calls is coming to be regarded as a 'necessity'.

12 The very proposition that wages are above subsistence is premised upon the concept of subsistence *retaining* meaning. In fact, the notion of subsistence has been engaged in modern marginalist (neo-Walrasian) economics as well—though in a rather more physiological than conventional sense—because of the so-called 'survival problem'. That is to say, the problem that at an equilibrium vector of prices, with the endowment of the economy arbitrarily distributed among agents, there is no guarantee that all agents will be able to subsist—unless it is *assumed* that each agent's endowment already contains the subsistence bundle of commodities.

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10
Ricardo and the wages fund

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Introduction

This paper sets out to show that wages fund notions were not part of Ricardo's wage theory, and that he did not envisage the inverse relation between the real wage rate and the employment level implied by the wage fund doctrine. While it is generally agreed that the latter was formulated in a clear, definite form only after Ricardo's death by economists such as McCulloch, J.S.Mill and Senior, the theory of wages of their predecessors (Ricardo included) has also traditionally been interpreted as being based on wage fund notions and 'Malthusian' population theory. In simple terms, according to this common interpretation of classical wage theory, the wage rate is determined, at a given time, by the ratio of the given wage fund to the fully employed working population. Variations of the latter in response to differences between the current wage rate and its natural subsistence level make the wage rate tend to subsistence. Following this view both the 'market' and the 'natural' wage are actually determined according to the wage fund theory, although the latter is regulated, *through population changes,* by the 'subsistence' of the workers. The contention of this paper is that neither market nor natural wage are thus determined in Ricardo.

The view of Ricardo's theory just described can be found in standard reference texts like Cannan (1893:231, 242–3) Taussig (1896:168 ff), St Clair (1965:100), Schumpeter (1982:665–8) and several contemporary interpreters among whom Blaug (1985:90), Blith (1987:836), Morishima (1989:12). It is also shared by writers on both the so called 'New View' and 'Fixwage' sides of the controversy over the interpretation of Ricardo such as Casarosa (1978:43) on the one hand and Kaldor (1955:353 and n. 8), Pasinetti (1959–60:8, 10, 12), Caravale and Tosato (1980:108, 112) on the other.[1]

This interpretation has probably been favoured by the existence of some terminological continuity. Expressions such as 'the fund destined to the maintenance of the labourers' or similar ones are very frequent in the writings of Ricardo, and this may have lent support to the tendency to interpret his wage theory in the light of that formulated by his successors. On the other hand, the latter tendency might also be regarded as a reflection of the diffi-culty, on the part of modern economists, to understand a point of view which has been 'submerged and forgotten' (Sraffa 1960: v) by the subsequent emergence and dominance of a different approach to economic theory.

While the wage fund doctrine shares certain notions with contemporary economics—namely that of an inverse relation between the wage rate and the employment level, and consequently a tendency to the full employment of labour in a competitive economy—this is not so for the wage theory of Ricardo. Thus a different approach to both wage and employment determination, from what we are used to today, is implied.

Even those who have interpreted Ricardo's theory of wages as largely influenced by wage fund notions have not failed to notice some of the difficulties met by this interpretation. It may be worthwhile to recall two of the most evident among them, as they may serve to justify the reconsideration of the matter undertaken in the next sections. The conclusion of the chapter 'On Machinery' as regards the possibility of technological unemployment is incompatible with wage fund theory and wage flexibility, which imply the tendency to full employment of labour. Such a conclusion has often been explained as the result of the fact that in this case, unlike in the rest of his economic writings, Ricardo peculiarly discusses only the very short-run consequences of the introduction of machinery, ignoring the longer run adjustment that must take place as a result of the fall in wages and its favourable effect on employment (Wicksell 1934: vol. 1, 137; Schumpeter 1982:683; Blaug 1985:185). Yet Ricardo describes technological unemployment not as a transitory phenomenon but, as Blaug himself notices with some perplexity, as one that is likely to last 'for a considerable interval' (Blaug 1985:133). On this point Schumpeter writes that Ricardo's statement that machinery can 'make population redundant' cannot refer to the permanent effects of machinery 'for we are not told what happens to the workmen who have lost their jobs, yet they cannot remain unemployed, unless we are prepared to violate the assumption that perfect competition and unlimited flexibility of wages prevail' (Schumpeter 1982:683). However, quite interestingly, the possible 'correction' to unemployment that Ricardo mentions and Schumpeter illustrates thereafter has nothing to do with wage flexibility and its effects on employment. Technological unemployment, according to Ricardo, may only be gradually counterbalanced by a faster pace of accumulation, which in turn might result from the higher profits determined, independently of any change in the real wage rate, by technical innovation (Ricardo 1951–73,1:390)[2]. Such a correction operates by affecting the gradual 'secular' (Marshall 1982:315) evolution of the economic system, and contradicts the temporary nature of unemployment.

The second difficulty is that the traditional interpretation of classical wage theory appears to be unable to explain the assertion (common not only to Ricardo but also to Smith and many other economists of the period) that taxes on wages or on wage goods, and a rise in the natural price of such goods would always lead to an *immediate* increase of the natural (money) wage, such as to leave the real disposable income of the workers unaltered (Shoup 1960:73; St Clair 1965:128–33; Hollander 1979:393–5, 1987:158–60). St Clair for example writes about Ricardo's position on the consequences of taxing wages:

> This does not give the idea of a fixed wages fund…. On the contrary, the impression it conveys is that the capitalists require a certain quantity of labour, and are not to be balked in obtaining what they want by a mere rise in price. If they cannot obtain the quantity they require at the old price, they will offer more.

(1965:128)[3]

What I propose to show is not just that Ricardo did not provide a clear and consistent statement of the wage fund theory, as expounded, for example, by J.S.Mill (a thesis with which many would probably agree). I mean to contend that none of the ideas that would later characterize that theory had any role in Ricardo's views on wage determination, and also that, contrary to what is often maintained,[4] they are not logically implied by his theoretical approach. Quite the opposite, the latter is inconsistent with wage fund notions.

Three complementary lines of argument will be developed throughout the paper in support of this thesis: textual analysis, demonstrating that some of Ricardo's conclusions are incompatible with wage fund theory, and that he explicitly criticized statements that characterize that theory; economic analysis, showing that wage fund theory is not logically implied by other features of Ricardo's approach, such as the notion of wages as 'advanced capital'; the proposal of an alternative interpretation of the role of supply and demand in wage determination, which proves to be more consistent than the traditional one with Ricardo's writings on wages and other matters. After describing the main features of the wage fund theory (section 1), I shall argue that Ricardo did not conceive of a given wage fund determined independently of the wage rate, and explain why this notion is not logically implied by that of wages as advanced capital nor by discontinuities in production (sections 2 and 3). Subsequently I will set out to show that Ricardo did not envisage an inverse relation between employment and the wage rate and suggest an alternative interpretation of his wage theory (sections 4 and 5). Finally, it will be shown that the notion of a given amount of 'circulating capital' determined, independently from distribution, by saving decisions, has no foundations within the framework of Ricardo's economic analysis (section 6). In the concluding section I shall outline some implications of the arguments developed for the on-going controversy on the interpretation of Ricardo's wage theory.

1 Main features of the wage fund doctrine

Differing formulations of the wage fund theory may be found in its various exponents. For our purposes it will be sufficient to describe the main common traits, in order to discuss in the ensuing sections the possibility of finding any of them in Ricardo's writings. However, it may be worth noticing at this stage that there are two differing ways of defining the 'wage fund'. This can be understood as a given amount of (mainly agricultural) subsistence goods that must have been produced and stocked in advance, in order to support the workers in the period of time necessary to complete the production process (a version of the theory found in McCulloch). Alternatively, it can be interpreted as a predetermined amount of savings, destined by a decision of the capitalists to the support of labourers in that same period (J.S.Mill, among others). In both versions, what is determined by the theory is the *real* wage rate: even though savings can be expressed in money, they are the counterpart of a portion of real national income. Also, in both versions wages may actually be paid in money—the distinguishing feature is whether the physical amount of wage goods available for the workers is conceived as given over some time period (McCulloch 1864:47–8), or instead the physical composition of output

is regarded as unimportant, as it can rapidly adjust to changes in the composition of demand (Mill 1871:56; see also Stirati 1998). The arguments developed below address the presence in Ricardo of both notions of the wage fund.

The main common features of the wage fund theory are well summarized in the following passage by J.S.Mill:

> The demand for labour consists of the whole circulating capital of the country, including what is paid in wages for unproductive labour. The supply is the whole labouring population…. The theory rests on what may be called the doctrine of the wages fund. There is supposed to be, at any given instant, a sum of wealth, which is unconditionally devoted to the payment of wages of labour. This sum is not regarded as unalterable, for it is augmented by saving, and increases with the progress of wealth; but it is reasoned upon as at any given moment a predetermined amount. More than that amount is assumed that the wage-receiving class cannot possibly divide among them; that amount, and no less, they cannot but obtain. So that, the sum to be divided being fixed, the wages of each depend solely on the divisor, the number of participants. In this doctrine it is by implication affirmed, that the demand for labour not only increases with the cheapness, but increases in exact proportion to it, the same aggregate sum being paid for labour whatever its price may be.
>
> (Mill 1869:515, emphasis added)

The main features of the theory are therefore the following: (i) the real wage is flexible, and is equal to the ratio between the wage fund and the active population;[5] (ii) the wage fund is given before and *independently* of the real wage: any fall in the latter must therefore imply a proportional rise in employment, and its downward flexibility ensures the tendency to full employment, which is implied by the determination of the wage rate as equal to the ratio of the wage fund to the population; (iii) it follows from (i) and (ii) above that should the wage be fixed (for example by combinations of the workers) at a rate higher than the full employment rate, part of the workers would remain unemployed.

2 The wages fund not given before and independently of the wage rate: textual evidence

The notion of a wage fund determined before the wage rate and independently of it has generally been regarded as necessarily associated with the classical conception of wages as circulating capital *advanced* to the workers at the beginning of the 'year' or production period.[6]

The notion of wages as advanced capital is definitely present in Ricardo but, on textual and logical grounds, is not associated with the idea that the 'fund for the maintenance of the labourers' is determined before and *independently* of the wage rate.

As mentioned above, the discussion of the incidence of taxation, and of the effects of changes in the natural price of subsistence goods is hardly compatible with the notion of a predetermined wage fund conceived as savings 'devoted to the payment of wages'.

Ricardo's discussion of taxation appears also inconsistent with the notion of the wages fund as a given amount of wage goods (*Appendix* 1, n. 28); while on the other hand it is not clear what the consequences of an increase in the natural price of necessaries should be if the wages fund is conceived as a fixed amount of wage goods; however McCulloch, to whom the latter notion is generally attributed, held the same views as Mill, which will be discussed presently (McCulloch 1864:327–8; J.S.Mill 1871:346–7). Indeed, Ricardo's conclusions on all these matters differ from those of J.S.Mill. Ricardo believed that a tax on wage goods as well as a direct tax on wages, or a rise in the natural price of 'corn' (agricultural subsistence goods) would determine an *immediate* rise of the natural (money) wage rate such as to leave the real disposable income of the workers unaltered. By contrast Mill believed that the purchasing power of the workers would be reduced, and only a lengthy process of population decline might eventually cause a rise in money wages. The adjustment supposed by Ricardo, other things being constant, must imply an increase in the 'wage fund' advanced by the capitalist employers to the workers. His conclusions could be reconciled with wage fund theory only if the adjustment of the (money) natural wage could be attributed to changes in the divisor, i.e. population, rather than the numerator (the wage fund). Ricardo however explicitly denied any role of population changes in the adjustment of the natural wage rate following taxation; an adjustment that he believed would take place very rapidly, so that 'no interval which could bear oppressively on the labourer, would elapse between the rise in raw produce, and the rise in the wage of the labourer' (Ricardo 1951–73, I:166; see also *Appendix* 1). In addition, in the examples given in the chapter on profits, while wages increase in consequence of the higher price of corn, each capitalist's production and employment of labour remain unchanged (*ibid*.: III, 117). This clearly implies that the share of capitalists' income devoted to the payment of wages must increase as the natural wage rises.

It is also clear that Ricardo did not regard the physical amount of wage goods available for workers' consumption as independent from distribution. He explicitly criticized the idea—that had just begun to appear in the writings of some of his fellow economists—that the amount of 'corn' (agricultural subsistence goods) available in the economy is determined independently of workers' demand, hence of their income. Such a critique is advanced against Malthus in the *Principles:*

> Mr. Malthus appears to me to be too much inclined to think that population is only increased by the *previous* provision of food…instead of considering that the general progress of population is affected by the increase of capital, the consequent demand for labour, and the rise of wages; and that *the production of food is but the effect of that demand*. …This demand then is the effect of an increase of capital and population, but not the cause—it is only because the expenditure of the people takes this direction, that the market price of necessaries exceeds the natural price, and that the quantity of food required is produced.
>
> (*ibid*.: 406–7, emphasis added)[7]

'What motive', Ricardo asks, 'can a farmer have to produce more corn than is actually demanded?' (*ibid*.: 407). This dissent with Malthus also leads Ricardo to hold, in one respect, a different view from his friend on the poor laws:

> You do not always appear to me to admit that the tendency of the poor laws is to increase the quantity of food to be divided, but assume in some places that the same quantity is to be divided among a larger number.
>
> (letter to Malthus, 21 Oct. 1817, VII:202)

The same issue is taken up in the correspondence between Ricardo and Trower in 1820. Ricardo disagrees with the latter's opinion that an increased amount of corn must be available prior to any increase in employment, in order to make such an increase possible. Ricardo thus describes the issue between them: 'does the supply of corn precede the demand for it, or does it follow such demand? You are of the former, I of the latter opinion' (letter to Trower, 26 Sept. 1820, VIII:255). Ricardo argues that the amount of corn produced and available in the economic system is determined—just in the same way as any other commodity—by effectual demand, hence by the purchasing power of the workers. This in turn cannot be regarded as independent of income distribution and the wage rate:

> If, in the division of gross produce, the labourers commanded a great proportion the demand would be for one set of commodities—if the masters had more than a usual share, the demand would be for another set […] In every state of society there will be a demand for some commodities, and it is these which it will be the interest of capitalists to produce.
>
> (letter to Trower, 13 Oct. 1820, VIII:273)[8]

To sum up then, both versions of the wage fund doctrine appear inconsistent with important propositions in Ricardo's writings. The idea of a predetermined wage fund conceived as savings 'devoted' to the support of the workers would contrast with Ricardo's theory of the incidence of taxation and his views concerning the immediate adjustment of the money wage to a rise in the natural price of corn—a proposition that plays a crucial role in his theory. The notion of a predetermined wages fund conceived as a given stock of subsistence wage goods is explicitly denied in the criticisms addressed to Malthus and Trower, and is also inconsistent with Ricardo's discussion of taxation.

3 A given wages fund not a 'logical implication' of advanced wages and discontinuities in production

We can now turn to the question of why, analytically, the conception of wages as advanced capital is not associated with that of a wage fund determined independently of the wage rate.

The focus of Ricardo's theory was on the determination of the normal rate of wages, i.e. a long-period normal variable in Marshallian terms (Marshall 1982:315). This is

regarded as resulting from rather persistent data and forces of the economic system, whose gradual changes over time are provisionally ignored, while the continuous disturbances caused by accidental and temporary phenomena are also neglected (Marshall 1982:289; Schumpeter 1982:112, n. 5). It is of course controversial whether in Ricardo's theory the market wage is a long-period normal price (as for example maintained by Hicks and Hollander 1977), but this question need not be taken up here (see Stirati 1995). What matters for our purposes is that the focus of Ricardo's wage theory was on long-run forces.

The data and forces that determine the normal wage rate are supposed to be effectual over a period of time longer than a single year. The normal real wage rate therefore, along with the employment level, determines the amount of corn produced, on the average, every year, that can be advanced to the workers at the beginning of the following year. Whenever there is a persistent increase in money wages, if this brings about an increased demand for corn (rather than for manufactured goods), there will initially be a rise in the market price of corn, as its supply falls short of effectual demand. This in turn will induce an increased production of corn the following year, while its price will return to the previous natural level (Ricardo 1951–73, I:163, 406–7).[9] The workers will thus be able to consume an increased amount of corn.

Of course at the time when the classical economists developed their theory, agricultural production used to be subject to large unexpected fluctuations, and because of this the amount of corn actually available every year could differ widely from the normal level of production necessary to satisfy effectual demand at the given normal wage. But according to Ricardo such unexpected oscillations of the actual agricultural yield cause temporary deviations of the actual real wage rate from its normal level, and do not determine the latter (*ibid.*: 162; II:230, 248). Furthermore, these oscillations do not imply that the 'fund destined to the labourers' should be regarded as a predetermined amount even in a single year (see Ricardo, VII:202, quoted in section 4 below). Indeed corn is consumed not only by workers but also by all the other classes of society (see also St Clair 1965:95). Although the workers' absolute consumption of corn is likely to diminish in a year of scarce yield, whether and how much the workers' share of total corn output will vary will depend on the various circumstances that may affect the movements of the market price of corn and the actual money income of the workers.[10]

In conclusion both the notion of wages as advanced capital and the existence of discontinuities in agricultural production do not necessarily imply, and did not actually imply for Ricardo, a conception of the wages fund as a quantity determined prior to the wage rate. Variations of workers' purchasing power due to a change in the natural rate of wages will bring about the modifications in the composition of production necessary to make the amount of wage goods demanded at the new level of the natural wage rate available (on the average) at the beginning of each year. Nor would the increase in the production of these goods take place, as Ricardo emphasizes, unless the existence of an additional effectual demand was clearly signalled by the market.

4 The inverse relation between the wage rate and the employment level

Ricardo explicitly rejected the existence of an inverse relation between the wage rate and the employment level. This necessarily follows, in the wage fund theory, from the idea that in any given period the wage fund available for the payment of the workers cannot be altered.

Ricardo's view is made explicit in some criticisms addressed to Malthus. In commenting on some passages added by Malthus to the 5th (1817) edition of the *Essay on Population*, Ricardo found himself confronted with the following:

> Dr. Smith has clearly shown that the natural tendency of a year of scarcity is either to throw a number of labourers out of employment, or to oblige them to work for less than they did before, from the inability of the masters to employ the same numbers at the same price.
>
> (Ricardo 1951–73, VII:202, n. 6)[11]

His comment is a sharp: 'I can neither agree with Adam Smith nor with you' *(ibid.)*. Ricardo therefore did not regard the fall of the wage rate or the increase in unemployment as alternatives; not even with reference to a single year in which the availability of corn is limited by the bad yield of the season.

Further on in Ricardo's comments we find an even more revealing disagreement. Malthus had written that any rise in the wage rate caused by 'combinations of artificers and manufacturers' would determine an exactly proportional fall in the employment level. Ricardo replies that: 'A combination among the workmen would increase the amount of money to be divided among the labouring class' (VII:203).

The relevance of this passage in illuminating Ricardo's position is evidently great. First, it is further evidence that Ricardo did not regard the 'wage fund' (workers' aggregate real income), as given independently of the wage rate.[12] Second, it shows that Ricardo did not envisage an inverse relation between the wage rate and the employment level.[13] Third, it demonstrates that Ricardo regarded as possible, at least in principle, a permanent modification in income distribution in favour of the workers, and believed that it could be brought about by institutional changes, such as the emergence of workers' combinations.[14]

The absence of an inverse relation between the wage rate and employment in Ricardo's theory also sheds light on his admission of persistent unemployment caused by technical change. As we have already mentioned above, this conclusion has caused some discomfort to many interpreters of Ricardo, leading them to envisage some sort of inconsistency in Ricardo's writings on the matter. Indeed, on the basis of the passages just discussed it can be argued that Ricardo's conclusion about the possibility of persistent unemployment is perfectly consistent with his theory of wages and employment, and with his method of analysing the long-period consequences of economic changes such as the introduction of a new technology.

The wage rate is not regarded by Ricardo as perfectly flexible and, more importantly, *its fall would not lead to a rise in the employment level* (except gradually through its possible, but not necessary influence on the pace of accumulation). Hence, when a technical innovation displaces labour, there are no necessary, automatic mechanisms of adjustment at work that will lead the economic system towards full employment (see Montani 1985).

This also explains why Ricardo, both in his chapter 'On Machinery' and in his parliamentary speech 'On Mr. Owen's Plan' (see section 5 below), explicitly admitted the existence of unemployment while at the same time using arguments based on the acceptance of Say's law. In the classical approach, while entailing full utilization of the existing capacity, Say's law does not also imply full employment of labour. It would do so only under two further assumptions common to both wage fund theory and modern marginalist economics, namely: (i) when there is unemployment the wage rate falls as a consequence of competition between workers and between employers; (ii) whenever the wage rate falls this causes a rise in the employment level. When these two propositions hold, Say's law ensures that, as the wage falls, the output produced by the additional workers employed will be sold, with no constraints arising from insufficient aggregate demand. Proposition (i) and, most importantly, proposition (ii) however made their systematic appearance in economic theory only with the emergence of the wage fund doctrine.

The notion of a predetermined wages fund is not the only basis on which a decreasing demand for labour with respect to the wage rate is attributed to Ricardo. Some interpreters have suggested that the ideas of substitutability in production and consumption that are the analytical foundation of the decreasing demand schedule for labour in modern economic theory can also be found in Ricardo, albeit perhaps in a yet approximate form.[15] Ricardo's denial of an inverse relation between wages and employment, his views concerning the incidence of taxation,[16] and the possibility of non-transitory unemployment caused by machinery, are in fact all inconsistent with such a 'neoclassical' representation of his economic theory. However, a full discussion of this point is not within the scope of this paper. I will just recall that despite the recent revival of interpretations that tend to emphasize the similarities between the classics and the moderns (following Marshall's original example), on balance the main body of the secondary literature can hardly be said to attribute the modern notions of direct and indirect substitution to Ricardo.[17] Indeed, even the main supporters of such an interpretation appear to oscillate between the claim that notions of substitution and decreasing demand schedules were actually present in the theory of this economist and the much weaker one that, although they were not really there, they are *compatible* with it.[18]

5 Demand and supply in Ricardo's wage theory

We now turn to a discussion of the meaning and analytical role of the 'demand for labour' if, as argued, the wage fund interpretation has to be abandoned.

In his chapter 'On Wages' and elsewhere Ricardo often discusses the influence on the wage rate of the 'proportion of supply to demand' in the labour market (or occasionally,

of the proportion of 'capital to population'). This proportion is actually indicated as the other major factor determining the real wage rate along with the 'habits and customs' of the people, while the money wage reflects the natural prices of 'the commodities on which the wages of labour are expended' (Ricardo 1951–73, I:93–4, 97). What does Ricardo mean by this 'proportion', if it is not to be interpreted in the traditional fashion as the ratio of the wages fund to the working population?

In the chapter 'On Wages' Ricardo defines the demand for labour in connection with the notion of capital. The latter he defines as the part of the national wealth employed in production, consisting of 'food, clothing, *tools, raw materials, machinery*, etc., necessary to give effect to labour'. And he continues: 'in proportion to the increase of capital will be the demand for labour; in proportion to the work to be done will be the demand for those who are to do it' (*ibid.*:95, emphasis added).[19] The demand for labour depends on the amount of capital and its growth over time, where capital means 'productive capacity' consisting of machines, raw materials etc. combined together according to the requirements imposed by the techniques in use and the current composition of output. To a given productive capacity or capital will correspond a determinate employment level, i.e. a given demand for labour ('in proportion to the work to be done will be the demand for those who are to do it'), depending on the size and technical characteristics of that capacity.

Ricardo considers both the composition of output and techniques as given when he discusses the effects of accumulation on employment, while discussing the effects of changes in output composition and technical innovation on employment growth at separate stages of analysis. This explains why he here treats the increase in employment as proportional to that in capital, although clearly he is aware of the fact that there would be no such proportionality if, for example, technical progress took place in the course of accumulation (*ibid.*:ch. xxxi and 278). Similarly, in the passage quoted the wage rate is implicitly assumed constant. With changes in the wage rate, one component part of the capital (wages) would change, regardless of changes in the other components of capital and in employment (see the numerical examples in Ricardo's chapter on profits, *ibid.*:111–12).

Thus, what Ricardo means by the 'proportion of demand to supply' (or 'of capital to population') is the ratio between the desired employment, determined by the existing capacity, and the available supply of workers.[20] This ratio was regarded as describing labour market conditions, that is, the ease or difficulty in finding employment. It is, in other words, a measure of the excess supply of labour.

This interpretation of the meaning of expressions such as the 'proportion of demand to supply' or 'of capital to population' appears to be confirmed by a passage occurring in Ricardo's parliamentary speech 'On Mr. Owen's Plan' (Dec. 1819) in which he discussed the distress of the working classes, and Mr. Owen's proposed remedies to it. In this speech Ricardo argued that what the country did want was 'demand for labour' and that this was due to the 'insufficiency of capital, and the consequent disproportion between wages and population' (V:31–2). He then described the situation, saying that: 'The capitalist would be induced to remove his property from Great Britain to a situation where his profits would be more considerable:…the effect of it was to produce a *deficiency of employment* and consequent distress' (*ibid.*:32, emphasis added). It was therefore obviously this 'deficiency of employment' that was described, at the beginning

of the speech, as 'insufficiency of capital, and…disproportion between wages and population'.[21]

Interestingly, Ricardo did not suggest in the speech (as he did not in the chapter 'On Machinery') that the 'deficiency of employment' could be overcome, other things being equal, by decreasing the real wage rate; instead he saw a possible remedy in a faster pace of accumulation. The speech 'On Mr. Owen's Plan' precedes Ricardo's change of opinion regarding the possibility of unemployment resulting from the introduction of machinery; indeed, it is precisely in this speech that Ricardo expressed the view later refuted in his chapter 'On Machinery'. Ricardo's change of opinion concerned the possibility that investment in fixed capital should cause *fall* in the employment level. This is a different question from whether unemployment may exist, in any given economic situation, simply because the size of the productive capacity and the techniques in use are such as to employ a number of workers which is less than the given labour supply. This possibility was admitted by Ricardo independently of his views about the effects of machinery, and is the logical result of the absence of a decreasing relation between the wage rate and the employment level.

It is therefore the existence and size of the excess supply of labour with respect to a given demand (employment level desired by employers) that Ricardo had in mind when he discussed the influence of demand (or capital) and supply of labour (or population) on the real wage rate. He thus referred to increasing unemployment under such circumstances, when maintaining that an accumulation of capital which does not match population growth (I:101), that is, an 'excess supply of labour' (*ibid.*:165) will worsen the conditions of the labouring classes. Vice versa, when the accumulation of capital and the growth of employment proceed more rapidly than population, the excess supply of labour will tend to disappear, or demand may exceed population, and wages will rise: 'In new settlements,…it is probable that capital has a tendency to increase faster than mankind: and if the deficiency of labourers were not supplied by more populous countries, this tendency would very much raise the price of labour' (*ibid.*:98). The scarcity of hands in a situation of rapid accumulation favours the workers because 'it produces an increased competition among the employers of labour, and a consequent rise in its price' (*ibid.*:163), and is a condition for such a rise:

> I fully agree…that an increase in the wages of labour implies full employment to all the labouring classes.
>
> ('Notes on Malthus' II:412)[22]

> [The division of income between wages and profits] depends also on the state of the market for labour…for if labour be scarce the workmen will be able to demand and obtain a great quantity of necessaries.
>
> ('Absolute value and exchangeable value' IV:365–6)

On the other hand, while the ratio of employment to population remains unchanged (and given the 'habits and customs' of the labourer) there is no reason why the worker's real disposable income should change, as his bargaining position is unaltered: 'in the case of…a tax on corn there is not necessarily any excess in the supply of labour, nor any

abatement of demand, and therefore there can be no reason why the labourer should sustain a real diminution of wages' (I:165–6; see also Appendix 1 below).

To sum up then, the size of the excess supply of labour or surplus of labour (measured by the ratio of employment to population) in any given period contributes (along with 'habits and customs') to fixing the real wage rate at a given level that will be above subsistence if the excess supply of labour is low or nil. As the size of this surplus of labour changes over time when employment and population (average) growth rates are not equal, this will affect the evolution of the real wage rate.[23]

6 The 'decisions to save' as the determinant of the wages fund

Despite the previous discussion, it may still be wondered whether the idea that wages are advanced from capital must not imply the notion of a given amount of capital, determined by gross savings, which will give employment to more or less labour according to the wage level. This view might seem to be suggested for example by Schumpeter's statement that '[fjunds are, in the classic theory, "destined" for the maintenance of productive labour by the decision of the saver and thus are determined if annual savings are' (1982:667, n. 51; see also n. 6 above). In other words, it might be inferred that as under Say's law the accumulation of capital requires an act of saving, and as wages are treated as capital advanced to the workers, it must follow that the wage fund can *only* be increased by a previous voluntary decision to save on the part of the capitalists and is independent of the wage level. This, we shall presently argue, would be a false conclusion, as will be shown by means of a very simple numerical example. For simplicity we shall run it for a single good economy,[24] and assume that both capitalists and workers consume in the current period the income produced in the previous 'year'.

Suppose a stationary economy producing 1000 units of corn per year by means of 200 units of corn used as seed and 100 units of labour paid in advance a yearly wage of 4 units of corn; 600 units of corn are therefore the capital advanced each year by the capitalists, while the remaining 400 units are their profits, entirely consumed. Suppose now that in this economy a successful combination of the workers manages to impose at the beginning of the period a higher wage rate, 6 units of corn. Profits on the replacement costs of capital are now reduced to 200 and the capitalists must reduce their consumption if they want to keep the same level of production. With given inputs proportions, any attempt on their part to reduce the employment level and preserve their consumption in the current period would lead from the end of the current period onwards to a reduction of output, hence an even larger fall in their income and consumption. In our numerical example, output and profits would be reduced to 762 and 162 respectively if the capitalists decided to keep their total investments unaltered; and to 667 and 133 if they kept the wages fund unaltered. In other words, in Ricardo's classical framework of analysis there is no rational basis for a reduction in employment on the part of individual capitalists when faced with a rise in wages—provided this is not such as to reduce the profit rate below the minimum necessary to compensate the 'risk and trouble' of investment (Ricardo 1951–73,1:122).[25]

The increase in the 'wages fund' that follows the increase in the wage rate is simply 'financed' by the reduction in profit income and does not require a voluntary (i.e.

independent of changes in the wage rate) decision of increasing their savings on the part of the capitalists.[26]

While it is therefore rightly maintained that Ricardo regarded the capitalists' decision to save and invest as a condition for the expansion of employment (and consequently, with a given wage rate, of the 'funds destined for the maintenance of the labourers'), this should not lead to the false conclusion that it is also a *necessary* precondition for a rise in the wage rate and total 'wage bill'.

Conclusions

In Ricardo, the 'fund for the maintenance of the labourers' is not conceived as a magnitude determined before the wage rate and independently of it. This fund is simply equal to the wage rate times the number of workers employed. Independent variations in the employment level or the wage rate will induce a corresponding change in the size of the fund.

In any given state of the economy (i.e. ignoring changes associated with the accumulation process), employment is determined, independently of the current wage rate, by the size of output and the productivity of labour. These in turn are the result of the previous history of accumulation and technical change. The real wage rate is determined, according to Ricardo, by the historically determined subsistence of the workers and by the 'proportion of supply to demand' in the labour market. By the latter Ricardo meant the ratio of the employment level to the labouring population. Its persistent changes modify the bargaining position of the workers and may therefore affect the wage level. These features of Ricardo's wage theory are fully in the classical tradition, and can be found in most of his predecessors, Smith included (see Stirati 1994).

This suggests two considerations concerning the on-going controversy on Ricardo's wage theory.[27] First, although a major focus of the controversy is the very role of demand and supply of labour in determining the wage rate, relatively little attention appears to have been paid to what exactly is meant by 'demand for labour' in Ricardo's approach.

Second, the 'new view' interpreters of Ricardo emphasize the role of demand and supply in determining the wage rate. On this basis they more or less explicitly infer that there is a substantial continuity between classical wage theory and contemporary neoclassical theory, as both would provide a 'supply and demand' explanation of income distribution. The arguments presented above suggest that, although 'demand' and 'supply' may have a lasting *influence* on the wage rate in Ricardo's theory, the meaning of 'supply' and 'demand' and the way in which they affect wages differ from those found in marginal theory. In the latter, demand and supply schedules determine the wage rate as a full employment equilibrium price, an indicator of the scarcity of the resource labour relative to other, similarly fully employed, resources. By contrast, in Ricardo the 'proportion of demand to supply', i.e. the ratio of the employed to the given labour supply, influences the real wage level, within boundaries set by the historically determined subsistence minimum. No endogenous and necessary adjustment mechanisms are envisaged that could correct unemployment, which may only decrease gradually in the course of accumulation, if labour supply grows at a slower rate than employment.

APPENDIX 1 Ricardo on taxation of wages and necessaries

My purpose here is to establish whether wage fund notions play a role in Ricardo's discussion of the incidence of taxation or if, on the contrary, this is inconsistent with the wage fund doctrine.

The views entertained on the matter by representative exponents of the wage fund theory—J.S.Mill (1871:79–88, 827–9) and McCulloch (1852:88–108, 164, 167)—can be thus summarized:

(a) If wages are above the customary living standard of the workers ('subsistence'), then taxation of wages or necessaries will be borne by the labourers.
(b) If wages are at 'subsistence', taxation is still borne by the wage earners. However the worsened conditions of the labourers following taxation will tend to decrease population. When (adult) labour supply has accordingly fallen, before-tax wages will rise, restoring workers' purchasing power, and profits will be reduced. The change in labour supply is however very slow (20 years is the mentioned length), hence taxation might in fact lower the living standard instead of decreasing population, and in this case it would be borne by the workers even in the very long run.
(c) There is an exception to the process described in (b). If the government spends the yield of taxation not in purchasing goods but in hiring workers directly (be they productive or unproductive), before-tax wages will rise immediately, real disposable wages will not be affected and profits will

The rationale for this position is the following. If the yield of taxation is spent by the government in consumption goods, the production carried out to satisfy this demand will take the place of the now ceased (because of taxation) demand/production of the goods consumed by the workers. No addition is made to the wages fund of the country, hence before-tax wages cannot change, other things being equal. Only if population falls (given the wages fund), will wages rise. However, if the government spends the money raised by taxing wages in hiring labour directly, part of the income of the country previously devoted to (workers') consumption is now added to the capital/ wages fund. *As there is full employment,* the increased wages fund results in an immediate increase in before-tax wages, proportional to the tax, while employment remains unchanged.[28]

By contrast, Ricardo's general conclusions concerning taxation of wages or necessaries are the following:

(a) Wages will *immediately* rise after taxation, so as to leave the after-tax purchasing power of the workers unaltered.[29] This adjustment does not require any changes in population.
(b) Wages may actually rise less than required to leave workers' purchasing power unaltered *if* the decrease in profits caused by taxation negatively affects accumulation and hence the demand for labour (employment)

Let's now analyse Ricardo's arguments following his exposition closely. In the chapter where he discusses taxes on necessaries Ricardo argues: 'A tax, however, on raw produce and on the necessaries of the labourer…would raise wages…if they [the labourers] had to pay 8s per quarter in addition for wheat…they would not be able to subsist on the same wages as before, and to keep up the race of labourers' (1951–73, I: 159). Here the

argument might appear to be based on population changes (as in the wage fund theorists). But the ensuing discussion clearly shows this is not the case. Ricardo writes that one of the objections often moved to taxes on corn is that 'there would be a considerable interval between the rise in the price of corn and the rise of wages, during which much distress would be experienced by the labourers' (*ibid.:*160). He answers however to this objection:

> Those who maintain that it is the price of necessaries that regulates the price of labour, always allowing for the particular state of progression in which the society may be, seem to have conceded too readily, that a rise or fall in the price of necessaries will be very slowly succeeded by a rise or fall in wages…in the case of…a tax on corn there is not necessarily any excess in the supply of labour, nor any abatement of demand, and therefore there can be no reason why the labourer should sustain a real diminution of wages. A tax on corn…does not necessarily diminish the demand compared with the supply of labour; why should it diminish the portion paid to the labourer?
>
> (*ibid.:*161–6)

If the 'proportion between demand and supply' in Ricardo were to be interpreted as the ratio of the wages fund advanced by the employers to the supply of labour, the argument that neither has been changed by taxation should lead to the conclusion, consistently drawn by the wage fund theorists, that the wage rate *before tax* cannot and will not change. Ricardo on the contrary concludes that the wage *after tax* cannot change, hence the wage before tax will have to increase *immediately* (i.e. without waiting for changes in population). While this is inconsistent with the interpretation of 'demand' as a given wages fund, it is fully consistent with the interpretation suggested in this paper: the wages enjoyed by the laboures (i.e. after tax) are determined by the customary living standards of the workers and by their bargaining position, influenced, among other things, by the proportion of employment to the given labour supply. As taxation does not alter the determinants of the real disposable wage, it cannot modify it. That is, workers will be able to obtain the required increase in the money wage.

Ricardo concludes that:

> no interval which could bear oppressively on the labourer, would elapse between the rise in the price of raw produce, and the rise in the wages of the labourer; and that therefore no other inconvenience would be suffered by this class, than that which they would suffer from any other mode of taxation, namely, the risk that the tax might infringe on the funds destined for the maintenance of labour, and might therefore check or abate the demand for it.
>
> (*ibid.:*166; see also letter to McCulloch quoted below)

Despite the use of the expression 'funds destined for the maintenance of labour' this proposition too is in conflict with wage fund theory, according to which the tax will damage the workers (until population has adjusted) not necessarily because it 'infringes'

on ‘the funds’ but just because these funds stay equal. What Ricardo means here is that any tax, if borne by profit earners, *might* negatively affect the size of the capital of the country or its rate of growth, hence the level or growth rate of employment, which in turn influences the bargaining position of the workers and the (after-tax) wages they can obtain.

In the chapter concerning taxes on wages the arguments advanced are largely the same as those expounded in the chapter on taxes on raw produce and necessaries. At one point however Ricardo explains why wages must increase after they are taxed, in a way that may appear consistent with the wage fund doctrine. The government, he says, will employ the fund raised by the tax to hire labourers, however unproductive. Hence ‘[i]f labour were not to rise when wages are taxed, there could be a great increase in the competition for labour, because the owners of capital…would have the same funds for employing labour; whilst the Government who received the tax would have an additional fund for the same purpose’ (*ibid.:*220). But immediately after this Ricardo discusses an example that further shows he did not rely on wage fund notions in his analysis, namely the case in which the government spends abroad the money raised by taxing wages.[30] In this case, according to the wage fund theory, there should be no immediate rise in wages. Alternatively, if one assumes that (for reasons foreign to wage fund theory in its full formulation) wages will rise after taxation, the given wage fund must imply diminished employment. Let’s now see what Ricardo says. In such a case, according to him ‘there would be a diminished demand for labour, and wages might not rise’ (*ibid.:*221).

