Replacement Costs, Stocks and the Valuation of Inputs

Freeman, Alan

The University of Greenwich

25 April 1995

REPLACEMENT COSTS, STOCKS AND THE VALUATION OF INPUTS

Alan Freeman
the University of Greenwich
afreeman@iwgvt.org

ABSTRACT

This unpublished paper, written for distribution on the OPE-L list, seeks to clarify the conception of socially necessary labour time in Marx's conception of value. It shows that this is not reducible to 'replacement cost' as simultaneist authors argue. Moreover that the implied conception of a compulsion upon capitalists to replace consumed inputs, along with attendant concepts such as a physical surplus product arising from replacement in kind, is alien to Marx's thinking. The notion of replacement cost leads to obvious logical contradiction, and a full treatment must account properly for stocks of constant capital.

REPLACEMENT COSTS, STOCKS AND THE VALUATION OF INPUTS

Alan Freeman 29 April 1995

1 INTRODUCTION

A growing number of authors (notably Carchedi, Giussani, Kliman, Naples, McGlone, and myself) reject the traditional interpretation of Marx's value theory based on the simultaneous equation systems popularised by von Bortkiewicz.

Our common starting point is this: a simultaneous equation system forcibly equates two magnitudes which cannot in general be equal, namely the price of a commodity at the end of a period of production and the price of the same commodity at the beginning of the same period of production. Unless change over time is ignored, the formation of neither values nor prices can be represented mathematically by such systems. They necessarily misrepresent any economic process involving change – in particular, capitalism.

This objection is neither trivial nor metaphysical. Both Andrew Kliman and myself, using assumptions identical to those of N. Okishio in his famous theorem, have shown that the profit rate falls when traditional theory predicts (and most 'marxists' accept) it should rise.

Likewise the traditional criticism of Marx's transformation procedure, based on the contention that the 'price of inputs must equal the price of outputs' is rooted in this misconception and constitutes an assimilation of value theory to neoclassical general equilibrium, true neither to Marx nor observed reality.

This short piece has been written for two reasons. First, several authors in the simultaneous tradition have countered that, although values change over time, nevertheless the value which constant capital transmits to the product is, as Marx stresses, the labour time socially necessary to acquire it at the time it is used, by no means equal to the labour time that went into its production. From this they leap directly to the claim that this value transferred is its 'cost of replacement': the value sum needed to replace the consumed means of production in kind at the point when their product is created or realised, justifying the use of simultaneous equations.

I seek to show that Marx's conception of socially necessary labour time is not reducible to replacement cost, moreover that the implied conception of a compulsion upon capitalists to replace consumed inputs, along with attendant concepts such as a physical surplus product arising from replacement in kind, is alien to Marx's thinking. The notion of replacement cost leads to obvious logical contradiction, and a full treatment must account properly for stocks of constant capital.

Second, the recognition that input values differ from output values is a purely negative result and does not fully determine the value transmitted to outputs by constant capital, in particular, again, in the presence of stocks of constant capital in any form. Thus Carchedi, a trenchant and pioneer critic of simultaneist theory, attempts to distinguish a tendential value which is determined by replacement cost from a realised value which is determined by historical cost, in my view tendentially straddling two unrealisable views.

I suggest how the accounting should be done, proposing a complete and general solution to the question 'how much value is transferred to the product by consumed constant capital?'

Finally, in order to establish the contradictions of the replacement cost approach I submit an example of expanded reproduction involving technical change which illustrates a vital but neglected concept of Marx's, namely the tie-up and release of constant and variable capital. This example, which cannot be represented or explained on the basis of simultaneous equations, will I hope re-open the long-neglected debate on relative surplus value and expanded reproduction.

2 THE PROBLEM STATED

In many passages Marx makes the indisputable point that a change in the productivity of labour brings about a change in unit values. Thus pp309-310 of Capital Volume I states:

> Let us assume that some invention enables the spinner to spin as much cotton in 6 hours as he was able to spin before in 36 hours. His labour is now six times as effective as it was, considered as useful productive activity directed to a given purpose. The product of 6 hours' labour has increased sixfold, from 6 lb to 36 lb. But now the 36 lb of cotton absorb only the same amount of labour as did the 6 lb formerly. One-sixth as much new labour is absorbed by each pound of cotton, and consequently the value added by the labour to each pound is only one-sixth of what it formerly was.

