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David Yaffe

Why the organic composition of capital must rise with accumulation.

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If we regard technical progress as increasing the social division of labour, the productiveness of labour and, therefore, producing relative surplus value, it follows that the organic composition of capital must rise. As Marx puts it:

> "However much the use of machinery may increase the surplus labour at the expense of the necessary labour by heightening the productiveness of labour it is clear that it attains this result, only by diminishing the number of workmen employed by a given amount of capital. It converts what was formerly variable capital, invested in labour power, into machinery which, being constant capital, does not produce surplus value....." (Capital Vol I, p407)

The introduction of a machine for the purpose of cheapening a product is limited in the following way:

> "The use of machinery for the exclusive purpose of cheapening the product, is limited in this way, that less labour must be expended in producing the machinery then is displaced by the employment of that machinery. For the capitalist, however, this use is still more limited. Instead of paying for the labour, he only pays the value of the labour power employed; therefore, the limit to his using a machine is fixed by the difference between the value of the machine and the value of the labour power replaced by it". (Capital Vol I, p392)

This latter point can be made algebraically as follows:

$$c_2 - c_1 < v_1 - v_2$$

Clearly if all labour is to be employed, **C** must increase at a faster rate than **V** for total social capital.

Similarly, if we consider total social capital in periods 't' and 't + 1' and let **W** be the total value produced in one period of production:

$$c_t + v_t + s_t = w_t \qquad (1)$$

and

$$c_{t+1} + v_{t+1} + s_{t+1} = w_{t+1} \qquad (2)$$

For accumulation $w_{t+1} > w_t$ (reproduction on an extended scale) (3)

If we assume technical progress then:

$$\frac{s_t}{v_t} < \frac{s_{t+1}}{v_{t+1}} \qquad (4)$$

If the total time available to society for productive labour remains constant (working-day given and working population constant).

Then $v_t + s_t = v_{t+1} + s_{t+1}$ (5)

and $v_t > v_{t+1}$ (6) from (4) & (5)

From (1), (2) and (5)

$$c_{t+1} > c_t \qquad (7)$$

and from (6) and (7)

$$\frac{c_{t+1}}{v_{t+1}} > \frac{c_t}{v_t}$$

This point is really obvious. The next point to show that there is a tendency of the rate of profit to fall is more difficult.

The tendency of the rate of profit to fall

With the usual notation:

$$r = \frac{s}{c + v} \quad \text{and this can be written} \quad \frac{s/v}{c/v + 1}$$

Now if c/v increases, what happens to s/v (= e, the rate of exploitation) is clearly important. According to Marx it increases with a growing organic composition. If we can show that the increase of s/v is limited in a way that c/v is not, we shall have shown a long run tendency of the rate of profit to fall.

If n is the labour-time available to society and $\frac{dn}{dt} = k$ (const.)

Then $v + s = n \qquad (8)$

and $\frac{s}{e} + s = n \qquad (9)$

(since s/v = e)

and $s(\frac{1}{e} + 1) = n \qquad (10)$

Differentiating (10) with respect to time we obtain

$$\frac{1}{e} \cdot \frac{ds}{dt} - \frac{s}{e^2} \cdot \frac{de}{dt} + \frac{ds}{dt} = \frac{dn}{dt} = k \text{ (const.)} \qquad (11)$$

That is:

$$\frac{ds}{dt} \cdot (\frac{1}{e} + 1) - \frac{s}{e^2} \cdot \frac{de}{dt} = k$$

So that:

$$\frac{1}{s} \cdot \frac{ds}{dt} = \frac{k.e}{(1 + e)s} + \frac{1}{(1 + e)} \cdot \frac{1}{e} \cdot \frac{de}{dt}$$

as s increases:

$$\frac{ke}{(1 + e)s} \to 0,$$

or if the growth of the working population is negligible (so that v + s = const.)

So that:

$$\frac{1}{s} \cdot \frac{ds}{dt} \approx \frac{1}{1 + e} \cdot \frac{1}{e} \cdot \frac{de}{dt}$$

So that a unit increase in **s** will require a larger increase in **e**, the larger **e** is already. So that the higher the rate of exploitation (the less time it requires to produce the value of labour-power) the greater must be the increase in the rate of exploitation in order to increase the gross profits sufficiently to overcome the

falling rate of profit. The tendency of the profit rate to fall asserts itself in the long-run because of the increasing difficulty in increasing the rate of exploitation as capitalism progresses.

This is what Marx meant when he said:

> "The compensation of the reduction in the number of labourers by means of an increase of exploitation has certain insurmountable limits. It may, for this reason, check the fall in the rate of profit, but cannot prevent it entirely". (Capital, Vol III, p242)

Capital saving innovation

This only has meaning in so far as the "elements of constant capital are cheapened" by "gratis" increases in the productivity of labour. Marx said:

> "Like the increased exploitation of natural wealth by the mere increase in the tension of labour power, science and technology give capital a power of expansion independent of the given magnitude of the capital actually functioning. They react at the same time on that part of the original capital which has entered upon its stage of renewal". (Capital, Vol I, p605)

A number of points can be made.

> (1) In so far as technical progress is "disembodied" progress it acts as a counter tendency to the rate of profit to fall. **But** it is "logically" completely separate and extraneous to the general law of capitalist accumulation. Those making this point about capital-saving innovation have to show that it **must necessarily** regularly occur and therefore can alter the general law substantially. No evidence exists that this is the case, although periods of the "new inventions" etc have certainly allowed capitalism a new lease of life. This "Deus ex machina" of bourgeois theory just will not do. There are many inventions that capitalism will not use although they would save labour-time.
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> (2) Capital saving innovation is an ideological term. It really is labour-saving; less labour-time is required before to produce a given amount of capital. This both affects the mass of surplus-value produced i.e. since the number of labourers employed decreases in the capital goods industries and devalues the original capital. Unless concentration of capital takes place at a faster rate than before there would be unemployment. So more surplus value needs to be invested than before to maintain full employment. The extra-profit obtained by the industries (firm) utilising the invention will lead to increasing centralisation of capital and to a higher rate of exploitation. So that expansion and accumulation will be given an impetus. But unless such "gratis" inventions keep returning the general tendency will reassert itself.

Clearly the higher the organic composition of capital already achieved the less effect such inventions will have.

Finally, today, a great deal of surplus-value goes into research and development and it seems more than likely that technical change is not only "paid" for but is also a means to the increasing centralisation of capital; a tendency that follows from the general law anyway and intensifies the competition between capitals.