First, it must be noted that wages *might* not rise, which means that they might. Indeed in a letter to McCulloch in which he discusses a similar case (a tax on necessaries to finance a subsidy to a foreign state) Ricardo insists, against McCulloch’s opinion (and in sharp contrast with wage fund notions), that there will be no impoverishment of the labourer nor any change in population, but that wages ‘will undergo such a moderate increase as will compensate the labourer for the tax laid on his necessaries’ (VIII:195–6).

Second, Ricardo’s explanation of why wages might not rise is *not* that the ‘fund’ of the employers is unchanged, while no addition to it is made in this case by the government (the explanation, that is, that would be consistent with the wage fund doctrine). Rather, he argues that after-tax real wages might be affected because the demand for labour is diminished, and ‘the same would happen…if in any other manner the same sum had been raised to supply this subsidy’ (I:221). Demand for labour (employment) thus is diminished by the fact that a transfer to a foreign state implies a fall in national income—a conclusion independent of wage fund considerations.

Ricardo’s discussion on taxation is perhaps weak in providing a clear explanation of why wages should rise. However the mechanisms that would be consistent with wage fund theorizing—that is changes in population or yield of taxes entirely spent on wages—are either very clearly denied (population changes) or treated as non-necessary conditions (as in the example of tax revenue spent abroad). By contrast Ricardo’s arguments and conclusions appear consistent with the interpretation of his wage theory advanced in this paper.

APPENDIX 2 Ricardo on machinery

Ricardo's chapter on machinery has been the object of a very large body of literature, the discussion of which is evidently beyond the scope of a brief appendix. My only purpose here is, again, to discuss whether the conclusions drawn in this chapter rest upon wage fund notions.

The numerical example expounded at pp. 388–9 of the *Principles*, runs as follows. A capitalist produces yearly necessaries worth 15.000*l*., of which he pays (in the next period) 13.000*l* to his own workmen, while 2.000*l*. are his profits. Suppose now that the capitalist starts the year employing only half of his workmen in the production of necessaries, while the other half he employs in constructing a machine. During that year he would pay them as usual an amount of necessaries (produced in the previous year) worth 13.000*l*. But the next year:

> after deducing [2.000*l*. profits] for his own expences he would have no greater circulating capital than 5.5000*l*. with which which to carry on his subsequent operations, and, consequently, all the labour which was before employed by 7.500*l*. [the value of the machine] would become redundant. The reduced quantity of labour that the capitalist can employ, must, indeed, with the assistance of the machine, and after deductions for its repairs, produce a value equal to 7.500*l*., it must replace the circulating capital with a profit of 2.000*l*. on the whole capital [the total value of which is unchanged].
>
> (I:388–9)

This example may suggest that it is the fact that the production of necessaries has diminished that causes the fall in employment. In other words it may seem that here Ricardo is indeed reasoning in terms of a given 'wage fund' constituted by the 'corn' produced in the previous year determining employment (given the wage rate). This contrasts with his own arguments quoted above (section 2), according to which the amount of 'corn' (wage goods) produced in the economy is determined, as that of any other commodity, by the 'effectual demand' for it. This however appears to be a wrong interpretation if one looks at the whole of Ricardo's argument. In his next example, the capitalist introducing the machine is a clothier whose production does not consist of wage goods:

> In the trade of a clothier less cloth would be produced after the introduction of machinery; for a part of that quantity which is disposed of for the purpose of paying a large body of workmen, would not be required by their employer…. It may be said, however, that the demand for cloth would be as great as before…. But by whom would the cloth be demanded? By the farmers and the other producers of necessaries, who…gave corn and necessaries to the clothier for cloth, and he bestowed them on his workmen for the cloth which their work afforded him. This

> trade would now cease; the clothier would not want the food and clothing, having fewer men to employ and less clothes to dispose of…. The demand for labour would diminish, and the commodities necessary to the support of labour would not be produced in the same abundance.
>
> (*ibid.*:391)

Or, as he further explains to McCulloch:

> the use of machinery often diminishes the quantity of gross produce, and although the inclination to consume is unlimited, the demand will be diminished, by the want of means of purchasing.
>
> (letter to McCulloch, 18 June 1821, VIII:387)

Hence the causality clearly goes from the diminished employment in the trade in which the new machinery is introduced, to the diminished production of necessaries. The amount of wage goods produced therefore does not determine, but is itself determined by the employment level associated with the new technology and the given wage rate.[31]

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Notes

1 Recently, interpretations have been advanced in which wage fund notions are clearly *not* attributed to Ricardo: Bharadwaj 1983; Garegnani (1984:294–7, 1990:118–22); Picchio 1981, 1992). Along different lines of interpretation Hollander too rejects this view in favour of a full-employment marginal product determination of the wage rate (Hicks and Hollander 1977; Hollander 1979:326–34, 368–73). In none of these works however are arguments against the wage fund interpretation developed along the lines of the present paper.

2 All references to Ricardo's writings are to volume and page of Sraffa's edition of his *Works and Correspondence*.

3 While in the literature on Ricardo's treatment of taxation and machinery is often found difficult to reconcile with the traditional interpretation of his wage theory, on various occasions of discussion of this paper it has been objected that Ricardo's arguments on these questions appear to rely on wage fund notions. Accordingly, I felt the need to provide a more detailed discussion of the matter in two appendices to this paper.

4 See for example O'Brien 1981:368; Schumpeter 1982:667; Blith 1987:836.

5 In a different, later version of the theory, formulated by Cairnes, the full employment wage is: $w=C/P-l/\mu$, where C is total (fixed plus circulating) capital; P is population (labour supply);

μ is the given proportion between labour and the value of fixed capital (Cairnes 1874:170–5; evidently it is neglected here that it is impossible to provide a measure of the value of a set of heterogeneous capital goods which is independent of distribution). In this version of the theory what is taken as given is the value of total capital rather than circulating capital, labour demand has an elasticity of less than one, and the part of capital destined to the payment of wages is not independent of population size; apart from this, propositions (ii) and (iii) in the text still hold. In the following I will not in general explicitly discuss this version of the theory. The reader however will easily find that most of the arguments can be extended to apply to this particular version of the theory also.

6 For example, Schumpeter writes: 'The basis of the wage-fund doctrine is the proposition that (industrial) wages are "advanced" from capital…. He who accepts it cannot oppose the wage-fund doctrine' (1982:667); similar opinions can be found, among others, in O'Brien (1975:111–12) and in Blith (1987:836).

7 On this point see also I:405, n. 2; *Notes on Malthus*, II:135–6 and the letter to Malthus of 2 Jan. 1816, VI:2–3. See also the letters addressed to Trower dated 15 and 26 Sept. and 13 Oct. 1820, VIII:236–7, 255–8, 273, from which some quotations below.

8 The following passage is similar in content, as an increased production of food is regarded as the consequence of an increase in wages and the effectual demand for food:

> The aggregate capitals will be increased! if labour cannot be procured no more work will be done with the additional capital, but wages will rise, and the distribution of the produce will be favourable to the workmen. In this case no more food will be produced if the workmen were well fed before, their demand will be for conveniences and luxuries. But the number of labourers are increased, or the children of labourers! Then indeed the demand for food will increase, and food will be produced in consequence of such demand.
>
> (VIII:258)

9 This is of course true if the increase in agricultural production has not been such as to cause diminishing returns. If production costs of corn have risen, the natural price of corn will be higher than before. Ricardo however thought that changes in the natural price of corn would not persistently modify the real wage. So in our example if the circumstances that determine the latter have caused a certain increase, the money wage will further adjust after the rise in the price of corn to preserve workers' purchasing power.

10 Concerning the degree of variation in market prices see Smith 1976, I.vii:9–10, whose discussion is fully subscribed by Ricardo. The workers' money income may vary following a poor crop in agriculture, as with given input/output proportions, a lower output implies diminished employment.

11 Malthus does not make any precise reference to passages in the *Wealth of Nations.* There is however a passage in the chapter 'Of the Wages of Labour' in the *Wealth of Nations* to which he seems to be referring: '[In a year of sudden and extraordinary scarcity] the funds destined for employing industry are less than they had been in the year before. A considerable number of people are thrown out of employment, who bid against one another in order to get it, which sometimes lowers both the real and the money price of labour' (Smith 1976, I.viii:55). Smith, however, is evidently saying something different from what is attributed to him by Malthus. He simply observes that many people will lose their employment, and this may lower the actual or market wage rate. There is no hint at a positive effect of such a decrease on the employment level, nor at the existence of an alternative between unemployment and the fall of wages, as suggested by Malthus.

12 Since Ricardo holds the value of money constant in his analysis, an increase in money income is also an increase in real income, i.e. in income expressed in corn or any other commodity (see Ricardo 1951–73, I:50). Hollander too quotes the passage in the text, and

some of those quoted in section 4 below, in support of the view that a wage fund theory should not be attributed to Ricardo (1979:326–34, 368–73). In principle, Ricardo's statement could be interpreted as resulting not from the absence of an inverse relation between wages and employment but rather from its being of elasticity less than one. However, Ricardo makes no reference to the unemployment that according to the latter interpretation would be caused by 'combinations', nor does he qualify his statement by saying that if, and by how much, workers' income will increase depends on the employment effects of wage increases. Thus it is difficult not to believe that the increase in workers' income is indeed the *only* effect envisaged by Ricardo.

13 Blaug (1973:76) is of different opinion, stating that Ricardo 'could and did recommend wage cuts as an effective device for clearing the labour market'. In support of this he quotes a passage from Ricardo's correspondence with Malthus in which Ricardo writes: '…if wages were previously high, I can see no reason whatever why they should not fall before many labourers are thrown out of work…. I must say that a sudden and diminished demand for labour *in this case* must mean a diminished reward to the labourer, and not a diminished employment of him' (Ricardo 1951–73, IX:25, emphasis added). It must be noted that here Ricardo is referring to the particular case being discussed. The context shows that this is a situation in which the demand for labour (i.e. the desired number of workers) is already larger than the given supply; accordingly, every further investment results in greater competition among the employers and in wage increases with no increase in production, because more labour cannot in fact be procured. The fact that in such peculiar circumstances a decrease in labour demand, reducing the gap, would cause a fall in the wage level and not in the employment level does not prove Blaug's point, i.e. that Ricardo believed a fall in the wage rate would bring about an *increase* in the employment level.

14 There is one other instance in Ricardo's writings in which it is affirmed that institutional changes can bring about a persistent improvement of the situation of the working classes: it is the criticism Ricardo addressed to Place (1822) for the latter's conclusions about the consequences of a 'system of equality':

> in the latter part of the first chapter it is I think *inferred that under a system of equality population would press with more force against the means of subsistence than it now does*. This I do not think is true. I believe, that under such system, mankind would increase much faster than it now does, but so would food also. A larger proportion of the whole capital of the country would be employed in the production of food-necessaries, and a less proportion in the production of luxuries, and thus we might go on, with an increase of capital, without any increase in difficulty…. It should always be remembered that we are not forcing the production of food to the extent of our power.
>
> (letter to Place, 9 Sept. 1821, IX:49–50, emphasis in the original)

These remarks clearly show that a system of equality is believed to increase persistently the income of the working classes; the change in income distribution associated with such a system is not said to set in motion countervailing forces resulting from the creation of unemployment, and the growth of population does not, under these circumstances, cause a fall in wages.

15 Particularly Samuelson (1978); Hollander (1979, 1987); and, on consumption theory, Barkai (1967) and Rankin (1980).
16 If the real wage were determined as the equilibrium price by means of the usual supply and demand schedules, a tax on wages or on wage goods would not in general leave the real disposable wage unchanged. The more so as Ricardo regarded supply of labour as given at any given point in time (a vertical line in the usual diagram).
17 See for example Hutchison (1952) who argues against any continuity between the classics and the moderns, quoting in his support many neoclassical authorities. A similar view can be found in Cannan (1893:200–6) and Knight (1956:75). On the absence of substitution mechanisms in production see Schumpeter (1982:679, n. 94) and Blaug (1987:441). For a criticism of those who attribute substitution mechanisms in consumption (decreasing demand schedules) to Ricardo, see Roncaglia (1982a and b) and Garegnani (1983, 1987:565–66). Some of the works in note 15 are criticized in Peach (1988b, 1993:241–77); and Stirati (1994:188–96, 1992:47–9)
18 See, among many other examples, Hollander (1982:370); Barkai (1967:75, 1986:609, 611–12).
19 Ricardo appears to refer here only to productive workers employed in the capitalist sector of the economy.
20 Our interpretation of the 'demand for labour' as neither a fund nor a schedule, but simply as the number of workers employed, finds further support in the analogy with the definition of demand—or 'effectual demand'—of a commodity (Smith 1976, I. vii:7–8; Ricardo 1951–73, I:91). The proportion between the demand and the supply of the commodity is the ratio between two quantities: the number of hats, pounds of wheat etc. that are 'brought to market' (supply) and the number of hats etc. that the consumers want to buy at the normal price. As labour demand may in principle be larger than the supply, I use the term desired (i.e. including vacancies) employment in the text.
21 Note that according to the wage fund doctrine an 'insufficiency of capital' would result in low wages, and not in a 'deficiency of employment'.
22 Here Ricardo comments on Malthus's statement that an increase in real and money wages is an 'infallible sign of health and prosperity' of the economy and implies full employment of labour.
23 In some parts of the *Principles* Ricardo seems to hold, like Smith, that persistent changes in the ratio of employment to population will affect the *natural* wage, given the lower limit to the latter represented by the historically determined 'subsistence' of the labourer; in the chapter 'On Wages' however these changes are said to cause deviations of the market from the natural wage (Stirati 1995). Market wages may fall below subsistence, as the latter is conceived as a 'floor' for the *natural* wage.

For those who prefer simple algebra to literary exposition, Ricardo's (Smithian) views can be stated as follows (in the assumption of one good only, 'corn'):

$$E = \overline{X}/\pi \tag{1}$$

where E is employment plus vacancies, X is output, taken as given, and π is the productivity of labour

$$L^s = \overline{P} \tag{2}$$

where L^s is labour supply and P the given (adult) working class population.

$(E/L^s)^* \leq 1$ is the ratio between demand and supply of labour above which the bargaining position of the workers begins to improve, allowing them to obtain above subsistence wages. Several reasons suggest that it should be less than one. The main ones are that when unemployment is low, even if positive, unemployment spells will be shorter and hence less threatening for the workers, while the time required to fill vacancies will be longer, and employers may want to shorten it by offering higher wages. When unemployment is 'low', that is $E/L^s \geq (E/Ls)^*$, we have:

$$w = s + b\left(\frac{E}{L^s}\right) \tag{3a}$$

where w is the real wage, s is the subsistence minimum, $b>0$ is a parameter. With low ratios competition for employment is high, so that when $E/L^s < (E/L^s)^*$, $b=0$ and the following holds:

$$w=s \tag{3b}$$

Given the wage rate, thus determined, the profit rate is:

$$r = \frac{X - wE}{wE + C} \tag{4}$$

where r is the rate of profit and C the corn used as seed.

The values of s and b depend upon institutional, cultural, social circumstances. The particular form (i.e. linear) of the relation (3) is arbitrarily chose for the sake of exposition. Changes over time of the wage rate will be determined by persistent changes in the ratio of employment to population, and by changes in s and b due to institutional and social factors. As explained elsewhere, representing the dynamics of the system by means of functions relating population and employment growth rates to distributive variables is not loyal to Ricardo's views (Stirati 1992:49–50, 52, 1994:116–22, 157–63).

24 Should two (or more) goods be produced, and one be consumed by the capitalists and the other by the workers, the substance of the argument would not change, but a time lag would be required to allow production to adjust to the changed distribution of income (see the foregoing section).

25 This difference with marginal theory depends on the fact that employers are not faced with a downward sloping schedule of the marginal product of labour based on substitution mechanisms in consumption or in production. It was shown above that Ricardo did not believe in an inverse relation between wages and employment, and that the absence of systematic substitutability between labour and other inputs in his approach is widely recognized.

26 See Garegnani (1960:165–75) for the discussion of a similar point in the context of criticism of Wicksell's notion of the 'subsistence fund'. Similar lines of argument were advanced by the critics of the wage fund theory and accepted by J.S.Mill in his recantation (Stirati, forthcoming). These appear to be valid also against Cairnes's version of the theory (n. 5 above), despite its attempt to take into account the existence of given input proportions. In this version too there is no reason why individual employers should choose to diminish employment when faced with an increase in the wage rate.

27 Assessments of this debate can be found in Hollander (1983); Rosselli (1985); Peach (1988a); Stirati (1994:157–68). For the last round of the controversy see Hollander (1990), Peach (1990) and Stigler (1990).

28 These arguments, developed *both* by J.S.Mill and McCulloch, are fully consistent with Mill's conception of the wage fund *not* as a physical amount of wage goods. But one may wonder if McCulloch's definition of it as such a given amount should not lead, in some instances, and if wages are paid in money (as McCulloch admitted to be generally the case), to different short-run conclusions. Consider the following example. Wages are advanced in money while the given amount of existing wage goods (corn) is stored up, waiting to be bought by the labourers. The government taxes (money) wages in order to buy paintings etc. for its museums. What should now happen is that the market price of corn—available in fixed quantity—falls, and this raises the purchasing power of the workers, albeit not necessarily in exact proportion to the tax. (If the tax revenue were instead spent to buy corn, donated to non-working sections of the population, real after-tax wages would fall, consistently with the argument described in the text.) We do not find in McCulloch instances of short-run analysis along the lines of our first example. The relevant point for our purposes however is that Ricardo's conclusion that the purchasing power of workers will not be affected by taxation does not rest on the short-run analysis described above, based on the existence of a given 'physical' wage fund, but on the argument that money wages will persistently rise in consequence of taxation (see text).

29 It is not entirely clear whether according to Ricardo this is always the case or if it is so only when wages are at subsistence. While some passages support the latter view, in the chapters on taxation Ricardo assumes that wages will adjust also when they are regulated not only by the cost of subsistence but also by the 'circumstances of the country' (and may therefore be higher than subsistence). See the passages quoted below.

30 Here, as in the correspondence with McCulloch quoted below, the example appears to be discussed without any consideration of the possible effects of such transfer abroad on the quantity of money and the channels of international trade. The example appears simply meant to rule out that the income raised by taxation will give employment to any workers in the country.

31 Samuelson's (1994) criticism of wage fund notions and their use in the discussion of machinery thus appears to apply to the interpreters of Ricardo rather than to Ricardo himself.

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11
The special thing I learned from Sraffa

Paul A.Samuelson

This is written in homage to Pierangelo Garegnani, who not only has been a most faithful disciple to the Master but has in his own right been a creative innovator and expositor for the Sraffian heritage. None has benefited more than I from the Garegnani corpus (in English), both as a general reader but also in more personal communications. As I shall relate, Professor Garegnani on a good chance 1962 visit to Cambridge, Massachusetts prevented me from perpetrating a misdemeanor in print. And it was he—with Luigi Pasinetti, Michio Morishima, and Bruno, Burmeister and Sheshinski—who corrected in the 1966 *Quarterly Journal of Economics* an absurd conjecture that I had thrown toward an MIT graduate student. Yes, Homer nodded twice.

Snapshots

But it is of one Sraffian insight that I write today. Still it is appropriate to register first some *ad hominem* detail. If you have seen Shelley plain, albeit not intimately, it is incumbent to report on that. My generation of American economists knew of Piero Sraffa so to speak at our birth. We knew his seminal 1926 *Economic Journal* article that brilliantly corrected Alfred Marshall's fuzzy attempt to have a firm be in purely competitive 'equilibrium' even though its own marginal cost was declining. In this connection, Sraffa was a parallel progenitor in England of the Joan Robinson imperfect competition breakthrough; parallel with 1838 Cournot and, in America, 1921 Viner, Allyn Young's oral tradition at Cornell and Harvard, and Edward Chamberlin's independent explorations of monopolistic competition.

Intertemporal diminishing returns

There was another half to Sraffa's 1926 piece: his grappling with the artificial inadequacies of Marshall's crude *partial* equilibrium. American students were long taught that Sraffa had in effect ruled out Marshallian 'increasing cost' as a valid and relevant category of competition. Yet, as Walras and Wicksell knew well, any *competitive* system with primary factors of production—such as land and labour or male

and female labour—would (save in singular cases) be presumptively subject to the *increasing* cost category: a shift in tastes from beer to burgundy wine would presumptively raise both short- and long-run P_{wine}/P_{beer}. There is thus no Ricardo '*natural* price'. At best there are (corrected) Marshall '*normal* prices'.

Figure 11.1 shows the guns vs. butter trade off that ten million beginners have learned in their first week of economic study. Paraphrasing one of Marshall's three 'boxes', the convex AB *increasing returns* locus is inconsistent with sustainable competition (*sans* externalities). CD depicts Sraffa's emphasized special case of constant *costs*, which is unrealistic save in singular technologies (involving gratuitous coincidence for labour/land ratios). The generic case of *increasing cost* is any one of EF, E′F′, E″F″.[1] Note that any successful marginalist critique has to be consistent with the fact that limits of EF, E′F′,…sequences can come indefinitely close to the neoclassical E″F″ (see n. 3).

Figure 11.1 of course does not pertain directly to intertemporal trade offs and the diminishing returns properties that they must obey in a convex time-phased technology. Figure 11.2(a) addresses how consumption of *guns now* are in technical trade off with *guns tomorrow* (or yesterday). Figure 11.2(b) depicts trade off between *butter today and guns tomorrow*. How different from the generic concavity of Figure 11.1 can 11.2(a) and 11.2(b) be in a convex intertemporal technology (of any complexity)? Despite the important surprises sprung by the Sraffian breakthrough, in general the same concavity property must prevail—quite in accordance with the essential stipulations of Fisher's 1930 *Theory of Interest*.

Intertemporal diminishing returns applies

Do not rule out reswitching, or Wicksell effects, or multiplicity of heterogeneous capital goods in a vectoral definition of capital. Do deny smoothly

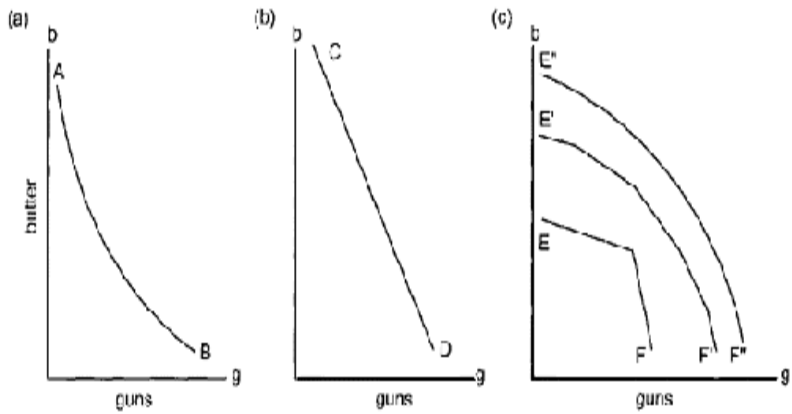

Figure 11.1

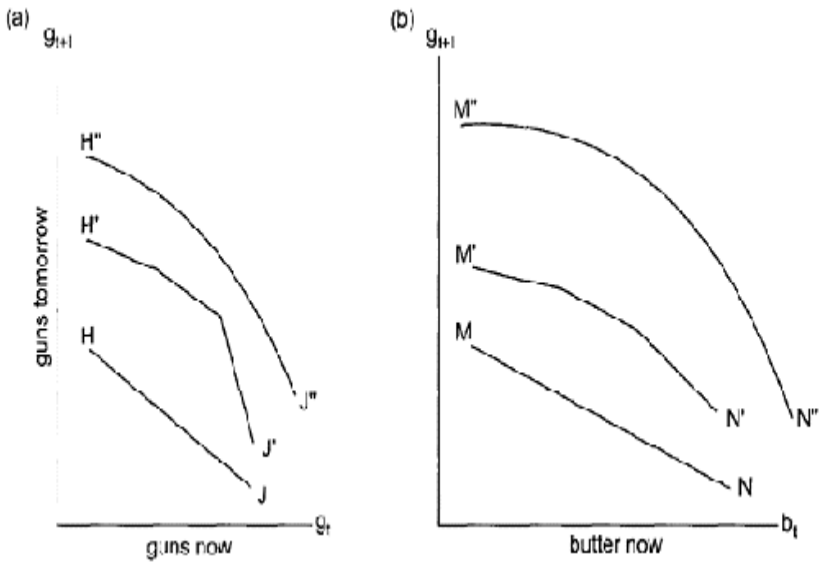

Figure 11.2

differentiable production functions, thereby denying non-spurious marginal products. In other words contemplate a neoclassicist's nightmare to which some future worked-out Sraffian critique of marginalism will *validly* apply. Still, the good old law of diminishing returns does definitely apply intertemporally in the Figure 11.2 fashion. To Joan Robinson that ought to come as bad news. For she hoped to regard the old Senior apologetics for thriftiness as a swindle to brainwash the masses in favour of capitalism. If more of future consumption can come only with less of current, then there is a Paretooptimality property to the intertemporal world of Walras, Arrow, or Debreu.

I understood this by 1945 and still believe it to be an undeniable truth. Where I went off the tracks was in thinking that such diminishing returns somehow implied that 'the lower the steady-state interest, the higher (if anything) the level of per capita consumption must be'. I falsely expected c=*f*(r) to be a *globally monotone decreasing* function—a false conclusion but one which happened to be valid in a one-capital-good world like the Leets model of Joan Robinson.

I warn of another tempting false interference. Do not think that because the steady-state factor price trade off frontier between any two primary factors' return is necessarily convex for a fixed rate of interest and a fixed level of return for a third primary factor, that the steady-state interest rate can be treated just as if it had the properties that any primary factor's return had. In the trinity (land, labour, capital) and their related (real rent rate, real wage rate, real interest rate), since before 1850 sophisticated economists perceived that 'capital' is *not* a factor *parallel* with (labour, land), so that at the same time the interest rate as capital's competitive return can *not* be strictly parallel with its (real wage, real rent) that are the respective returns of (labour, land). Capital theory deals with how labour and land are used over time to produce intermediate inputs that join with them in producing outputs of different dates. Even before Jevons, Menger, and Wicksell,

and before Smith, a glimpse of this truth had been achieved. Unfortunately, in special models that J.B. Clark liked, the essential difference can be glossed over.

Indeed, the single most manageable model of the mathematical graduate seminar—in which Q(t)=C(t) dK/dt=F[labour(t), land(t), K(t)]=[$L^{⅔}$, $A^{1/6}$, $K^{1/6}$]—capital can be virtually treated like any other input. For such a F[K, A, T]≡F[V_1,V_2,V_3] with real returns [w_1, w_2, w_3]≡[wage rate, rent rate, interest rate], marginal productivity does apply: [w_1, w_2, w_3] does equal [$\partial F/\partial V_1$, $\partial F/\partial V_2$, $\partial F/\partial V_3$] and duality theory easily deduces a convex factor-price frontier in w_1, w_2, *and* the interest rate! Singularly in this special model, r happens to behave just like the primary wage and rent rates!

Sraffa was important in teaching me to understand how very misleading is this one-scalar-capital model, not only for *his* discrete-technology capital vector model, but also for the general Clark-Ramsey-Meade neoclassical model involving (L, A) and the (K_1 K_2,…) vector. Even where, *generically*, any pair of steady-state (wage rate, rent rate, interest rate) determines the third in a factor-price trade off contour, and even where the technology is convex *sans* joint products, the *ceteris paribus* trade off between the primary w_1 and r, or between primary w_2 and r, need *not* have the *convexity* property that the *ceteris paribus* tradeoff between the primary (w_1, w_2) *must* have in all convex technologies.

This may seem like knit-picking but actually it is a distinction of subtle and deep importance. And it was in working out responses to Dr Garegnani's objection to a first draft of my 1962 Surrogate Capital paper that I was able to understand the Sraffian implication. Even Dr Garegnani cannot realize how important his words were in leading me to the light. *Caveat:* It would be a misunderstanding of this clarification if it were construed to add weight to what can be valid in a Sraffian critique of 'marginalism': thus, it is an important truth in any smooth neoclassical model that happened to be invulnerable to any marginalist critique.

Here is not the place to provide clear, complete and rigorous expositions. It is best that I conclude with an eludication of that special thing that mainstream economists like me learned from Sraffa's classic 1960 book.

The one basic novelty

Here, too briefly, is that one special thing.

(A). Long before 1960 one understood that, in general, *no scalar magni-tude* can denote what is the 'accumulation of capital' when a society abstains from present consumption to effectuate a permanent rise in potential future consumption. The capital/output ratio, as Joan Robinson (1956) demonstrated, is a treacherous guide because of 'Wicksell' and other effects. No reliable independent meaning can be given to 'more or less roundaboutness' or, to 'degree of mechanization' and other measures of capital 'intensity'.

(B). Even when capital is intrinsically vectoral rather than scalar, its real return as measured by its *steady-state* or stationary-state rate of *interest: profit* is indeed a *scalar* parameter in equilibrium. And, for each rate of interest, r, there is a determinate maximal level of sustainable *'consumption'*, c, vectoral (or, as a *scalar*, once the market-basket composition of consumptions is specified).

(C). One could therefore, around 1960, still describe the following process of capital accumulation: when society is not already at a golden-rule state of technology, sacrificing some vectoral amounts of current consumption over a finite time period is both a necessary and (generically) sufficient condition for achieving a permanently higher time path of (vectoral) consumption forever. And, in a convex technology (of Sraffa or von Neumann type, or of Clark-Walras neoclassical type), an *intertemporal law of diminishing real returns* invariably obtains generically for the vectors involved. (None of that is vitiated by possible 'reswitching', Wicksell effects, joint products, or anything else!)

(D). Although any close reader of Irving Fisher's 1907 *The Rate of Interest* should have known better, around 1960 I vainly hoped to be able to summarize the essence of (C) above, by asserting that, as r rises above the golden-rule rate (of, say, zero), c of consumption must if anything fall in the entailed stationary state equilibrium. When we can write c as a function of r, c =*f*(r), then:

$$\text{Max } c = \underset{r}{\text{Max}}\, f(r) = f(0),\ f'(r) \leq 0 \text{ near } r = 0.$$

There is no error in the above *local* relation. Where my thinking went wrong was in believing that *f*′(x) and (Δc)×(Δr) had to be (if not zero) negative *globally*.

Although I may never have put such a false conjecture into explicit print, it was from brooding over Sraffa that I learned that:

> *f*(r) can rise—but not to above *f*(0)—for ranges of r a finite distance above the golden-rule r^*.[2]

When I chanced to write the above to a French savant, he objected: 'But that is nowhere in Sraffa! Never did he speak of golden ages. And too rarely did Sraffa leave the realm of price dualities in an input-output model to elaborate on its quantity dualities'.

I replied:

> Each of your words is true. But you are too young to recognize the innuendo of the author. Long before Joan Robinson (1956, pp. 109–10 on the Ruth Cohen phenomenon), Piero had proved to himself that there can (in general) exist no objective way to decide that Technique A, in comparison with Technique B, is more 'capital-intensive', 'roundabout', or 'durable'. The critique of Eugen von Böhm-Bawerk by Irving Fisher (1907, pp. 331–34) might have earlier convinced me of this, but I was playing tennis the mornings that Jacob Viner and Joseph Schumpeter lectured on those subjects.

To the trained ear the 1960 Sraffa book whispers the relevant hints.

'What, only one thing learned from a classic? You must be pretty dumb', readers may aver.

No. There were indeed many theorems and lemmas to be learned from *Production of Commodities by Means of Commodities*. But for the savvy youngsters in the Leontief Circle, many were not new.

What counts though are the big insights a genius brings to an important problem of science. By this test Piero Sraffa is still not fully recognized in the mainstream literature.[3]

Acknowledgments

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Notes

1 A microscopic reading of the 1926 Sraffa text will reveal that, after all, he does not disagree with this. Alas, Ricardo's editor did not point out that Ricardo never enunciated this and other principal properties of his labour-land-time system. And his best modern historians—Stigler, Hollander, Blaug—miss the essential point.

2 It may be added that Liviatan and Samuelson (1969) had by another route fabricated a one-capital-good joint-product model for which *f*(r) is single-valued, falling for r near 0 but recovering part way for an intermediate interval of r, and then indefinitely.

3 I need to record an important *caveat*. Geniuses who do great *net* good can also do some gross harms. Sraffa did not live to articulate a future 'critique' of marginalism. We can glean only hints of what he intended to assert. It is my tentative inference from those hints that he thought this: the errors he uncovered as being special to popular neoclassical parables—by showing how in his *discrete* technologies they were not necessarily valid—were somehow proof of weaknesses and unrealisms in assuming *smoothly differentiable* technologies that possessed *marginal products*. I believe such a view is crucially flawed. A von Neumann could show that *generically* all that can happen or cannot happen in a *discrete* Sraffa world also can or cannot happen in a *smooth* neoclassical world. It is an empirical matter as to how good or poorly marginal productivity equalities apply to the real world's equalities—inequalities. Senior and Marx can use either or both technologies to make their valid points. To understand this note, consider in Figure 11.3(a) the simplest case where Marshall's *dd* demand curve is a line with −45° slope. It intersects his *ss* supply curve, which has a +45° slope. This is the smooth case and for it every beginner knows the simple comparative statics: A shift up in demand raises price and quantity; a lateral shift in *ss* supply lowers P and raises Q. Now in Figure 11.3(b) approximate each line by a staircase with *many* steps and risers that are 'small'.

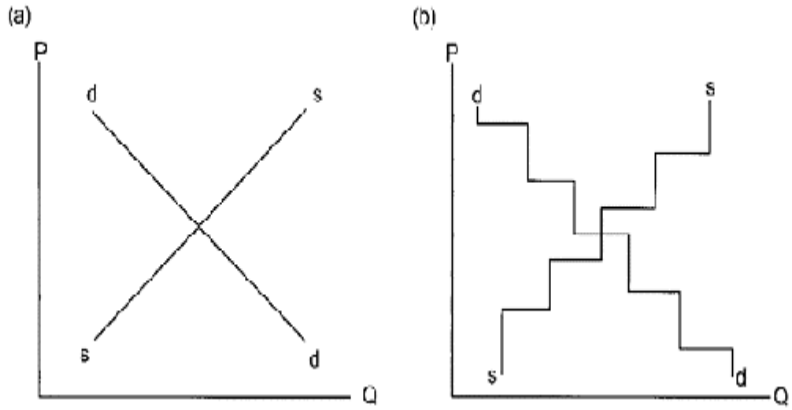

Figure 11.3

The same qualitative comparative statics applies; and, the 'smaller' the steps, the closer are the quantitative (ΔP, ΔQ) changes in the two models. Intertemporal distribution theory is just like that in the von Neumann-Debreu world.

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Part III
Accumulation and technical change in the light of the surplus approach

12
New and old neoclassical growth theory

A critical assessment

Sergio Cesaratto

> Here at least is a connection between 'thriftiness' and 'growth'.
>
> (Lucas 1988:23)

> There is nothing complicated or deep about this, it is just as simple as that.
>
> (Solow 1992:21)

1 Novelty and continuity in neoclassical growth theory

The New or Endogenous Growth Theory (hereafter EGT) has become, within a few years, a substantial component of mainstream theory, replacing, or more correctly, integrating the well-established Solow (1956) growth model. In this contribution, I will present a critical assessment of EGT by interpreting it as the modern development of old and well-known issues in neoclassical economics, and in particular, in the light of earlier attempts to integrate Solow's model that took place shortly after its publication. As it will be seen, the novelty of most (although not all) of the ideas advanced by EGT is considerably reduced once the first generation of EG models, let alone the influence of Marshall and of the early Hicks, is taken into consideration. Of course, as often happens in science, it is not so important who first advanced a new idea. What are important are the contributions of those who, possibly favoured by more suitable circumstances, manage to make the idea visible, attractive and practically relevant. This is precisely the case with EGT. Nonetheless, singling out the continuity between the old and new growth theory is a relevant exercise. One approach would be to maintain that EGT consists of a radical departure from neoclassical theory (and is therefore something really new or even non-orthodox[1]). A less pretentious approach would be to conclude that EGT advances some well-known neoclassical lines of thought, which being under-exploited, were suitable for further development. The large degree of continuity in the neoclassical research programme justifies an assessment of EGT that emphasises its traditional background, while at this stage neglects some of the novelties.[2]

In short, my interpretation of EGT is the following. From a theoretical point of view, both early and recent EG models deal with the dissatisfaction concerning one main result of Solow's model, that is the independence, on the one side, of the rates of output growth from the saving propensity of the community[3] and, on the other side, its dependence on

the exogenous rates of growth of the labour force and technology. This result contradicts the conventional (neoclassical) view of thrift as the 'engine' of growth. The exogenity of the determinants of the growth rate has two consequences. The first, of which the early marginalists were well aware, was the 'spectrum of stagnation'. In the absence of the exogenous forces of growth, net saving could lead to a progressive abundance of capital with respect to labour and hence to a fall in the marginal productivity of capital. The second concerned the irrelevance for the growth rate of the policy prescriptions aimed to increase the share of investment (saving) in income. To this, modern EG theorists add the claim that Solow's model represents a poor explanation of the diversity of growth experiences that has become evident after the emergence of the newly industrialised countries (NICs) from the crowd of underdeveloped countries. In order to reach this conclusion, 'exogenous' technical change is identified with the idea of 'equal access' to technical change (equal access implies in this theory the secular convergence of growth rates). Much of EGT concerns how to make technical change dependent on the community's preferences between saving and consumption, so as to explain the variety of growth experiences. The paper will show the constraints that the neoclassical structure superimposes on the ways in which a theory of accumulation that deals with these problematic features of Solow's model can be obtained.

The ability shown by EGT to develop well-known although little exploited directions within the neoclassical research programme can be seen as a sign of vitality of the latter. On the one hand, this vitality has certainly been favoured by the recent recovery by the profession of the most traditional pre-Keynesian views—in line with the current political mood. On the other hand, EGT relies on theoretical concepts, such as the aggregate production function, that have been shown to present serious logical inconsistencies.

Most of the criticism directed at the logical consistency of neoclassical growth theory is implicit in the work of Piero Sraffa that resulted in the capital-theory controversy. Its first victim was the set of 'parables' based on the aggregate production functions largely used in the growth literature in the 1960s, but also by EGT.[4] Since the controversy is already discussed by other contributors to this volume, in my criticism I will not put much emphasis on this aspect, relying more on other limitations of EGT.

2 Thrift as the engine of growth and the Malthusian Ghost

The 'conventional wisdom' from Marshall to Romer

The neoclassical theory of value and distribution is also a theory of output. On the basis of given endowments of 'productive factors', individual preferences and technical conditions of production, the neoclassical economists determine relative prices, distribution and the level and composition of the social output. The existence of decreasing demand curves for the productive factors, derived by marginal productivity analysis and/or, in the case of fixed coefficients, by marginal utility analysis, would assure that, on average, the economy *tends* to a full employment level of output.