It follows that if the productivity of the labour employed in producing raw materials or machines changes, then this will work its way through to the value of the product that consumes this raw material or emerges from this machine. He continues, in the same passage:

> Let us now assume that the productivity of the spinner's labour, instead of varying, remains constant, that he therefore requires the same time as he formerly did to convert one pound of cotton into yarn, but that the exchange-value of the cotton varies, either by rising to six times its former [price] or by falling to one-sixth of that [price]. In both these cases, the spinner puts the same quantity of labour into a pound of cotton, and therefore

adds as much value, as he did before the change in the value; he also produces a given weight of yarn in the same time as he did before. Nevertheless, the value he transfers from the cotton to the yarn is either six times what it was before, or, in the second case, one-sixth as much. The same result occurs when the value of the instruments of labour rises or falls, while their usefulness in the labour process remains unaltered. [The Penguin translation wrongly renders the German 'Preises' as 'Value' where indicated]

If one pound of cotton is produced using 10 minutes of socially-necessary labour, then each such pound consumed in making yarn transfers this 10 minutes to the yarn. If at a previous point of time it required 1 hour this is of historical interest only.

So far, however, nothing has been said about replacement. No-one disagrees that a fall in the value of cotton before it reaches the spinners must lower the value of yarn. And I hope no-one claims that a fall in cotton retrospectively revalues the yarn after it is sold. Our differences are at their most substantial if the fall in value takes place while the yarn is in fabrication. How much value does old cotton, purchased when it was worth 1 hour per pound, transfer to the yarn if external changes in productivity reduce its value to 10 minutes per pound while still being worked up?

The difficulties arise because cotton has fallen to 10 minutes per pound by the time the yarn is sold, even though it was worth 1 hour per pound when purchased by the spinners. Clearly, the spinners are not going to realise the full value of their outputs since their rivals are by now spinning cheaper yarn. The price of yarn will be depressed. Is this a decline in the price of yarn below its value, or, as is more consistent with Marx's other writings, an actual fall in its value? And if the latter, how can this be reconciled with the assertion that the value transferred to this yarn by the cotton is equal to its original value at the time of purchase?

The argument itself contains the clue to its own refutation. As is well-known from Chapter 10 of Volume III of Capital, the market value of the yarn will not sink to that determined by the cheapest available process of production but to an intermediate value, between the individual value of those producers who have just purchased their cotton and the individual value of those producers who are still using up old stocks. Therefore, although the value transferred by the cotton has sunk below its original value, it has by no means sunk to the individual value of the producers now entering the market with stocks of new, cheap cotton. It is neither equal to its replacement cost, nor to its original historic cost, but to some intermediate value, dependent on the relative weight in the market of the producers buying new cotton and the producers using old cotton – and hence in turn dependent in the quantity of new cotton on the market, in comparison with the size of the stocks of the old cotton. The difficulty, therefore, is how to determine this intermediate value.

Immediate contradictions arise if our 'replacement cost' theorists insist that this is equal to the value of new cotton. Its change in value could have taken place at any time while the yarn was being produced. If it occurs one microsecond after the yarn is produced, the 'replacement cost' interpretation must conclude, then a pound of yarn incorporates 1 hour per pound of consumed cotton. If it happened one microsecond before, the same interpretation tells us same pound of yarn incorporates 10 minutes per pound. We end up with the ridiculous claim that a delay in production of two microseconds can cut the value of the yarn by up to five-sixths. This is just another expression of the logical absurdity in the idea that raw materials can transfer to the product a value which they do not yet possess.

Moreover, yarn is produced continuously. Suppose the change in value of the cotton takes place halfway through the process of production. Then half the yarn incorporates 1 hour per pound of cotton, and the other half incorporates 10 minutes per pound. What is then the value of the combined output of the entire period?

Finally, and we shall return to this, it should not be forgotten that, assuming sale at prices equal to values, the spinners actually paid the old price for the cotton and whatever the subsequent changes in the market, they face the awkward difficulty of recovering, not their replacement costs but their actual costs. Nor is this problem confined to the spinners; it must be faced by the Marxists too, as is the way of the world. For the total expenditure of the previous period of production includes the purchase of inputs at their old values, not their new values. If the total value of inputs falls subsequent to their purchase, where does the lost value go to? This is by no means a scholastic question as can be seen if we assume a rise, instead of a fall, in value. Where did the extra value come from? It could not have come from production, since the amount of value added in the production of yarn is determined only by the living labour employed in the production of yarn. Therefore, it must have arisen in circulation. We have uncovered a source of value other than labour; surely such a great historical discovery, completely refuting the foundations of Karl Marx's thought, should be discussed more widely?

The difficulty is that the concept of 'period of reproduction' cannot be accepted uncritically. Most treatments blithely assume all goods are consumed and produced in one year. This permits at least two possible interpretations. It is normally claimed that inputs to production are entirely consumed at the beginning and outputs entirely produced at the end. But if this simplification is made it must be stuck to. You cannot with one voice claim that all inputs enter production in January and then, when it proves convenient to refute an annoying disturbance, proclaim with another voice that the value they transfer to the product is what they acquire in December. This superficial argument leads to insoluble contradictions, as we shall see.

A more reasonable alternative is to regard the magnitudes involved in a period of reproduction as an average over the year. But in this case it makes a difference whether the change in value took place at the end of the year or the beginning. The average value of cotton in 1990 is not greatly affected by a fall on December 31st 1990 but completely dominated by a fall in January 1st 1990. In general the rise takes place neither in January nor December but over time during the whole year, and the analysis is therefore more or less complicated.

To resolve this issue we must look deeper inside the idea of a 'period of production' and, in fact, the process of abstraction which leads to the concept itself.

We risk a false debate between two 'extreme' interpretations. One extreme is to treat the change 'as if' it occurred at the beginning of the process of production. This corresponds to the fullblown 'replacement cost' valuation and for the reasons given above is logically contradictory. The alternative, against which the 'replacement cost' theorists polemise, is to treat the change in value 'as if' it occurred at the end of the process of production. If this were the case, it would have no effect on the value of the yarn; this is one possible interpretation of the 'sequential' valuation but by no means the only one; we shall argue it is incorrect.

I shall show that in fact neither 'extreme' interpretation is acceptable, neither was adopted by Marx, and both lead to contradictions. A deeper analysis is needed. At least two numerically distinct unit values for the yarn can be deduced from the same set of facts. This contradiction, just like the Ricardian contradiction between values and prices of production, cannot be 'forcibly suppressed' by arbitrarily imposing an extreme assumption.

3 WHAT DOES MARX SAY?

Whatever Marx's view was, it is not reducible to the 'replacement cost' argument given above.

A key passage (among many) is the following from page 317 of Capital Volume I, which Ramos cites in a reply to myself which he submitted to the EEA value theory mini-conference:

> The definition of constant capital given above by no means excludes the possibility of a change of value in its elements. Suppose that the price of cotton is one day sixpence a pound, and the next day, as a result of a failure of the cotton crop, a shilling a pound. Each pound of the cotton bought at sixpence, and worked up after the rise in value, transfers to the product a value of one shilling; and the cotton already spun before the rise, and perhaps circulating in the market as yarn, similarly transfers to the product twice its original value.

[We note in passing, as does Ramos, that this passage strongly supports the view that the value transmitted by constant capital to the product is given by the value of the money used to purchase it, not the elements of this constant capital themselves, and that it strongly contradicts the idea that Marx neglected to transform inputs; in this passage the transformation of inputs is effected. However, this point is not essential to our present argument.]

An uncritical reading of this passage supports a 'replacement cost' interpretation. The value transferred by the cotton to the yarn is not the labour originally embodied in it, but the value it represents at the time of consumption. But there is a key phrase in this passage which cannot lightly be ignored: 'worked up after the rise in value'. That is, the value transferred by the cotton to the yarn has risen because this value rose before the cotton entered the labour process. A vital distinction has been drawn by Marx, between the time of purchase of the cotton and the time of use. In the intermediate period the purchased cotton serves as productive stocks, capital in its P form awaiting the labour process, but not yet worked up into finished goods.

However understanding Marx's position involves more than raiding his works for supporting quotations. Ramos in this citation omits the immediately following sentence:

> It is plain, however, that these changes of value are independent of the valorization of the cotton in the spinning process itself.

That is, the reason the cotton transfers more value to the yarn is not because of some mysterious compulsion on the capitalists to transfer to their goods a value which does not yet exist. The change of value does not arise in the labour process but in the sphere of circulation, externally and prior to the labour process:

> If the old cotton had never been spun, it could be resold at a shilling a pound after the rise, instead of sixpence.

The owners of stocks of cotton have benefitted from a windfall gain. Because the market value (and price) of cotton as a whole has risen through changes in productivity, the value of their cotton is no longer sixpence a pound but a shilling a pound. Their wealth has doubled. This change, however, took place before production commenced; obviously, or they would not be able to resell the cotton in its raw form. Moreover, this rise in the value of cotton, a phenomenon of circulation, must be balanced by an equivalent fall in the value of other goods elsewhere; the windfall gain of the cotton stock owners must be balanced by a speculative drain of value from the stocks of some other good. If not, we return to the unacceptable conclusion that value has been created out of nothing, has arisen from a source other than living labour.

This is the nub of the problem. To employ Marx's own distinction, stocks of cotton entering production function as circulating, not fixed, constant capital. That is, their turnover is less than an annual period of reproduction. Conventionally, this has been taken to mean that stocks of circulating constant capital can be ignored. But in fact what happens is this: during the period of turnover of capital of any sort, a stock of this capital has to be maintained in existence. This stock, which is constantly depleted by production, and augmented by circulation, affects the formation of social or market values and prices and this effect must be allowed for in a full accounting.