The early neoclassical growth theory was not based on the notion of the steady state. Economic change was investigated through the comparison of long-period equilibria (or 'long-period positions', see Cesaratto 1995, 1996a), examined, e.g., before and after the

introduction of an innovation (see chapter VI of Hicks' *Theory of Wages*, 1932). The idea was that the long-period equilibria would act as centres of gravitation for quantities and prices at any point of time. The long-period equilibria were understood as moving equilibria that resulted from secular changes of the capital and labour stocks, of technology, and of preferences. The introduction of the notion of 'steady-state growth' is generally attributed to Cassel (1932) who coined the notion of the 'Uniformly Progressing State' in which the economy grows at the rate set by population growth with a constant per-capita capital stock and steady income distribution. The possibility to endow new workers with the constant amount of capital depended on 'sacrifice, namely, a voluntary restriction of wants that could be satisfied' (1932:35).

However, some of the early marginalists showed concern for the secular effects of net capital accumulation on distribution and economic growth in the absence of population growth. This because in neoclassical theory the progressive abundance of the capital stock relative to the remaining scarce 'productive factors' could lead, in the long run, to a fall of the marginal productivity of capital. In equilibrium the marginal productivity of capital (net of depreciation) is equal to the rate of profit, and, once the latter has fallen near to zero, this would result in a discouragement of net saving (assumed to depend on a positive rate of return) and to the stationary state.[5]

Innovations, in particular, the class of 'labour-saving inventions' introduced by Hicks (1932:124–5), were seen by neoclassical authors as a counter-acting force to the relative abundance of capital. 'Labour-saving' (or 'labour-augmenting') technical progress is nothing other than a way to increase labour supply in efficiency units. Hicks compares two economies, the first where technical progress is 'lethargic', and the second where it is rapid. In the former:

> as capital continues to grow, it is certain that the more advantageous applications will be used up…. Eventually the fall in interest will check saving, and the community whose technique does not progress will approach the 'stationary state' of the classical economists.
>
> (Hicks 1932:128–9)

In the second, with a constant flow of 'labour-saving inventions', capital accumulation does not lead to the stationary state, and the positive role of saving as the trigger of growth is preserved. 'Labour-saving inventions' are 'endogenous' in Hicks (in opposition to 'autonomous' inventions that depend on exogenous scientific progress). As long as the progressive abundance of capital with respect to labour results in higher real wages and a lower profit rate, entrepreneurs are induced to introduce that class of inventions.[6]

A second way to counteract the fall of marginal productivity due to the (relative) abundance of capital was seen in the existence of increasing returns to scale. As Abramovitz put it: 'One implication of the influence of scale on returns is that *a priori* there is no clear and definite reason to think that the potential productivity of capital will begin to drop when the ratio of capital to other resources increases' (1952:155). Abramovitz could therefore conclude that 'the neoclassical writers, deriving their outlook from Marshall, beheld a fairer future. For them, the Malthusian ghost was already laid' (*ibid.:*169). In view of a better appreciation of EGT, let us look closer to the analytical foundations of Abramowitz's emphasis on increasing returns to scale. What he implies is

that net capital accumulation, by bringing about a larger output, induces a greater *efficiency* of the *given* quantities of the *other* resources so that, as a result, the relative proportions between capital and the other resources, measured in efficiency units, is not changed. Noticeably, increasing returns to scale are brought about by the increase in the supply of a *single* factor that induces a proportional increase in the efficiency of the other production factors.[7]

The Keynesian criticism inverted the traditional causal relation between saving and investment by showing that, within the limits of a given productive capacity, it is investment that determines saving. Shortly thereafter, the models of Harrod and Domar set out to discuss the relation between saving and investment in a long-run context in which the capacity-creation effects of investment decisions are taken into account. For neoclassical economists, the models of Harrod and Domar present at least one appealing result. Although embodying Keynesian features, they seemed to restore confidence on the 'received view' or 'conventional wisdom' which regards saving as the engine of capital accumulation. This is shown by the (Harrodian) equation for the warranted rate of growth $g_w=s/v$ in which an increase in the saving rate s determines an increase of the growth rate. Moreover, at least as long as there is a sufficient labour supply in efficiency units (that is as long as $g_w<\lambda$, where λ is the growth rate of labour supply) the exogenous growth of the labour force does not play any essential role. This conventional feature of the warranted rate had a significant impact on development studies, but was not initially appreciated by neoclassical economists, with the exception of Frankel (1962) (see below). More recently, it has been taken up by EGT.[8]

Solow's model (1956) demonstrated that in a one-commodity neoclassical economy, the warranted rate was both stable and corresponded to a full-employment path.[9]

Paradoxically, however, in order to obtain this, the appealing side of the warranted rate equation was lost since the equality between the latter and the natural rate (corresponding to the exogenous growth rates of the labour force in efficiency units), $\lambda=g_w$, meant that the equilibrium growth rate was insensitive to changes in s. In the steady state equilibrium, changes of s only affect per capita income.[10] Solow's result was, of course, quite consistent with neoclassical theory: given the tendency to the full employment of the available resources, the secular rate of growth of the 'endogenous' factor ('capital'), must adjust to the rate of growth, in natural or efficiency units, of the 'exogenous' factor (labour).

A number of recent comments tend to describe the impact of this result as a surprise. For instance, Stiglitz (1990) stated '[Solow's] paper presented a stunning result'.[11] The literature in the early 1960s seems to confirm that these comments are not an *ex post* justification for the recent criticism of Solow's model, but recall quite correctly a theoretical uneasiness that was present at that time.[12] A second result by Solow (1957) contributed to this feeling of dissatisfaction (perhaps more profoundly since it was supported by empirical results): most of the growth of labour-productivity in the American experience seemed to be explained by 'exogenous' technical change and not by the ('endogenous') growth of the per capita capital endowment. This gave rise to a 'wave of investment pessimism' (Phelps 1962:550).[13]

In summation after Solow's model the neoclassical theory of growth was left with two unresolved problems (which are two sides of a same coin). The *first* was the exogenity of the secular rate of growth that was independent of individual preferences and policy

prescriptions devoted to increase the share of investment (saving) on income. The *second* was the 'Malthusian Ghost' of a progressively increasing abundance of capital in the absence of exogenous forces of growth. Induced inventions and increasing returns to scale were the forces traditionally envisaged as counteracting the tendency to the stationary state. The first problem called for a solution. The existing solutions to the second cried out for a better formalisation. In the early 1960s, and in the late 1980s, there was an attempt to obtain a unique solution to both problems.

In addition to these two issues, EGT adds a third problem brought about by the necessity of explaining the recent high growth rates of the Asian NICs (and of Japan in earlier decades). One impressive fact about these countries has been their capacity to assimilate and develop new technologies and train their labour force. Nowadays, the search for endogenity is presented as the search for an explanation of the lack of convergence of growth rates among various groups of countries. This convergence is predicted, according to EGT authors, by Solow's model. This is done by attributing to Solow the idea that all countries have access in the long run to the same rate of technical change, and that the latter is exogenous to economic activities.[14] However, this looks like an *ad hoc* attribution. Solow observed that he took technical change as 'exogenous' since a good theory of it was not yet available, and in a scientific enterprise one takes as exogenous what one cannot satisfactorily explain (1992:17). Moreover, an exogenous rate of technical change does not *per se* imply that different countries have equal access to technical knowledge.[15] It is more correct to argue that EGT attempts to explain the divergence of growth rates on the basis of the 'conventional wisdom', i.e. thrift as the engine of growth. The conventional view was demonstrated by Solow's model to be something that does not spring, naturally from the standard neoclassical framework.

This section sets out to show the continuity of the issues and dilemmas from the early days of marginalism to EOT. Two roads towards endogenity are to be found in the early and recent literature on endogenous growth.[16] The first pursues endogenity by linking technical change to the (endogenous) rate of accumulation. The second links technical change to the share of the labour force that the community (or their political representatives) 'saves' and devotes to the accumulation of knowledge.

3 Accumulation and technical change

Vintage models

The earliest attempt at modelling endogenous growth occurred in the 1960s with the analysis of vintage models. By first observing that in the empirical estimations of the sources of productivity growth 'the possibility of speeding up economic growth by faster accumulation of capital was extremely limited', Solow (1960:97) suggested that the pace of *introduction* of technical change had to be considered endogenous, as it depended on the rate of accumulation. By renewing more rapidly its capital stock a frugal community could grow faster than a more prodigal one. Unfortunately, the subsequent debate on the various sorts of vintage models re-established the old truth as to the absence of effects of variations of the rate of saving on the rate of growth (see e.g. Phelps 1962; Allen 1967: ch. 15; Solow 1970: ch. 3).[17]

Learning-by-doing and increaslng-returns-to-scale models

If the attempt to look at investment as the *channel* of innovations failed as a road to endogenous growth, a second direction was taken by Arrow (1962) and Frankel (1962) who regarded the process of adoption of new vintages of capital goods as the *source* of improvements in the design of subsequent vintages. To preserve the assumption of perfect competition, technical change took the shape of an 'externality'.

The manner in which Frankel (1962) framed the question is the best synthesis of this approach. He argued that the appeal of the Harrod-Domar model in a neoclassical perspective was the result of the selection, in that model, of a simple production function $P=aK$. This production function, associated with the community's saving ratio (and assuming a sufficient labour supply), results in the Harrod-style warranted rate. Unfortunately, he continues, this production function is useless for the theory of distribution. On the contrary, a neoclassical production function such as the Cobb-Douglas provides useful results in distribution theory, but yields the disappointing Solow-type out-comes in growth analysis. Before I illustrate Frankel's own suggestion as to how obtain the best of both worlds, let us look at some other approaches on the basis of a simple neoclassical model (e.g. Frankel 1962:1009):[18]

$$P=aK^{\beta}(HL)^{1-\beta} \qquad [1]$$

$$S=sP \qquad [2]$$

$$I = dK/dt = \dot{K} \qquad [3]$$

$$S=I \qquad [4]$$

$$L=L_o e^{\lambda t} \qquad [5]$$

$$H=H(t) \qquad [6]$$

Most of the equations are well known and it is sufficient to specify that P is the social product, λ the growth rate of the labour force in natural units, and H is an as yet unspecified function that represents the efficiency level of labour. Depreciation is neglected.

The Solow-type specification for H was:

$$H=H_o e^{\mu t} \qquad [7]$$

where μ is the exogenous rate of technical change.

Arrow (1962) proposed a specification:[19]

$$H=K^{\alpha} \qquad [8]$$

where $0<\alpha<1$. The rate of change of labour efficiency μ is now linked to capital accumulation since from [8] it follows that:

$$\mu = \frac{\dot{H}}{H} = \alpha \frac{\dot{K}}{K} \qquad [9]$$

In spite of this hypothesis concerning technical change in the expressions for the steady-state aggregate and per capita growth rates ($g=\lambda/(1-\alpha)$ and $g'=\alpha\lambda/(1-\alpha)$ respectively), no terms appear that are related to decisions to accumulate capital (s in this simple model).[20]

The economic reason for this 'paradoxical' result (Arrow 1962:166) is that the rate of increase of labour efficiency generated by endogenous capital accumulation is less than proportional to the rate of capital accumulation. Analytically this outcome hinges on the assumption $\alpha<1$ in equation [9]. As a result, although endogenous technical change enhances the efficiency of the labour force, in the course of the accumulation process the relative proportion between K and HL changes in favour of K, and without a positive growth rate of labour supply ($\lambda>0$) the tendency towards the stationary state would still prevail.

The alternative assumption $\alpha\geq1$ has recently been put forward by Romer (1986). In this case, the rate of growth of the capital stock generates a proportional (or possibly more than proportional) rate of increase of the efficiency of labour. As a result, the economy can grow without the necessity of the exogenous growth of the labour force. In the EGT parlance this is expressed in the following way: in the traditional model if net capital accumulation is not accompanied by exogenous labour growth, it will generate decreasing marginal returns to the 'reproducible factor' K. By assuming $H=K^{\alpha}$ with $\alpha\geq1$ there are constant (or even increasing) returns to the 'reproducible factor' even when L remains constant. It can be appreciated that what Romer is recovering is Abramowitz's suggestion of increasing returns brought about by the increase in the supply of a single factor.

The problem with Romer's approach is that, even with the milder hypothesis $\alpha=1$, the model falls into serious difficulties if it attempts to accommodate the full employment of a growing labour force. This is so because the increasing returns (which reveal themselves by augmenting the efficiency of the existing labour stock) can be so 'strong' that an excess of labour is produced during the process of growth. The progressive fall of the wage rate leads the economy out of the steady state.[21] Fixed coefficients, which rule out the possibility of factor substitution, would not solve the problem.[22] These problems seem to explain why Arrow assumed $\alpha<1$. Romer's road to endogenous growth was well known to highbrow economists in the 1960s, but was dismissed as it led to undesirable results.[23]

For the sake of the argument let us now follow Romer and suppose that $\alpha=1$ and $\bar{L}$. With these assumptions, equation [8] tells us that the rate of capital accumulation, by affecting in the same proportion the efficiency of labour, is enough to assure a steady-state growth in which the capital stock, labour (in efficiency units) and, therefore, aggregate and per capita income grow at the same rate *with a constant (physical) labour force*. This rate is equal to that of capital accumulation. Our simple algebra suggests that the latter is the Harrod-style warranted rate. Substitute [8] in [1] to obtain:

$$p=AK \qquad [10]$$

where $A = a\bar{L}^{1-\beta}$.

Substitute [2], [3] and [10] in [4] to obtain the warranted rate:

$$\dot{K}/K = s/v, \quad \text{where } v = 1/A$$

This type of model has recently became popular among EGT authors. Solow argues that the essence of these models is that 'there is no primary factor, labor has disappeared' (1992:32). In Romer's model increasing returns or learning-by-doing processes, linked to capital accumulation, erase the relevance of the exogenous growth of labour supply for the determination of the growth rate. Increasing returns have to be 'powerful enough', such that a given growth rate of the capital stock could generate an equal growth rate of the efficiency of labour. As demonstrated, the 'strength' of increasing returns hinges on the value taken by the α coefficient in equation [8]. In other models labour disappears in various ways: (i) either by just dropping it in the aggregate production function, or in the production of some basic commodity, such as capital goods (Rebelo 1991); or (ii) by circumscribing its role in the aggregate production function (Jones and Manuelli 1990).[24]

For neoclassical economists these 'pseudo-Harrodian' models, as they may be defined, have the same nice features and problems of the original Harrod Domar models. On the one hand, growth depends on the saving rate and exogenous labour growth does not matter. However, they are not full-employment models. A growing amount of social product is obtained with an increasing amount of capital. Since the latter is of better design, it uses the same amount of the progressively more efficient labour, but the model cannot accommodate a positive growth of the labour stock.

A limited way out from this uncomfortable situation was attempted by Marvin Frankel (1962) in the same year of Arrow's learning-by-doing paper. In his model the externality arising from capital accumulation took the following analytical shape:

$$H = \left(\frac{K}{L}\right)^{\gamma} \qquad [11]$$

Frankel termed equation [11] the 'modifier' of the Cobb-Douglas production function. By substituting [11] in [1] (which is obtained by Frankel by aggregating the production functions of n identical firms) the expression $P=aK^{\beta+\gamma(1-\beta)}L^{(1-\beta)-\gamma(1-\beta)}$ is derived. With $\gamma=1$, the equation becomes $P=aK$. With $\dot{K} = sP$, a Harrod-style growth rate $g=as$ is obtained. This is the kind of result that Frankel had advocated as the best suited for the conventional wisdom of economic growth.[25]

As in Arrow, Frankel's technical progress function takes the form of a *positive* externality linked to *aggregate* capital accumulation, but in addition there is a *negative* externality brought about by the growth of the labour force. An economic rationale for Frankel's modifier [11] has recently been provided by Romer (1987:7). Romer recovered the Hicksian class of induced inventions arguing that 'an increase in the total supply of labor causes negative spillover effects because it reduces the incentives for firms to

discover and implement labor-saving innovations that also have positive spillover effects on production throughout the economy'. If the labour stock is a constant, say L=1, then equation [11] becomes H=K, and Frankel's model is identical to Romer's version of Arrow's model.[26] A positive growth of the labour force, which created problems for balanced growth in Arrow and Romer, is accomodated in Frankel's model by the negative externality on technical change. However, if the growth rate of the labour force, λ, is larger than the output growth rate, g, that is if λ>*a*s, technical change must be negative in order to assure the steady state. Clearly, this is a disturbing implication of the model. On reflection, this outcome shows that Frankel's attempt to reconcile, in a traditional perspective, the advantages of the Harrod-Domar model in growth theory and the full employment and distributional results of neoclassical theory did not fully succeed.

4 Endogenous labour-augmenting technical change

Whereas the first class of endogenous growth models links technical change to capital accumulation, in the second class of endogenous growth models technical progress is generated from investment in education, R&D etc. The *scale* of the process rests upon 'accumulated knowledge' and its *pace* on the social preferences between present and future consumption.

Phelps (1966) tied the growth rate of labour efficiency to the amount of research labour force L_R (which is diverted from current production). The technical progress function proposed by Phelps is:

$$\dot{H} = \varnothing\left[\frac{L_R(t)}{H(t-\Omega)}\right]H(t-\Omega) \qquad [12]$$

In [12] technical change depends on 'accumulated knowledge', H, and on the amount of R&D—labour, L_R, which is divided by the amount of accumulated knowledge. Ω is a time delay in the use of existing knowledge to create new knowledge. Defining u as the share of labour employed in production (and therefore 1−u as the share of research labour) and λ the growth rate of the (fully employed) labour force, [12] can be written as:

$$\frac{\dot{H}(t)}{H(t-\Omega)} = \varnothing\left[\frac{(1-u)L_0e^{\lambda t}}{H(t-\Omega)}\right] \qquad [13]$$

To obtain a constant growth rate of labour efficiency, Phelps introduced the strong assumption that the growth rate of the labour force and that of knowledge were the same.[27]

Analogous technical progress functions have been put forward by EGT authors. To avoid the restrictive assumption made by Phelps, Romer models an economy in which there is an R&D sector that produces 'designs' of new capital goods by using a *constant amount* of 'human capital', L_R, plus the existing stock of knowledge H (measured by the number of already available designs, Romer 1990:S80). The technical progress function is:

$$\dot{H} = \delta L_R H \qquad [14]$$

The restrictive assumption made by Phelps is clearly replaced by another *ad hoc* assumption concerning the fixed amount of research labour to be used in the design sector. Similar specifications are in Grossman and Helpman (1989) and Aghion and Howitt (1992).

Shell (1966) proposed the following technical progress function:

$$\dot{H} = \sigma\gamma Hp \qquad [15]$$

where γ is the fraction of per capita income, p=P/L, devoted to R&D and σ is the share of successful innovations. On this basis Shell singles out a long-run equilibrium of the economy, actually a saddle-point, with both the time derivatives of physical capital and technical progress equal to zero, that is $\dot{K} = \dot{H} = 0$.Clearly, a stationary state is not a satisfactory outcome for an endogenous growth model.

Interestingly, a discussant of Shell's model, K.Sato (1966), pointed out two shortcomings of the approach: the assumption of Hicks-neutral technical progress and the analytical shape of equation [15]. The first assumption may explain the instability of Shell's long-run equilibrium, given the fact that stability of the neoclassical growth model hinges upon the choice of Harrodneutral (or labour-augmenting) technical change. With regard to equation [15], Sato notes that the expression $\dot{H}/H = \sigma\gamma p$ goes to infinity as k tends to infinity [recall that p=Hf (k)]. This suggests a reason why Shell studied the rather trivial solution $\dot{K} = \dot{H} = 0$.Sato amended equation [15] proposing equation [16]:

$$\dot{H} = \sigma\gamma H \qquad [16]$$

In this case technical change proceeds at a constant (endogenous) rate $\sigma\gamma$. Sato's amendment is reflective of a common practice in EGT, i.e. to adapt the shape of the equations that describe technical progress to the analytical needs of the model. The empirical content of the equations is subordinate to these needs.

A second amendment to Shell's model can be suggested. Let us take a 'well-behaved' production function with Harrod-neutral technical change, P=F(K, HL) and write it in per capita terms, p=f(k), where p=P/HL and k=K/HL. Shell's equation [15] can be amended writing it $\dot{H} = \gamma_{Hp}$. This time, k remains constant along the balanced growth path (K grows at a rate that is the summation of the growth rates of H and L). It follows that $\dot{H}/H = \gamma\ Hp_{HP}$ is also a constant. Something analogous has been advance by Conlisk (1967) who proposed a technical progress function:

$$\dot{H} = p \qquad [17]$$

with p=f(k) and k=K/HL. His hypothesis is that the growth over time of the labour efficiency depends on the level of per capita income that plausibly affects education levels etc. Conlisk found the most obvious way to insert endogenous growth in Solow's model: since in the latter an increase of the saving rate would positively affect the level of per capita income, why not make the rate of labour-augmenting technical progress a function of the level of per capita income, and indirectly of the saving rate? The limit of this model was perhaps that the solution was too openly *ad hoc;* nonetheless, it gives much of the flavour of EGT.

Quite similar to K.Sato's suggestion is the description of technical progress advanced by Uzawa (1965). In his model the rate of technical change depends on the level of accumulated knowledge *and* on some parameter indicating social preferences:

$$\dot{H} = H\,\Omega\,(1-u) \qquad [18]$$

where Ω is a constant and (1−u) is a given fraction of the labour force devoted to education, R&D, etc. If the share of 'saved labour' increases (that is, the community gives up some present consumption), the rate of growth would increase (and the community will have more consumption goods in the future). Note that this model envisages a 'knowledge sector' that, except for a parameter referring to social preferences, is exogenous to the other economic activities. No reference to K, L or Y appears in equations [17] and [18], so as to avoid too much interaction among the dynamics of technical change, the dynamics of labour supply and distribution. As a result, Solow's model is integrated with an 'endogenous' constant rate of labour-augmenting technical change that does not meet any of the restrictive assumptions made by the pseudo-Harrodian models.

Uzawa's model has been revived by Lucas (1988). The strictly analogous specification proposed by Lucas is:

$$\dot{h}(t) = h(t)^{\zeta}\,\delta[1-u(t)] \qquad [19]$$

where 1−u is the share of the labour time devoted to educational activities. In order to obtain a constant growth rate Lucas assumes ζ=1.

This approach has attracted some objections by Solow (1992:21) and others. Their criticism focused on the values taken by the parameter ζ that leads to exponential growth rates (i.e. rates increasing over time), if ζ>1, or exogenous growth, if ζ<1.[28]

5 Plus ça change…

From a theoretical perspective, the unifying theme of endogenous growth theory is the attempt to tie the growth rate to the saving rate. This is done by relating the community's labour-augmenting technical progress to its saving rate. Given this common strategy, two approaches have been examined. The pseudo-Harrodian models relate technical change to endogenous capital accumulation. The second group of models *à la* Uzawa-Lucas envisages a quasi-independent sector in the economy where 'knowledge' in the form of human capital, designs etc. is produced at a rate that depends, *inter alia*, on the decisions

of the community to invest in this sector. The two approaches overlap (Rebelo 1991) in that there is a 'core' sector of the economy that generates labour-augmenting technical change either as the result of capital accumulation (e.g. equations [8] and [11]) or of the accumulation of knowledge (e.g. equations [13]–[19]). In both cases this occurs without using 'scarce' resources (typically labour) so as to give up marginal decreasing returns.

Specific problems are encountered by the first class of 'pseudo-Harrodian' models in dealing with physical labour growth. Solow (1992) has pointed out that this class of models consists of a return to Harrod-Domar models where exogenous labour supply did not play any role in the determination of the warranted rate. Frankel's (1962) model shows that this return was an intentional objective. The modifications introduced by Romer (1986) to Arrow's learning-by-doing model also have the effect of designing an economy where labour growth is not an essential engine of growth. However, the target is overshot since a steady-state growth rate is obtained only if the employed labour force is constant and increasing returns are not 'too powerful'. In the most extreme '*A*K-model', labour is eliminated or plays a non-essential role in the production function, while in the long run growth depends only on 'reproducible factors' (namely those whose reproduction rate hinges on preferences). The situation is somewhat paradoxical since Solow's model was intended precisely to take care of the absence of a stable full-employment dynamic equilibrium in the Harrod-Domar models. It is not clear how full employment is accommodated by the *A*K-model (if it is still an objective), or why entrepreneurs should expect the warranted rate so that investment adjusts to capacity saving. The association between investment and technical change advocated by the pseudo-Harrodian models seems to have solid foundations in growth experiences. In the light of the Keynesian and Sraffian criticism (Garegnani 1978–9), what is less sound is the faith of EGT in saving as the main determinant of capital accumulation and, indirectly, of technical change.

With respect to the second group of models *à la* Uzawa-Lucas, we have seen a sample of the *ad hoc* hypotheses made by these authors in the selection of the technical progress functions. It is often argued that this criticism is not decisive since models must only be 'capable of exhibiting behavior the gross features of which resemble those of the actual world' (Lucas 1988:5). However, the point made here does not concern simplification (a legitimate procedure) but what Hahn has christened 'backward reasoning': i.e. those forms of technical change are selected that are more consistent with the neoclassical framework in order to obtain balanced (secular) growth rates.

Looking at the economic content of the description of technical change proposed by the second group of EG models, it is relevant to consider whether the latter has seriously improved the description of technical change implicit in Solow's model. In the latter, technical change was a function of time, which in turn was taken as a proxy for various learning and R&D activities not specified in the model (in the mind of the economists it was not, therefore, 'manna from heaven', as it is too often superficially argued). Analytically technical progress was usually expressed by equation [7], rewritten as:

$$\dot{H} = \mu H \qquad [20]$$

The step taken by Uzawa (1965), Lucas (1988) and others has been to relate the term μ to endogenous social preferences (or to the optimisation process of a representative agent).

However, the economic content of equations [18] and [19] is not profoundly different. Technical change is still partially exogenous, in so far as the source of new knowledge is existing knowledge, as in equation [20], without much exploration of the economic and social mechanism through which this process takes place. The only social mechanism introduced in these equations concerns the propensity of the community to divert part of the social product to R&D, educational activities, etc. on which the rapidity of the cumulative process rests. Therefore, the role of preferences in equations [18] and [19] looks rather auxiliary, aimed only at establishing the desired 'endogenity' (Solow 1992:21). It is tempting to call these EG models 'neo-exogenous growth models'.

In addition, is it credible to establish a mechanical relation between the efficiency with which a community transforms accumulated knowledge into new knowledge and the share of resources devoted to knowledge creation? No doubt that growth is *accompanied* by a progressive diffusion of education, investment in research etc., but the direction of causality is not clear and the process seems to depend on a host of other factors, economic, social and institutional, both at national and international levels.

This is not to deny that many of the specifications concerning technical change in EGT make sense as far as they go, and that mainstream theory is trying to collect bits of the rich but sparse knowledge that we have on economic development. Nonetheless, one cannot help but feel that in spite of the current proliferation of EGT models and the related econometric exercises, systematic knowledge concerning growth has not really advanced and much is being lost about the variety of geographical, historical and sectoral experiences, a variety that calls for less bold and more systematic classification (what Lucas, with much contempt, has called 'perceptive tourism', 1988:13).[29]

In general, the theoretical vision behind EGT is the neoclassical one in which growth is a supply-side phenomenon with no problems of effective demand. Even if one is prepared to digest the mechanical descriptions of technical change put forward by EGT, it is the belief that economic growth can be approached only on the supply side that makes EGT—and indeed the entire neoclassical approach—unsound.

Once a non-orthodox approach to economic growth is accepted, the investigation of the sources and impact of technical change is also affected. The long-run level of effective demand is the engine of growth in the non-orthodox approach (Garegnani 1962; Kaldor 1970; Kalecki 1971; Serrano 1996). This approach does not deny the relevance of the supply side. However, the role of the latter is appreciated in relation to the demand side. Two important issues that derive from this approach may be mentioned here. One is the absence of any natural tendency towards full employment. Therefore, 'technological unemployment' is a long-period problem in this context. The second, more controversial issue is the role of innovations in the determination of the long-period level of effective demand.[30]

Conclusions

The paper has attributed the origin of EGT to the disappointment of neoclassical economists with respect to the independence of the secular rate of growth from the saving rate in Solow's (1956) model. This result was one aspect of an earlier problem in

neoclassical economics, that is the tendency of net saving to lead to the stationary state in the absence of an exogenous growth of labour supply.

The appeal of EGT may lie in its attempt to synthesise a variety of supply-side factors of economic growth that have emerged from the literature on the experiences of Japan and other Asiatic NICs. This is a worthwhile project. However, the variety of institutional, economic and industrial policies experienced by those countries is barely dealt with by the excessively simple mechanics of EGT. More specifically, the coupling of supply and demand policies experienced by those countries is simply neglected by EGT. Demand management policies, at the national and international level, are out of fashion in contemporary academic economics. Therefore, it is not surprising that mainstream economists have focused on the supply side in order to provide the profession a role as policy advisors. This is done by focusing on the individual decisions to save and invest in innovative activities and in education as the trigger of growth. This view is too simplistic and may be out of place in a world where the educational and technological potential is underutilised, less developed countries included. The attempt of mainstream theory to capture something of the recent flourishing of studies on technical change signals that the most interesting developments are taking place outside that theory. These are sufficient reasons to question the relevance of EGT as a useful direction for research and to look at alternative traditions.

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Notes

1 As in the review of Barro and Sala-i-Martin (1995) in *The Economist*, Feb. 1996.

2 It does not seem that taking into account these novelties (e.g. the introduction of stochastic innovation processes (Aghion and Howitt 1992) or the introduction of ‘monopolistic competition’ (Romer 1990)) would change our conclusions. A further limitation of the present contribution should be noted, namely that it does not discuss empirical issues, in particular whether EGT has provided a satisfactory explanation of the variety of patterns of growth. Questions have been raised concerning its empirical value (Pack 1994).

3 Given the hypothesis that the economy is, on average, at full employment, mainstream authors have generally identified economic growth with per capita output growth.

4 The aggregate production function was only the easiest target, see Garegnani (1970) and Petri’s contribution to this volume. Malinvaud (1993:174–5) is the only major mainstream economist to recognise the negative impact of the capital controversy on the development of neoclassical growth theory at the end of the 1960s. One suspects that also Frank Hahn’s (1994) scepticism on EGT derives from its weak theoretical background. That EGT still uses the old version of neoclassical theory with an aggregate quantity of ‘capital’ should not, however, come as a surprise. This approach is used whenever mainstream economists deal

with real phenomena, given the generally recognised limitations of modern general equilibrium theory as a description of actual economies (cf. Petri, this volume).

5 Abramovitz's (1952) survey on the 'Economics of Growth' is a sort of 'summa' of the pre-Solow views on growth. The relation between distribution and capital accumulation was effectively summarised in this way:

> This is the area in which orthodox theory is most at home. Its starting point is the older static theory of income distribution. This theory makes the marginal productivity of factors depend on their relative supply…. Although explicit treatment is hard to find, it is this static analysis of distribution which seems to have determined the orthodox view of the determinants of capital productivity in its bearing on the level of capital formation…. Given the supply schedule of saving (unless it be completely inelastic), the volume of current capital formation will be greater, the higher the marginal productivity of capital. It will, therefore, vary directly with supplies of labor and other natural resources and inversely with the stock of existing capital.
>
> (Abramovitz 1952:154)

For an early reference to this problem, see Wicksell (1934:212). More recently, Helpman (1992:240) raises the question in similar terms: *'the economy grows in the long run if the marginal productivity of capital does not decline too much as the result of capital accumulation'* (original italics; see also Sala-i-Martin 1990, I).

6 'The general tendency to a more rapid increase of capital than labour which has marked European history during the last few centuries has naturally provided a stimulus to labour-saving invention' (Hicks 1932:124–5). The Hicksian notion of 'induced inventions' has been revived by various authors in the 1960s, and recently by Romer (1987, and section 3 below).

7 These are the passages I am referring to:

> An increase in the supply of a factor…brings an increase in aggregate output in addition to a change in factor proportions. And with an increase in scale of output there are increases in efficiency due to improvements in the organisation of industry. That is to say, there are increasing returns associated with the scale of output and, therefore, with the change in factor supply to which an increase in output is due. If we admit the importance of increasing returns in problems of secular growth, we should have to amend the traditional conclusions to read: Capital formation will vary directly with supplies of labor and other natural resources, and *either* inversely *or* directly with the stock of existing capital depending on the relative strength of the forces making for diminishing returns—which depend on changes in factor proportions—and for increasing returns—which depend on changes in the scale of output.
>
> (1952:154)

Dealing with the same problem few pages later, Abramowitz proposes a different interpretation of the origin of increasing returns that, however, breaks the bounds of the neoclassical framework. He talks there of 'the possibility of increasing returns, a process whereby capital accumulation, by increasing income, broadened the market, and so created ever larger opportunities for the application of capital' (*ibid.*:169).

8 Referring to the Harrod-Domar model, a modern neoclassical commentator has argued that 'this simple theory has been and remains very influential' especially on mainstream

development analysis (Stern 1991:124). In the latter, according to the conventional view, 'one of the necessary conditions for economic growth and development is the increase in the national saving rate' (Sala-i-Martin 1990, I:10). It seems of some interest to ask how it is that the Keynesian set-up used by Harrod and Domar led to the conventional result as to the influence of saving on investment. The warranted rate of growth is obtained if entrepreneurs invest all capacity-saving (the saving supply at full employment of the existing productive capacity). Harrod put it in terms of expectations: if entrepreneurs expect the warranted rate, their investment decisions would be such that the actual rate comes out equal to the warranted rate. However, this is just a more sophisticated way of saying that if entrepreneurs believed in Say's Law (that is that everybody is investing their saving), then the economy would grow at the warranted rate. Not surprisingly, therefore, as long as for some fortunate reasons entrepreneurs always had correct expectations, the rate of accumulation would be governed by the saving rate as much as in Say's world (cf. Serrano 1996). It is interesting to note that the self-fulfilling nature of correct forecasts in Harrod's model do not justify it as a sort of 'rational expectations' model (as argued e.g. by M.King, 1992:585–6) since, according to it, there are no objective market forces to guide the formation of correct expectations.

9 A parallel may be drawn between Wicksell (and other early marginalists) and Solow. Wicksell integrated Say's Law with a theory showing the tendency to full employment equilibrium both in the saving/investment and in the labour markets. Solow performed the same integration with respect to the Harrod-Domar models. In this sense the approach in terms of 'steady-states' could be interpreted as a 'dynamic' development of the traditional 'static' method (Hicks 1932 ['Commentary', 1963]: 362). After Solow's integration, the warranted rate can be seen as the outcome of a 'rational expectations' model in which objective forces in the financial and labour markets help entrepreneurs to adjust their expectations in the correct direction. The steady-state method was seen as particularly useful to investigate the secular outcome of a 'dynamic' process in which population grows at a continuous rate and there is a net saving supply. Kaldor's 'stylised facts' about capitalist development reinforced the plausibility of studying steady states (Solow 1970: ch. 1).

10 In Solow's model the saving rate affects the growth rate in the transition towards the *secular* position. The theoretical discussion on the temporal length of these transitions has been inconclusive (for a recent account see King and Rebelo 1993). Not surprisingly mainstream economists have attempted more solid roads to establish the endogenity of the secular rate of growth.

11 'Solow's 1956 conclusion that changes in savings rates are level effects…was startling at that time, and remains widely and very unfortunately neglected today', comments Lucas in his seminal paper on EGT (1988:12). Another modern mainstream growth economist, Srinivasan, argues that 'by showing that the long-run steady state growth rate could be unaffected by the rate of savings (and investment) and even in the short run, the rate of growth was mostly accounted for by the rate of labor augmenting technical progress, Solow challenged the then conventional wisdom' (1994:244–5; see also Sala-i-Martin 1990, I:10; Stern 1991:124). In a popular textbook on growth theory the disappointment is evident: '[Solow's] neoclassical proposition seems paradoxical in the extreme. It seems to contradict the commonplace of the policy maker that an increase in the rate of economic growth requires more saving and investment' (Jones 1975:83).

12 The following passages by Frankel (1962) support our reconstruction: on the one hand, he argues, 'economists have found [Harrod-Domar] models attractive because of their relatively simple structure, because of the emphasis they give to capital accumulation as an "engine of growth"—an emphasis with deep roots in economic thought—and because of their pragmatic satisfying results. In consequence they have played a central role during recent years in theories of growth and development'. Unfortunately—he continues—this theoretical set-up:

> 'has nothing interesting to say about resource allocation or income distribution'. On the other hand, whatever its merits in distribution theory, 'the limitations of the Cobb-Douglas function…in a growth setting, are…weighty. When this function is used in a growth model of the kind just described, with growth in the labor force taken as autonomous, the resulting *long-term* rate of growth in output turns to equal the rate of growth in the labour force. Growth in output per worker, commonly regarded as the essence of development, is zero, and the rate of investment exerts no effect!'
>
> (*ibid.*:1996).

At the beginning of his famous 'learning-by-doing' paper Arrow (1962) described his dissatisfaction with an explanation of labour productivity growth based on exogenous technical change:

> A view of Economic growth that depends so heavily on an exogenous variable, let alone one so difficult to measure as the quantity of knowledge, is hardly intellectually satisfactory. From a quantitative, empirical point of view, we are left with time as an explanatory variable. Now trend projections, however neces-sary they may be in practice, are basically a confession of ignorance, and, what is worse from a practical viewpoint, are not policy variables.
>
> (1962:155)

13 Another quote from Frankel is appropriate: 'One may be led…to the conclusion that increases in capital, and hence in investment, do not exercise much influence on the rate of growth in output…. The finding…stands in sharp contrast to the rather popular view, conditioned and supported by growth models of the Harrod-Domar variety, that output will grow at about the same rate as the growth in capital' (1962:1008).

14 In the words of Romer: 'Both Robert Lucas (1988) and I (Romer 1986) cited the failure of cross-country convergence to motivate models of growth that drop the two central assumptions of the neoclassical model: that technological change is exogenous and that the same technological opportunities are available in all countries of the world' (Romer 1994:4).

15 'One would expect convergence of growth rates only if technology is universally available. New growth theory argues that it is. I am less sure. Textbooks are surely international, the sociological infrastructure is not, nor is the set of attitudes towards change, work, enterprise, etc. that may be needed for genuine access to technology. [Is that lack just a matter of human-capital investment? Doubtful]' (Handouts distributed by Solow during his doctorate lectures at the University of Siena in 1992.)

16 Besides the third one on 'induced innovations' mentioned above. A fourth research direction attempted to endogenise fertility (e.g. Becker et al. 1990).

17 Vintage models have attracted the attention of neoclassical economists for another reason. In these models, using severely restrictive assumptions, is it possible to assign a value to a 'heterogeneous' capital stock that is independent from distribution (Fisher 1965, and the contribution by Petri in this volume). Note that in these models, 'capital' is heterogeneous in the limited sense of different efficiency of vintages of a unique type of capital good (i.e. corn-seeds of different efficiency). Recently, Romer (1990) adopts this approach in an EG model without any discussion of its severe limitations.

18 Current EGT models appear more complicated since the saving propensity is not taken as given, but is the result of the optimisation of a consumption path by a representative agent on the basis of intertemporal preferences. No substance is added to these models by this procedure (cf. Solow 1992:15; Malinvaud 1993:183–4).

19 For the sake of comparison with other models, we discuss Arrow's model in the 'putty-putty' context of the Cobb-Douglas production function (following She-shinsky 1967). A brief discussion of some relevant features of the original 'clay-clay' model is in n. 22.