The actual size of this stock is determined by the efficiency of the processes of circulation and production or by the relation between what Marx termed the turnover time of production and the period of circulation. Modern Just-In-Time techniques have reduced it to a small proportion of total stocks. However, between theory and actuality lies a simplification; the assumption that production takes a full period of reproduction, normally considered to be one year. If

this simplification is to be maintained consistently then it must be assumed that at the beginning of the period sufficient stocks are purchased to produce one year's output. This results in a distortion, since actual stocks are smaller or larger depending on the efficiency of circulation. In my view, as I shall explain, this distortion has to be removed by reducing the 'period of reproduction' to an infinitesimal size, moving from difference equations to differential equations and from discrete to continuous time. However, the process is by no means a simple one and if the necessary intermediate steps are omitted, the result is contradiction.

4   FIXED AND CIRCULATING CONSTANT CAPITAL; THE NEED FOR A UNIFORM TREATMENT

The error in the 'replacement cost' argument thus arises, essentially, because stocks of circulating constant capital have been left out of the reckoning. However, Marx does not at leave them out of the reckoning and integrates them systematically into his thinking. His whole discussion of the turnover time of capital is directed to exactly this point, because the turnover time of any given capital establishes the ratio between the capital consumed in any period, and the capital advanced at the beginning of this period. If the turnover time of cotton is 3 months, and 10 lbs per month are processed, then 30lbs of stocks are needed to start production. If with the same rate of consumption the turnover time is 6 months, then 60lbs of stocks are required to start production and the capital to be advanced is correspondingly greater. This point is understood not just by Marx but Ricardo, who grasped its deadly implications for his theory of value: namely, it is possible that two producers consuming exactly the same annual amounts of labour and capital can nevertheless have an unequal profit rate.

The turnover of capital is a Great Silence of the modern tradition. It appears as an oddity, a quirky Victorian concern with Engels' accounting practices, and appears seldom if ever in the endless writings on transformation and the rate of profit. Where does this blind spot arise? It begins, as do many such problems, with the peculiar simplification made by Bortkiewicz according to which the whole of society's constant capital is turned over exactly and completely in a year. This simplification, religiously incorporated into virtually every subsequent treatment, is essential to his calculation because if any component of capital turned over in less than a year or more than a year, then his formula for the rate of profit would be false, since the capital advanced would not be equal to the capital turned over. His formula would be revealed for what it is, the calculation not of a rate of profit but of a mark-up on turnover.

The identification of turnover with stock has had a very important side-effect; it has been possible for three generations of writers to forget about stocks. In effect there has been an uncritical assimilation of a distinction between fixed capital and circulating capital which is alien to Marx and derives in fact from Walras via Smith: the notion that fixed capital exists in the form of permanent stocks, while circulating constant capital is consumed instantaneously. Circulating constant capital is thus placed on a par with variable capital (Smith in fact treated variable capital as a kind of circulating capital)

Fixed capital is treated by both Smith and Walras as a qualitatively distinct kind of capital. In Smith's case it is capital which 'does not pass from master to master' while being consumed; for Walras it is capital which is not consumed at all.

This has passed into the modern tradition as the idea that fixed capital, distinct from circulating constant capital, requires some 'special' and distinct treatment, for example using the theory of joint production. This is not at all Marx's conception; as Ramos notes and as we shall discuss, he devotes an entire chapter of Volume III (chapter 6) to the discussion of stocks of raw materials and their impact on value and price formation.

The basis of Marx's distinction between fixed and circulating constant capital can easily be misunderstood. His purpose in drawing the distinction was not to create a qualitative wall between the two forms in which constant capital operate but to establish their qualitative identity as regards the production of value, despite their qualitative distinction as regards the ownership of value. It arises from his polemic with Smith, who reduced gross product to the sum of wages and profits and ignored the value transferred to the product from stocks of capital. The effect of this was to create an account of capitalist reproduction in which it appeared as though the capitalists' stocks were not created by the workers but existed in some sense externally to the process of production as a separate 'factor', an error which subsequent writers transformed into an apologetic tradition that we know only too well.

Marx wished to show that all capital, whether totally consumed in the given period (circulating) or partially consumed (fixed) functions in the same way in the labour process: both as a source of value in the form of dead labour which is transferred to the product over time and as a product of the labour process itself. In the course of reproduction, the workers are obliged to recreate all components of the means by which the capitalists oppress them: not only their own labour power but the property of the capitalists itself, in turn is the basis of the economic coercion which obliges the wage-slave to sell her or his labour to the capitalists. A nominally free contract was thus converted into a relationship of domination and subordination which the worker herself reproduces in the labour process, which conclusion cannot be drawn from Smith's writings.

> The introductory act of circulation, the purchase and sale of labour-power, itself depends in turn on a distribution of the social elements of production which is the presupposition and premise of the distribution of social products, viz., the separation between labour-power as a commodity for the worker, and the means of production as the property of non-workers.(Volume II:461-2)

Bortkiewizc's 'simplification' in which all value is transferred to the product uniformly in a single year, has lent itself to the idea that in order to 'remove' this simplification we have to introduce a special, distinct kind of capital – fixed capital – which transfers value to the product in a different manner. From this have descended all manner of frankly fantastical constructions such as the von Neumann/Sraffa idea that fixed capital reproduces itself by joint production, or that fixed capital is stratified into countless vintages, each a distinct use value in its own right.

At the heart of all such constructions is the perverse notion that there is a qualitative distinction between the way value is transferred from fixed, and from circulating capital. There is no such qualitative distinction; all forms of productive capital exist both as stocks and as flows and the only difference between them is the time it takes for the stock to metamorphose into new products. The real weakness of the Bortkiewicz construction is not that it omits fixed capital, but that it fails to recognise that all capital, including circulating capital, exists simultaneously in the form of stocks and flows. The resultant errors are already present in his treatment of circulating capital and no special introduction of fixed capital is required to identify those errors. What is required is a systematic examination of the manner in which stocks of all kinds enter the process of value and price formation.

Hence what is required is a uniform treatment of the relation between stocks and flows which applies equally to fixed and to circulating capital. This has to be based on the recognition that production cannot take place in the absence of stocks.

This is the key to the entire matter. The principal purpose of our enqury, dealt with fully elsewhere, is to arrive at a general theory of stocks in the formation of values which brings the treatment of both circulating and fixed constant capital under the same roof. When this is undertaken in a consistent manner, the alleged contradictions of the sequential approach vanish and an extraordinarily simple treatment can be arrived at which fully supports Marx's most controversial and contested conclusions.

5 MARX, REPRODUCTION AND REPLACEMENT

I shall return to the calculation outlined above shortly. Before doing so, some further textual evidence will help establish that, whatever Marx's view was, it certainly does not accord with the 'replacement cost' theory foisted on him by his little helpers.

Marx's most exhaustive discussion of both reproduction and replacement appears in the 'Economic Manuscripts of 1861-1863', sometimes known as the 'second draft of Capital' and translated into English in Volume 34 of the collected works of Marx and Engels. I agree wholeheartedly with Fred Moseley that this is one of the most important manuscripts for modern Marxism to understand and absorb. In particular I would like to commend the attention of both Fred and other marxists to pp218-9 of this work, where Marx writes:

> not all of the surplus product represents surplus value; this is a confusion found in Torrens and others. Assume, for example, that the year's harvest is twice as large this year as the previous year, although the _same_ amount of objectified and living labour was employed to produce it. The _value_ of the harvest (disregarding here all deviations of price from value brought about by supply and demand) is the same. If the same acre produces 8 qrs of wheat instead of 4 qrs, 1 qr of wheat will now have half as much value as before, and the 8 qrs will have no more value than the 4 had. In order to exclude all outside influences, assume that the seed was cultivated on specific fields, which yielded the same product as the previous year. Thus a qr of seed would have to be paid for with 2 qrs of wheat, and all the elements of capital as also surplus value would remain the same (similarly the ratio of the surplus value to the total capital). If the situation is different in this example, this is only because a part of the constant capital is replaced in natura from the product; hence a smaller part of the product is needed to replace the seed; hence a part of the constant capital is set free and _appears_ as surplus produce.'

This is flatly incompatible with a replacement cost framework. How are we to interpret the statement that 'a qr of seed would have to be paid for with 2 qrs of wheat'? Marx's point is this: how do the capitalists (for these are capitalist farmers) pay for the seed corn which they purchased at the end of year 1, in order to produce the wheat at the end of year 2? This seed corn is a part of the product of year 1 and its value is, let us say, £1 at the time it is produced. The capitalists produce corn whose value is halved; so the value of year 2 corn is 50p per qr. If the constant capital consumed in order to produce this corn was valued at its _replacement cost_ then the seed corn would have to be valued at 50p, and 1 qr of seed corn would therefore be paid for with the proceeds of the sale of 1 qr seed corn. But it isn't. It is paid for with the proceeds of the sale of 2 qrs of year 2 corn; its value as far as the capitalist is concerned is still the £1 it possessed when it entered production as seed corn.

If the value transmitted to the product by the seed corn were the cost of replacing it, then the value of this year's output could never be affected, in the slightest degree, by the value of last years' output. It would be completely irrelevant whether the farmer purchased their seed corn for £1, £2 or £1,000,000; its value on output would be solely a function of the quantity of seed corn consumed this year, the quantity of seed corn produced this year, and the amount of labour time worked this year, as indeed the Sraffian, simultaneist construction demands.