20 Logarithmic differentiation of the capital-labour ratio k=K/HL gives $\dot{k}/k = \dot{K}/K - \dot{L}/L - \dot{H}/H$. Then use [5] and [9] to get $\dot{k}/k = (1-\alpha)\,\dot{K}/K - \lambda$. Equations [1] to [4] provide that $K/K = sp/k$, where p=P/HL, so that $\dot{k}/k = (1-\alpha)\,sp/k - \lambda$. But for the term $(1-\alpha)$, this expression is the well-known neoclassical fundamental equation of economic growth (Solow 1956). With $\alpha<1$ the equation has a unique and stable steady state solution (that corresponds to a constant value of k, i.e. to $\dot{k}/k = 0$) equal to $g_w=\lambda/1-\alpha= sp/k$. The rate sp/k=s/v is the (Solow) adjustable warranted rate. The rate of labour productivity growth is easily obtained by subtracting from the aggregate rate that of the labour force.

21 See Ramanathan (1982:97). He notices that if $\alpha\geq1$, the first term of the right hand side of the neoclassical fundamental equation (in n. 20) would be zero or negative, thereby making $\dot{k}$ negative. As a result, k steadily declines to zero and the neoclassical model would not have a solution with a positive value k^*. The economic rationale of this result is clear from equation [9]. With $\alpha\geq1$ (and *a fortiori* with $\lambda>0$) the labour supply in efficiency units would increase at a faster rate than the capital stock. The natural rate would therefore exceed the warranted rate at which K grows. The ensuing fall of the wage rate determines the adoption of more labour intensive techniques leading to the fall of k and v. The warranted rate would rise, but this leads via equation [9] to a further increase of the natural rate and a stable non-trivial solution cannot be found.

22 Fixed coefficients were assumed by Arrow in his original 'clay-clay' model. In this model the different 'vintages' are distinguished by the year of construction or by serial numbers G(t). Technical progress is represented by a labour coefficient $bG^{-\alpha}$ that decreases with the appearance of new vintages, b is a constant and $\alpha>0$. G^* is the serial number of the oldest vintage in use at time t; L is total employment; λ is the growth rate of the employed labour force; x is gross product and s is the share of saving. The real wage adjusts to ensure that a sufficient number of vintages is kept in use so as to employ all the labour supply (the oldest vintage yields a zero quasirent and its net product is equal to the real wage). On the basis of these assumptions Arrow obtains a production function:

$$x = aG\left[1 - \left(1 - \frac{L}{cG^{1-\alpha}}\right)\right]^{1/(1-\alpha)}$$

where $c=b/1-\alpha$ and $\alpha\neq1$. With $\alpha<1$ there are increasing returns to scale when the quantity of *both* factors is varied. If $\alpha>1$ an increase of G is enough to determine a more than proportional increase of x. Finally, if $\alpha=1$ the production function becomes $x=aG[1-e^{-L/b}]$. In this case, there are constant returns to scale with respect to G.

Let us assume $\alpha\neq1$. Gross investment at time t is given by:

$$\dot{G} = saG\left[1 - \left(1 - \frac{L}{cG^{1-\alpha}}\right)\right]^{1/(1-\alpha)}$$

A solution to this differential equation (Levhari 1966) is given by:

$$G(t) = G_0 e^{\lambda/(1-\alpha)t}$$

It follows that:

$$\dot{G}(t) = \frac{\lambda}{1-\alpha} G_0 e^{\lambda/(1-\alpha)}$$

The constant rate of growth is:

$$g = \frac{\dot{G}(t)}{G(t)} = \frac{\lambda}{1-\alpha}$$

(as in the 'putty-putty' case). On this base, Arrow argues that since G(t) cannot ever fall, 'the most natural case, of course, is $\lambda>0$, $\alpha<1$' (1962:166). Conversely, a 'too strong' technical progress (that is $\alpha\geq1$) would imply a negative employment growth ($\lambda<0$). This is not a result that a neoclassical economist would easily abide, given the difficulty of this theory to accommodate the existence of forces different from demand and supply to explain why the wage rate does not fall to zero when there is unemployment.

Even in the most favourable case ($\alpha<1$) Arrow (1962:158, 166) encounters a second problem common to all 'clay-clay' models (e.g. Solow *et al.* 1966). In these models, in the absence of factor-substitution (substitution in consumption is ruled out by the assumption of a one-commodity world), a greater labour supply is accommodated by a lengthening of the economic life of capital goods. However, if the economic life T^* necessary to assure full employment is higher than the physical life $\overline{T}$, that is if $T^* > \overline{T}$, then there will be unemployment. Also from this point of view labour-augmenting technical change cannot be too strong (Solow 1970:56).

23 Hahn and Matthews (1964) argue that 'so long as the tendency to increasing returns to scale is not so powerful as to cause increasing social return to capital by itself, steady growth is possible…. On the other hand, growth at a constant rate is obviously impossible if there are increasing returns to capital itself. *Growth* is then possible, even without population growth or technical progress, but not steady growth' (1964:833–4, see also Wan 1971:231). Among recent authors Sala-i-Martin observes, in a footnote, that with 'strong' increasing returns to scale, 'when the population growth rate is positive, the increasing returns to scale models run into trouble'(1990:7).

24 Rebelo's model is characterised by a 'core' industry of capital goods that can be produced 'with constant returns technologies and without the direct and indirect use of non-reproducible factors' (1991:502). In a one-commodity world the core industry would coincide with the economy 'generating a one-sector economy with a linear production function $P_t = AZ_t'$ (*ibid.*:507). In a similar vein, Jones and Manuelli (1990) propose a production function $P=AK+BK^{1-\beta}L^{\beta}$. The right-hand side has two components: the first, which consists of the '*A*K' production function, would provide long-run endogenous growth; the second, which consists of the traditional Cobb-Douglas production function, provides decreasing returns to capital accumulation in the absence of an exogenous growth of L.

25 Recall model leads to an equation P=*A*K (with *A* constant and equal to $a\overline{L}^{1-\beta}$, whereas Frankel arrives at an aggregate production function P= *a*K. The substance is the same.

26 Both Frankel (1962:108–9) and Romer (1994:4–10) use equation [11] in a growth accounting context to show that once the positive external effects of capital accumulation,

and the negative external effects of a growing labour supply, are properly taken into account, then a rise in the investment growth rate would have a substantial effect on the per capita income growth rate. The strategy is to reduce the role of labour in the production function 'so that labor is relatively less important in production and diminishing returns to capital accumulation set in more slowly' (Romer 1994:7). From a Cobb-Douglas production function $P = HK^{\beta}L^{1-\beta}$ the simple, well-known, equation $\hat{p} = \beta\hat{k} + \hat{H}$ is derived, where p= P/L, k=K/L, and H represents technical progress (taken here as 'neutral', but with a Cobb-Douglas, this form is formally equivalent to the labour-augmenting class). If it were possible to show that $\beta \approx 1$ (i.e. that labour is irrelevant to production), then even with $\hat{H} = 0$, $\hat{p} = \hat{k}$. Alternatively, by taking equation [11], $H = (K/L)^{\gamma}$, with $\gamma=(1-\beta)$ the expression $\hat{p} = \hat{k}$ is also obtained.

27 With this assumption, given u and ø, the fraction in the right hand side of [13] is a constant. Since labour efficiency grows at the same rate as the labour force in physical units, the aggregate growth rate will be the double that of the latter, i.e. 2λ (see Wan 1971:234–5).

28 Similar critiques have been advanced with regard to Romer's models (Chiappori 1989; Stern 1991:126–7). The empirical plausibility of looking at historically increasing growth rates has been advocated by Romer (1986). However, most EGT authors seem to focus on constant secular rates.

29 'Societies differ in many *easily* observed ways and it is *easy* to identify various economic and cultural peculiarities and *imagine* that they are keys to growth performance' (Lucas 1988:13). Our italics are sufficient to comment on this passage.

30 EGT scholars admit that innovations create frictional unemployment only 'when labor is heterogeneous and the skill composition of new hires does not necessarily match the skill composition of displaced workers' (Helpman 1992:264). This is literally the view initially maintained and then rejected by Ricardo (1951–73:386). The Sraffian criticism of the neoclassical theory lends support to Ricardo's view (Cesaratto *et al.* 1995). With regard to the relation between innovations and investment, Garegnani (1962) and Kalecki (1971) suggest that technical change may be one explanation of the long-run level of gross investment. Some economists see here a field of convergence between Keynes and Schumpeter (e.g. Freeman *et al.* 1982). In particular, innovation-induced investment has been seen as a 'compensation effect' on the demand side to technological unemployment (for a criticism see Caminati 1986; Cesaratto *et al.* 1995). By contrast, mainstream economists do not pay any attention to the effects of technical change on investment since gross investment is adjusted anyway to the gross saving supply. A related topic concerns the role of supply and demand factors in the explanation of innovations (Dosi 1982). The ultimate focus of the Schumpeterian tradition is on the 'innovating firm' as the unit of analysis (Dosi *et al.* 1994), neglecting effective demand problems (cf. e.g. Schumpeter 1936). This view is criticised by Rosenberg (1976) and Cesaratto (1996b). The institutional factors that affect technical change are emphasised by the tradition that goes from Friedrich List to Amsden (1989). Finally, the role of the patterns of aggregate and per capita demand in the innovation process is outlined by Adam Smith (1776:748), Schmookler (1966), Kaldor (1970) and Pasinetti (1981). By looking at these contributions, one is led to conclude that the non-orthodox research agenda on technical change appears more promising than the neoclassical one.

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13
Wicksell after Sraffa

‘Capital arbitrage’ and ‘normal’ rates of growth, interest and profits

Edward J.Nell

Wicksell defined the money rate of interest in contrast to the natural rate, and argued that the relationship between them was unstable, so that arbitrage—shifting of capital—would lead to cumulative movements of prices, without reducing the difference between the two rates. When i<r, capital would shift from financial assets into real, and prices would rise without limit; when i>r, capital would shift into financial assets, and prices would fall.

Wicksell’s treatment of the rate of profit, though path-breaking for its time, suffers from the defects made evident in the capital controversies—and from other difficulties.[1] However, interpreting his natural rate as the rate of profit in a classical system allows for a consistent treatment (Nell 1967). There remain difficulties in his theory of circulation, but this is not at issue here. To close the classical system of production and distribution, one of the distribution variables—the real wage or the rate of profits—must be fixed independently. In a famous passage, Sraffa says:

> The choice of the wage as the independent variable…was due to its being regarded as consisting of specified necessaries determined by physiological or social conditions which are independent of prices or the rate of profits. But as soon as the possibility of variations in the division of the product is admitted, this consideration loses much of its force. And when the wage is to be regarded as ‘given’ in terms of a more or less abstract standard, and does not acquire a definite meaning until the prices of commodities are determined, the position is reversed. The rate of profits, as a ratio, has a significance which is independent of any prices, and can well be ‘given’ before the prices are fixed. It is accordingly susceptible of being determined from outside the system of production, in particular by the level of the money rates of interest.
>
> (Sraffa 1960:33)

It has become an important part of the neo-Ricardian approach to claim that the rate of interest on money, set by the monetary authority, can (and presumably does) under

appropriate circumstances, determine the rate of profit. Consequently, this approach must reject Wicksell's claim that the relationship between the money rate of interest and the real rate of return is unstable. Instead neo-Ricardians argue that the money rate of interest governs the ratio of money prices to the money wage—thus determining the real wage (Pivetti 1985, 1991; Nell 1988). When i falls below the current normal rate of profit, for example, money prices will be forced down by competition relative to money wages, raising the real wage and reducing the rate of profit. Prices and interest rates move together—as 'Gibson's Paradox' indicated (Keynes 1930, Vol. 2:198–200). On Wicksell's account of the interest and profit rates, by contrast, prices and interest rates would appear to move inversely, although he provided a somewhat strained explanation of why this was not necessarily the case. The neo-Ricardian view therefore rejects Wicksell's contention that the relation between the rate of interest and the rate of profit is unstable, leading to persistent changes that fail to overcome a divergence between the rates.

The rate of interest is not the only ratio capable of determining the rate of profit, however. Many post-Keynesians have argued that the rate of growth (of capital and output, assuming a stable and fixed capital/output ratio) is the appropriate independent force acting to determine the rate of profit. In simplest terms, when growth is strong, prices will be bid up relative to money wages, reducing the real wage and raising the rate of profits (Kaldor 1956; Robinson 1962; Pasinetti 1975). Another line of argument treats the matter from the perspective of the firm (Eichner 1976; Wood 1978; Nell 1992). Given an anticipated rate of growth of demand (sales), firms will set prices in order to earn the profits to finance the investments they will have to make to serve their growing markets. Thus the expected rate of growth (of demand) determines both prices (relative to costs) and the rate of profits; g determines r, subject to capitalist consumption out of profits. However, this perspective largely ignores i, the rate of interest.

The view that growth determines the rate of profits results in the so-called 'Cambridge equation', and this has been subjected to serious criticism (Garegnani 1992). Normal and actual profit rates must be distinguished. Growth certainly can determine the actual or realized rate of profit, but, it is claimed, it cannot determine the normal rate. For the equation $g=s_c r$ cannot relate a normal rate of profit to an actual (or ex post) rate of growth. Actual r can be related to actual g, but such an equation cannot, of course, determine the normal or long-period rate of profit (Garegnani 1992). If investment is determined in the Keynesian way, by animal spirits combined with short-run influences, then the resulting rate of growth, equal to current investment divided by the capital stock (valued at normal prices), is not a normal or long-period variable—and hence cannot determine the normal rate of profits.[2]

But having agreed that the equation cannot mean that Keynesian investment determines the normal rate of profit, we shall find that it becomes harder to go further along this road. This route begins with the claim that investment is determined by Keynesian forces, and will be unpredictable and subject to wide swings. So there is no centre of gravitation, no central trend. No long-period theory of investment is possible; it can only be determined by short-run influences and animal spirits. (As we shall see, this is questionable; under some circumstances there may be a pattern of 'normal' growth.) But if investment is always short-run, it can't determine the long-run normal rate of profit; hence that rate must be determined some other way. And so we are led to the view

that the rate of interest is the determining force (Vianello 1985; Panico 1988; Pivetti 1991).

Yet this is a weak reed on which to rest the theory of growth and profits. Can the monetary authority always set the rate of interest? Even if it can, will the rate of interest influence prices sufficiently to determine the rate of profit? In particular, are these lines of influence independent of the rate of growth? We need to consider five points, then:

1 whether the central bank can set the rate of interest, and also whether the latter has a 'normal' level;
2 whether a non-temporary change in the rate of interest can affect the rate of profits, by affecting costs;
3 whether—and in what sense—the rate of growth could determine the rate of profits;
4 whether, given 'animal spirits', a 'natural rate of growth' can be defined and if so, under what circumstances it might exist; and
5 whether either the rate of return or the rate of growth will 'gravitate' to the rate of interest, i.e. whether the relationship between them is stable.

The rate of interest and the rate of profits

The claim has been advanced that the monetary authority can set the rate of interest on money and that subsequent effects on prices will tend to adjust the rate of profits to the level of interest rates. Both parts of this claim are questionable.

Animal spirits and normal interest rates

The argument favouring the view that the interest rate determines the profit rate holds that manufacturing prices in modern industry are set in relation to costs, including interest costs (although labour costs are far more important), by balancing the likely effect of prices on market growth with the effects on the ability to finance new capacity. Hence if interest costs go up, new capacity will be more expensive, and prices may have to be raised. A higher rate of profit may be needed. Thus changes in the rate of interest will bring changes in prices and the rate of profits (Pivetti 1991; Nell 1988, 1992).[3]

Only a normal rate of interest could be supposed to determine the normal rate of profits. It does not make sense to suppose that the latter could be set by an accidental, or temporary, or politically volatile monetary policy. And normal wages and the normal rate of profits are required to determine normal prices. On the other hand, it is very doubtful that the money rate of interest, as determined by the central bank, or monetary authorities, can ever be considered to have a long-period or normal position. The rate of interest might have such a position by reflection, as it were, if it were determined by the long-period rate of profit (or by the normal rate of growth), but if it is determined by the central bank, independently of the rate of profits, then it is difficult to see how we can define the 'normal' level of the rate of interest.[4]

There are three points to consider here. First, monetary policy fluctuates in response to current variables, to market crises, and to political concerns. Secondly, the long-term rate is the relevant rate for investment, and for influencing profits through costs, but the central bank has much greater ability to control the short-term nominal rate. Thirdly, in

the post-war era it is crucial to distinguish nominal from real rates. The central bank can control nominal rates, subject to the above qualifications, but (if we reject monetarism) we have to accept that it cannot control real rates, because it has no control over the rate of inflation. Temporarily, subject to the political winds of fortune, central banks can set nominal short rates. Yet only a normal, real, long rate of interest could be relevant to determining the rate of profit. In addition, there are limits to what central banks can do, not only of a political sort, but also market limits. The power of the central bank is essentially monopoly power, so the central bank cannot move too much against the market. Moreover, for long periods in the history of capitalism, including the recent Volcker era of monetarism, central banks did not even try to peg the nominal interest rate.

There is a deeper objection, also. A long tradition of monetary thinking holds that the monetary system, or monetary markets, or some financial markets, are unstable, all or some of the time (Wicksell 1898; Minsky 1986). It is hard to avoid this conclusion, given the history of monetary/financial crises, not only in capitalism, but even in the Mercantilist era. But if the monetary system, or part of it, is systematically unstable, it is difficult to argue that monetary pressures will hold the rate of interest sufficiently steady in order to set the rate of profit. If financial markets are unstable, does the rate of interest still have a 'normal' level? What determines this?[5] (Consider this question in times when (a) no central monetary authority exists at all, or when it is too weak to peg the rate, (b) the authority exists but decides e.g. to target monetary quantities, (c) the markets are so unstable that the monetary authority lacks the means to peg the rate.) How do the rate of profit and prices behave when financial markets are fluctuating unstably?

Both evidence and theory show that money and finance have inherent tendencies to generate speculative bubbles. But if the monetary system is a source of important instability, then monetary forces cannot plausibly be recruited to determine the stable, long-term core relationships of the economy—the rate of profits and prices.

Finally, the cost effect of interest rate changes on prices certainly exists, but should be considered a minor and, at times, unreliable effect; it depends on the judgement that interest costs have changed permanently. Moreover, other factors could offset this effect.[6] The point is that, in a modern mass production economy, firms set prices by balancing their impact on the growth of mass markets against their consequences for financing investment. Higher prices will inhibit market growth, but provide security for borrowing or equity profits to invest directly; lower prices and profit margins will mean less security for borrowing, but will encourage market expansion. Hence anticipated growth is central to the determination of prices and profits. (It should be noted that the fact that firms set prices with an eye to growth is not an indication that competition has been supplanted by monopoly, or even that it has become riddled with imperfections. On the contrary, competition is alive and well in mass production economies; but it takes the form of competing in the race to grow. Competition establishes 'one price', and tends to pull profit rates and growth rates together.)

It is therefore very implausible to argue that the rate of interest, as determined by the monetary authorities, sets or determines the rate of profits. On the other hand, the argument that the rate of interest is determined by the normal rate of profit, or by the normal rate of growth, seems to face no such objections. Normal market forces would operate; such forces would fluctuate in the short term, but established market operators

would detect the central tendencies, and build their expectations accordingly. The fact that financial markets are unstable creates no difficulties at all; the interest rate will tend to the level of the rate of profit (or rate of growth) but will sometimes deviate due to unstable market processes.

On this view, it would be quite normal for the central bank to intervene and use its dominant position to cause the actual market level of interest rates to deviate from what the financial markets would determine in its absence. Its ability to do this will not be unlimited—e.g. the case of'Daltons' in the Labour Government after the war. But normally the central bank will have quite a lot of latitude. So in theory the rate of interest is or would be determined by the rate of profit, or, as we shall see, by the rate of growth (always subject to financial instability), but in practice it will be set by the central bank, not in the abstract, but by virtue of its market power, as a sustained, but varying, deviation from the rate of profit or rate of growth. The claim that interest rates govern profit rates through the cost effect on prices must be judged implausible *prima facie*.

The rate of growth and the rate of profits

The Cambridge Equation, in the hands of Kaldor and Robinson, purported to show that the rate of profit was determined by the rate of growth. Garegnani, in arguments further elaborated by Vianello, has contended that this relationship is flawed for a number of reasons.

The critique I: volatility of investment

The first claim is that investment is unpredictable because governed by animal spirits: but this is not a well-formulated position, because it does not distinguish two aspects of investment. Investment decisions are the decisions to build new productive capacity, as opposed to current investment spending, which is expenditure on activities carrying out previous decisions. The two depend on quite different factors. Investment decisions are, first and foremost, *long-run* decisions. It is irrational for business to make them on short-run grounds or in response to animal spirits. For business to decide to build a factory or adopt a technology or a product design, they must know that when they have completed the construction and installation, there will actually be a market for the output, at a suitable price. They must have good reasons for thinking this; of course, they can't know for certain that the anticipated market will materialize, but they must have made their marketing studies, sales analyses, etc. So business investment decisions—about size of plant, technology, product design, location etc.—will be made on good, well-studied, long-run grounds.

By contrast, having determined to adopt a technology and build, business then has the further problem of deciding how fast to implement those decisions. When should the new plant come on line? Should construction be speeded up or slowed down? At what point should the company enter the financial markets? These are questions about investment spending, which is the true Keynesian variable, and decisions on this matter are indeed influenced only by short-run variables, and being somewhat speculative, they are very much subject to guesswork and animal spirits.

Investment decisions, as opposed to investment spending, can be given a long-period interpretation, it will be argued here. In a later section it will be shown that, under some circumstances, a normal rate of growth for the economy as a whole, can be defined. Moreover, a look at the evidence tends to support this interpretation: from quarter to quarter and even from year to year, investment fluctuates very dramatically. But when moving averages are taken, the fluctuation smoothes out, and very clear trends emerge, which hold steady for considerable periods.

An objection: capacity utilization rates can differ

But even if growth were persistent, it has been objected that a steady higher rate of growth of output (in one period or economy as opposed to another) need not imply a higher rate of profit, since capacity utilization rates could differ. Vianello, for example, asks 'Why should we not suppose that the two economies (one which doubles in 10 years, the other in 15, in response to demand pressures from colonies) have the same propensities to save and to import, and the former (10 year doubling) has a higher level of exports, investments and national income than the latter (15 year doubling)—but not a higher proportion of its national income devoted to investments and exports?' (private correspondence, Nov. 1994). In other words the faster growing economy could have a higher degree of capacity utilization, instead of a higher rate of saving, nor would the faster growing economy necessarily have a lower real wage or higher share of profits. Presumably, the implication is that if the monetary authorities in both settled on the same policies, fixing the same interest rate, then both economies could have the same *normal* rate of profits and prices, in spite of the systematic difference in growth rates (and actual profit rates). This is the neo-Ricardian picture.

There are three rates of growth to consider—of demand, of output (income), of capital.[7] For long-run macro equilibrium they must all be equal (assuming no changes in productivity). (They *need not* all be balanced or steady-state. Some sectors may be growing faster than others, etc. But at the macro level the growth of demand must equal the growth of output.) So we have:

$\Delta D/D=\Delta Y/Y=\Delta K/K$

where D is aggregate demand and we assume that D=Y, i.e. that current output adjusts to current demand. (Notice that this implies that an increase in Y, due for example to higher capacity utilization, will be matched by a corresponding increase in D. Hence if ΔD is unchanged, the rate of growth of demand, and so of output, falls.) Continuing:

$\Delta Y=\Delta K(Y/K)$, and $\Delta K=I=s_cP$.

Hence:

$\Delta Y/Y=s_c(P/K)=s_cr$.

Under these conditions, if the growth of demand rises, the growth of output will have to increase, which will require higher I and so with a given s_c, P will have to rise. So far this differs from the standard neo-Ricardian story only in the emphasis on the growth of demand, gd (which, however, should *not* be thought of as caused by or generated by the supply process, e.g. the multiplier).

First, let us consider the contention that the rate of growth can vary independently of the real wage and the profit margin because the rate of capacity utilization can vary. Then we will return to the claim that the monetary authority can set the rate of interest without regard to the rate of growth. We will see that this brings us back to Wicksell.

Why capacity utilization rates differ

Neo-Ricardians contend that a higher level of profits, P, could result from more intensive utilization of existing capital. If production facilities are elas-tic, as Keynes claimed they were, then additional output can be supplied by working them more intensively. If costs are constant or roughly constant, then profits can be increased by more intensive use of existing equipment. (The proportional increase in output must be greater than the proportional rise in unit costs, presumably wage costs.)

Two cases must be distinguished. The simplest occurs when output is expanded by adding more labour, e.g. by recalling layoffs, and running the plant on the weekends; conversely, to reduce output, labour can be laid off, or put on short time. But whatever part of the plant is used, and whatever work is done, activities take place in the normal way. There is no difference in the way work is organized, and the coefficients of labour and other operating inputs are unchanged. (In practice, there may be small variations, but these are considered to offset one another, with some inputs exhibiting a small degree of increasing efficiency and others decreasing as utilization varies.) When the plant was built, its ability to operate at higher levels of capacity utilization—including extra shifts—was foreseen and planned for. The transition between different levels of utilization is ideally smooth, quick and costless.

By contrast, the second case involves changing the way work is organized, and may require reorganizing the plant. New shifts are defined, equipment is rearranged, and production tasks are divided up between the shifts. Later shifts receive extra pay or bonuses. This changes the labour coefficients and therefore relative costs, with implications for prices. A change in shift work can be considered analogous to a change in technique, and can be analysed in the same way (Kurz 1990). Different patterns of shift work may entail different ratios of ‘labour’ to ‘capital’, and hence lead to different normal positions. But given the real wage, the normal position will be determined.

To see the issue posed by the second case, consider an investment question: should a firm facing an increase in demand build a second small plant, so that it operates two plants, each working one shift, or should it reorganize its present plant so that it can be operated for two shifts? The two plants will last longer, but the investment will be larger; the single plant will wear out more quickly, and will operate with higher labour costs, since it will have to pay a premium to the workers on the second shift.[8] The intuitive trade off here is between operating a larger plant for a shorter work day, versus a smaller for a longer. The larger plant wears out more slowly, so lasts longer. But the longer work day requires a wage premium for later shifts. The longer lasting plant might also become obsolete before wearing out. These costs must be evaluated in the context of given prices and the rate of profits, and they will generally be different for different rates of profit. The problem is strictly analogous to the ‘choice of technique’, and the analysis focuses on a given rate of profit. But, for that very reason the second type of changing capacity utilization is not relevant. The question at issue is whether a change in the growth rate of

demand can be accomodated by changing capacity utilization rather than by changing prices (the real wage). Only the first type of variation in capacity utilization is relevant.

The claim is that growth rates can be higher, while real wages and the profit share stay the same—if capacity utilization is higher. For short periods this is surely true, but it is surprising to see this observation figure in an argument that considers 'long-period positions', that is, positions in which the forces making for changes have reached a point of rest. The claim appears to be that two or more significantly different rates of growth could be compatible with the same long-period position. This is highly questionable.

Under conditions of mass production, manufacturing businesses—and quite a number of services also—build plant or service facilities that are designed to operate over a wide range of possible levels, with running costs per unit of output approximately the same at any level within the range. Mass production plants do not have a single unique level of most efficient operation. Any level within the range is acceptable. Furthermore, as the plant is 'broken in', management and workers will learn to use it more effectively, and will see how to improve their use of it, so that its average level of productivity will rise over time—and will rise more rapidly the more intensively it is used. Hence, from the supply-side perspective, it is difficult to define an optimal level at which to operate plant, although, in general, productivity is likely to increase more rapidly when demand pressure is high, as Kaldor showed.

Against the effect on productivity must be set the fact that high levels of demand—low unemployment—tend to strengthen unions and worker bargaining, and to erode management's position. Higher levels of operation, involving late shifts, may call for higher wages, and lead to higher breakdown and accident rates. On the other hand, firms may feel that if they operate at such levels for a sufficient time, they may learn to overcome these difficulties. Firms will choose a normal level of operation, and that level will be cost-minimizing, but other levels of operation may be no more costly. (A level of 'normal' operation at a higher percentage of capacity, for example, might not provide a firm enough extra capacity to maintain its market share in boom conditions.) In such cases the normal level of operation will be chosen because it is expected to be the most frequent, and because the plant can be operated in ranges above and below that level with approximately the same costs.

So in response to Vianello's question, we can agree that two mass production economies, using the same techniques and having the same normal real wages and prices, could grow for a long time at different rates because one systematically used its capacity to a higher degree. This would not be possible in a Marshallian world: the more intensive use of craft-based capacity in the faster growing economy would imply higher unit running costs. Hence the two economies would have different prices, different rates of profit, and would be likely to operate different techniques.

But while the suggested difference in capacity utilization is *feasible* in a mass production economy, if the growth rates in the two economies are both *foreseen*, then the situation described in the quote will not be consistent with rational policies by the firms. For capacity is built to a certain size, with a certain carefully designed range of operation, in the expectation that this range will cover the normal variance of sales. The ability to adjust output to sales has been built into the production plan, because it is expected to save enough money to cover the cost of designing the plant to have such a range of 'constant running costs'. The normal operating level will be set to provide enough surplus

capacity to maintain market share in booms—the firm will not want to lose share in boom and have to try to recapture lost customers in the downturn. And it must be possible to reduce utilization below normal in a slump without unit variable costs rising—the firm will not want to face higher operating costs in a slump. The cost of so designing and building the plant—as compared to a plant with less flexibility—must be considered an investment, which must cover its expense and earn a payoff (by keeping market share in the boom and avoiding higher costs in the slump) within the normal payoff period.

The range of operating levels will be adjusted to the level and variation of sales, and it will be expanded as the market expands. A certain point in that range (depending on technical and market considerations), will be some sort of expected average level of utilization. The range will extend on both sides of that point to a distance that reflects the normal pattern of variation of sales (given warehousing costs, etc.) The range is built so that the firm can quickly and easily adjust output to changing market demands, without experiencing serious changes in unit operating costs. Now if in fact capacity is normally operated in the upper end of the range, above the point of expected normal use, then the range has been set too low. Some fluctuations at the upper end of the scale will fall out of the range. But the range was designed precisely to accommodate such fluctuations; hence capacity should be increased. Conversely, if utilization constantly lies in the lower end of the range, firms are carrying capacity that they do not need. Hence, if these problems are foreseen, firms that are constantly operating at the upper end of the scale will tend to expand their investments and raise the level of normal capacity (thus lowering the degree of capacity utlization), while firms operating persistently in the lower levels will contract theirs (and raise the degree of capacity utilization).

Hence capacity will be constructed on the basis of the demand levels that are foreseen, and their expected variance. Two significantly different rates of growth imply two different levels of demand at any point in time, and two different patterns of variance. Only the one of these which was foreseen can be consistent with the capacity that is currently in existence.

To put the point another way: normal capacity levels were chosen for a reason. To operate above or below them means accepting higher costs. These may be operating costs, or they may be opportunity costs, that is, lost opportunities for specially advantageous sales. If g_n rises, then, by definition, business expects demand to grow faster on a permanent basis; to supply this demand without raising prices (lowering the real wage) to increase profits and savings producers would have to operate regularly above normal capacity. But this means they will have to accept higher costs or strategic losses, because they will not be able to adjust to cyclical fluctuations. If actual growth is to be financed by actual profits, then the costs of operating at a higher level of capacity must be offset somehow, for example, by raising prices. (In the short run, these costs may be negligible; but in the long run, logically they have to be significant—otherwise, business would have built a smaller plant in the first place.)

The critique II: capacity adjustment

This is not the end of the story. There is another arrow in the neo-Ricardian quiver. In the long run, it is argued, capacity itself will adjust, when capacity utilization changes. Garegnani (1992) has provided examples showing that a higher rate of utilization need not be permanent, that is, need not go on indefinitely, since the higher utilization will create higher incomes, with consequent higher savings and investment, which will result in the creation of additional capacity. Thus a higher rate of utilization implies a compounding creation of capacity, moving the system to the desired position faster. Hence, an increased rate of capacity utilization will be able, after a time, to fall back to normal, since the increased capacity will now be able to supply the increased demand.

A once-for-all increase in demand can be met with a rise in capacity utilization—and this higher level of utilization will, indeed compound, over time, raising capacity. However, there is a problem. If capacity utilization can be expanded to provide the higher income which will generate the savings to match investment—why does there have to be investment? Why not simply increase capacity utilization? True, capacity utilization will now be above 'normal', but so what? Unit current costs are the same, and average costs are lower. A further increase in demand might be difficult to accommodate, but unless this further increase is expected (in which case we are not dealing with the once-for-all situation), why should firms plough back their profits or increase their debt, when they could just raise capacity utilization?

If further increases in demand are expected, that is, if demand is expected to increase each period then it makes sense to invest rather than run up capacity utilization. But now consider, not a once-for-all increase in demand, but an increase to a higher rate of growth of demand. This means that *in each period* demand will increase by the amount required to stand in the new higher ratio to the level of demand of the previous period.

Now consider the argument that higher capacity utilization increases capacity through the compounding effects of higher savings and investment. A rate of growth of demand implies that demand is growing at a compound rate. But a higher rate of capacity utilization will increase the current level of income. With given propensities to spend this will raise the current level of demand. A higher rate of growth of demand will then imply that next period's demand will be increased in proportion to the current level—a level which reflects the higher rate of capacity utilization! Each time capacity is increased through investment, that investment increases current demand, and therefore future demand rises in proportion. Increasing capacity utilization will simply be self-defeating.

To put the point another way, if the anticipated increase in demand is once-for-all, then when capacity utilization expands, increasing incomes and therefore the current level of demand, *the rate of growth of demand* (the increase divided by the current level) will fall. Instead of the growth of supply adapting to the growth of demand, just the reverse happens!

Investment and prices: optimal size and output elasticity

Perhaps the argument that higher investment need not imply higher prices (a lower real wage) could be validated so long as each firm makes a single once-for-all investment

decision, in a context where overall demand is growing. Consider: each period sees a new crop of entrepreneurs, who borrow once only to invest, establishing a firm at its optimal size, at which they operate ever after. Each period demand grows at a 'normal' or perhaps a varying rate, but for each crop of entrepreneurs the experience is unique. A larger investment requires a larger group of entrepreneurs, a smaller investment, a smaller group. Entrepreneurs are of varying talents; at higher interest rates only the best will survive, at lower interest rates the less adept will be able to make it. Thus the supply of new firms will be governed by interest rates. The shift in demand for new output each period is the shift of a given demand function, showing that additional demand will be larger the lower the price. Prices, however, may (for the sake of argument) be assumed to be determined partly by interest rates. High interest rates require high prices, so the increase in demand will be small. With low interest rates prices can be low, so the demand increase will be large. The number of new firms and the new demand for goods can both be considered governed by the interest rate.

But how will the savings be generated to offset the new investment? The suggestion is that this can be done by working existing capacity more intensively. If so, then interest rates could govern prices as suggested, and would also determine investment, although not along neoclassical lines. Unfortunately, there is a problem. The system works because firms make a once-for-all decision—they choose an optimal size which, once attained, is thereafter maintained. This precludes the elasticity which is essential to the capacity utilization story. For if output is not elastic, then a higher rate of growth will only be attainable if consumption contracts. A higher level of investment will require expansion of the capital goods sector; this will require capital goods industries to produce for investment in themselves; hence they must cut replacement and expansion deliveries to consumer goods industries (cf. Lowe 1976 on the 'traverse'; also Hagemann 1992). Thus—assuming producetivity to be given—to reduce the pressure deriving from the consumer goods sector, the rea! wage must fall.

Why does investing one time only, to build to 'optimal size', preclude output elasticity? If firms could operate at constant costs over a considerable range, then new firms would be hard put to enter on a regular basis. Entry would be a risky business; existing firms could always expand their utilization to sop up any new demand. If there were two types of industries—craft, with inelastic production, and mass production, with elastic output—entrepreneurs would always prefer to enter craft industries, since in such industries, if expected demand were greater than current output plus planned expansion, they would know that there was room for a new entrant. But in mass production, existing firms might be able to expand utilization enough to absorb the new demand, leaving no room for newcomers. If output is elastic, the present firms in an industry have the ability, and, of course, the incentive, to shut out new entrants, by absorbing the new demand before the newcomers get their plant running. Existing firms can then plough back their profits and expand to meet the new demand themselves, reducing capacity utilization to normal, and thus maintaining their flexibility.

But if existing firms plough back their profits, then they are planning to adjust capacity to the growth of markets over the long term. If a normal growth of demand is expected, firms will plan accordingly, which requires that they set prices to earn the profits that will make it possible to invest just enough to build the range of capacity needed to supply the growing demand, given its expected variability.

The critique again: competition and entry

Against this it may be suggested that while firms might *wish* to set prices at a level that will earn the profits needed to underwrite the investment required to keep pace with the growth of demand, they might very well not be *able* to do so. Competition would keep prices down, according to a traditional argument. Consider an interest rate, set by the monetary authority, lying below gd. Potential entrants, funded by banks or financial markets at such an interest rate, lower than the growth rate of demand, would keep prices and the rate of profits down (the real wage up). (Alternatively, various existing firms might draw on banks or capital markets, to obtain funds at $i<g_d$, making it possible for them to expand at lower prices.) The resulting prices will be too low to provide a rate of profits, which when invested, would expand capacity at the rate, g_d. Hence each period there will have to be an infusion of capital from outside, to make up the shortfall. Capital would have to flow into the industry in every period because prices and profits are too low! (Otherwise capacity utilization will have to rise steadily, until all firms are overworking their plant and equipment, at which point prices will be driven up, leading the real wage to fall.)

There are good reasons to reject this scenario. First, in each period profits will be too low to provide the capital needed to meet the growth of demand and firms will have to borrow. So the debt-equity ratio of the industry will rise steadily. Secondly, firms will no doubt wish to borrow funds for new capital at such a rate of interest. But where do these funds come from? If they are drawn from savings, then (assuming a classical savings function) where can sufficient savings be found if $r<g_d$? Alternatively, the source of the funds could be bank money. But if bank money is loaned, then the banks will face a problem maintaining their covering ratio (bank capital/working assets), since (assuming they plough back their earnings) their capital will accumulate at $i<g_d$, while they continue to lend at rate g_d. Hence, over time their capital will fall relative to their loans. If their cover were just adequate at the beginning, it will necessarily fall, until it is insufficient.

Furthermore, banks might not be willing to lend for the purpose of investing to obtain r=i. The rate obtainable on loans is i, but, if capital in any sector is growing *part passu* with demand, by participating in a venture, that is, by taking an equity position in a specific project, the capital so invested would grow at rate $g_d>i$. Banks might then prefer to lend to portfolio managers who will seek out equity positions, putting them in a position to pay a higher rate to obtain funds.

Then there are difficulties with the incentives to enter. A firm will not be disposed to enter unless there is room, that is, unmet demand, or unless the firm believes that it can produce more cheaply, or produce a better quality product for the same price. The latter cases pose no problem. It is the former that is at issue here. The claim is that, if g_n were to rise, if firms already in an industry raised prices to generate the profits to finance the capacity to meet the more rapidly growing demand, outside firms could enter, using the *same* technology, and meet the demand at the old price. Consider first the case where g_n rises, across the board, that is, for ‘outside’ firms as well as those inside any particular industry. The claim must be that new firms will be created and funded at an interest rate equal to the original profit rate. If all firms fear entry, and don’t raise price, then overall profits will be too low to underwrite the investment needed to grow at the higher rate. The new entrants will cause capacity utilization to rise. So then, all firms will operate at higher capacity; but, as we have seen this implies higher costs and lost opportunities. To

cover this they will have to raise prices, after all. And, being rational, they will plan for larger investment at higher prices. As for the entering firms, the argument supposes them to enter an industry at a price which they know will not permit them to keep pace with the growth of the market. They might enter at a low price in order to grab a part of the market, but if they can't keep up, they will raise their price in line with everyone else. Why should they accept a lower rate of profit than that prevailing in the market?

Leaving entry to one side, consider the position of the present owners of firms in the various industries. They have two strategies by which to expand *pari passu* with demand:

1 Keep prices low, earn $r=i<g_d$, and make up the difference g_d-r by selling shares in the business. Shares will have to be sold each period, so that over time the proportion held by new owners rises relative to that held by the original owners. Again we have an inflow of capital in every period because prices and profits are too low! (And again we have to ask where these funds come from.)
2 Set prices high enough to earn $r=g_d$, grow by reinvesting profits and maintain ownership of the entire equity, and prevent entry by meeting the new demand by overusing capacity. Even if firms enter, keeping prices down, they will have trouble finding a market because existing firms can temporarily satisfy all the demand. (Under the above assumptions, firms might take advantage of the lower interest rate to increase their leverage by borrowing. This would enable them to expand faster with lower prices; the lower prices might also raise the rate of growth of demand.)

Clearly the second strategy is the only rational one for the present owners to consider. But in that case present owners will only be interested in borrowing, and not more than a certain amount, while portfolio managers will only wish to buy equity. Moreover, lenders would surely be wary of potential entrants into an industry in which production was elastic. Such entry has to be considered risky; hence they would have to charge a premium, bringing i nearer to g_d. But if they made loans to existing firms, then over time debt would rise relative to equity, exactly as new ownership had to rise relative to old in the case just considered. Loan capital must flow in every period, so the debt/equity ratio of existing firms must inexorably rise. At some point, the increase in lenders' risk has to call for a premium.

The Harrod problem

Of course, just because firms want to increase capacity in relation to normal sales does not necessarily mean they can actually do it. Suppose demand exceeds capacity all around, and all firms try to increase their capacity in relation to sales at the same time, without raising prices. They propose to increase capacity utilization in order to build capacity in proportion to sales, in an amount indicated by the capital/output ratio. They will increase their investment spending; but the additional investment spending, in turn, will raise demand according to the multiplier. Hence sales will rise along with capacity—and the two will grow together at a rate given by the multiplier divided into the productivity of capital! The initial excess of demand over capacity will remain. This is the Harrod problem, and, of course, it also holds for attempted reductions of capacity in relation to sales, allowing for problems in relation to scrapping etc.

The Harrod problem implies that there can be *persistent* deviations of actual capacity utilization from that desired. So the case suggested is quite possible, according to this view. But it is not an equilibrium, or a normal long-term position; on the contrary, it would be the result of an unstable interaction between capacity construction and demand creation.

By contrast, the normal position will be determined by considering the expected growth of markets at different prices, and relating this to the ability to finance capacity construction at different prices. As argued above, under various circumstances a 'normal' rate of growth of demand can be defined, and this will give rise to normal prices and profits. When there is no definable 'normal' rate of growth, there will be a distribution of different sectoral growth rates. If there are no strongly growing sectors, or few innovators, pulling the basic input producers along, the system may well slide into depression—as happened in the 1930s and at other times. Looking to the factors that generate growth of markets is surely the right way to extend the Keynesian perspective to the long-run.

The rate of growth of demand

The idea of a rate of growth of demand

One reply might be to claim that there cannot be any such thing as a rate of growth of demand. Why should new markets open up, systematically over time, in a definite, normal proportion to current markets? At the sectoral level several answers jump to mind:

- demonstration effects: new customers are attracted in proportion to the number of existing ones;
- complementarities: new 'improved' products (made by the same companies using the same processes) sell in proportion to older or ordinary products; and
- replacement of domestic or non-market activities by industry is proportional to general or regional prosperity.

All of these are the stuff of marketing studies. At the macroeconomic level the growth of demand results from changes in the structure of the economy, e.g. earlier in the century each of the following created a new set of markets: the rise of the middle class (resulting from new demands for professionals as mass production brought about the replacement of the family firm by the modern corporation), urbanization, the development of suburbs, the increasing size of government in relation to GNP, and so on.

Of course, a normal rate of growth of demand will not last forever. If it is generated by a structural change, then after a time, when the change is complete, it will come to an end—to be replaced, however, by another. Thus the history of capitalism will be the history of growth, driven by market expansions generated by structural changes, where the effect of the market expansion is to bring about further structural changes.

'Normal' growth

So what about the rate of growth? On what grounds can we speak of a 'normal' rate? Consider this question in two stages. First, if there were a strong and growing demand for a sufficiently large portion of net output, then the rest of the surplus would have to be invested to produce a growing output to meet that growing demand. Further, the interdependence of industries would require all basic industries to grow in tandem, so that planned capacity could be kept at the level where it would be utilized normally. (In practice, of course, the actual expenditure carrying out investment plans proceeds unevenly, responding within the framework of the plans, to all sorts of short-run and speculative influences.) Hence if a reason to expect a growing demand for a suitably large portion of net output can be found, then the rest of the system will also grow at that rate. This is the second stage—to define a set of forces determining a growing demand for a large portion of net output.

Two scenarios come to mind: one for economies of the last century, more or less, the other for the post-war world. The first depends on colonies and the frontier. Population moves to colonize or conquer new territories. There is a steady flow of population to the new area. Then as it grows, the new colony demands growing imports of manufactured goods from the home country. These will be demanded in fixed proportions, reflecting the dominant 'style of life', and the technologies that the colony wishes to import. (The determinants of such a pattern of demand are sketched in Nell 1992: Ch. 17. Of course, such proportions are not strictly fixed; but variations will be limited.) The home country must therefore grow at an appropriate rate in order to satisfy this growing export demand. (The goods exported will be the composite commodity needed to establish the life-style desired by the colony. The colony, in turn, will supply the home country with better and cheaper raw materials and foodstuffs, raising productivity and reducing rents on land and mines.) Such export growth is not a short-run matter, nor is planning to satisfy such a growing demand a question of animal spirits. Nor does growth depend on interest rates, etc. The ultimate determinant will be the rate at which the colony grows, a matter about which business and government may make informed judgements (and develop policies, e.g. emigration policies). Given this rate of growth, the home country must divide its surplus into exports and investment, so that the investment out of the surplus will be just sufficient to increase the output of exportable goods at the rate the colony is growing.

The second scenario can be built around the welfare state. With the decline of the extended family and the shift from rural to urban, the training of the young and the care of the aged increasingly devolve on the State. Urbanization and mass production create new kinds of health problems, as well. As the economy shifts to modern industrial methods, spending on education, pensions, and health will have to grow. Again the demands that such growth sets up will be for 'composite commodities' consisting of the goods that make up a life-style. Subject to the well-known trends in consumption patterns—Engel Curves—these will stand in fixed proportions. As these demands grow, the industries which supply them must grow, hence the means of production must grow, etc. Hence again, the basic sector must expand. Of course, in more modern economies, the 'normal' level of capacity utilization may be a range, rather than a point. Hence the connections between industries will not be so tight.[9]

The preceding scenarios define a reasonably uniform balanced rate of growth for the system as a whole. A third scenario can be imagined, however, in which definite expectations of growth can exist, but in which different sectors will be expected to grow or decline at different rates. Consider an economy in which new products and processes are replacing old. Industrial products may displace domestic production and craft products. Or whole new sectors may emerge—the railroad, automobiles, airplanes, not only displaced older modes of transport, but vastly increased productivity and opportunities in the process. The economy as a whole grows partly because the new capital is more productive than that which it displaces, partly because, being cheaper, the new goods are more widely diffused, so that the scale of the new is larger than what is displaced, and partly because the new products and processes have external effects that increase productivity in other sectors. All that is necessary is that the various growth rates of the sectors be reliably forecast, and that expectations be consistent with the interdependence of the sectors.

When growth slows down in craft economies, prices fall relative to money wages, the real wage rises, employment and output fall slightly, and the average profit rate falls. When growth slows down in a mass production economy, there will be a temporary rise in unemployment. Productivity growth will slow down permanently. Prices do not fall, and money wages continue growing at their trend rate. The adjustment of the profit rate comes about, not by way of a rise in the money wages, or a fall in money prices, but chiefly through the fall in the rate of productivity growth, coupled with an established trend in money wages. In time this trend will be adjusted, so that real wages will grow more slowly, in line with the new lower rate of productivity growth. But there will be a once-for-all increase in the real wage, coupled with a once-for-all decrease in the normal rate of profit, to match the lower normal rate of growth.

Conversely, as the neo-Ricardians have emphasized: when normal growth rises, real wages do not fall. Indeed, they may rise. Capacity utilization rises, but more important, productivity grows at a higher rate. Prices will be set on the basis of expected costs, but as productivity changes, pricing plans will be adjusted. In so far as operating at higher levels of demand makes economies of scale and scope possible, obviously prices do not have to be raised in order to grow faster. Operating improvements, management practices, scheduling, ‘critical path’ adjustments, and the like, all seem to be stimulated by high demand. That productivity grows faster at higher levels of operation seems to be an integral part of mass production. So a rise in the expected growth of markets does not require a decline in the real wage.

But there is another interesting case. Suppose that because of innovations, unfocused public policy, or whatever, business expectations are highly diverse, so that no expected ‘normal’ rate of growth exists. Investment may become highly volatile; industries and markets may grow for short periods at highly diverse rates, and many will slump altogether, while business withholds spending, waiting to see a new pattern develop. Under these conditions unemployment might rise substantially and remain high; productivity growth would fall off sharply, and money wages could well begin to drift down. Real wages would then tend to fall, which would mean that the normal rate of profit would rise. The actual rate of profit would sink to a fluctuating and irregular level corresponding to the actual and irregular rate of growth. We would thus expect to find a

low rate of profit and a low rate of growth combined with high profit margins, and low utilization rates (as in the US in recent years).

Hence there can be a reasonably defined 'normal' rate of growth—in the circumstances stated. When there is such a rate, then prices can be determined (Nell 1992: Ch. 17, 1994, 1998: Ch. 10) so as to provide the profits to finance such growth—hence defining a normal rate of profit. A higher rate of growth will call for increased capacity, so more investment, hence for higher prices in relation to money wages; a lower rate will call for lower prices. Thus, given productivity, a higher rate of growth implies a lower real wage.[10] But productivity is not given; it is itself a function of demand pressure. The associated prices will of course be Sraffa's, or will differ from Sraffa's because of special conditions in particular markets. When different rates of growth are expected in different sectors, then prices will still be determined in the same way in expanding sectors, but competition will often be inhibited in declining markets.

Capital Arbitrage and Wicksellian processes

The claim examined earlier contended that if the rate of interest were high, prices must be set high in relation to money wages, thus implying a lower real wage and hence a higher rate of profit. In conjunction with the critique of the Cambridge Equation, it implies that the monetary authority could set the rate of interest at a level different from a strongly expected rate of growth, and in doing so, determine the normal rate of profit (Panico 1988; Pivetti 1991). The rate of profit will tend to gravitate towards the rate of interest; these two will not only 'track' one another, but any divergence between them will tend to be eliminated. We have seen that neither the claim nor the critique can be supported, but it remains to examine the tendencies to gravitate and to track.

We will first examine the implications of a divergence between the rate of interest and the rate of growth, and then consider whether there are pressures tending to bring them together with one another or with the rate of profit. We shall see that market forces do not tend to eliminate divergences, but they do lead the rates to track one another.

'Capital arbitrage'—rates of growth and rates of interest

For the sake of argument, let us assume that the monetary authority has the power to peg "the" (long-term) nominal rate of interest. We consider a mass production economy, in which large corporations invest by ploughing back profits. The rate of profits therefore is the net earnings of corporations divided by the value of the productive plant, equipment, etc., operated by the corporations. This implies that in making portfolio decisions asset-holders do not react directly to the rate of profits; instead they concentrate on the relation between the rates of interest on and the yield from holding stocks. This last is made up of dividends and share price appreciation. Here we meet an important difference between mass production and craft-based economies.

In the latter profits are earned by the family firm, and are either saved or used to pay interest. Interest in turn supports rentiers or is itself saved, and savings are loaned for investment by new firms. A representative asset-holder has a choice between owning a business of a given size, earning the going rate of profit, and owning a bond yielding the

going rate of interest. Asset-holders arbitrage between the rate of profit and the rate of interest.

By contrast, in mass production economies, asset-holders have a choice between stocks or shares in a corporation, and bonds. Profits are ploughed back, so the value of the share reflects not only, and perhaps not chiefly, its current and near term future earnings, but its future growth prospects. In other words, asset-holders arbitrage between the rate of interest and the rate of growth. Let's consider this more closely. Asset-holders—households, trusts, non-profit institutions, pension funds, etc.—will be supposed to have portfolios composed of two kinds of holdings: financial assets, such as bonds, which are commitments to pay principal and interest on certain dates, independently of the economic success of the payer, and 'real' assets (in inverted commas to indicate that these are claims), such as growth stocks, holdings of venture capital, and participation in direct ownership, where payments, and market value, are conditional on economic performance.

We assume that there are good reasons to expect the economy to realize a certain rate of growth (allowing for a normal degree of variation, comparable to the variations one might expect in the rate of profits), and further that this rate of growth is expected to hold for the indefinite future. Under these circumstances the value of an asset that consitutes a claim to real resources (or is held in terms that vary strictly with real growth, such as growth stocks) will compound at the rate of growth. (Assuming that stock markets have the appropriate information, the price of the asset—the claim on real invested resources—will appreciate at a rate equal to the rate of growth.) A similar position held in financial assets would compound at the rate of interest. A representative asset-holder must build a portfolio by comparing the rate of growth to the rate of interest.

We assume also that portfolio holders manage their assets to best advantage, but we need not settle on any particular formulation. They may maximize the present value of the portfolio or the rate of growth of asset values, they may or may not be subject to any of various plausible constraints, they may or may not have a finite time horizon, and the markets may or may not be 'imperfect'. But in any of the usual formulations, when the rate of growth and the rate of interest are equal, after making appropriate allowances for risk and liquidity, etc., portfolio holders must be indifferent at the margin between what we have just termed 'real' and 'financial' assets. And when i is not equal to g, one will compound faster than the other, which creates an incentive to shift capital until increasing risk or some other factor offsets the advantage provided by the difference between i and g. At this point we can ask, what will be the effects of portfolio managers selling one kind of asset to buy into the other?

First, suppose market pressures and the monetary authority have combined to establish a position in which nominal i<real g. 'Real' assets compound faster than financial; hence asset-owners will tend to shift into real holdings, buying into partnerships, growth stocks, and takeovers, and putting up funds for new investment projects. As a result:

- Bond prices will tend to drift down, raising i.
- Investment in real terms will tend to rise, raising g.
- When i<g debt will be falling as a share of income; hence the rise in nominal i will have little or no effect on g. But it will mean higher interest costs. Since demand is strong firms will tend to pass these along in higher prices, setting off a wage-price

spiral. The resulting inflation may offset the tendency for nominal i to rise, keeping real interest rates low.
- To maintain the level of nominal i initially established, the monetary authority would have to infuse funds into the bond market at a rate equal to that at which funds are shifting into 'real' assets.

Since both i and g tend to rise, as a result of a certain amount of capital shifting from financial to real, the difference, g−i will tend to be maintained. They need not rise in exactly the same proportion, but there seem to be no grounds for expecting i to rise faster. Hence the tendency for capital to shift will persist.

Arguably g cannot rise indefinitely. But this will not lead to i catching up to g. At a certain point g will hit a capacity-constrained maximum, where one or more basic industries cannot expand production to keep pace with the proposed level of investment. Such bottlenecks will lead to rising prices among basic goods, which will then be generally diffused as a cost inflation. (Moreover a rise in growth might cause prices to rise in primary sectors.) But inflation reduces the real rate of interest. Hence at the point where g can no longer rise, inflation emerges to prevent the real rate of interest from achieving parity with the growth rate. The difference still persists, and the tendency to shift capital remains.

Next suppose that market pressures and the monetary authority have established a position in which nominal i>g: 'Real' projects will compound more slowly than financial assets. Funds will therefore be shifted out of 'real' and into financial investments; new savings will be channelled into financial markets rather than put into new construction. Intermediation will increase. As a result:

- Bond prices will tend to rise, lowering i.
- Investment in real terms will tend to fall, lowering g.
- When i>g debt is rising, leading firms to cut back and trim costs. As a result the rate of inflation will tend to fall, offsetting the tendency of nominal rates to decline.
- To maintain the level of nominal i initially established the monetary authority will have to sell securities, withdrawing funds from the financial markets, at the rate at which they are being injected by the transfer from 'real' holdings.

Since both i and g tend to fall, as the result of a certain amount of capital shifting from real holdings to financial ones, the difference, i−g, will tend to be maintained, as the two move in the same direction. Hence the tendency for capital to shift will persist. Further, as growth declines, so will the rate of inflation, which will tend to raise the real rate of interest, offsetting any tendencies that might bring them together.

There are symmetries and asymmetries here. Just as there is a maximum to the growth rate, so there appears to be a minimum. Growth will not fall below the replacement level. But although inflation will slow, prices will not necessarily ever decline. A fall in investment and growth, in the modern economy, will lead to a clear-cut and determinate decline in capacity utilization, but prices will tend to remain steady or decline only slightly and irregularly. Once inflation has fallen to zero no rate of price decline will develop to raise the real rate of interest.

However, other factors may limit the decline in i. When bond prices are high above normal, there will be speculative fears of a collapse, inhibiting further bidding up of bonds. When interest rates are too low, the earnings of financial institutions will be low.

Hence risk will rise in financial markets, and this will inhibit further shifts of funds. Thus the difference between i and g will not be eliminated, yet the two will tend to move together.

The claim is not that a persistent gap between i and g will last forever; the point is rather that it will not close until there is a change in basic parameters. Hence the argument here is relevant to the analysis of 'long swings' in economic behaviour. Thus i<g is consistent with the long post-war boom, from the end of the war to the first oil shock, and i>g with the growing stagnation since then. The gap in each case will tend to close with the changes that bring about the turning points—but rather than an equilibrium, a new regime of persistent divergence is likely to be established.

Unbalanced growth

Next consider the case where there is no clear-cut expectation of a single, economy-wide rate of growth. Instead, different sectors will be expected to grow at different rates. These expectations are definite, but there will be no overall uniform, balanced rate of growth for the economy as a whole.[11]

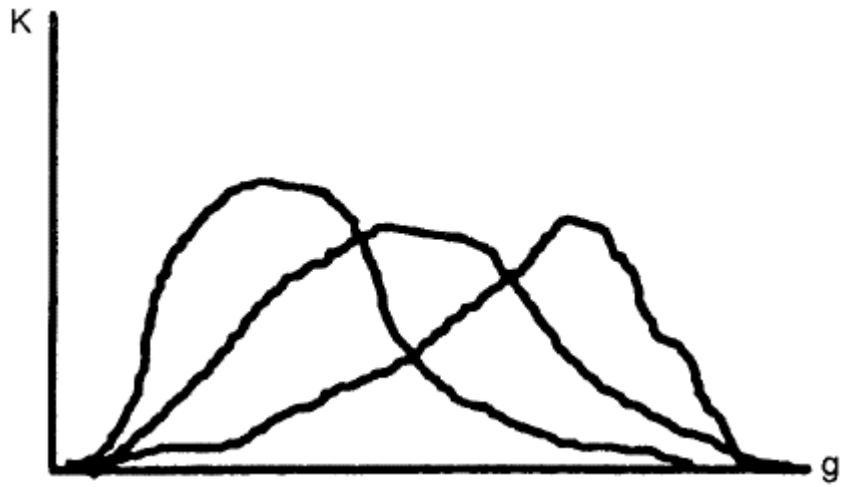

Figure 13.1

A distribution of growth rates can be drawn, with gi on the horizontal axis and K_i, the amount of capital in the i^{th} sector, on the vertical (see Figure 13.1). Three possible distributions are illustrated in Figure 13.1. The areas under the curves, total K, should be equal. Consider the middle distribution, approximately normal. Holders of 'real' assets in low-growth sectors will prefer a safe financial asset if the interest rate is above their growth rate. Holders of financial assets, on the other hand, might well be willing to shift to a 'real' asset growing more rapidly.[12] If i is set equal to the mean rate of growth g, then, *ceteris paribus*, the flow of funds from low-growth sectors to financial markets will just offset the flow from financial markets to high-growth sectors. Growth rates and

sectoral sizes are symmetrically distributed above and below the mean, creating symmetrical incentives to shift capital. There will therefore be no pressure on the rate of interest to change, and no need for the monetary authorities to continually intervene.

But this rule is not without problems. Consider the other distributions. In the first, a few large sectors have low growth rates, which, however, will be close to the average, while a large number of small sectors have high growth rates, many well above average. The large sectors with low growth rates close to the mean are unlikely to shift much capital into financial assets; but this may not be a problem since the small high-growth sectors may not be able to absorb that much. So this distribution may stimulate a lower degree of capital-shifting than would take place under a normal distribution. The third distribution, on the other hand, with many small low-growth sectors, and a few large high-growth ones is likely to face a difficulty. Since the low-growth sectors are small, not much capital will shift out of them, but the large high-growth sectors are likely to strongly attract funds from the financial markets. The rule, setting i=mean g, may have to be modified here.

Nevertheless, the principle is clear. When there are different growth rates in different sectors, the mean of the growth rates is the rate to which i should be pegged, allowing for minor adjustments. If i lies below or above that rate, persistent movements of funds will take place, just as if i were below or above a uniform balanced growth rate.

Two conclusions may be drawn from this. First, the difference between g and i is not eliminated by the shifting of capital, and as long as it is not, the incentive to shift will remain. This can create difficulties for the monetary authorities, if they wish to try to peg the interest rate at a level significantly different from the growth rate. Second, the growth rate and the interest rate will tend to move together, that is, in the same direction, and even to the same degree. They will tend to track one another, and this may be the most important effect of ‘capital arbitrage’. Since prices and inflation will tend to move in the same direction as the growth rate, prices, inflation and the interest rate will also tend to move together.

Conclusions

The main points can be summed up in five propositions:

1 There cannot reasonably be an independent ‘normal’ rate of interest—on the contrary, in equilibrium it must be equal to the rate of growth or to the mean of the various sectoral rates of growth.
2 Nor can we reasonably hold that the rate of interest could determine the rate of profits by affecting costs.
3 By contrast, the rate of growth—understood as the rate of growth of demand—can, and in normal conditions does, determine the rate of profits. Changes or differences in the long-term expected or ‘normal’ growth rate, a rate which equals the rate of growth of demand, cannot be accommodated by changes in the rate of capacity utilization; they call for price changes.
4 It is perfectly possible to define a ‘normal’ rate of growth for the economy as a whole, a rate at which supply grows in pace with demand, where the growth of demand is defined in terms of the expansion of markets. Under some cirumstances this will be a

uniform, balanced rate—the same in every sector, allowing for minor variations and irregularities. Under other circumstances, however, the rates of growth of different sectors will be different, and it may be that some sectors are declining, as others displace them. In this case the average rate of growth, weighted by sectors, will be significant for financial markets.

5 The relation between the growth rate and the interest rate will not be stable—a difference between them will set up incentives to shift capital, but the shifts will not eliminate the difference, and hence flows of capital between sectors and pressures on the rates to move will tend to be persistent. But the result will be a tendency for i and g to move together, hence for i and inflation to move together—the modern form of Gibson's paradox.

Thus we are back to something like a modified version of Wicksell. A divergence between the money rate of interest and a rate of return on capital leads to systematic and cumulative movements, which, however, fail to achieve adjustment. But, in modern systems based on mass production, instead of the rate of profit, it is the rate of growth that arbitrages with the rate of interest, and instead of prices it is outputs and real growth—and sometimes inflation—that are affected.

Acknowledgements

Over the years I have discussed these issues with Pierangelo Garegnani, from whom I have never ceased to learn. I have also had helpful and interesting conversations with Massimo Pivetti. More recently I've benefited greatly from talks and correspondence with Fernando Vianello and Fabio Petri. They should not be implicated in the views expressed here; I am responsible for any errors.

Notes

1 In different works, he provided two different and seemingly incompatible definitions of the 'natural rate'. In one it is the average rate of return on the existing stock of capital; in the other, later definition it is the rate which equates saving and investment (Wicksell 1898:103–4, 1935, Vol. 2:193). The former definition can be clarified by reinterpreting it as the rate of profit in a Sraffa system (Nell 1967:389–90).

2 Joan Robinson made this mistake (Garegnani 1992; Vianello 1995). Her defence was that the 'normal rate of profit' was an imaginary variable, on a par methodologically with neoclassical equilibrium ideas. She would have been sympathetic to the idea of a 'normal' rate of growth only to the extent that it reflects the fact that firms have good reasons for expecting a quantitatively definite expansion in their demand, and for expecting such expansion to continue from period to period.

3 Notice that Pivetti's line of argument implies that a reduction in the quantity of money, which will be needed to raise interest rates, will lead to a rise in prices. This requires some explanation, since it is the direct opposite of the usual argument and moreover runs counter to most empirical studies.

4 The average level of the long-term rate of interest was fairly stable, from the mid-nineteenth century until World War I, and after the war continued to be moderately stable until the 1930s. Kalecki, for example, calculated deviations from a nine-year (cycle-long) moving average of UK consols, and showed that they were very small. (1990:297, Table 16). He

considered this sufficient justification to treat the long rate as a constant in developing models of the business cycle. What Keynes termed Gibson's Paradox held during more than a century—levels and changes in the nominal interest rate were closely correlated with levels and changes of the wholesale price index, and the long rate was more closely correlated than the short rate. Both these patterns contrast markedly with the post-war era. The long-term rate of interest varied substantially in the post-war era. From the early 1950s to the early 1960s, the real long-term rate rose from near zero in both the US and the UK; it then fell to nearly zero in 1975, then rose steeply to over 7.5% in 1985, and fell again thereafter. Thus it fell during the inflation of the 1970s, and rose during the early 1980s, as inflation declined. But the nominal long-term rate closely tracked the rate of inflation, with interest close to inflation in the 1950s, lying above it in the 1960s, then falling below in the mid-1970s, and rising above again in the 1980s. The correlation is high, and the turning points match closely.

5 Financial instability will typically result in sharp, sometimes substantial movements of the interest rate. Bond prices will boom and/or then crash. The central bank may try to control the short rate, and may step in to support bond prices, but the dispersion of rates will widen, and the long rate may swing quite sharply. Even when full-blown crises do not develop, market pressures can cause large movements. And for real rates the swings are likely to be even wider.

6 Higher interest rates also raise the cost of living, and lead to COLA adjustments, and to union pressure in wage bargains. This would be a possible influence, albeit perhaps a weak one, on the actual rate of profit, but it would tend to be in the opposite direction.

7 The issue is not steady-state, but 'normal' growth—in particular, growth of demand, that is, of markets. Vianello (1995:13), following Garegnani, contends that 'real-world' investment decisions determine the level of investment, 'whose ratio to the stock of capital will usually be higher or lower than the fully-adjusted rate of accumulation'. But the 'fully-adjusted rate of accumulation', or the steady-state growth rate, is not the relevant concept from which to begin an analysis of long-run adjustments to demand. ('Long-run', not 'long-period', because the latter carries the connotation of fully adjusted. 'Long-run' means capacity will be adjusted, but not necessarily fully or correctly.) Garegnani (1992) introduces g^*, a pure supply-side concept. He defines it as the ratio of the savings which take place at normal utilization to the capital stock. Since this assumes a particular level of demand, it cannot help us to study the effect of changes in demand on the rate of profit.

8 Strictly speaking, the question is independent of demand. It is simply a matter of the best way to utilize equipment, given that more intensive use wears it out faster, but produces output sooner, but at higher labour costs. Kurz and Salvadori (1995:204–7) formulate the issue as follows: given input coefficients per unit output, per year, and machines that last two years run at one shift, one year when run for two, which will be cheaper—to operate two shifts, wearing the equipment out in one year and paying a wage premium for second shift labour; or to operate only the first shift, but using two processes, one with new machinery and another with partly worn-out equipment, and paying labour only the normal wage? The answer depends on the wage, the wage premium, the rate of profit and the price of the new machine. It does not depend on demand.

9 This suggests that the 'long-period method' may be inappropriate for modern mass production economies; for, if 'normal capacity' denotes a range, 'normal profits' must be a range as well. Then the 'normal rate of profit' will be any rate that lies within a band, so long as over time the average rate also lies within those limits, and the classical equations should be interpreted as showing the structural relationships in the system (Nell 1998).

10 The qualification is crucially important. A higher rate of growth of demand leads to higher productivity growth, so that money wages rise. Real wages need not fall, and, empirically, usually rise in periods of high demand growth. Note the suggested sequence: demand growth increases, so investment and planned prices rise. Then productivity begins to rise and money

wages increase. The rise in demand leads to increases in both prices and money wages—'creeping inflation'.

11 Unbalanced growth must be consistent with the simultaneous expansion of the basic sectors. Final output as a whole cannot expand faster than the slowest growing basic sector. A component of final output, produced using the slowest growing basic product, could expand faster than that slowest growing basic if another component, relying on that same basic, were growing more slowly, or shrinking, so that the first could expand at the expense of the second. But once the second becomes a small proportion of final output, this will not matter. In general, the interdependence of basics tends to pull growth rates together.

12 Why don't holders of low-growth assets shift directly into high-growth assets? Because this is not a barter model. Holders of low-growth assets must sell the assets first, and, in general large real assets are sold not for cash but for financial assets, usually at the liquid end of the spectrum. Then, of course, these same asset-holders might wish to buy into a high-growth industry, but the point about purchasing real assets is that direct knowledge of the business is required. Acquiring this, and making informed judgements will take time.

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Part IV
Issues in the theory of production

14
Transferable machines with uniform efficiency paths

Neri Salvadori

Sraffa (1960) revived the 'old classical idea' of treating old machines left at the end of each period as economically different goods from the machines that entered the production at the beginning of the period. After him Schefold (1971, 1976, 1978, 1980, 1989: Chs 12–18), Roncaglia(1971), Baldone(1974), Varri (1974), Salvadori (1988), Kurz and Salvadori (1994, 1995: Chs 7 and 9), and Bidard (1996) built up models in which fixed capital was explicitly distinguished from other kinds of joint products. However, all these authors have always assumed that old machines are *non-transferable*. That is, they have assumed that an old machine produced jointly with a finished good cannot be used in the production of another finished good. For instance, an oven formerly used to bake bread cannot be used to bake biscuits. This is a very strong assumption. Almost all these authors have argued that the transferability of machines implies all the complications of joint production, and some of them have produced examples to illustrate this (see, for instance, the examples provided by Schefold 1971; see also Schefold 1989:151–2).

In this paper I will show that the assumption of non-transferability of old machines can be weakened. If the transferable machines have a uniform efficiency path—a concept that will be formalised in the following—then the cost-minimising techniques have the same properties that have been investigated in fixed capital models with non-transferable machines. In this paper, however, I will limit the analysis to the case in which machines are not used jointly. I conjecture that a similar formalism can be found for the case in which machines are used jointly.

The idea of non-transferable old machines was put forward by Sraffa himself:

> The same type of machine (e.g. a lorry) may be used in several industries and it may be subject to greater wear and tear when employed in one than in the other and have a shorter life; or, even if the total life is the same, its efficiency may fall at different rates from year to year or require more repairs.
>
> Since the price of the new machine is the same for all industries it can continue to be denoted by p_m. But in successive years it may have a different book-value according to the use to which it is put. The new uses will be represented by additional equations and the new book-values by additional symbols. Thus we may call $M_{g_1} p_{mg_1}$, $M_{g_2} p_{mg_2}$, etc. the

> machines at successive ages multiplied by their respective book-values in the 'g' industry; $M_{h_1} p_{mh_1}$, $M_{h_2} p_{mh_2}$, etc. those in the 'h' industry, and so on.
>
> (Sraffa 1960:66–7)

In the above quotation the relevance of the efficiency path for the problem of the non-transferability or otherwise of machines is very clear. Its importance is even emphasised in the concluding paragraph of section 78, which follows those just quoted:

> If in all the industries the machine had the same working life and constant efficiency, the book-values for each age would be equal in all of them, since the annual charges would all be equal to the annuity described in § 75.

Hence, the non-transferability of machines seems to be necessary to obtain the neat properties of fixed capital models (which come very close to those of single product models) only if machines have either different working lives in different sectors or if their efficiency is not constant in at least one sector, or both. The idea I will try to develop here is to generalise this suggestion by Sraffa concerning constant efficiency to the case in which the efficiency of a machine is not constant but is still independent of the sector in which it is used.

Basic definitions

Technology

It is assumed throughout the paper that there exist z perfectly divisible processes and n perfectly divisible commodities. Each process of production i (i=1, 2,…, z) is defined by the triplet $(\mathbf{a}_i^T, \mathbf{b}_i^T, l_i)$, where $\mathbf{a}_i^T = (a_{i1}, a_{i2}, \ldots, a_{in})$ is the non-negative[1] material input vector, $\mathbf{b}_i^T = (b_{i1}, b_{i2}, \ldots, b_{in})$ is the non-negative output vector, and l_i, a scalar, is the non-negative labour input. Thus, the whole technology is defined by the triplet **(A, B, ℓ),** where:

$$\mathbf{A} = \begin{bmatrix} \mathbf{a}_1^T \\ \mathbf{a}_2^T \\ \vdots \\ \mathbf{a}_z^T \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} \mathbf{b}_1^T \\ \mathbf{b}_2^T \\ \vdots \\ \mathbf{b}_z^T \end{bmatrix}, \quad \boldsymbol{\ell} = \begin{bmatrix} l_1 \\ l_2 \\ \vdots \\ l_z \end{bmatrix},$$

The following assumptions are assumed to hold:

Assumption 1 It is not possible to produce something without using material inputs, i.e.:

$$\mathbf{e}_j^T \mathbf{A} \geq \mathbf{0}^T \qquad j = 1, 2, \ldots, z.$$

Assumption 2 All commodities are producible, i.e.:

$$\mathbf{Be}_j \geq 0 \qquad j = 1, 2, \ldots, n.$$

Assumption 3 Labour enters directly into the production of all commodities, i.e., $\ell > 0$.

The results here presented still hold if Assumption 3 is substituted by the following:[2]

*Assumption 3** Labour enters directly or indirectly into the production of all commodities, i.e.:

$$\forall \varepsilon > 0 \, (\mathbf{x} \geq 0, \mathbf{x}^{\mathrm{T}}(\mathbf{B} - \varepsilon \mathbf{A}) \ngeq 0^{\mathrm{T}}) \Rightarrow \mathbf{x}^{\mathrm{T}} \boldsymbol{\ell} > 0.$$

The assumption regarding technology that will be explored in this paper is the following:

Assumption 4 It is possible to partition the set of commodities into two subsets in such a way that the following axioms (i)–(vi) hold: commodities in the first subset will be called *finished goods* and commodities in the second subset will be called *old machines*. Let m be the number of finished goods and (n−m) the number of old machines.

(i) Old machines are never requested for consumption,

(ii) Each process is assumed to produce one and only one finished good and, perhaps, an amount of one old machine. Each process is also assumed to utilise as material inputs only finished goods and, perhaps, an amount of one old machine.

(iii) All processes can be divided in first degree processes, second degree processes, third degree processes, and so on. A *first degree process* is one that exclusively uses finished goods as inputs. A *second degree process* is one that uses finished goods and an amount of an old machine produced by a first degree process as inputs. A *third degree process* is one that uses finished goods and an amount of an old machine produced by a second degree process as inputs. And so on.

A machine produced by a first degree process and utilised by a second degree process is said to be *one year old*. A machine produced by a second degree process and utilised by a third degree process is said to be *two years old.* And so on.

(iv) It is possible to normalise the physical units of the old machines in such a way that for each one-year-old machine h there is a finished good k such that if a process has a units of h among its outputs, then it has *a* units of k among its inputs and for each t year old machine u ($t \geq 2$) there is a $t-1$ year old machine v such that if a process has β units of u among its outputs, then it has β units of v among its inputs.

The finished good k mentioned in Axiom (iv) is a *new machine*. The old machines involved in a sequence of processes each of which (except the first one) uses as an input an old machine which has been produced as an output by the preceding process are defined as vintages of the same *type of machine;* the new machine used as an input in the first process of the sequence is the *new machine of that type*.

(v) If a type of machine is used in the production of finished goods i and j ($i \neq j$), then there is a vector ($\mathbf{a}_{ij}^{\mathrm{T}}, \mathbf{b}_{ij}^{\mathrm{T}}, l_{ij}$) such that for each process ($\mathbf{a}_s^{\mathrm{T}}, \mathbf{b}_s^{\mathrm{T}}, l_s$) producing finished good i using a machine of that type (old or new) there is a process ($\mathbf{a}_t^{\mathrm{T}}, \mathbf{b}_t^{\mathrm{T}}, l_t$)

producing finished good j such that the vector $(\mathbf{a}_t^T, \mathbf{b}_t^T, l_t)$ is a linear combination of vectors $(\mathbf{a}_s^T, \mathbf{b}_s^T, l_s)$ and $(\mathbf{a}_{ij}^T, \mathbf{b}_{ij}^T, l_{ij})$

(vi) For each process producing an old machine there is another process with the same inputs and the same outputs except for the old machine which is not produced.

Axiom (i) is the only assumption we need concerning consumption paths: old machines are requested only in order to be used as means of production. If they were required for consumption, the proportions in which they are required would contribute to determining their overproduction and therefore their prices: all difficulties of joint production would be introduced in this way. Axioms (ii) and (iii) are usually introduced to avoid that old machines are used jointly (cf. Kurz and Salvadori 1995:187, 253). Axiom (ii) allows one to divide processes in sectors, a *sector* being constituted by all the processes engaged in the production of a given finished good. Axiom (iii) allows one to introduce the age of an old machine and to divide old machines on the basis of their age. Axiom (iv) is required when the efficiency path of machines is investigated (cf. Kurz and Salvadori 1995:260–1): here it is required at this stage of the analysis, since it is exactly an assumption on the efficiency paths of machines that gives the desired results. Moreover, Axiom (iv) allows one to introduce the concept of 'new machine', another concept that turns out to be useful only with respect to the problem of the efficiency of machines. Axiom (v) is the key assumption investigated in this paper and it will be clarified soon that this assumption implies that transferable machines have a uniform effi-ciency path across sectors. Axiom (vi) implies that any machine can at any time be worn out at a zero scrap value; in other words, old machines can be disposed of freely.