But the entire section of this work dealing with reproduction contains a far more damning indictment of the entire 'replacement' approach and clearly establishes what Marx himself understood by the concept which he himself introduces, that capitalists must replace their inputs out of the proceeds of sale of the outputs.

The conventional understanding of replacement – from which derives the entire Sraffian concept, for example, of 'surplus product' as well as many presentations of the New Approach 'net product' is as follows: in each period (normally a year) the capitalists produce a certain collection of goods, and consume a certain collection of goods. If they are to restart production, they must, so the argument goes, replace all the consumed inputs in kind – as indeed Marx states in his discussion of simple reproduction.

In this case, the argument runs, the value of gross output can be decomposed – as Marx appears to suggest – into the three familiar components C, V and S. Of these the first two, the value of constant and variable capital, are said to be equal to the value of the inputs which must be purchased in order to resume production on the same scale. S is then the value of the so-called surplus product. On this flimsy foundation almost the whole edifice of Post-Sraffian writing has been constructed. Unfortunately it is somewhat liable to subsidence.

First of all, why should the capitalists replace the inputs they have just consumed? In simple reproduction this takes place by definition; but capitalism cannot exist on the basis of simple reproduction as Marx points out on p199 of Volume II of Capital:

> This assumption [simple reproduction] is equivalent to assuming the non-existence of capitalist production and therefore the non-existence of the industrial capitalist himself. For capitalism is already essentially abolished once we assume that it is enjoyment that is the driving motive and not enrichment itself…It is moreover technically impossible.

If capital is to expand, it must invest not in the same labour process as before but in new and more productive labour process. Steam gives way to electricity, the handloom to the power loom, the boat the the aeroplane, iron to steel and steel to plastic, and cotton itself to artificial fibre. Capitalism is endless revolutions in productivity. The capitalists do not replace their inputs in kind, and those that do soon cease to be capitalists. As Marx points out as early as the Grundrisse, p720:

> As soon as capital is turned back into money, it can transform itself e.g. into conditions of production other than the original ones, throw itself from one branch of production into another one, so that reproduction, regarded materially, is not repeated in the same form [emphasis in original]

Neither the net product, nor the surplus product, in the traditionally accepted sense, even exist, let alone possess a value which can be used as the basis for calculating value magnitudes. The apparent 'compulsion' to replace inputs in kind arises because of fixed capital which imposes for a period (the lifetime of the fixed capital) certain technical proportions on the individual capitalist:

> The introduction of fixed capital changes this…the reproduction of the circulating capital must also proceed in the same material form during this whole time…there can be no doubt whatever that the cycle which industry which industry has passed through since the development of fixed capital on a large scale, at more or less 10-yearly intervals, is connected with this total reproduction phase of capital.(ibid, my emphasis)

But the fixed capital is not renewed in the same form. It is replaced by more productive machinery as a result of technical revolutions which are immanent to capitalist accumulation. And since these revolutions proceed at a different pace and at different times in different branches of industry, the interconnection of these branches means that capitalist reproduction proceeds on the basis of continuous revolutions in value, from which Marx consciously abstracts only in order to study the reproduction of capitalist social relations, in Volume II.

Marx does have a concept of surplus product. But not only is it different from the post-Sraffian concept; he explicitly polemises against such a concept in the passage we already cited from Volume 34, p220: 'not all of the surplus product represents surplus value; this is a confusion found in Torrens and others.' What is Marx's conception of surplus product? Very simple; it is the portion of the product left behind after paying for consumed inputs, not replacing them. It is the surplus remaining after replacing, not the use-value but the exchange-value of the consumed constant and variable capital. This is the diametrical opposite of the replacement cost 'theory'.

His conception is this: the gross product is sold at the end of the year for a certain sum of money. Out of this money certain outlays have to be met since the capitalist began with a sum of money with which s/he made a number of purchases that must be reimbursed as a minimum precondition for the expansion of this sum. These having been paid for, what remains is profit, or surplus value, which over the whole of society is the same thing.

Thus the gross product is not decomposed by Marx into use-values which replace C, use-values which replace V and use-values consumed as S, but into exchange-value which replaces C, exchange-value which replaces V and the residual exchange-value, S.

It is the exchange value – that is, the money – which has to be replaced, not what this money purchased. In actual fact the capitalist, having realised the sale of the gross product, is by no means obliged to replace either C or V in kind and will in fact spend it according to the normal rules of capitalism, that is, in such a way as to maximise profits.