In order to simplify the exposition, let the commodities be ordered in such a way that the first m commodities are finished goods and the last n—m ones are old machines. Moreover, the unit level of processes that either produce old machines, or uses them, or both will be chosen in such a way that all input or output coefficients referring to old machines in matrices **A** and **B** equal 1.[3] This is possible since the above Axiom (iv) holds. These choices of units allow one to state the following. If the t processes $(\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i, \bar{\boldsymbol{\ell}}_j)$ are all the processes producing finished good i and using machines of a given type (including the new machine) and processes $(\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\boldsymbol{\ell}}_j)$ are all the processes producing finished good j and using machines of the same given type (including the new machine), then Axiom (v) implies that also the processes $(\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\boldsymbol{\ell}}_j)$ are t in number and they can be ordered in such a way that there exist vectors $(\mathbf{a}_{ij}^T, \mathbf{b}_{ij}^T, l_{ij})$ and h such that:

$$(\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i, \bar{\boldsymbol{\ell}}_i) = (\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\boldsymbol{\ell}}_j) + \mathbf{h}(\mathbf{a}_{ij}^T, \mathbf{b}_{ij}^T, l_{ij}). \tag{1}$$

As a consequence vector $(\mathbf{a}_{ij}^T, \mathbf{b}_{ij}^T, l_{ij})$ is proportional to vector:

$$\mathbf{e}_s^T[(\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i, \bar{\boldsymbol{\ell}}_i) - (\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\boldsymbol{\ell}}_j)]$$

whatever is s. This is enough to assert that the last n−m entries of vector $\mathbf{a}_{ij}^{T}$ are nought and all entries of vector $\mathbf{b}_{ij}^{T}$ are nought except the i-th and the j-th which have opposite sign. Moreover equality (1) can be stated as:

$$(\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i, \bar{\ell}_i) = (\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\ell}_j) + k_s \mathbf{e}_s^{T}[(\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i, \bar{\ell}_i) - (\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\ell}_j)]$$

where $h_s^{-1}\mathbf{h} = k_s = (\mathbf{e}_s^{T}\bar{\mathbf{B}}_i\mathbf{e}_i)^{-1}\bar{\mathbf{B}}_i\mathbf{e}_i = (\mathbf{e}_s^{T}\bar{\mathbf{B}}_i\mathbf{e}_i)^{-1}\bar{\mathbf{B}}_i\mathbf{e}_i > \mathbf{0}$, whatever is s ($1 \leq s \leq t$).[4] Finally the last n−m columns of matrices $\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i$ are equal to the last n−m columns of matrices $\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j$, respectively. Therefore if x(g) is a vector such that the last n−m entries of vector $\mathbf{x}^{T}(g)\left[\bar{\mathbf{B}}_i - (1+g)\bar{\mathbf{A}}_i\right]$ are nought, then the last n−m entries of vector $\mathbf{x}^{T}(g)\left[\bar{\mathbf{B}}_j - (1+g)\bar{\mathbf{A}}_j\right]$ are also nought. And this is enough to assert that if we deal with the old machines involved in the production of i as different from those in the production of j, these *two* types of machines would have exactly the same path of depreciation, that is, the same efficiency path (cf. Kurz and Salvadori 1995:203–4). This is the reason why we interpret axiom (v) as the *uniform efficiency path axiom*.

An example can further clarify this point. Let us assume that the choice of techniques involves just the determination of the age at which to wear out the machine and that the inputs ana the outputs of processes producing finished goods i and j with a machine of age t can be seen as the sum of two parts, one which depends only on the finished good produced (i or j) and one which depends only on the age of the machine used (t):

$$(\mathbf{a}_{i(t)}^{T}, \mathbf{b}_{i(t)}^{T}, l_{i(t)}) = (\mathbf{k}_i^{T}, \mathbf{e}_i^{T}, \lambda_i) + (\mathbf{m}_t^{T}, \mathbf{n}_t^{T}, \mu_t)$$
$$(\mathbf{a}_{j(t)}^{T}, \mathbf{b}_{j(t)}^{T}, l_{j(t)}) = (\mathbf{k}_j^{T}, \mathbf{e}_j^{T}, \lambda_j) + (\mathbf{m}_t^{T}, \mathbf{n}_t^{T}, \mu_t).$$

Salvatore Baldone has suggested to me that this is a typical example of ‘multiple production’, that is the production of several but very similar finished goods produced in different periods by the same firms and using the same fixed capitals, like the production of paints of different colours. It is immediately checked that in this example:

$$(\mathbf{a}_{ij}^{T}, \mathbf{b}_{ij}^{T}, l_{ij}) = (\mathbf{k}_i^{T}, \mathbf{e}_i^{T}, \lambda_i) - (\mathbf{k}_j^{T}, \mathbf{e}_j^{T}, \lambda_j).$$

Choice of technique

As is well known, with fixed capital there is always a problem of the choice of technique to be solved. This concerns at least the choice of the economic life time and of the pattern of utilisation of a type of machine (cf. Kurz and Salvadori 1995:204–7). The problem of the choice of technique, can be analysed by means of two equivalent approaches that have been called the ‘direct approach’ and the ‘indirect approach’ (cf. Kurz and Salvadori 1995: Chs 5, 7, 8, 9). For the sake of simplicity, I will deal here with the direct approach only. Following this approach the problem of the choice of technique is reduced to that of determining the scalar w and the vectors x and p such that:

$$[\mathbf{B} - (1 + r)\mathbf{A}]\mathbf{p} \leqq \mathrm{w}\boldsymbol{\ell}, \tag{2a}$$

$$x^T[B-(1+r)A]p=wx^T\ell, \tag{2b}$$

$$x^T[B-A]=d^T, \tag{2c}$$

$$\mathbf{p} \geqq \mathbf{0},\ \mathbf{x} \geqq \mathbf{0},\ \mathrm{w} \geq 0,\ \mathbf{f}^T\mathbf{p} = 1; \tag{2d}$$

r is the rate of profit, the non-negative vector $d \in \mathbb{R}^n$ defines the requirements for use and must satisfy axiom (i), vector f defines the numeraire and is any given semipositive vector whose positive elements refer to commodities that are certainly produced, vector p is referred to as the price vector, vector x as the intensity vector and scalar w as the wage rate. If **(P*, x*, w*)** is a solution of the system of equations and inequalities (2), then we say that there is a cost-minimising technique constituted by the processes whose corresponding elements of vector **x*** are positive, and **p*(x*, w*)** is referred to as the *long-period price vector (long-period intensity vector, long-period wage rate).*

One of the aims of the contributions to the literature on fixed capital has been to prove that when machines are not used jointly, then the long-period price vector is independent of the consumption and investment choices provided that they are feasible. This will be confirmed in this paper. Vector d can be defined as the sum of two vectors, the consumption vector and the investment vector. If the economy is assumed to grow at a uniform growth rate, we have:

$d^T=c^T+gx^T\mathbf{A}$**,**

where c is the semipositive consumption vector and the entries corresponding to finished goods can be positive, all the others being nought, and g is the growth rate, $0 \leq g \leq r$. Since we want to prove that both g and the amounts of the positive entries of vector c have no role in determining **p*,** we can also think of c as a given vector. Let us assume that only the first k commodities are consumed, $1 \leq k \leq m$, and therefore the first k finished goods are certainly produced. In this case it can be convenient to assume that the last n−k entries of the semipositive vector f in system (2) are zero. Finally we can concentrate on the case in which w>0. When this is done, system (2) becomes:

$$[\mathbf{B} - (1 + \mathrm{r})\mathbf{A}]\mathbf{p} \leqq \mathrm{w}\boldsymbol{\ell}, \tag{3a}$$

$$x^T[\mathbf{B}-(1+r)\mathbf{A}]p=wx^T\ell, \tag{3b}$$

$$x^T[\mathbf{B}-(1+g)\mathbf{A}]=c^T, \tag{3c}$$

$$\mathbf{p} \geqq \mathbf{0},\ \mathbf{x} \geqq \mathbf{0},\ \mathrm{w} > 0,\ \mathbf{f}^T\mathbf{p} = 1 \tag{3d}$$

Main results

Existence

In what follows I shall prove that long-period price vectors do exist and are independent of the growth rate and of the positive elements of vector c, provided that $-1<g\leq r<R$, where **R** may depend on *which* elements of c are positive, but not on their magnitudes. More precisely, I will prove the following.

Theorem 1 If the first k entries of vector c are non-negative, the others being nought, and if $-1<g\leq r<R$, where:

$$R = \sup\{r \in \mathbb{R} | \exists \mathbf{z} : \mathbf{z} \geqq 0, \mathbf{z}^T[\mathbf{B} - (1+r)\mathbf{A}] \geq \mathbf{a}^T\},$$

and **a** is a vector whose first k entries equal 1, all the others being nought, then there exists a solution **(p*, x*, w*)** to system (3) and **p*** is independent of g and of the amounts of positive entries of vector c. Moreover, the elements of vector **p*** corresponding to produced finished goods are positive.

It is a well-known result that if $-1<r<R$, the following system of inequalities (4) has a solution (whereas system (4) has no solution for $r\geq R$):

$$[\mathbf{B} - (1+r)\mathbf{A}]\mathbf{y} \leqq \boldsymbol{\ell} \tag{4a}$$

$$\mathbf{q}^T[\mathbf{B} - (1+r)\mathbf{A}] \geqq \mathbf{a}^T \tag{4b}$$

$q^T[\mathbf{B}-(1+r)\mathbf{A}]y=q^T\ell$ (4c)

$$\mathbf{q}^T[\mathbf{B} - (1+r)\mathbf{A}]\mathbf{y} = \mathbf{a}^T\mathbf{y} \tag{4d}$$

$$\mathbf{q} \geqq \mathbf{0},\ \mathbf{y} \geqq \mathbf{0}. \tag{4e}$$

Because of axioms (ii) and (vi) if system (4) has a solution, it has a solution with the weak inequality (4b) satisfied as an equality. Let the vectors $(\hat{\mathbf{y}}, \hat{\mathbf{q}})$ be such a solution to system (4) and let the processes **(A*, B*, ℓ*)** be the processes corresponding to those week inequalities (4a) which are actually solved as equalities when $y=\hat{y}$. Hence, also because of axiom (vi):

$$[\mathbf{B}^* - (1+r)\mathbf{A}^*]\hat{\mathbf{y}} = \boldsymbol{\ell}^* \tag{5a}$$

$$\mathbf{q}^{*T}[\mathbf{B}^* - (1+r)\mathbf{A}^*] = \mathbf{a}^T \tag{5b}$$

where **q*** is obtained from $\hat{\mathbf{q}}$ by eliminating the zero entries that do not correspond to processes **(A*, B*, ℓ*)**. Moreover, let us reorder the finished goods in such a way that the first h, $k\leq h\leq m$, are produced by the processes **(A*, B*, ℓ*),** whereas the last m−h are not.

Lemma 1 If a process whose corresponding entry of vector **q*** is positive uses an old machine of type α and produces finished good i, then processes **(A*, B*, ℓ*)** must include a process producing finished good i, using a machine of type α and not producing any machine. Moreover, if the degree of this process is q+1, then processes **(A*, B*, ℓ*)** must

include processes of degree 1, 2,…, q using machines of type α and producing finished good i.[5]

Proof If an old machine of type α is used in a process whose corresponding entry of vector **q*** is positive, then equation (5b) implies that processes **(A*, B*, ℓ*)** must include a process using a machine of type α and not producing any machine. Moreover, if the degree of this process is q+1, then equation (5b) implies also that process **(A*, B*, ℓ*)** must include processes of degree 1, 2,…, q′ using machines of type α. If machines of type a are used only in the production of commodity i within processes **(A*, B*, ℓ*),** the proposition is proved since $q \leq q'$ Let $\mathbf{e}_s^T(\mathbf{A}^*, \mathbf{B}^*, \boldsymbol{\ell}^*)$ and $\mathbf{e}_t^T(\mathbf{A}^*, \mathbf{B}^*, \boldsymbol{\ell}^*)$ be two processes among the processes **(A*, B*, ℓ*)** producing finished goods i and j, respectively, and using two machines of type α of different age, respectively. Axiom (v) ensures that there are in the set of the available processes **(A, B, ℓ)** two other processes, $\mathbf{e}_u^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$ and $\mathbf{e}_v^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$, such that:

- process $\mathbf{e}_u^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$ produces finished good i and uses the machine used by process $\mathbf{e}_t^T(\mathbf{A}^*, \mathbf{B}^*, \boldsymbol{\ell}^*)$,
- process $\mathbf{e}_v^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$ produces finished good j and uses the machine used by process $\mathbf{e}_s^T(\mathbf{A}^*, \mathbf{B}^*, \boldsymbol{\ell}^*)$, and
- there is a positive scalar θ such that:

$$\mathbf{e}_u^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell}) = \mathbf{e}_s^T(\mathbf{A}^*, \mathbf{B}^*, \boldsymbol{\ell}^*) + \theta\left[\mathbf{e}_t^T(\mathbf{A}^*, \mathbf{B}^*, \boldsymbol{\ell}^*) - \mathbf{e}_v^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})\right]. \tag{6}$$

The proposition is proved when it is demonstrated that both processes $\mathbf{e}_u^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$ and $\mathbf{e}_v^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$ are among the processes **(A*, B*, ℓ*)**. If process $\mathbf{e}_u^T(\mathbf{A}, \mathbf{B}, \boldsymbol{\ell})$ is not, then:

$$\mathbf{e}_u^T(\mathbf{B} - (1 + r)\mathbf{A})\hat{\mathbf{y}} < \mathbf{e}_u^T\boldsymbol{\ell},$$

and, as a consequence of equality (6)

$$\mathbf{e}_v^T(\mathbf{B} - (1 + r)\mathbf{A})\hat{\mathbf{y}} > \mathbf{e}_v^T\boldsymbol{\ell}.$$

A contradiction has been obtained, since vector ŷ satisfies inequality (4a).

Q.E.D.

Let the q′+1 processes mentioned in Lemma 1 be denoted as $(\mathbf{A}_i^*, \mathbf{B}_i^*, \boldsymbol{\ell}_i^*)$. With an appropriate choice we can assume that the j-th row of matrix $(\mathbf{A}_i^*, \mathbf{B}_i^*, \boldsymbol{\ell}_i^*)$ refers to a j-th degree process. Then we can define vector $\mathbf{h}_i(g)$ whose j-th entry equals $\mathbf{h}_i(g)\,(1+g)^{-j}$ and scalar $h_i(g)$ is determined in such a way that $\mathbf{h}_i^T(g)\mathbf{B}_i^*\mathbf{e}_i = 1$. It is immediately recognised that all the entries referring to old machines of the vector $\mathbf{h}_i^T(g)[\mathbf{B}_i^* - (1 + g)\mathbf{A}_i^*]$ are nought, all the others being non-positive except the i-th, which may be positive and actually will be if g is small enough. We will refer to:

$$(\mathbf{h}_i^T(g)\mathbf{A}_i^*(\mathbf{I}, \mathbf{0})^T, \mathbf{h}_i^T(g)\mathbf{B}_i^*(\mathbf{I}, \mathbf{0})^T, \mathbf{h}_i^T(g)\boldsymbol{\ell}_i^*),$$

where **I** is an hxh identity matrix and 0 is an hx(n−h) zero matrix, as a *coreprocess* of finished good i. A core-process can be regarded as a single production process whose input coefficients are functions of g. (Note that $\mathbf{h}_i^T(g)\mathbf{B}_i^*(\mathbf{I},\mathbf{0})^T = \mathbf{e}_i^T$). Obviously, if ($\mathbf{a}^T$, $\mathbf{b}^T$, 1) is a production process not using or producing old machines, then (a^T**(I,** 0)^T, b^T**(I,** 0)^T, 1) is the corresponding *core-process* (cf. note 3).

Now Theorem 1 can be proved. This will be done in the simplified case in which Assumption 3 holds. If Assumption 3 does not hold, but Assumption 3* does, then the theorem is still valid. What is needed is just the following Lemma 2.

Proof of Theorem 1 Since Lemma 1 holds, by using only the processes **(A*, B*, ℓ*)** it is possible to build up a core-process for each of the finished goods that are produced (i.e., the first h), then there is a non-negative matrix **H**(g) such that matrix **H**(g)**B***(**I,** 0)^T equals the hxh identity matrix and the last n−h columns of the matrix **H**(g) [**B***−(1+g)**A***] are zero. If g≤r:

$$\mathbf{H}(g)[\mathbf{B}^* - (1+g)\mathbf{A}^*]\hat{\mathbf{y}} = \mathbf{H}(g)\boldsymbol{\ell} + (r-g)\mathbf{H}(g)\mathbf{A}^*\hat{\mathbf{y}} > 0. \tag{7}$$

In fact **H**(g)**ℓ**>0 since Assumption 3 holds. Hence, because of a known theorem (cf., for instance, Kurz and Salvadori 1995:510–11, Theorem A.3.1) the square matrix $\mathbf{H}(g)[\mathbf{B}^* - (1+g)\mathbf{A}^*](\mathbf{I},\mathbf{0})^T$ is invertible and its inverse is semipositive. Therefore, whatever is g≤r and whatever are the first h non-negative entries of vector c, the others being nought, there is a non-negative vector $\hat{\mathbf{x}}$ such that:

$$\hat{\mathbf{x}}^T[\mathbf{B}^* - (1+g)\mathbf{A}^*] = \mathbf{c}^T.$$

Indeed:

$$\hat{\mathbf{x}}^T = \hat{\mathbf{c}}^T\{\mathbf{H}(g)[\mathbf{B}^* - (1+g)\mathbf{A}^*](\mathbf{I},\mathbf{0})^T\}^{-1}\mathbf{H}(g) \geqq \mathbf{0}^T,$$

where $\hat{\mathbf{c}}$ is obtained from c by eliminating the last n−h entries. Finally, let **x*** be the z-vector obtained by augmenting vector $\hat{\mathbf{x}}$ with zeros, and let $w^* = (\mathbf{f}^T\hat{\mathbf{y}})^{-1}$ and $\mathbf{p}^* = w^*\hat{\mathbf{y}}$. Then it is immediately recognised that **(p*, x*, w*)** is a solution to system (3). Finally obtain from equation (7) that:

$$\mathbf{H}(g)[\mathbf{B}^* - (1+g)\mathbf{A}^*](\mathbf{I},\mathbf{0})^T\bar{\mathbf{y}} = \mathbf{H}(g)\boldsymbol{\ell} + (r-g)\mathbf{H}(g)\mathbf{A}^*\hat{\mathbf{y}},$$

where $\bar{\mathbf{y}}$ is obtained from ŷ by eliminating the last n−h entries. This is enough to prove that $\bar{\mathbf{y}} > \mathbf{0}$.

Q.E.D.

Lemma 2 If Assumption 3* holds, the square matrix **H**(g)[**B***− (1+g)**A***](**I,** 0)^T mentioned in the proof of Theorem 1 is invertible and its inverse is semipositive.

Proof Let $\varepsilon > 0$ be not larger than 1+g and so small that $\mathbf{e}^T\mathbf{H}(g)(\mathbf{B}^* - \varepsilon\mathbf{A}^*)(\mathbf{I},\mathbf{0})^T > \mathbf{0}^T$ where e is the sum vector (note that

$\mathbf{e}^{\mathrm{T}}\mathbf{H}(g)\mathbf{B}^{*}(\mathbf{I},0)^{\mathrm{T}} = \mathbf{e}^{\mathrm{T}}$). Hence, because of the same known theorem mentioned in the proof of Theorem 1 the square matrix $\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}$ is invertible and its inverse is semipositive. If $\varepsilon = 1 + g$, the Lemma is proved. If $\varepsilon < 1 + g$ the last n−m columns of matrix H(g)($\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*}$) are non-negative. Moreover, if h<m, $\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})\mathbf{e}_j \approx 0 (j = h+1, h+2, \ldots, m)$. Hence, whatever is i:

$$\mathbf{e}_i^{\mathrm{T}}[\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*}) \geqq \mathbf{0}^{\mathrm{T}},$$

And since:

$$\mathbf{e}_i^{\mathrm{T}}[\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g) \geq \mathbf{0}^{\mathrm{T}},$$

Assumption 3* implies that [$\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g)\boldsymbol{\ell}^{*} > \mathbf{0}$, which will be used soon. Since the last n−h columns of matrix $\mathbf{H}(g)[\mathbf{B}^{*} - (1+g)\mathbf{A}^{*}]$ are nought,

$$\mathrm{H}(g)[\mathrm{B}^{*} - (1+g)\mathrm{A}^{*}](\mathrm{I},0)^{\mathrm{T}}\bar{\mathrm{y}} = \mathrm{H}(g)[\mathrm{B}^{*} - (1+g)\mathrm{A}^{*}]\hat{\mathrm{y}} = \mathbf{H}(g)\boldsymbol{\ell} + (r-g)\mathrm{H}(g)\mathrm{A}^{*}\hat{\mathrm{y}},$$

where $\bar{\mathbf{y}}$ is obtained from ŷ by eliminating the last n−h entries. Then, if g≤r:

$$\mathbf{H}(g)[\mathbf{B}^{*} - (1+g)\mathbf{A}^{*}](\mathbf{I},0)^{\mathrm{T}}\bar{\mathbf{y}} \geqq \mathbf{H}(g)\boldsymbol{\ell}.$$

From which it is immediately recognised that:

$$\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}\bar{\mathbf{y}} \geqq \mathbf{H}(g)\boldsymbol{\ell}^{*} + (1+g-\varepsilon)\mathbf{H}(g)\mathbf{A}^{*}(\mathbf{I},0)^{\mathrm{T}}\bar{\mathbf{y}},$$

and therefore:

$$\{\mathbf{I} - (1+g-\varepsilon)[\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g)\mathbf{A}^{*}(\mathbf{I},0)^{\mathrm{T}}\}\bar{\mathbf{y}} \geqq$$
$$[\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g)\boldsymbol{\ell}^{*} > 0.$$

Hence, because of the known theorem mentioned in the proof of Theorem 1 the square matrix:

$$\{\mathbf{I} - (1+g-\varepsilon)[\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathbf{A}^{*})(\mathbf{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g)\mathbf{A}^{*}(\mathbf{I},0)^{\mathrm{T}}\}$$

is invertible and its inverse is semipositive. Finally, the Lemma follows from the fact that:

$$\mathrm{H}(g)[\mathrm{B}^{*} - (1+g)\mathrm{A}^{*}](\mathrm{I},0)^{\mathrm{T}}$$
$$= \{\mathbf{H}(g)(\mathrm{B}^{*} - \varepsilon\mathrm{A}^{*})(\mathrm{I},0)^{\mathrm{T}}\}\{\mathbf{I} - (1+g-\varepsilon)[\mathbf{H}(g)(\mathbf{B}^{*} - \varepsilon\mathrm{A}^{*})(\mathrm{I},0)^{\mathrm{T}}]^{-1}\mathbf{H}(g)\mathrm{A}^{*}(\mathrm{I},0)^{\mathrm{T}}\}$$

Q.E.D.

Q.E.D.

Uniqueness

It is also possible to prove that if system (3) has more than one solution, then the prices of produced commodities and the wage rate are common to all solutions. More precisely, the following will be proved:

Theorem 2 Let **(p*, x*, w*)** and **(p′*, x′*, w′*)** be two solutions to system (3), then:

(i) the processes which are operated with one solution do not incur extra costs at the prices and wage rate of the other solution;
(ii) w*=w′*, and the elements of vectors **p*** and **p′*** which correspond to commodities that are produced with at least one of the two solutions are equal;
(iii) $(\lambda p^*+(1-\lambda)p'^*, x^*, w^*)$, with $0\leq\lambda\leq1$, is also a solution to system (3).

Proof Since Theorem 1 holds, generality is not lost if we assume g=r and c=f=a. Both vectors **x*** and **x′*** are solutions to the primal of the following pair of dual Linear Programs and both vectors$(1/w^*)\mathbf{p}^*$ and $(1/w'^*)p'^*$ are solutions to the dual of the same following pair of dual Linear Programs:

(primal)		(dual)	
Min	$q^T\ell$	Max	a^Ty
s. to	$q^T[B-(1+r)A]\geqq a^T$	s. to	$[B-(1+r)A]y\leqq\ell$
	$q\geqq0.$		$y\geqq0.$

Therefore:

$x'^{*T}[\mathbf{B}-(1+r)\mathbf{A}]p^*=w^*x'^{*T}\ell,$
$x'^{*T}[\mathbf{B}-(1+r)\mathbf{A}]p'=w'^*x^{*T}\ell,$

This proves statement (i) and the statement that:

$$(\lambda\mathbf{p}^*+(1-\lambda)\mathbf{p}'^*, \mathbf{x}^*, \lambda w^*+(1-\lambda)\mathbf{w}'^*),$$

with $0\leq\lambda\leq1$, is also a solution to system (3) with g=r and **c=f=a**. Hence in order to prove statement (iii) we just need to prove statement (ii). Let the processes **(A*, B*, ℓ*)** be the processes corresponding to those weak inequalities (3a) which are actually solved as equalities when w=w* and **p=p***. Since statement (i) holds, for each finished good produced with at least one solution we can choose a set of processes among processes **(A*, B*, ℓ*)** which can determine a core process for that finished good and we can also make these choices by involving either all processes corresponding to positive entries of vector **x*** or all processes corresponding to positive entries of vector **x′***. Let us call the processes corresponding to the first choice **(F*, G*, m*)** and the processes corresponding to the second choice **(F′*, G′*, m′*)** In order to simplify the notation let us delete all columns of matrices **F*, G*, F′*,** and **G′*** corresponding to commodities that are not

produced with at least one of the two solutions to system (3). Using a procedure used in the proof of Theorem 1 we can find non-negative matrices **H**(r) and **H′**(r) such that:

$$\mathbf{H}(r)[\mathbf{G}^* - (1+r)\mathbf{F}^*](\mathbf{I},\mathbf{0})^T\hat{\mathbf{p}}^* = w^*\mathbf{H}(r)\mathbf{m}^*,$$

$$\mathbf{H}'(r)[\mathbf{G}'^* - (1+r)\mathbf{F}'^*](\mathbf{I},\mathbf{0})^T\hat{\mathbf{p}}'^* = w'^*\mathbf{H}'(r)\mathbf{m}'^*,$$

$$\mathbf{H}(r)[\mathbf{G}^* - (1+r)\mathbf{F}^*](\mathbf{I},\mathbf{0})^T\hat{\mathbf{p}}'^* \leqq w'^*\mathbf{H}'(r)\mathbf{m}^*,$$

$$\mathbf{H}'(r)[\mathbf{G}'^* - (1+r)\mathbf{F}'^*](\mathbf{I},\mathbf{0})^T\hat{\mathbf{p}}^* \leqq w^*\mathbf{H}'(r)\mathbf{m}'^*,$$

$$\{\mathbf{H}(r)[\mathbf{G}^* - (1+r)\mathbf{F}^*](\mathbf{I},\mathbf{0})^T\}^{-1} \geq \mathbf{0},$$

$$\{\mathbf{H}(r)[\mathbf{G}^* - (1+r)\mathbf{F}^*](\mathbf{I},\mathbf{0})^T\}^{-1} \geq \mathbf{0},$$

where $\hat{\mathbf{p}}^*$ and $\hat{\mathbf{p}}'^*$ are vectors obtained by deleting the elements of vectors **p*** and **p′*** corresponding to all old machines and to finished goods that are not produced with both solutions to system (3). As a consequence:

$$w^*\hat{\mathbf{p}}'^* \leqq w'^*\hat{\mathbf{p}}^* \leqq w^*\hat{\mathbf{p}}'^*.$$

Taking account that $\hat{\mathbf{a}}^T\hat{\mathbf{p}}^* = \hat{\mathbf{a}}^T\hat{\mathbf{p}}'^* = 1$, where $\hat{\mathbf{a}}$ is a vector obtained by deleting the elements of vector a corresponding to all old machines and to finished goods that are not produced we obtain first that $w^* \leq w'^* \leq w^*$, i.e. $w^* = w'^*$ and as a consequence that $\hat{\mathbf{p}}'^* \leqq \hat{\mathbf{p}}^* \leqq \hat{\mathbf{p}}'^*$, i.e. the prices of finished goods that are produced in at least one of the two solutions are the same in both solutions, $\hat{\mathbf{p}}'^* = \hat{\mathbf{p}}^*$. To complete the proof we need to prove that the prices of old machines that are produced with at least one of the two solutions are equal. This is an immediate consequence of statement (i) and the following Lemma 3.

Q.E.D.

Lemma 3 If the profit rate, the wage rate, and the prices of finished goods are given and able to satisfy the equation among prices (including wage rate and rate of profit) implied by an operated core-process, then the equations among prices implied by the operation of the processes that determine that core-process determine uniquely the prices of the involved old machines.

Proof Let **(F, G, m)** be the processes among those which determine that core-process which produce an old machine (i.e. the process using the oldest machine as an input is excluded). In order to simplify the notation let us delete all columns of matrices **F** and **G** corresponding to old machines which are not produced. Then:

$$\mathbf{G}_1\hat{\mathbf{p}} + \mathbf{G}_2\bar{\mathbf{p}} = (1+r)(\mathbf{F}_1\hat{\mathbf{p}} + \mathbf{F}_2\bar{\mathbf{p}}) + w\mathbf{m},$$

where matrix $\mathbf{G}_1(\mathbf{F}_1)$ consists of the columns of matrix **G(F)** corresponding to finished goods, matrix $\mathbf{G}_2(\mathbf{F}_2)$ consists of the columns of matrix **G(F)** corresponding to the old machines whose prices are to be determined, $\hat{\mathbf{p}}$ is the vector of the prices of finished

goods, $\bar{\mathbf{p}}$ is the (unknown) vector of the prices of the old machines, r is the rate of profit and w is the wage rate. It is immediately checked that by an interchange of the rows of matrices **F** and **G** and vector m we can obtain that $\mathbf{G}_2=\mathbf{I}$ and matrix $\mathbf{F}_2$ is a matrix all of whose elements are zero except those on the diagonal just below the main one which equal 1. Hence matrix $[\mathbf{G}_2-(1+r)\mathbf{F}_2]$ is invertible.

Q.E.D.

The wage frontier

Finally it is also possible to prove that provided that the numeraire consists of produced finished goods only, the wage rate is a decreasing function of the rate of profit. More precisely, it will be proved the following.

Theorem 3 Let **(p*, x*, w*)** be a solution to system (3) for **r=r*** and let **(p**, x**, w**)** be a solution to system (3) for **r=r**<r*,** then **w**>w***.

Proof Let the processes **(A*, B*, ℓ*)** be the processes corresponding to those weak inequalities (3a) which are actually solved as equalities when **r=r*, w=w*** and **p=p***. Let s be the number of such processes and let finished goods be ordered in such a way that the first h of them are those produced with solution **(p*, x*, w*)**. From inequalities (3a) we obtain:

$$[\mathbf{B}^s-(1+r^s)\mathbf{A}^s]\mathbf{p}^{**}+(r^*-r^{**})\mathbf{A}^s\mathbf{p}^{**}\geqq w^{**}\boldsymbol{\ell}^s. \tag{8}$$

Using a procedure used in the proof of Theorem 1 we can find a non-negative hxs matrix **H*(r*)** such that the last n−h columns of matrix $\mathbf{H}^*(r^*)[\mathbf{B}^*-(1+r^*)\mathbf{A}^*]$ equal zero, and:

$$\{\mathbf{H}^s(r^*)[\mathbf{B}^s-(1+r^s)\mathbf{A}^s](\mathbf{I},0)^{\mathrm{T}}\}^{-1}\geq 0,$$

$$\frac{1}{\hat{\mathbf{f}}^{\mathrm{T}}\{\mathbf{H}^s(r^*)[\mathbf{B}^s-(1+r^*)\mathbf{A}^*](\mathbf{I},0)^{\mathrm{T}}\}^{-1}\mathbf{H}^s(r^*)\boldsymbol{\ell}^s}=w^s,$$

where $\hat{\mathbf{f}}$ is obtained by the first h entries of vector **f** (the eliminated entries being nought). Then we obtain from inequality (8) that:

$$1+(r^s-r^{**})\hat{\mathbf{f}}^{\mathrm{T}}\{\mathbf{H}^s(r^s)[\mathbf{B}^s-(1+r^s)\mathbf{A}^s](\mathbf{I},0)^{\mathrm{T}}\}^{-1}\mathbf{H}^s(r^s)\mathbf{A}^s\mathbf{p}^{**}\leq\frac{w^{**}}{w^s}.$$

To prove the Theorem we just need to show that:

$$(r^s-r^{**})\hat{\mathbf{f}}^{\mathrm{T}}\{\mathbf{H}^s(r^s)[\mathbf{B}^s-(1+r^s)\mathbf{A}^s](\mathbf{I},0)^{\mathrm{T}}\}^{-1}\mathbf{H}^s(r^s)\mathbf{A}^s\mathbf{p}^{**}>0.$$

Since Assumption 1 and Axiom (iv) of Assumption 4 hold, whatever is the net product at least one of the finished goods produced with solution **(p*, x*, w*)** is used as an input and therefore at least one of the first h entries of the vector:

$$\hat{\mathbf{f}}^{\mathrm{T}}\{\mathbf{H}^s(r^*)[\mathbf{B}^*-(1+r^*)\mathbf{A}^*](\mathbf{I},0)^{\mathrm{T}}\}^{-1}\mathbf{H}^*(r^*)\mathbf{A}^*$$

is positive. Then the Theorem is proved since all finished goods which are produced with solution **(p*, x*, w*)** have positive prices with solution **(p**, x**, w**)**. This is so since Theorem 1 holds, **r**<r*** and:

$$r^* \in \{r \in \mathbb{R} | \exists \mathbf{z} : \mathbf{z} \geqq \mathbf{0}, \mathbf{z}^T[\mathbf{B} - (1+r)\mathbf{A}] \geqq \mathbf{a}^{*T}\},$$

where **a*** is a vector whose components referring to finished goods produced with solution **(p*, x*, w*)** equal 1, all the others being nought.

Q.E.D

Conclusion

In this paper we have explored a model with transferable used machines. We have shown that if the depreciation of the transferable machines is independent of the sector in which the machines are used, then all good properties found when old machines are not transferable hold.

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Notes

1 The following conventions for vector inequalities are used: $\mathbf{x} \geqq \mathbf{y}$ if $(\forall j)\mathbf{x}^T\mathbf{e}_j \geq \mathbf{y}^T\mathbf{e}_j, \mathbf{x} \geq \mathbf{y}$ if $(\mathbf{x} \geq \mathbf{0}, \mathbf{x}^T(\mathbf{B} - \mathbf{A}) \geqq \mathbf{0}^T \Rightarrow \mathbf{x}^T\boldsymbol{\ell} > 0$, and $x \neq y$, and $x > y$ if $(\forall j)\, \mathbf{x}^T\mathbf{e}_j > \mathbf{y}^T\mathbf{e}_j$, where e_j is the j-th unit vector. If $\mathbf{x} \geqq \mathbf{0} (\mathbf{x} \geq \mathbf{0}, \mathbf{x} > \mathbf{0}), \mathbf{x}$ will be said to be non-negative (semipositive, positive).

2 It is possible to prove that if **B=I,** Assumption 3* holds if and only if $(\mathbf{I}+\mathbf{A}+\mathbf{A}^2+\ldots+\mathbf{A}^{n-1})\boldsymbol{\ell}>0$ where **I** and **A** are nxn. Note that Assumption 3* is more restrictive than the more usual

*Assumption 3*** Labour is indispensable for the reproduction of commodities, i.e.

$$(\mathbf{x} \geq \mathbf{0}, \mathbf{x}^T(\mathbf{B} - \mathbf{A}) \geqq \mathbf{0}^T \Rightarrow \mathbf{x}^T\boldsymbol{\ell} > 0.$$

In fact, if $\mathbf{B=I}$, $\mathbf{A=ee^T}$, $\boldsymbol{\ell=0}$, where **e** is the sum vector, Assumption 3** holds, whereas Assumption 3* does not.

3 The unit level of processes which neither produce old machines nor utilise them will be chosen in such a way that the output coefficients referring to the produced finished good equal 1.

4 Since the processes $\bar{\mathbf{A}}_i, \bar{\mathbf{B}}_i, \bar{\boldsymbol{\ell}}_i$ do not produce commodity j and the processes $\bar{\mathbf{A}}_j, \bar{\mathbf{B}}_j, \bar{\boldsymbol{\ell}}_j$ do not produce commodity i, $\bar{\mathbf{B}}_i\mathbf{e}_j = \bar{\mathbf{B}}_j\mathbf{e}_i = \mathbf{0}$. As a consequence $\bar{\mathbf{B}}_j\mathbf{e}_j - \mathbf{k}_s\mathbf{e}_s^T\bar{\mathbf{B}}_j\mathbf{e}_j = \bar{\mathbf{B}}_i\mathbf{e}_i - \mathbf{k}_s\mathbf{e}_s^T\bar{\mathbf{B}}_i\mathbf{e}_i = \mathbf{0}$. Thus, since $\bar{\mathbf{B}}_i\mathbf{e}_i > \mathbf{0}$ and $\bar{\mathbf{B}}_j\mathbf{e}_j > \mathbf{0}, \mathbf{k}_s = (\mathbf{e}_s^T\bar{\mathbf{B}}_j\mathbf{e}_j)^{-1}\bar{\mathbf{B}}_j\mathbf{e}_j = (\mathbf{e}_s^T\bar{\mathbf{B}}_i\mathbf{e}_i)^{-1}\bar{\mathbf{B}}_i\mathbf{e}_i$, which implies also that $\bar{\mathbf{B}}_j\mathbf{e}_j$ is proportional to B_ie_i.

5 If we followed the direct approach to the problem of the choice of technique (cf. Kurz and Salvador! 1995: Chs 5, 7, 8, 9), an obvious consequence of Lemma 1 is that if the same type of machine is used in the production of two or more finished goods in a (square) cost-minimising technique, then more than one (square) technique is cost-minimising, that is, each point on the wage frontier is a switch point. In order to understand this let us consider that only one of these commodities is consumed and produced, then there is no process producing the others in the (square) cost-min-imising technique. If one of the others is consumed in a small amount, a process producing it must be operated, and this process can be any one of those which can be operated: one for each feasible age of the machine. Then we have T+1 (square) cost-minimising techniques, where T is the maximum age of that machine in those techniques: in each (square) cost-minimising technique T+1 processes produce the first finished good and one process produces the second finished good. A change in the proportions in which the two commodities are consumed and therefore produced may lead to the condition in which s processes producing the first finished good and T+2−s processes producing the second finished good must be operated in a (square) cost-minimising technique. In this case the number of cost-minimising techniques is (T+1)!/(T+1−s)!(s−1)!.

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15
Vertical integration and ‘reduction to dated quantities of labour’

Ian Steedman

In Chapter VI of *Production of Commodities by Means of Commodities* Sraffa considered prices ‘from their cost-of-production aspect’ and examined ‘the way in which they “resolve themselves” into wages and profits’ (1960:34). At other points in the same work he employed the concept of a ‘Sub-System’ (section 14 and Appendix A). Our simple purpose here is to bring these two sets of ideas together by applying the ‘dated labour’ type of analysis to a price and distribution system which has already been vertically integrated and to suggest that, in some respects at least, such an analysis is even more fruitful in such a context than in Sraffa’s original application of it to a ‘direct’, or unintegrated system. (See Kurz and Salvadori 1995: ch. 6, for a helpful discussion of’Alternative descriptions of a technique’; at p. 175 they propose the name ‘reduction to dated quantities of *embodied* labour’ for the approach adopted below. See also Pasinetti 1973: section 10; Schefold 1976: section 1.)

Consider then a square production system, involving only circulating capital and single products, in which the rate of profit is uniform and in which labour may be treated as homogeneous because relative wage rates are invariant. In an obvious notation, the vertically integrated system of price equations, with the Standard Commodity taken as the standard of value, may be written as:

$$p = \left[\frac{R-r}{R}\right] v + rpH \qquad (1)$$

It will be convenient to define scalar $\rho \equiv (r/R)$ and matrix $J \equiv RH$ and then to rewrite (1) as:

$$p=(1-\rho)(v+\rho vJ+\rho^2 vJ^2+\ldots) \qquad (2)$$

where $0 \leq \rho < 1$.

The $(1-\rho)\rho^n$ terms

Following the lead given by Sraffa (1960, section 47), we may now focus our attention on the way in which the various terms $(1-\rho)\rho^n$ change with ρ and hence vary in their relative magnitudes.

The first term, $(1-\rho)$, it need hardly be said, simply falls throughout as ρ rises from zero. The second term, $(1-\rho)\rho$, has an inverted parabola as its graphical representation, being zero at both $\rho=0$ and $\rho=1$ and having a maximum value of 1/4 at $\rho=1/2$. (It is convenient here to refer to the case $\rho=1$ even though it does not apply to (2).)

The third term, $(1-\rho)\rho^2$, is more like the remaining terms, for higher n, in that its first derivative is zero at $\rho=0$. More specifically, that first derivative is $(2\rho-3\rho^2)$ and is thus zero at both $\rho=0$ and $\rho=2/3$. The maximum value of this third term is thus 4/27; note that it is much smaller than the maximum value of the second term. The second derivative of the third term is $(2-6\rho)$ and is thus zero at $\rho=1/3$; the value of the term at this point is 2/27.

The remaining terms may be treated generically, as $(1-\rho)\rho^n$ for $n\geq 3$. The first derivative is $\rho^{n-1}\,[n-(n+1)\rho]$ and is clearly zero both when $\rho=0$ and when $\rho=(n/n+1)$. At this latter point the term takes its maximum value of $[n^n/(n+l)^{n+1}]$, which tends to zero as n increases without limit. The second derivative of the generic term is $n\rho^{n-2}[(n-1)-(n+1)\rho]$ and is thus zero both at $\rho=0$ and at $\rho=(n-1/n+1)$. The value of the generic term at this latter inflexion point is $[2(n-1)^n(n+1)^{-(n+1)}]$, which tends to zero as n increases without limit. And the ratio of this 'inflexion value' to the 'maximum value' is $2[(n-1)/n]^n$, which tends to (2/e) as n increases without limit.

Figure 15.1 shows how $(1-\rho)\rho^n$ varies with ρ for n=0,l,2 and 5. It will be immediately obvious how strongly the first term, $(1-\rho)$, dominates the other terms for small ρ. Since $(1-\rho)(1+\rho+\rho^2+\ldots)=1$ $(0\leq\rho<1)$ we see indeed that for any $0\leq\rho<1/2$, the first term *alone* is greater than the *sum* of all the remaining terms. Similarly, the sum of the first *two* terms—$[(1-\rho)+(1-\rho)\rho=1-\rho^2]$—is greater than the *sum* of all the remaining terms for $0\leq\rho<0.707$. Since, for 'practical' purposes, one is interested only in relatively low values of ρ, it is certainly only the very early terms in the series $(1-\rho)\rho^n$ which are important.

The labour vectors

In (2) it is not, of course, only the $[(1-\rho)\rho^n]$ terms which influence relative prices and the fact that those terms decrease rapidly as n increases (for small ρ) would be less significant if the labour vectors which they multiply—the vJ^n—were to increase rapidly in magnitude as n increases. Hence the *norm* of matrix J is important here. By the definition of J, its Perron-Frobenius root is unity. If, by chance, H and hence J should happen to be normal matrices (whether diagonal or otherwise), it would then follow at once that $(vJ^n.J^{nt}v^t)\leq(vv^t)$, where t denotes transposition. Hence *no* vector $v\mathbf{J}^n$, for n=1, 2,…, would be of greater Euclidean length than v and the decrease in $[(1-\rho)\rho^n]$ with n would certainly not be counteracted by any tendency for the vectors vJ^n to increase in magnitude with n. More generally, we can of course say that there will be no such

tendency provided that every matrix J^n has a norm of unity or less—but this is merely true by definition and we

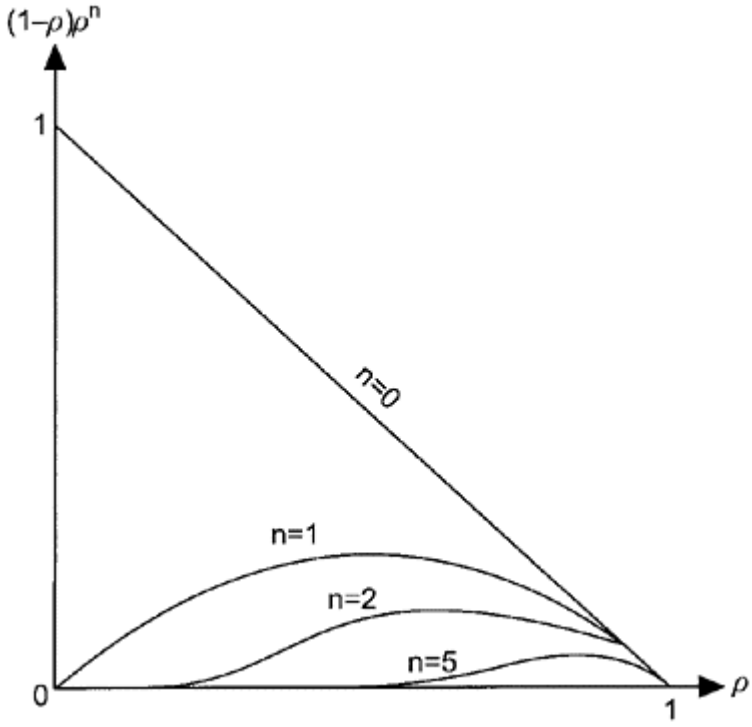

Figure 15.1

shall not attempt here to characterize the conditions on H under which this requirement will be met.

Comparison with Sraffa's reduction

We may now compare the reduction presented in (2) above with that derived by Sraffa from a 'direct' (as opposed to a 'vertically integrated') price and distribution schema; in an obvious notation, let us write Sraffa's direct reduction as:

$$p = \left[\frac{R - r}{R}\right][\ell + (1 + r)\ell A + (1 + r)^2 \ell A^2 + \cdots] \qquad (3)$$

(a) We note first that Figure 15.1 is qualitatively different from Sraffa's corresponding Figure 2 (1960:36) in one significant respect. With respect to his diagram, relating to a direct reduction, Sraffa wrote: 'With the rise of the rate of profits, terms divide into two

groups; those that correspond to labour done in a more recent past, which begin at once to fall in value and fall steadily throughout; and those representing labour more remote in time, which at first rise and then, as each of them reaches its maximum value, turn and begin the downward movement' (1960:36). And he went on to point out that the former group consists of those terms for which $nR \leq 1$ (p. 37). By contrast, in Figure 15.1 there is just *one* term which falls throughout as ρ increases, that for n=0, and the value of R is quite irrelevant to the distinction between 'always falling' and 'non-monotonic' terms.

(b) Commenting on his own version of our (3) above, Sraffa observed that: 'How far the reduction need be pushed in order to obtain a given degree of approximation depends on the level of the rate of profits: the nearer the latter is to its maximum, the further must the reduction be carried' (1960:35). This observation would be equally correct if made of our reduction equation (2). But notice how *different* may be the extent to which the reductions (2) and (3) need to be 'pushed' to achieve a given 'degree of approximation'. Consider first the extreme—but important—case of $r=\rho=0$. In this case (2) gives the exact result (not an approximation) in its first term alone; by contrast, (3) may require many terms even to give a reasonable approximation to the exact result. This great superiority of the vertically integrated reduction of course reflects the fact that, as Sraffa put it in his Appendix A, 'in the sub-system we see at a glance, as an aggregate, the same quantity of labour that we obtain as the sum of a series of terms when we trace back the successive stages of the production of the commodity (ch. VI)'. At the other extreme, as r approaches R and ρ approaches unity, both reductions (2) and (3) become unhelpful, needing to be 'pushed' very far to produce useful approximations, and it is arguably better not to use *any* labour-reduction approach in this case.

What may be said of the most important case, that of small but positive values of r and ρ? In broad terms, it is clearly the case that reduction (2) will not need to be 'pushed' nearly as far as reduction (3), simply because vector p will not be very different from vector v. To give a precise response, however, it would be necessary both to decide whether the 'approximation' should refer to a particular price or to the price vector as a whole and, in either case, to specify a sensible measure of the 'degree of approximation'. This done, one could study how the number of terms required in (2) compared with that in (3) for a given value of r and a given 'degree of approximation'. Whether the result of such a study would be significantly more illuminating than the above statement in 'broad terms' may well be doubted, however, and we let the matter rest.

(c) Always with reference to his own direct reduction (1960: ch. VI), Sraffa made the following remarks: (i) 'this method [of Reduction] seems totally inapplicable to the case of joint-products' (1960:56); (ii) 'there is no equivalent in the case of joint-products to the alternative method, namely Reduction to a series of dated labour terms. In effect it is of the essence of such a Reduction that each commodity should be produced separately and by only one industry' (p. 58); (iii) 'The equations for fixed capital make it easy to see how an attempt to effect the "reduction" of a durable instrument to a series of dated quantities of labour will in general fail…we are engaged in a blind alley' (p. 67). Now it is not immediately evident that these remarks could legitimately be transferred in their application from (3) to (2) above. In at least some cases, a square jointproducts system can be vertically integrated to yield our equation (1) with v strictly positive and H such that the Perron-Frobenius theorems all hold good. What could then be the objection, in such cases, to our reduction (2)? More generally, almost all square joint-products systems

can be written in the form (1), the 'complication' being that v and/or H may contain negative elements. But this is not, *in itself*, an obstacle to performing the reduction (2); suppose, for example, that H^n tends to zero as n increases without limit, notwithstanding the presence of negative entries in H. And note that Sraffa himself seems to have accepted the legitimacy of negative terms in a reduction since, with reference to fixed capital, he remarked that, 'the "reduction" to dated labour terms, some positive and some negative, would become possible if the annual product were to *increase* with age' (1960:68). It follows then that the vertically integrated reduction (2) is of considerably wider application than is the direct reduction (3).

Concluding remarks

The vertically integrated reduction approach cannot be applied to all cases of interest. But it certainly can be applied whenever the direct reduction approach can be used—and indeed can be applied in many cases in which the direct approach is unusable. Nor is the greater generality of the vertically integrated reduction obtained at the cost of greater complexity. Quite the contrary. It generates a much simpler pattern of monotonically falling terms and non-monotonic terms. And it requires far fewer terms to give an acceptable approximation, at least in the most relevant case of small rates of profit. The 'reduction to dated quantities of labour' approach is thus better applied in its vertically integrated form.

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Part V
The surplus approach and economic policy

16
High public debt and inflation

On the ‘disciplinary’ view of European Monetary Union

Massimo Pivetti

I

It is my view that the European project for arriving at economic and monetary union (EMU) should be regarded as the combined result of a radical change, since the late 1970s, in the principal economic policy objective of the major industrial countries—an epoch-making shift in emphasis away from underployment and poverty to the objective of reducing inflation; and of the theoretical restoration that has occurred over the last twenty years, with the revival of pre-Keynesian conceptions in macroeconomic thinking. This view, which I have discussed elsewhere (Pivetti 1993), makes it reasonable to believe also that the project’s fortunes will reflect developments in these two ambits. Specifically, one can sensibly expect the EMU project to be definitively abandoned as soon as the social impact of actual unemployment will again make the pursuit of its reduction each government’s main focus of concern, at the same time leading to a widespread rejection of the ‘natural’ rate concept of the economy.

This process of gradual abandonment of the project, however, is likely to be delayed as regards countries in which EMU is seen as a means of solving a ‘commitment problem’ in their national economic policies—an irreplaceable source of discipline, that is to say, with respect to inflation, government budget deficits and government debt. An interesting case in point is that represented by Italy, the European country in which, according to ‘Eurobarometer surveys’, EMU appears to have received the strongest and largest support—by official circles and academic opinion, as well as by the business sector, trade unions and political parties.

American and Italian economists have been by far the most prolific contributors to the enormous amount of literature on the European Monetary System (EMS) and the EMU project of the last fifteen years. Interest, as well as support, by many American authors can be readily explained in the light of the theoretical underpinnings of the project—by its being a straightforward application to an international monetary regime of a few state-of-the-art macroeconomic concepts and propositions. Somewhat more puzzling is that Italian academic and official circles have revealed themselves to be more strongly positive towards EMU than the same circles in any other European nation. The fact that many Italian economists were trained in the USA in the 1970s and 1980s probably helps to explain their disposition to take certain mainstream contributions in the field of

monetary ‘regimes’ (such as work on time consistency and credibility) very seriously; their formation as professional economists may have made them more inclined to yield to the theoretical wind than their European counterparts. But the American formation of a significant section of the profession, albeit important, is unlikely to provide the chief explanation of the phenomenon under consideration. So widespread and strong has been support for EMU on the part of the profession in Italy that it must ultimately reflect the fact that both academic and (somewhat paradoxically) official circles have shared with the rest of public opinion a view of inefficiency, corruption and Mafia-type rules as being endemic in the country—as being a component part, so to speak, of the national character. It appears therefore very likely that ‘relinquishing discretionary policy’ and making ‘credible commitments’ (‘borrowing credibility’ from abroad, that is to say, through a ‘commitment’ to follow the policy of some foreign or international central authority; ‘sticking to rules’, enforced from the outside, that bind national policy actions over time) have actually acted as theoretical cosmetics that disguised deeper (unexpressible) aspirations to some form of protectorate.

Be that as it may, relatively high inflation rates and government debt to GDP ratios *have been* significant aspects of Italy’s actual experience over the last twenty years. On this account, the thesis of the disciplinary role of the EMU project may seem plausible at first sight—quite independently of the ‘time consistency’ and ‘credibility’ paraphernalia. It is thus worth examining whether or not evolution of central bank independence and the abolition of all restrictions to capital movements are functional tools to cope with the problems of relatively high inflation and public debt.

Central bank policy independence has actually increased in the Italian case, starting from the ‘divorce’ between the Treasury and the Banca d’ltalia, in 1981, which reduced the scope for accommodating monetary policy by monetary financing of government deficits. At the same time, a process of liberalization of capital movements was started by the Italian authorities in the mid-1980s, and completed in 1990 in agreement with the EEC’s resolution of 24 June 1988.[1] According to the prevailing view, both central bank policy independence and liberalization of capital movements should be regarded as fundamental sources of financial discipline: the former by ruling out debt monetization; the latter by preventing the public sector deficits from being financed at low interest rates.[2] And financial discipline arising from these two sources would in turn eventually resolve itself in lower debt to GDP ratios and lower inflation.

I shall now proceed to discuss the solidity of this view, by focusing in what follows on the implications of the loss of both monetary and fiscal autonomy—consequent upon the abolition of all restrictions on capital movements—for the dynamic of public debt and inflation.

II

With respect to the goal of checking the rise in the ratio of public debt to national income—in the face of interest rates that, since the beginning of the 1980s, have persistently exceeded growth rates—the first and most crucial aspect of financial liberalization concerns its impact on the level of domestic interest rates. Once it is acknowledged that in Italy’s actual conditions interest rates must be higher with full

capital mobility than with capital control, the question then becomes whether one can expect the negative impact of a higher rate of interest on the debt to GDP ratio to be more than compensated by a higher rate of growth of GDP—a higher growth rate than that attainable with capital control.

As is known, the severity of the budgetary stringency required to stabilize (and eventually reduce) the debt/GDP ratio, depends on the difference between the real rate of interest *(r)* and the real rate of growth of GDP *(g)*. Obviously, the debt to GDP ratio rises if the rate of growth of debt *(d)* exceeds *g* i.e. if:

$$\frac{primary\ deficit}{debt} + r > g,$$

since the left-hand side of this expression is equivalent to *d*. It follows that if $r>g$, checking the rise in the debt to GDP ratio requires a primary *surplus*, which will have to be larger the larger the difference between *r* and *g*. Now, what *form* is the required budgetary stringency most likely to take?

A first element to be considered in this respect is the influence exerted by the revaluation of the neoclassical thought that characterizes the theoretical climate. Neoclassical economics and supply-side economics provide important rationales for across-the-board reductions in tax rates to encourage labour supply and saving decisions, and hence unleash an allegedly depressed supply of effort. This stimulus to increased supply and real output is viewed as ultimately depending on reductions in government spending, because these are what can release the resources to be used to finance tax rate reductions. It is then clear that, if stabilization of the debt to GDP ratio requires the formation of primary surpluses, supply-siders *lato sensu*[3] will tend to rely almost entirely on spending reductions, in order to avoid major adverse effects on growth that they claim would result from heavier taxation of capital and other income.

More importantly and directly, however, emphasis on spending reductions tends to be imposed by financial liberalization itself, which, therefore, is bound to affect significantly not only the severity of the budgetary stringency needed to bring about primary surpluses, but also its form. This is because freedom of capital movements forces governments to avoid policies that might lead to capital flight: a more ‘saving friendly’ tax system becomes a must.

III

It is well known that in the area of capital income taxation there are significant differences between the fiscal systems of the various European countries: differences in tax rates, tax bases and the availability of tax relief, as well as in the actual capacity of the various tax authorities to assess investment incomes (cf. Conseil National du Credit 1988; Banca d’ltalia 1989; CEPII OFCE 1990; OECD 1991; Ruding Committee Report 1992, ch. 3). It is also widely acknowledged that, *rebus sic stantibus*, the abolition of all capital controls tends to favour countries with low capital taxation and tight secrecy laws, and results in tax avoidance and evasion becoming major determinants of international capital flows. Their liberalization actually allows ‘corporations to locate in the countries that permit minimization of tax burden, financial intermediaries to locate in low-withholding

tax countries, and individuals to evade capital-income taxes by using the services of intermediaries in tax havens and exploiting the protection of bank secrecy laws' (Giovannini 1989a:367).

The outflow of financial and productive capital from the countries with less competitive tax jurisdictions obviously may create balance of payments difficulties for the national authorities concerned, as well as budgetary difficulties through the erosion of the country's tax base. The problem, as I see it, is that, with full liberalization of international capital flows, there does not seem to be any way for the authorities of any individual country to deal with both types of difficulties. Competition for capital through higher interest rates, to compensate for less competitive taxation, increases the charges for interest in the national budget; efficiency and equity problems clearly arise if the increased interest charges are met by cuts in the provision of public goods and/or higher taxes on labour or consumption. Competition for capital through tax cutting, on the other hand, poses the same efficiency and fiscal equity problems, to the extent that the diminished revenues caused by this 'fiscal competition' are not allowed to result in higher budget deficits.

In principle, with the liberalization of capital markets these balance-of-payments and budgetary problems could be tackled either through harmonization of tax structures across countries, or through an international agreement that succeeded in making it fiscally indifferent which country to invest in, without at the same time having to eliminate all differences in the taxation of capital. But both these solutions meet with serious obstacles and short-comings.

Apart from the sheer difficulty of choosing a satisfactory structure of common tax rates and tax bases and the question of 'the rest of the world',[4] harmonization of capital income taxation within the European Union (EU) would conflict with the sovereign right of individual countries to set taxes differently according to differences in their public goals and/or in economic and social structures that require different fiscal policies to pursue the same goals. EU economies differ widely as to rates of growth of their labour force, real productivity growth and unemployment rates;[5] industrial structures and their exposure to demand and supply shocks;[6] income distribution and the quantity and quality of their public goods; the overall situation of their public finances (see OECD 1992). Once, in the field of capital income taxation, common tax rates and tax bases have been agreed upon, the tax burden of any stabilization effort by this or that country—or of employment-incomes policies requiring an expanded provision of public goods—would have to concentrate on income derived from wages and salaries, contrary to fiscal equity. The point is that budgetary autonomy and the fundamental right of each country to choose the form of taxation of its citizens can hardly be overrated, unless one is inclined to believe that economic and social structures do not 'really differ much across European countries' (Malinvaud 1989:377)—so that policies that are appropriate for any one country are also appropriate for the other member countries; or else the development of a single financial market is mistaken for a decisive movement towards a unified polity.

In order for differences in tax systems between countries not to exert any influence on the choice of which country to invest in, it would be necessary that the residents of any particular member country faced the same effective marginal rate of capital income taxation (reflecting the impact of both tax rates and tax bases), whatever the member country in which they invest. Such 'capital export neutrality' within the EU, in turn,

would require a Union-wide consensus on a system of taxation based on the residence principle, under which capital income 'is taxed at the rate of, and revenue accrues to, the country in which the recipient—personal or corporate—resides' (Keen 1993:27). But though in principle taxes based on this rule could reconcile the free mobility of capital with the freedom of each country to choose the form of taxation of its residents, it is widely recognized that an effective functioning of the residence principle meets with the difficulty of detecting the income earned abroad (see e.g. Grilli 1989:376; Giovannini 1989b:371; Malinvaud 1989:376; Giovannini and Hines 1991; Ceriani 1993; Paladini 1993). Before the liberalization of capital markets, capital controls also served this purpose—in fact, in many cases they were the means by which the tax authorities of a country could detect income earned abroad by its residents (cf. Banca d'ltalia 1989:18–21, 56–7, 65, 74). With the removal of controls and free capital mobility within the EU, assessment of the capital income earned in the other member countries (and of the tax due) by the authorities of the country in which the recipient resides, requires that the following two conditions are met: (1) member countries agree to adopt common bank disclosure requirements with respect to tax authorities—i.e. bank secrecy towards national tax authorities is abolished; (2) a tax enforcement agreement is reached between the member countries, by which data and information obtainable from the banks, and made available to national tax authorities, are systematically exchanged between them.

Between 1977 and 1987, a number of initiatives and recommendations were adopted by international organizations on the issue of bank secrecy and the consequences that it may have as an obstacle to international exchanges of information on tax matters, as well as from the point of view of equity and efficiency of tax collection. Thus a Recommendation on Tax Avoidance and Evasion was adopted in 1977 by the Council of the OECD, and a recommendation on the same subject was adopted in 1978 by the Parliamentary Assembly of the Council of Europe (Recommendation 833). A position similar to that contained in these two recommendations was then taken in 1984 by the United Nations ad Hoc Group of Tax Experts (Guidelines on International Co-operation in Tax Matters), while in 1987 a 'Convention on Mutual Administrative Assistance in Tax Matters' was drafted by the OECD Committee on Fiscal Affairs, in conjunction with the Council of Europe.

The views put forward in these documents found a clear expression in a short report prepared by the OECD Committee on Fiscal Affairs, published in 1987, where the position was stated that bank secrecy should be lifted in the case of tax authorities on account of its 'undesirable consequences':

> Governments are deprived of receipts because tax administrations remain ignorant of a number of transactions;
>
> There is a lack of equity between those tax payers who can and do exploit this particular loophole, and those who cannot—in particular those whose income is derived entirely from wages and salaries—or do not, which distorts the distribution of the tax burden and which may lead to disillusionment with the fairness of the tax system;
>
> International co-operation between tax administrations may be hampered.
>
> (OECD Committee on Fiscal Affairs 1987:109)

In actual fact, however, no steps forward have been made in the following years towards a generally accepted approach to bank secrecy.[7] Quite to the contrary, parallel to the process of liberalization of capital movements, there has been a tendency in recent years towards a general competitive tightening of bank secrecy laws—the Commission of the European Communities itself having changed since 1989 its previous orientation in favour of a relaxation of bank secrecy, in view of the 'serious obstacles' that such relaxation 'would be likely to encounter in those Member States where banking secrecy is a long-standing tradition' (quoted in Grilli 1989:321).[8] But even if this 'long-standing tradition' were eventually broken within the EU—so that a lifting of bank secrecy in the case of tax administrations were generally accepted, and exchange of information procedures agreed upon between the member states—a full application of the residence principle would still require cooperation between the Union and all non-European states. In fact without such cooperation—the feasibility of which is quite hard to conceive—capital controls *vis-à-vis* non-European countries would still be necessary in order to avoid out-flows of capital outside Europe for tax evasion.[9]

In conclusion, consideration of the practical/political difficulties of a system of capital income taxation based on the residence principle, as well as of the shortcomings of harmonization of capital taxation within the EU, leads one to realize that without capital control it is practically impossible to avoid the influence of capital taxation on capital movements—and hence it is impossible to preserve each state's sovereign right to choose its tax system. Indeed, the issue of the enforcement procedures that would have to be agreed upon between the member states, and that of the cooperation that would have to be established also between the Union and all the non-European states, has led to an increasingly wider recognition in the literature that the most fundamental consequence of capital movement liberalization for fiscal systems is a steady decrease in reliance on capital taxes as a primary revenue source.

IV

In Italy, capital income taxation has recently experienced a significant change. Shareholders who renounce their tax credit for the corporation income tax (proportional at a 36 per cent rate) are allowed to stay anonymous and be taxed at a final withholding rate of 12.5 per cent—equal to the rate which applies to interest on public and private bonds. Considering the anonymity appeal and the fact that Italian shareholders are concentrated in the top bracket of rate payers (gross annual incomes over 150 million lire, around 95,000 US dollars), it is reasonable to expect that the great majority of them will opt for the new regime. With this, virtually all income from financial assets will be subject to proportional taxation and excluded from the base of the personal and progressive tax. Now, fear of capital flight and the ensuing tax competition are bound to aggravate in the coming years the problem of personal tax erosion determined by this exclusion. A substantial reduction of the tax rate on deposit interest appears as the next most likely outcome of tax competition,[10] to be followed probably by the reduction of the corporation income tax.

But if, on the other hand, capital movement liberalization forces us to rule out increases in capital taxation, one can hardly think, in the Italian case, of increases in the

tax burden on labour incomes, and on incomes of small firms, as significant sources of primary surpluses.

As to dependent labour income, heavy discrimination against it is already the distinguishing feature of Italy's tax system—so much so that its chief component, the personal and progressive tax (Irpef) has practically become a special tax on dependent labour income. This situation can be traced back to the following: (i) direct taxes on this income are collected at source, under pay-as-you-earn procedures, so that tax evasion on it is absent, at least outside the underground economy; (ii) the massive presence in the Italian economy of independent workers[11] and small unincorporated firms whose incomes are difficult to assess, which has resulted in a compensatory-pivotal role having de-facto been assigned to the direct taxation of dependent labour; (iii) the already-mentioned exclusion of capital incomes from personal and progressive taxation. The ensuing 'horizontal' unfairness can be readily grasped by considering that the final withholding tax rate of 12.5 per cent which applies to interest on bonds (one-third of Italian households' financial assets), is only modestly higher than the minimum tax rate (10 per cent) which, in the Irpef system of steeply rising marginal rates, applies to gross annual labour incomes not higher then 7.2 million lire (about 4,500 US dollars). [12]

In sum, discrimination against dependent labour income has gone so far in Italy as to render any further increase in its direct taxation simply inconceivable. While this is generally recognized, it is often maintained that a significant contribution to the formation of primary surpluses could result from tax base broadening achieved through a drastic reduction of tax evasion on the part of independent workers and small firms. However the steps taken over the last ten years to deal with this issue have hardly been successful (see Guerra 1993), largely owing to persistent strong reliance on self-assessment of gross receipts and the rather limited capabilities of Italian tax officers. (In this respect, it is pertinent to observe that assessment of the effective incomes of self-employed workers and small firms would be greatly facilitated if bond owners and shareholders were not allowed to stay anonymous, as this would render it more difficult to hide the plunder of evasion. But both bond owners and, since 1994, shareholders are allowed to stay anonymous.) The point is that actual overall fiscal discrimination in favour of independent workers and small economic units ultimately reflects the fact that over the last fifty years they have been, and are likely to remain, the chief constituent of any Italian government's electoral base.

It would thus appear that a fiscal policy aimed at substantial increases in total tax receipts would have to rely chiefly on indirect taxation.[13] And, indeed, a certain shift in the tax system from direct to indirect taxation appears most likely to occur, also in the light of the prevailing theoretical climate: on the one hand it is claimed that eliminating capital income taxation would dramatically increase the capital stock (cf. Lucas 1990:14); on the other that 'top rates payers work 10 per cent harder and their marginal product is 2¼ times that of the average man' (Minford and Ashton 1993:38). Large gains in efficiency are thus expected to result from cutting top income tax rates and from greater reliance on sales taxes, relative to income taxes; moreover, increases in consumption taxes are the natural counterpart of a more 'saving friendly' tax system.

But also in the field of indirect taxation there are some serious obstacles that stand in the way of a marked increase. One obstacle may be posed by excise harmonization within the EU, with the projected shift from the 'destination' to the 'origin' principle. A second

obstacle is posed by the impact on inflation, and though the direct impact could not automatically feed back into higher domestic inflation through wage indexation—owing to its abolition and reforms in the wage settlements in 1992 and 1993 (see Banca d'ltalia 1994:59, 99–101)—still heavy reliance on indirect taxation to generate primary surpluses would be clearly in contrast with the objective of eliminating the country's inflation differential. Finally, there are the practical/political difficulties of monitoring VAT evasion, again especially diffused in the vast area of independent labour and small unincorporated firms.

All in all, therefore, once these limitations are taken into consideration, one can reasonably expect that fiscal contractions aimed at the formation of primary surpluses will essentially consist, in the Italian case, in a combination of increases in indirect taxation and public spending reductions, with by far the chief reliance on the latter. Cutting transfers to households (especially pensions) and government purchases of goods and services (health, education, transportation and public housing) is what spending reductions will actually consist in.[14] Considering then also the regressive impact of indirect taxation, it can be concluded that the concrete fiscal action most likely to be taken to generate primary surpluses is especially recessionary in nature, both directly and through its impact on income distribution.

Last but not least, the likelihood of a strictly recessionary policy course is further enhanced by the external constraint—that is, by the necessity to check imports, so as to generate export surpluses at least sufficient to service the external debt and stop it from mounting up. To the extent that full capital mobility forces the authorities to maintain a higher interest rate differential (Figure 16.1) than otherwise would be required—to induce residents to continue financing a high public debt—then also the country's foreign borrowing and overall external indebtedness are necessarily larger than they would be in the presence of capital control. And as external indebtedness keeps on rising as a result of a persistent interest rate differential, its negative impact on the country's current account is also bound to grow, through the outgoing stream of interest; interest payments on the country's external liabilities and the total amount of these liabilities fuel one another, in a vicious circle through which its creditworthiness deteriorates progressively. This is well illustrated by Italy's experience during the 'new EMS', 1987–1992 (cf. Pivetti 1992).

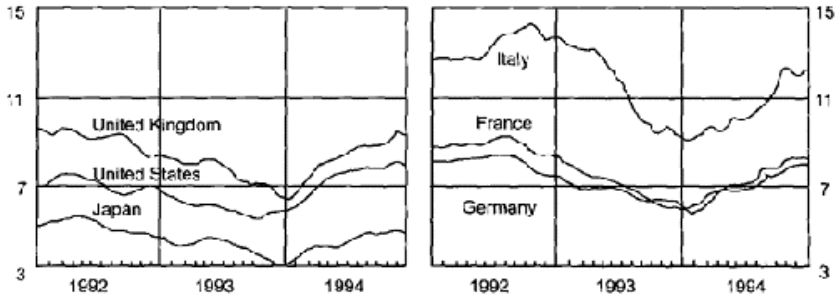

Figure 16.1 Long-term interest rates in six major industrial countries, 1992–94

Source: Banca d'ltalia

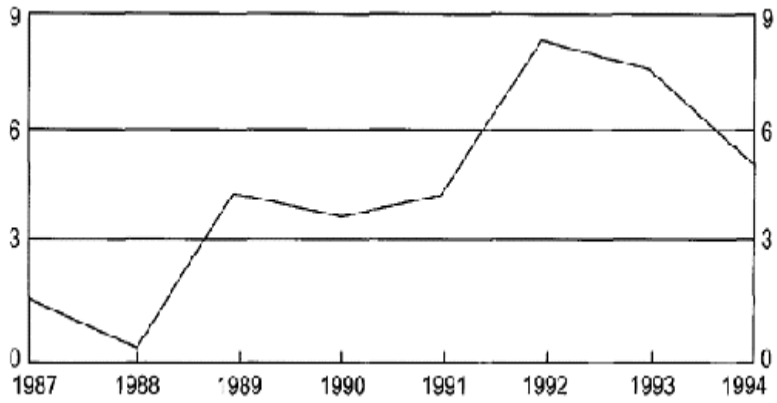

Figure 16.2 Italy's interest rate*-growth rate differential, 1987–94

* Yearly averages of real long-term rates

Both domestic and external constraints, therefore, tend to impose a marked recessionary stance upon fiscal policy. But while the efficacy of this recessionary stance is obvious as far as the formation of current surpluses is concerned, it is far from obvious as to the objective of stabilizing and eventually reducing the public debt to GDP ratio. Indeed, the more recessionary the budgetary stringency that leads to the formation of a given primary surplus, the larger the interest rate-growth rate differential will tend to remain (Figure 16.2)—and hence also the larger the new primary surpluses and fiscal contractions required to compensate for it. Thus in Italy a substantial primary surplus was obtained in 1992, followed by even larger surpluses in 1993 and 1994 (almost four times and two times that of 1992, respectively); the debt to GDP ratio, however, has kept on rising (so that additional restrictive measures are being taken), due to the impact of fiscal contraction on growth: in 1992–94 the annual growth rate of GDP has averaged only 0.7 per cent—with an unprecedented loss of jobs over the same three-year period (Figure 16.3a) notwithstanding a marked rise in exports, prompted by a devaluation of the lira by over 25 per cent from the autumn of 1992 to the end of 1994.[15]

Fiscal policy thus becomes a sort of Penelope's web, whereby what is being done during the day (through the formation of a primary surplus) is undone during the night (through its impact on GDP growth and total tax receipts). The absurdity of this vicious circle, as well as its actual presence in Italy's recent experience, can readily be seen by anyone who, having somewhat resisted the theoretical restoration of the last twenty years, is not too buoyed by it. The still widespread idea that 'severe fiscal contractions can be expansionary' (Giavazzi and Pagano 1990; see also Fratianni 1993:157–9) is perhaps the clearest expression of how far that restoration has gone in keeping invisible what is under everybody's eyes.

V

As mentioned in section I, the disciplinary view of Maastricht and the EMU project includes the issue of Italy's inflation differential. The latter interpretation—in fact, the interpretation of inflation generally—is marked by a substantial discrepancy between mainstream theoretical models on the one hand, with their emphasis on the degree of central bank independence and the credibility of its commitment to price stability, and on the other more applied approaches in which centre stage is occupied by cost behaviour and cost differentials. I shall base what follows on the view that, given the course of labour productivity, a country's inflation differential ultimately depends on the behaviour of three nominal variables: exchange, wage, and interest rates.[16]

The significance of the first two variables as primary sources of the decrease in Italy's inflation rates since 1987 is widely recognized. In 1987 the country's exchange rate policy shifted to more fixed nominal exchange rates, which, from that date to the exchange rate crisis in 1992, checked both imported inflation and the rise in domestic production costs via the disciplinary impact of the new exchange rate policy on industrial relations. The choice to assign the exchange rate tool to the objective of reducing inflation—through the price of imported inputs, as well as the indirect impact on wage costs—was frequently stressed in those years by the Italian monetary authorities (cf. e.g. Banca d'ltalia 1987:338, 1988:70,1990, 86–7). Following the exchange rate crisis of the autumn of 1992, the job of slowing down the rate of increase of wage settlements and speeding up the rate of increase of labour productivity continued, with compensatory virulence, by the government's resolve not to adopt any expansionary macroeconomic policy. So 'compensatory' has been the ensuing rise in unemployment (Figure 16.3b) that notwithstanding the devaluation of the lira by 25 per cent from the autumn of 1992 to the autumn of 1994, inflation decreased in that period by the same proportion.[17]

But interest, it is readily forgotten, is also an element in the cost of production, so that higher or lower interest rates must affect unit costs, and hence prices, correspondingly. Higher domestic costs resulting from the maintenance of higher nominal interest rates must therefore be set against their impact on inflation through the exchange rate and/or unemployment. Thus the 'dear money' policy followed in 1987–92 to bring defence of the parity into agreement with free capital mobility must have contributed substantially to Italy's persistently higher inflation in that period, when *domestic* sources of inflation were solely responsible for the countries inflation differential.[18]

What conclusion can then be drawn about the disciplinary impact of the EMU project on Italy's inflation differential? A policy of relatively high interest rates—which is what central bank independence and liberalization of capital movements actually amount to in the Italian case—tends to aggravate the problem of inflation. In fact, while on the one hand higher domestic interest rates translate into higher domestic production costs, on the other they cannot maintain exchange rate stability, except temporarily. This is

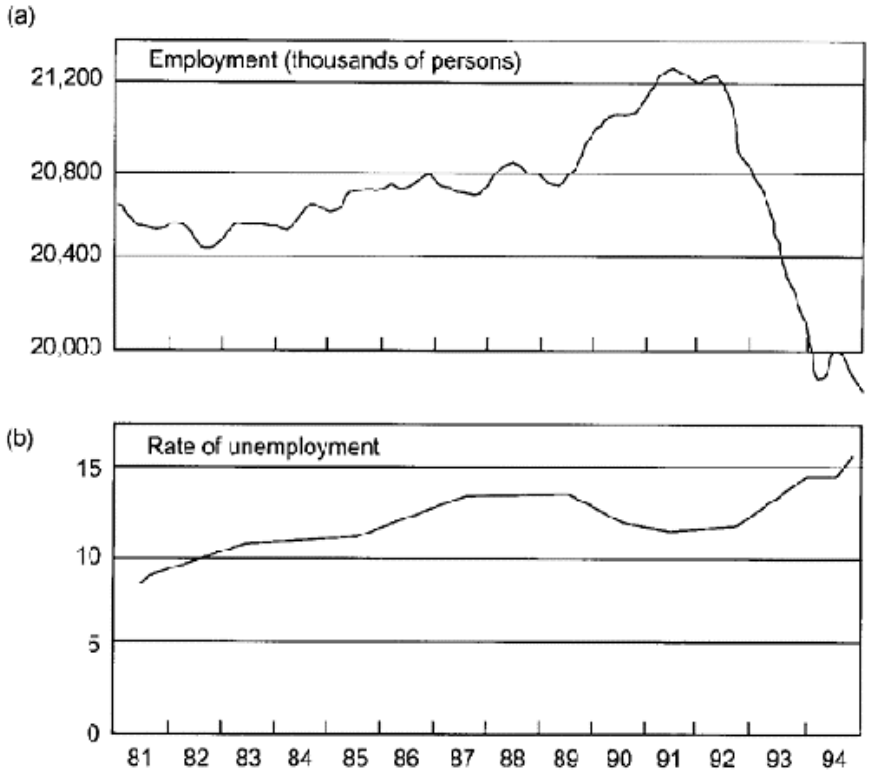

Figure 16.3 Italy: employment and unemployment, 1981–94

Source: Istituto centrale di Statistica and Banca d'ltalia

Note According to pre-1992 definitions (but excluding from the labour force people under 15)

because the credibility of a country's commitment to forgo parity changes ultimately rests on the course of the current account of its balance of payments; and, as shown by the Italian experience, relatively high domestic interest rates, to attract capital inflows and equilibrate the overall balance of payments, eventually *reduce* credibility, owing to the piling up of the country's external liabilities and the increasing incidence of the outgoing stream of interest on its current account.[19]

Finally, the problem of inflation is made more intractable by the impediment that 'austerity' measures aimed at generating primary surpluses pose for any credible incomes policy. These measures, prompted by the authorities' efforts to stop the rise of the debt to income ratio, naturally tend to be stricter the larger the interest rate-growth rate differential, and, for the reasons put forward in sections II–IV above, they are bound to

consist chiefly in reductions in social services and transfers to households. The only conceivable incomes policy thus remains that which is actually being pursued in Italy: improving the flexibility of the labour market—speeding up the increase in labour productivity and slowing down the increase in money wages—through increased unemployment.