6 EXPANDED REPRODUCTION WITHOUT STOCKS: AN ILLUSTRATION

In the special case of simple or proportionate reproduction, the replacement of exchange value coincides with the replacement of use value. But once we depart from this and take into account relative surplus value and hence expanded

reproduction, the coincidence vanishes and we must choose: Marx, or Sraffa; fact or fiction. They are not the same and they lead to different results.

This important fact has been neglected because Marx never completed his study of expanded reproduction, the topic on which he spent the last years of his life. The fragment on expanded reproduction in Capital Volume II offers only examples of what I term proportionate expanded reproduction, which sets aside technical change.

Nevertheless Marx discusses the impact of technical change on accumulation in many places, not least Volume 34 to which we have referred, and chapter 6 of Volume III. In both of these he furnishes a concept essential to our understanding of what is involved in the replacement of inputs, and hence the accumulation of capital, under conditions of technical change, that is, relative surplus value. This is the concept of the release or tie-up of capital.

We shall illustrate this with an example, presented somewhat hastily to the 1995 EEA mini-conference on value theory, which completes this presentation and hopefully serves as a reference. In this example stocks of constant capital are not preserved from one period to the next because we want to illustrate the concept of tie-up and release, as well as the contradictions of the replacement-cost method, in their simplest form. Stocks of capital will be introduced in the next section.

Begin with two departments (I and II, as normal) which, in a given period we shall call period 1, consume and produce the following use-values:

```
I:      36(I)   £1200(V+S)   =>   60(I)
II:     18(I)   £ 600(V+S)   =>   15(II)
```

Here the subscript I means 'commodities serving as means of production' and the subscript II means 'commodities serving as means of consumption'. The term £1800(V+S) in the first circuit means that labourers are employed for a time that creates new value equal to £1800. £1 is assumed to be the monetary expression of 1 hour's labour throughout, so that this could equally have been written as 1800 hours. The arithmetic is easier to follow if, as Marx does, we write this directly as the number of pounds which the labourers add to the product.

In order to establish an agreed, common starting point let us assume that in the first period the prices of the two commodities are £50 and £100 respectively. These are the prices which would permit simple reproduction with no change. Since the organic composition of the two departments are the same, these prices are also equal to values, allowing us, as throughout, to ignore any complications arising from the transformation of values into prices.

We now assume that the real wage is constant and equal to 1 unit of commodity II for each £200 of added value (that is, for each 200 hours worked). The unit value of labour power is thus always 1/200 of the unit value of wage goods, whatever at any time this may be

To introduce the notation throughout we summarise the effect of reproduction by placing exchange values in square brackets, preceded by a £ sign and followed by a symbol showing whether they correspond to Marx's constant or variable capital, to surplus value, or a combination of these:

```
I (pI = £50)     36(I) [£1800C] + £1200(V+S) => 60(I) [£3000(C+V+S)]
II(pI I= £100): 18(I) [£ 900C] + £ 600(V+S) => 15(II)[£1500(C+V+S)]
=================================================================
Total            54(I) [£2700C] + £1800(V+S) =>       [£4500(C+V+S)]
Less the wage:                   - £ 900(V)  gives £900S
```

So far this is perfectly straightforward and reasonably uncontroversial. Note, however, that at the end of production there is a surplus of 6 units of I as well as 9 units of II. The capitalists, therefore, do not receive all their surplus in the form of wage goods but accumulate a hoard of investment goods, which in the next period they use for the purpose of accumulation.

Now suppose that by the end of period 1 a new technology is available which permits the use of more constant capital with the same labour to produce a greater output, so that the gross output of department I may be deployed as follows:

```
I:     40(I)  £1200(V+S)   =>   80(I)
II:    20(I)  £ 600(V+S)   =>   20(II)
```

The two methodologies (simultaneous or 'replacement cost' and sequential) now diverge. First, we work through the sequential calculation. This assumes that the value transmitted to the product in period 2 by the consumed means of production is equal to the money which was paid for them, that is, their value at the time when production commenced. There are now, as a result, two different sets of prices(=values); the price of inputs and the price of outputs

This gives the following calculation

```
I(pI (in)= £50):       40(I)[£2000C] + £1200(V+S)=> 80(I) [£3200C+V+S]
II(pII (in)= £100):    20(I)[£1000C] + £ 600(V+S)=> 20(II)[£1600C+V+S]
=================================================================
Total                  60(I)[£3000C] + £1800(V+S)=>       [£4800C+V+S]
Less the wage:                         - £900V  gives £900S as before
```

Note that the unit price(=value) of outputs is given quite simply as the total price of each output divided by the total produced quantity of this output, namely

```
pI(out) = £3200/80 = £40
pII(out) = £1600/20 = £80
```

Prices have thus declined somewhat, corresponding to the rise in labour productivity, but have not yet fallen to their hypothetical equilibrium value, of which more later. As before there is a surplus of department I goods, this time 20I and as before this is re-invested resulting in further accumulation.