In sum, from the above view of inflation, as well as from consideration of Italy's experience, it follows that, in the context of financial liberalization, any substantial success in eliminating the country's inflation differential ultimately hinges on the severity of the fiscal action carried out to generate primary surpluses in the public budget and export surpluses in the balance of payments.

VI

Let me now draw some general conclusions from the above analysis. The view of the EMU project as the successful remedy for high public debt and inflation seems ill-founded. With the abolition of all restrictions to capital movements a country loses both monetary and budgetary autonomy (including in the latter its freedom to choose the tax system). In the Italian case, this actually implies that the very source of the continuous rise in the debt to GDP ratio is widened rather than narrowed: the rate of interest is necessarily higher and the rate of growth lower than they would be with capital control. As to the reduction of inflation, that same double loss has brought about some results, and is likely to continue to do so, but solely because of the impact of high unemployment on the functioning of the labour market. The remedy thus seems much worse than the disease, also in view of the fact that, together with unemployment, financial liberalization is further aggravating the other traditional source of social distress: the painful state of the country's public services compounded by the marked unfairness of its tax system.

Italy's experience shows clearly that fiscal policy cannot be thought of as independent of interest-rate policy. Sooner or later, a policy of relatively high interest rates calls for restrictions of domestic demand through fiscal contraction: (1) to generate an export surplus at least sufficient to service the external debt and stop its mounting up; (2) to try to check the rise in the ratio of public debt to national income.

My argument is above all to cast serious doubts on the soundness of the project's very pillars—central bank independence and full capital mobility, with the loss of national autonomy in monetary policy implied by the latter. National autonomy in monetary policy essentially means the ability of the monetary authorities to retain a reasonable amount of control over the level of domestic interest rates. Control of domestic interest rates in turn—owing to its fiscal and distributive repercussions, as well as its effects on the balance of payments, the external position of the country and the exchange rate—is a most crucial component of general economic policy and must be exercised as such.

It would thus appear that it has never ceased to be true that monetary policy 'cannot be envisaged as a form of economic strategy which pursues its own independent objectives' (Committee on the working of the Monetary System 1959:73); in fact, it is 'so inextricably connected with the Government's fiscal operations and with management of Government debt that decisions about the courses which the Bank is to pursue can no longer be disposed of either according to a single set of working principles or by a single

self-contained governing body (ibid.:276). In particular, ‘all decisions about the level of the Bank Rate, whether to move it or not to move it, are decisions of significant importance to the Government’s general economic policy’, so that the ‘true responsibility’ for them should continue to lie ‘with the Chancellor of the Exchequer, not with the Bank’ (ibid.:74–5).

The sensible flavour and practical relevance of this set of propositions could hardly be more distant from state-of-the-art conceptions and the philosophy of Maastricht.

Acknowledgement

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Notes

1 Cf. Banca d’ltalia (1990:134–5). In fact, Italy completed capital liberalization before the deadline requested for phase 1 of monetary unification, and, in the face of rising capital inflows, the lira entered the narrow fluctuation band in January 1990.

2 An influential report, prepared by a Commission appointed by the Ministry of the Treasury in 1982, pointed out that ‘restrictions on capital movements can help to maintain over time…[an] unsatisfactory state of…public finance’ by providing, ‘in their consequences, if not in their intentions, a substantial accomodation in the financing of public sector deficits’ (quoted in Bruni 1988:224–5).

3 All those, that is to say, who claim that the economy tends towards a ‘natural’ rate of unemployment which is independent of aggregate demand.

4 Harmonization within the EU would obviously not avoid outflows of capital outside Europe for tax evasion, unless it was accompanied by capital control *vis-à-vis* the rest of the world. Thus liberalization of capital markets and harmonization of capital income taxation within the Union would not allow the European countries to dispense with the need for maintaining the apparatus of controls.

5 The dispersion of unemployment rates in Europe is much larger than in the United States. It has been calculated that before the entry of Greece, Portugal and Spain into the EEC, the standard deviation of regional unemployment rates was twice as large in Europe as in the United States; and it became three times as large as a result of the enlargement of the Community (cf. Giavazzi and Giovannini 1989:202).

6 For example, European countries that are specialized in textiles or light industries tend to find themselves increasingly exposed to competition from non-European suppliers (see European Commission 1990).

7 Bank secrecy towards the tax authorities continues to differ widely across countries, also within the EU. (A detailed picture of such differences was provided in 1979 by OYEZ Intelligence Report.) Obstacles to a generally accepted approach to bank secrecy were already apparent at the time when the above-mentioned report of the OECD Committee on Fiscal Affairs had been prepared. Thus, in the ‘Final Remarks’ of that report it is stated that ‘Austria, Luxembourg, Portugal and Switzerland could not adhere to the text of this report, nor to the suggestions made in [it]’ (OECD 1987:112).

8 According to Modigliani, competitive tax cutting could be avoided ‘without breaking bank secrecy laws. Banks in each country could collect the taxes due from each depositor according to the tax rates of his country of residence and then remit total tax collections to each country without identifying the individuals who paid them’ (1989:374). It is not clear, however, why one should expect banks to collect ‘correctly’ the taxes due from each depositor, in the presence of bank secrecy laws that apply also to tax authorities. The abuse of confidentiality to protect taxpayers and escape taxation should rather be regarded as an aspect of the competition between financial intermediaries—an aspect which could be ruled out only if tax authorities in each country were given access to bank information.

9 There would be no difference, in this respect, between a system of taxation based on the residence principle and harmonization of capital income taxation (cf. n. 4 above): both solutions within the EU would not free the member states from the need to maintain capital controls.

10 Deposits in Italy amount to over one-third of households’ financial assets, and, with a final 30 per cent tax rate, taxation on deposit interest makes overall capital income taxation significantly less scanty as a revenue source than it would otherwise be. It has already often been suggested, by authoritative circles, that this rate should be substantially lowered (see e.g. Ministero del Tesoro 1987; Banca d’ltalia 1990:27–8; for a broad overview of the Italian tax system and a critical assessment of its topical aspects, see Guerra 1993).

11 According to OECD estimates, in 1993 self-employment as a percentage of total employment was more than twice as large in Italy (26.1) as in the United Kingdom (11.9), in France (12.3) and in Japan (13); and three times as large as in the United States (8.7) and in Germany (8.8).

12 It has been calculated that in 1990 the Irpef average incidence was around 18 per cent for a single independent worker, and around 15 per cent for a married worker with two children (see Ceriani *et al*. 1992, tables 14 and 16).

13 Increases in payroll taxes may be ruled out on account of their impact on labour costs and international competitiveness. In fact these taxes, which outside the underground economy share with Irpef on dependent labour income the advantage of ease of tax-base assessment, are already relatively high in Italy and are likely to be decreased, rather than augmented.

14 Reductions in transfers to firms, a particularly dynamic component of public expenditure in Italy (it increased from 2.7 per cent of GDP in 1964 to 9.7 per cent in 1983; see Alvaro 1984), will continue to be resisted by all means. According to EEC estimates, at the end of the 1980s transfer expenditure for private and public firms (current contributions to production, payments of the Wage Supplemental Fund, state assumption of certain employer social security contributions, capital account transfers to state-controlled companies, and net financing to the non-state sector) were in Italy around double those of France and the GFR, in relation to both GDP and the number of persons employed, and four to five times those of Great Britain (Commissione delle Comunitá Europee 1989; a reply by the Italian authorities to the European Commission’s report is contained in Senate della Repubblica 1990).

15 As was to be expected, the recessionary stance of fiscal policy, compounded by the devaluation of the lira, transformed a deficit of 2.3 per cent of GDP in the 1992 current account of the country’s balance of payments (2/3 of which was made up of net interest paid abroad) into a current surplus of 1.2 per cent of GDP in 1993 and 1.5 per cent in 1994 (cf. Banca d’ltalia 1994, 1995).

16 On this view of inflation and its relation with a classical-surplus approach to value and distribution, see Pivetti (1991: Part I).

17 From over 5 to less than 4 per cent. The rate of increase of unit labour costs, for the economy as a whole, has fallen from 8 per cent in 1991 to 3.7 per cent in 1992, 1.6 per cent in1993 and −0.1 per cent in 1994. Sluggish money wages and a more rapid growth of labour productivity have resulted in increasing profit margins, while real wages have actually fallen in the same period by over 4 per cent (cf. Banca d’ltalia 1994, 1995).

18 Besides the shift, in 1987, of Italy's exchange rate policy to more fixed nominal exchange rates, the foreign component of inflation was virtually eliminated by depreciation of the dollar and favourable development in international prices (in 1986 the price of oil had fallen sharply).

19 As I have argued elsewhere (a few months before the lira left the ERM in September 1992), 'the longer the period during which defence of the parity is achieved by a country through a piling up of its external liabilities, the higher must eventually be the cost, in terms of employment, of sticking to a central parity' (Pivetti 1992:158).

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The government sector in the post-Keynesian theory of growth and personal distribution

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1 Introduction

In an article published in Italian in 1964 and translated in English in 1979, Garegnani (1979:73fn, 79, 81) was the first to develop the suggestion of Sraffa (1960:33) that the rate of profit should be taken as a variable susceptible of being determined by the level of the money rates of interest.[1] This view on what determines income distribution has been considered by the literature alternative[2] to another post-Keynesian view, which relates the rate of profit to the rate of growth of the economy.

The role that monetary institutions and the government sector can play in the latter theory was largely neglected when it was originally proposed by Kaldor and Pasinetti. Yet, in the last few years this theme has been the subject of an intense debate.[3] This has focused on that version of the theory, proposed by Pasinetti, which refers to *classes*, like workers and capitalists, determining the 'personal' distribution of income.[4] In what follows an attempt will be made to summarise the results of this debate and to point out its implications for the determination of the rate of profit and its relationship with the rates of interest and growth. In particular, it will be argued that the introduction of the government sector within the theory makes it possible to reconcile the two views, present in the post-Keynesian tradition, which the literature has considered alternative. Distributive variables are made to depend not only on the rate of growth of the economy, as pointed out by Kaldor and Pasinetti, but also on the money rate of interest, as suggested by Sraffa and by the subsequent elaborations of a monetary theory of distribution.

The work develops as follows. It first outlines the main features of the post-Keynesian theory of growth and distribution, drawing a distinction between a proposition linked to the Pasinetti theorem, which deals with the relation between savings and profits, and the theorem itself based on the content of the Cambridge equation. Then, it argues that, when the government sector is introduced in the analysis, the Cambridge equation, unlike the proposition on the relation between savings and profits, does not always hold. The same occurs to the dual theorem, which also holds in a low number of cases. Finally, the work

underlines that the introduction of the government sector within this theory makes it possible to achieve two important results. Firstly, it allows the analysis to capture a crucial feature of Kaldor's work. This is his attempt to characterise monetary and fiscal policies by assuming: (1) an endogenous money supply, (2) a government expenditure varying to maintain steady growth conditions in the economy. Secondly, it makes it possible to reconcile two different views on income distribution present in the post-Keynesian tradition, since distributive variables are made to depend not only on the rate of growth of the economy, but also on the money rate of interest.

2 The post-Keynesian theory of growth and personal distribution

The post-Keynesian theory of growth and distribution was first proposed by Kaldor in his seminal 1955–56 article in the *Review of Economic Studies*. The theory, derived from the principle of the multiplier,[5] is characterised by the rejection of the neoclassical production function and by 'the "Keynesian" hypothesis that investment, or rather, the ratio of investment to output, can be treated as an independent variable' (Kaldor 1955–56:95). It was originally formalised by making a distinction between groups of income-earners with different saving habits.[6] Moreover, although both Kaldor (1955–56:98, 1958:137–9) and Kahn (1958:149, 154) recognised the importance of dealing with the State and with financial markets in the analysis of steady growth conditions, its first formalisation did not consider these elements. The rate of profit was so studied by moving from the equilibrium condition between aggregate demand for and supply of commodities in the simplified form 'saving equals investment'.

An outstanding contribution to the development of this theory was given by Pasinetti in 1962 and 1974. He introduced into Kaldor's analysis several new elements. Firstly, Pasinetti dealt with *classes* (capitalists and workers), rather than with *income groups*, thus determining the so-called personal distribution of income. Secondly, he introduced the dynamic equilibrium conditions, according to which capitalists' and workers' capital, like all variables changing through time, must grow at the same rate as the economy. Thirdly, he pointed out that workers too, if they save, must receive a part of the profit as interest, so that to determine the rate of profit it is necessary to specify the relationship between this rate and the rate of interest in steady growth. According to Pasinetti, 'in a long-run equilibrium model, the obvious hypothesis to make is that of a rate of interest equal to the rate of profit' (Pasinetti 1962:271–2). In his analysis this meant that the securities representing real capital earn the same rate of return as that yielded by real capital itself and that there is 'uniformity…of the rate of profit on all capital, independently of ownership' (Pasinetti 1989a:28).

The introduction of these elements allowed Pasinetti to develop the theory on the basis of the following model:

$$g(1-\alpha)k=s_w(1-r_k\alpha k) \tag{2.1}$$

$$g\alpha k=s_c r_k \alpha k \tag{2.2}$$

with $0<s_w<s_c\leq 1$

$$0\leq\alpha\leq 1 \tag{2.3}$$

$k=k(r_k)$

with $0 \leq r_k \leq r_{max}$

$r_k k(r_k)<1$ if $0 \leq r_k < r_{max}$

$r_{max} k(r_{max})=1$

$$g = \bar{g} \tag{2.4}$$

where:

g is the real rate of growth of the economy,

k is the value of the existing capital measured in terms of the net income of the economy,

s_w is the propensity to save of the workers, taken as a given parameter,

s_c is the propensity of the capitalists to save, taken as a given parameter,

r_k is both the rate of profit and the rate of return on securities representing real capital,

α is the quota of real capital owned by the capitalists.

The four equations (2.1–2.4) contain four unknowns, [g, k, r_k, α]. Equations (2.1) and (2.2) represent the dynamic equilibrium conditions, according to which workers' and capitalists' capital must grow at the same rate as the rest of the economy. Equation (2.3), which takes into account the post-Keynesian critique to the neoclassical theory of capital,[7] specifies the technological relationship determining the value of the existing real capital,[8] which in this model is also the value of the outstanding securities representing real capital. Equation (2.4) states that the rate of growth of the economy is exogenously given.

The equilibrium condition between aggregate demand for and supply of commodities in the simplified form 'saving equals investment' can be derived from equations (2.1) and (2.2) and is not linearly independent of them:

$gk=s_w(1-r_k\alpha k)+s_c r_k \alpha k$

From equations (2.1), (2.2) and (2.4) one can also derive the following two expressions, if it is assumed that $\alpha \neq 0$:

$$\bar{g}k = s_c r_k k \tag{2.5}$$

$$s_c r_k(1-\alpha)k=s_w(1-r_k\alpha k) \tag{2.6}$$

Expression (2.5) represents the condition 'saving equals investment' in a form where only r_k is unknown, since g is an independent variable and s_c a given parameter. From it one obtains:

$$r_k = \frac{\bar{g}}{s_c} \tag{2.7}$$

that is the Cambridge equation, upon which the Pasinetti theorem is based:

> *As long as, in the economic system, there is a category of savers that save exclusively out of profit,* the only rate of profit that is compatible with equilibrium growth is the one given by the Cambridge equation, independently of anything else.
>
> (Pasinetti 1974:128, original emphasis)

Expression (2.6), on the other hand, leads to the following proposition on the relation between savings and profits:

> In all equilibrium growth relations, workers' savings…always become equal to…the amount of savings the capitalists would do if workers' profits were to go to them.
>
> (Pasinetti 1974:128)

The Pasinetti theorem had a strong impact on the literature and gave rise to an important debate[9] in which Meade (1963) and Samuelson and Modigliani (1966a) tried to undermine its general validity. They argued that in an analysis like that presented in equations (2.1–2.4), the values assumed by g, by the parameter s_w and by the technological relationship $k=k(r_k)$ may be such that the quota of real capital owned by capitalists is not positive. In this case, $\alpha=0$ and the 'dual theorem' holds instead of the Pasinetti theorem.[10] This means that the capital-output ratio, rather than the rate of profit, is determined independently of the technological relationship connecting k and since:

$$\frac{s_w}{\bar{g}} = k = k(r_k)$$

3 Government sector and personal distribution

Following the analysis presented by Pasinetti in 1962 and 1974 the model introduced in the previous section neglects the existence of the government sector. Some aspects of this problem were considered by Steedman (1972). He showed that the introduction of a government sector with a *balanced* budget within the post-Keynesian theory of personal distribution confirms the validity of the Pasinetti theorem, since the rate of profit is still determined by the Cambridge equation, which now takes the form:

$$r_k = \frac{g}{s_c(1 - t_p)}$$

where t_p is the tax rate on profits.

On the contrary, Steedman argued, the dual theorem does not hold in his analysis unless it is assumed that the tax rates applied on wages and profits are equal.

The assumption of a balanced budget allowed Steedman to avoid dealing with the existence of financial assets issued by the government. This problem cannot be avoided when one examines the role of a government sector operating with an *unbalanced budget*.

The debate on the latter theme was opened by Fleck and Domenghino (1987), and was enriched by several contributions which clarify when the Cambridge equation and the dual theorem hold in the presence of an unbalanced government budget too.[11] To summarise these results let's present a steady growth model in which the existence of financial assets issued by the government is explicitly considered.[12] The model shows that the above-mentioned proposition on the relation between savings and profits has more general validity than the Cambridge equation. It holds in a revised form, even when the Cambridge equation does not. Moreover, the model clarifies that in the presence of the government sector the dual theorem holds in a low number of cases, as does the Cambridge equation. Finally, the model shows that, by following Kaldor's suggestions on the role that monetary and fiscal policy can play in maintaining steady growth conditions, it is possible to reconcile two different views on income distribution present in the post-Keynesian tradition, since distributive variables are made to depend not only on the rate of growth of the economy but also on the money rate of interest.

The analysis developed by the model refers to a closed economy with two classes, workers and *rentier*-capitalists,[13] whose propensities to save, respectively s_w and s_r, are such that $0<s_w<s_r\leq 1$. Rentier-capitalists, unlike workers, do not earn wages. They derive their income only from the investment of their wealth, which can be placed in money, bonds and securities representing real capital. Money and bonds are issued by the government to finance its deficits, according to the percentages γ and $(1-\gamma)$, with $0\leq\gamma\leq 1$. The former pays no nominal return, while the latter pay a nominal interest rate equal to R_b. Investment in real capital is financed only through the issue of securities which can be held by both classes and which pay a real rate of return r_k, which is also the rate of profit. The equality between the rate of return on securities representing real capital and the rate of profit is in line with Pasinetti's claim that in a long-period model the most obvious hypothesis to make is that of a rate of interest equal to the rate of profit. This assumption, which plays an important role in the development of the post-Keynesian theory of growth and distribution, does not imply the equality between the rate of interest on bonds and r_k.

With respect to the analysis presented in the previous section, the model here proposed thus assumes that the two classes can hold their wealth not only in the form of real capital, but also in the form of financial assets issued by the government. From this investment they can earn an income, composed of the nominal interests paid on bonds and of the profits of real capital, which will be named 'financial revenue'.

To maintain steady growth conditions, the model finally assumes that all variables changing through time grow at the rate $g+\dot{p}$, where $\dot{p}$ represents the inflation rate, which is constant through time, correctly anticipated, and instantaneous, like all rates considered in this essay.

The introduction of these assumptions on the composition of wealth and financial revenue and on the issue of money and bonds by the government leads to the specification of the following equations, which are relative to the financial part of the model:

$$W=h+b+k \tag{3.1}$$

$$\mathbf{F}=R_b b+r_k k \tag{3.2}$$

$$\gamma(\delta + R_b b) = (g+\dot{p})h \tag{3.3}$$

$$(1-\gamma)(\delta + R_b b) = (g+\dot{p})b \tag{3.4}$$

where:

W is the total wealth measured in terms of the net income of the economy,

h is the amount of money in circulation measured in terms of the net income of the economy,

b is the value of the outstanding bonds measured in terms of the net income of the economy,

k is the value of the existing capital measured in terms of the net incomeof the economy,

F is the total financial revenue measured in terms of the net income of the economy,

δ is the government deficit net of interest payments measured in terms of the net income of the economy.

The value of the existing real capital, which in this model is also the value of the outstanding securities representing real capital, is determined, as in the previous section, by the following technological relationship:

$k=k(r_k)$ (3.5)

with $0\leq r_k\leq r_{max}$

$r_k k(r_k)<1$ if $0\leq r_k<r_{max}$

$r_{max}k(r_{max})=1$

The demand functions for money, bonds and real capital, on the other hand, can be derived from portfolio analysis. To simplify the analysis we will assume that the groups of portfolio choosers have the same portfolio structure.[14] This assumption makes it possible to consider that the wealth of the economy and its financial revenue is divided between the two classes according to α, with $0\leq\alpha\leq1$, which now represents the quota of wealth owned by the rentiers:

$$a_h(R_b, r_k, \dot{p}, \tau) = h \tag{3.6}$$

$$a_b(R_b, r_k, \dot{p}, \tau) = b \tag{3.7}$$

$$a_k(R_b, r_k, \dot{p}, \tau) = k \tag{3.8}$$

where τ represents the tax rate, assumed equal on all forms of earnings and taken as given.

After having specified the equations relative to the composition of wealth and financial revenue and the equilibrium conditions of the securities' market, we can introduce the equilibrium conditions of the commodities' market when the government sector operates:

$$s_w(1-\tau)[1+R_b b-\alpha F] = (g+\dot{p})(1-\alpha)W-\dot{p}(1-\alpha)k \tag{3.9}$$

$$s_r(1-\tau)\alpha F = (g+\dot{p})\alpha W-\dot{p}\alpha k \tag{3.10}$$

where $[1+R_b b-\alpha F]$ represents the total amount of earnings, measured in terms of the net income of the economy, which is paid to the workers in the form of wages and financial revenues.

Equations (3.9) and (3.10) describe the dynamic equilibrium conditions, which clarify that the wealth owned by the workers and the rentiers must grow at the same rate $(g+\dot{p})$ as the economy and that their increase comes partly from the savings of each class, $\{s_w(1-\tau)[1+R_b b-\alpha F]\}$ and $\{s_r(1-\tau)\alpha F\}$, and partly from the revaluation of their real capital due to inflation, $\{\dot{p}(1-\alpha)k\}$ and $\{\dot{p}\alpha k\}$.

From equations (3.1), (3.3), (3.4), (3.9) and (3.10) we can derive the equilibrium condition between aggregate demand for and aggregate supply of commodities, which now takes the form 'saving equal investment plus government deficit' and is not linearly independent:

$$s_r(1-\tau)\alpha F = (g+\dot{p})\alpha W-\dot{p}\alpha k$$

The model can be completed by taking as given the real rate of growth of the economy, as is done in all post-Keynesian analyses of growth and distribution, and R_b. The latter assumption is introduced to follow Kaldor's suggestion to consider that the monetary authorities tend to make the supply of money endogenous by stabilising the money interest rate at a specific level:

$$g = \bar{g} \tag{3.11}$$

$$R_b = \overline{R_b} \tag{3.12}$$

The 12 equations (3.1–3.12) contain 12 unknowns [W, h, b, k, F, R_b, r_k, δ, γ, g, $\dot{p}_\alpha$]. They generalise the model of the previous section and the analyses presented in the recent debate on the government sector in the post-Keynesian theory of personal distribution, whose results can be here derived as particular cases.

From the equilibrium conditions of the commodities' market we can first derive the following expression if it is assumed that $\alpha \neq 0$:

$$s_r(1-\tau)F = (g+\dot{p})W-\dot{p}k = s_r(1-\tau)\alpha F + s_w(1-\tau)[1+R_b b-\alpha F] \tag{3.13}$$

This confirms the validity of the proposition on the relation between savings and profits, if the term 'profits' is replaced by 'financial revenues' and the term 'capitalists' by 'rentiers':

> In all equilibrium growth relations, workers' savings…always become equal to…the amount of savings the [rentiers] would do if workers' [financial revenues] were to go to them.
>
> (Pasinetti 1974:128)

Then, from the first of the two equalities (3.13), taking into account (3.1) and (3.2), it is possible to derive:

$$r_k = \frac{g}{s_r(1-\tau)} \frac{h+b+k}{k} - R_b \frac{b}{k} + \dot{p} \frac{h+b}{k s_r(1-\tau)} \tag{3.14}$$

This expression does not confirm that the rate of profit is independent of the technical conditions of production described by equation (3.5). Yet, in some particular cases, it is possible to transform equation (3.14) into the following revised version of the Cambridge equation:[15]

$$r_k = \frac{g}{s_r(1-\tau)} \tag{3.15}$$

A first case is that of a balanced government budget and coincides with that presented by Steedman (1972) and recalled by Pasinetti (1989a:28, 1989b:642 fn.) and Dalziel (1991a:288). They assume that h=0 and b=0, i.e. absence of money and bonds, so that financial revenue is equal to profit and wealth is equal to real capital.

In a second case, where the government deficit is not funded by issuing bonds (i.e. b=0), equation (3.14) is transformed into the revised Cambridge equation if it is also assumed that $\dot{p} = -g$.[16] Yet, from equations (3.3) and (3.4) one can notice that the assumption $\dot{p} = -g$ amounts again to that of a balanced government budget.[17] As a consequence, in equations (3.1–3.12) the revised Cambridge equation never holds in the presence of an unbalanced government budget which is *only* financed through the issue of central bank money. A different position has been held, instead, in some literature. According to Pasinetti (1989a: 32), Denicolò and Matteuzzi (1990:342–3) and Dalziel (1991a:293), this way of funding the Government deficit:

> is equivalent to imposing an implicit extra tax on citizens (what has been called an 'inflation tax') *in addition* to direct and indirect taxation. In real terms, the national income remains what it is, but an increase of the price level transfers some purchasing power from the private to the public sector…. This subtraction of public dissavings from private savings is carried out [in the analysis] under the least complicating of all assumptions, namely under the assumption of proportionality of the 'implicit' (or inflation) tax to the 'explicit' taxes. This no doubt crude but very simple assumption is precisely the assumption which, in the case of monetary financing…[leads] to the generalisation of the 'Cambridge Equation'.
>
> (Pasinetti 1989a:32, see also 1989b:646)

In a third case, where the Government deficit is only financed through bonds (i.e. h=0), the revised Cambridge equation holds if the absence of inflation[18] and equality between the rate of interest on bonds and the rate of profit[19] (i.e. $\dot{p}$ and $R_b=r_k$) are also assumed. This case is similar to that presented in a non-formal way by Pasinetti (1989a:32–4) and in a formal way by Denicolò and Matteuzzi (1990:341–2),[20] whose analyses however are not conceived to deal explicitly with the existence of inflation.

In a fourth case, where the government deficit is financed through both money and bonds, the revised Cambridge equation holds if $[s_r(1-\tau)R_b b = (g+\dot{p})(h+b)]$, i.e. if the government deficit is equal to the saving that the rentiers would make on the interests of the government sector if all interests were paid to them. This case has not yet been noticed by the literature.

In equations (3.1–3.12) then, the Cambridge equation has less general validity than the proposition, linked to the Pasinetti theorem, on the relation between savings and profits. Moreover, as Commendatore (1994:24–9) shows, the dual theory too holds in a low number of cases. From equations (3.1), (3.2), (3.9) and (3.10) it is possible to derive first an expression relative to α, the quota of wealth owned by rentiers, and then, by setting α=0, the following expression for the capital-output ratio when the class of rentiers disappears:

$$k = \frac{s_w(1-\tau)(1+R_b b) - (g+\dot{p})(h+b)}{g} \qquad (3.16)$$

In equation (3.16) k does not depend only on the parameters s_w, τ and on the exogenously given variable g. Consequently, it depends on the content of the other equations of the model, including the technological relationship described by equation (3.5). Yet, in some particular cases, similar to those in which the revised Cambridge equation holds, equation (3.16) can be transformed into the following equation, in which the 'revised' dual theorem can be considered to hold too:

$$k = \frac{s_w(1-\tau)}{g} \qquad (3.17)$$

The first case occurs when h and b are equal to zero. It coincides with that reached by Steedman (1972), which shows that in the presence of a government sector operating with a balanced budget the dual theorem holds if a uniform tax rate on all forms of income is assumed, as is done in equations (3.1–3.12).[21] The second, in which the Cambridge equation holds too, occurs when b=0 and $g = -\dot{p}$. As said above, this case too corresponds to that of a government sector operating with a balanced budget. A third case, in which the Pasinetti theorem also holds, occurs when h=0 and $\dot{p} = 0$. This is the case of a government deficit financed only through bonds, in which the validity of the dual theorem is confirmed if it is assumed that [R_bk=1], i.e. if the money rate of interest on bonds is equal to the maximum rate of profit implied by equation 3.5. Finally, a fourth case, which again has some correspondence to one in which the Pasinetti theorem holds, occurs when $[s_w(1-\tau)R_b b = (g+\dot{p})(h+b)]$, i.e. when the government deficit is

equal to the saving that the workers would make on the interest of the government sector if all interest was paid to them. Thus, when the analysis is extended to deal with a government unbalanced budget, both the Pasinetti and the dual theorems have no general validity and hold in the same number of cases. These results do not contradict those reached by Steedman (1972). They are rather complementary. The analysis presented above, unlike that of Steedman (1972), assumes that the tax rate is uniform for all kinds of incomes. Steedman (1972), on the other hand, limited his analysis to a balanced government budget.

Beside providing a generalisation of the results of the recent debate on the role of the government sector, the model presented in this section develops two other relevant aspects of the post-Keynesian theory of growth and distribution. Firstly, by taking as given the money rate of interest, Rb, and by considering as endogenous variables the monetary and fiscal policy parameters, γ and δ, it captures a crucial feature of Kaldor's work. This is his attempt to characterise monetary and fiscal policies by assuming: (1) an endogenous money supply, (2) a government expenditure varying to maintain steady growth conditions in the economy.[22] Secondly, by assuming that both g and Rb are exogenously given, the model is able to reconcile two different views on income distribution present in the post-Keynesian tradition. Distributive variables are made to depend not only on the rate of growth of the economy, but also on the money interest rate. This result contradicts the claim that these two post-Keynesian views on income distribution are alternative. It is due to the fact that, in the presence of a government sector operating with an unbalanced budget, the equilibrium condition in the commodities market, which establishes in the post-Keynesian theory a link between the rate of profit and the rate of growth, also includes as a dependent variable δ, the government deficit net of interest payments. The content of this constraint thus leaves one degree of freedom, which can be eliminated by associating it to the relationship between the rates of interest and profit, described by the monetary theory of distribution, while g and R_b are taken as given.

4 Conclusions

The analysis presented in the previous pages makes it possible to review the recent debate on the role of the government sector in the post-Keynesian theory of personal distribution and to clarify its implications. It has shown the possibility of widening the scope of this theory and of verifying the validity of the Pasinetti and the dual theorem. The analysis has proven that both theorems hold in some, but not all, cases in which the government sector is explicitly considered. On the other hand, the validity of the proposition, linked to the Pasinetti theorem, on the relation between savings and profits is confirmed. The limited validity of the Cambridge equation has no consequence on the post-Keynesian theory of growth and distribution, which is characterised by the elements described at the beginning of section 2, rather than by the content of the Pasinetti theorem.

The analysis developed above has also shown the possibility of reconciling two different post-Keynesian views on income distribution, which the literature has considered alternative. By following Kaldor's suggestions on the role that monetary and fiscal policies can play in maintaining steady growth conditions, we obtain that

distributive variables are made to depend both on the rate of growth of the economy, as pointed out by Kaldor and Pasinetti, and on the money rate of interest, as suggested by Sraffa and the monetary theory of distribution.

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Notes

1 A few years later, Nuti (1971) and Dobb (1973) considered Sraffa's suggestion a promising starting point to widen the boundaries of the theory of distribution and of economics in general. Further developments of this suggestion have been subsequently proposed by Panico (1980, 1985, 1988) and by Pivetti (1985, 1991).

2 See Moss (1978:306), Nell (1988), Wray (1988), Pivetti (1988), Pasinetti (1988), Abraham-Frois(1991:197, 202).

3 See Fleck and Domenghino (1987; 1990), Pasinetti (1989a; 1989b), Dalziel (1989; 1991a; 1991b; 1991–92), Denicolò and Matteuzzi (1990), Teixeira (1991), Teixeira and Araújo (1991), Panico (1992; 1993), Araújo (1992–93), Bortis (1993), Commendatore(1994).

4 In his seminal 1955–56 article in the *Review of Economic Studies*, Kaldor dealt with the 'functional' distribution of income, which refers to income groups, like wage-earners and profit-earners. He examined the 'institutional' distribution of income, which refers to sectors, like personal (family) and corporate (firm) sectors, in a footnote of his famous Appendix on the neo-Pasinetti theorem. See Kaldor (1966:215, fn. 3). The theory of 'personal' distribution was later developed by Pasinetti (1962). For more details on the definitions of the post-Keynesian theories of 'personal', 'functional' and 'institutional' distribution, see Pettenati (1967:491).

5 According to Kaldor, the principle of the multiplier can be 'alternatively applied to a determination of the relation between prices and wages, if the level of output and employment is taken as given, or the determination of the level of employment, if distribution (i.e., the relation between prices and wages) is taken as given' (Kaldor 1955–56:94).

6 See Kaldor (1955–56:95).

7 This critique, mainly developed in the 1960s, underlines the limits of validity of those 'neoclassical parables' stating that the behaviour of an economy with n>1 goods is similar to that of an economy with one good, as long as the relationship between marginal productivities and capital intensity is concerned. For more details on this critique, see Harcourt (1972) and Kurz (1985).

8 This specification seems to correspond to Pasinetti's position, according to which 'the capital-output ratio does, of course, depend on the rate of profit for many reasons…. However, nothing can be said *a priori* on the direction of any of these changes. If we represent the relation between the capital-output ratio k and the rate of profit r by $k = \phi(r)$, we can say that nothing is known in general on the shape of this function. The relevant properties of $\phi(r)$ can only be stated in negative terms. In general, this function is not monotonic' (Pasinetti 1974:133; see also 124 and 128).

9 To the debate contributed Meade (1963), Meade and Hahn (1965), Samuelson and Modigliani (1966a, 1966b), Pasinetti (1964; 1966a; 1966b), Kaldor (1966), and Robinson (1966).
10 For a concise review of this debate which also points out the role played by the neoclassical production function in the analyses of Meade (1963) and Samuelson and Modigliani (1966a), see Panico and Salvadori (1993:xvi–xix).
11 In this debate, Pasinetti (1989a; 1989b) and Dalziel (1989; 199la) examine the validity of the Cambridge equation by introducing into the analysis the Ricardian debt/taxation equivalence. Denicolò and Matteuzzi (1990) and Panico (1992; 1993) consider the same topic by introducing into the analysis the existence of financial assets issued by the government. Commendatore (1994), instead, deals with the dual theorem.
12 The model is derived from that presented by Panico (1992; 1993).
13 The term rentier-capitalists was used by Kaldor (1966:311).
14 The case of different portfolio structures is considered by Panico (1992; 1993), who points out the consequences of this assumption for the post-Keynesian theory of personal distribution in the presence of a government sector operating with an unbalanced budget. Some of these consequences are recalled in the subsequent notes.
15 This revised version can be found in Steedman (1972:1391), Pasinetti (1989a:28), Denicolò and Matteuzzi (1990:342). In Dalziel (1991a:296) it seems to refer to the money rate of return on capital.
16 Panico (1993:112) also points out that when the portfolio structures of the two classes are different, the revised Cambridge equation also holds with a rate of inflation different from zero, if b=0 and the demand for money coming from the rentiers is equal to zero.
17 The interpretation of this condition has been pointed out by Peter Skott.
18 Panico (1993:111) points out that when the portfolio structures of the two classes are different, it is also possible to obtain the revised Cambridge equation with the rate of inflation different from zero, if it is assumed that money is absent, that the rate of interest on bonds and the rate of profit are equal, and that the rentiers have a demand for bonds equal to zero. A similar result had previously been reached by Denicolò and Matteuzzi (1990:341–2).
19 Pasinetti (1989a:28) and Denicolò and Matteuzzi (1990:342) show that the equality must hold between these two rates net of taxation.
20 Pasinetti (1989a) considers a case in which the Ricardian debt/taxation equivalence holds. This equivalence is not assumed in what follows, nor is it in Denicolò and Matteuzzi (1990:341–2). Dalziel (1991a:295–6) also deals with this case. His analysis, however, seems to refer to the money rate of return on capital.
21 As is known, Steedman (1972) showed that, if the tax rates on the different forms of incomes are not uniform, then the revised Cambridge equation holds while the revised dual theorem does not.
22 See Kaldor (1958:137–9).

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Appendix
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1960 2 *Il Capitale nelle Teorie della Distribuzione*, Milano: Giuffrè.

1961 3 'Sulla Relazione fra Saggio di Progresso Tecnico e Vita Economica dei Capitali Fissi', *Rivista di Politica Economica*, 51:3–16.

1962 4 *Il Problema della Domanda Effettiva nello Sviluppo Economico Italiano*, Roma: SVIMEZ.

1964 5 'Note su Consumi, Investimenti e Domanda Effettiva (Parte Prima)', *Economia Internazionale*, 17:591–631.

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