Finally, we move on to a third period in which technology improves once again. The new technology is represented by

```
I:  50(I) £1200(V+S) => 100(I)
II: 30(I) £ 600(V+S) =>  30(II)
```

The value calculation, conducted as before, yields

```
I (pI (in)= £40): 50(I)[£2000C] + £1200(V+S) => 100(I) [£3200(C+V+S)]
II(pII (in)= £80):30(I)[£1500C] + £ 600(V+S) =>  30(II)[£2100(C+V+S)]
======================================================================
Total:            60(I)[£3500C] + £1800(V+S) =>          [£5300(C+V+S)]
Less the wage:                   - £ 720(V) gives £1080(S)
```

S is larger because wage-goods are now cheaper (relative surplus-value) Output values are now

```
pI(out) = £3200/100 = £32
pII(out) = £2100/30 = £70
```

lower still, but still not as low as the (new) equilibrium. Two observations are pertinent

1) for what it is worth, this is yet another illustration where the rate of profit clearly falls as predicted by Marx, and the organic composition rises, despite the cheapening of constant capital. As we shall see, the simultaneous calculation yields the opposite result. This difference is precisely because constant capital does not depreciate instantly to its equilibrium value as the replacement-cost hypothesis proposes but according to a definite process over time in which the accumulation of use-values outstrips their decline in value.

2) Consider the decomposition of the value of the gross product of period 2, £4800(C+V+S). In this sum,

> £3000C replaces the value of constant capital
> £ 900V replaces the value of variable capital
> £ 900S is available as surplus value for either private consumption or accumulation

Alternatively, we could decompose the gross product not in terms of its past but its future use. This gives us

> £3500C newly-accumulated constant capital
> £ 720V new variable capital
> £ 580S consumed surplus value for private consumption alone.

But now a striking fact emerges. If the capitalists were simply to replace their consumed capital in kind, their outlays would be as follows:

```
I:  40 units of C now costing £40 each = £1600
  1200 units of V now costing £0.40   = £ 480
Total:                                 = £2080 to replace used inputs

II: 20 units of C now costing £40 each = £ 800
    600 units of V now costing £0.40   = £ 240
Total:                                 = £1040 to replace used inputs

Overall:   60 units of C            =£2400
           1800 units of V          =£ 720
           Total replacement costs  =£3120
```

That is, £3120 is required simply to resume production at the same level; certainly not equal to the actual investment of £4220. £1100 has been added to the capital originally advanced, that is, it has accumulated. How can it be that £1100 worth of accumulation takes place, when there is only £900 surplus value and, moreover, the capitalist have consumed £580 of this privately? From somewhere, an extra £780 has become available for the capitalists to appropriate. Moreover gross sales amount to £4800. Thus, after the 'physical' replacement of inputs £1680 remains as a 'surplus' which is all available for expansion. Yet surplus value is only £900. The fund available either for private consumption or accumulation is greater than the surplus value by this same £780. Where does it come from?

The mystery is solved if we observed that the replacement of the money-form of the advanced capital by no means coincides with the cost of replacing their material form.

The difference is entirely accounted for by the very feature which the replacement cost hypothesis assumes out of existence: the decline in the cost of inputs, that is, it is the difference between the historical and the replacement cost of these inputs. This sum does not vanish. It is available to the capitalists as an additional accumulation fund, designated 'released capital' by Marx. This is defined in Volume III on p206:

> The first question that arises is what it is that we understand by the release and tying-up of capital. Revaluation and devaluation, for their part, are self-explanatory. We simply mean that the capital present increases or decreases in value as the result of certain general economic conditions (since what is involved here is not the particular fate of one single private capital), i.e. that the value of the capital advanced to production rises or falls independently of its valorization by the surplus labour it employs.
>
> By the tying-up of capital we mean that, out of the total value of the product, a certain additional proportion must be transformed back into the elements of constant or variable capital, if production is to continue on its old scale. By the release of capital we mean that a part of the product's total value which previously had to be transformed back into either constant or variable capital becomes superfluous for the continuation of production on the old scale and is now available for other purposes.

The sum of £780, essential to the understanding of the accumulation process, is wished out of existence by the simultaneous calculation. But it is of immense practical importance. It is part of the mechanism whereby accumulation breeds accumulation – creates the surplus required for its own continuation – not just through simple hoarding but because innovation itself, ceaselessly cheapening inputs, creates an essential additional fund. It is the existence of this very fund which doubles and redoubles the competitive edge, not just of the innovating sectors but the innovating nations, in the intercapitalist struggle which creates the extremes of rich and poor that make up the brave new world order we are now inhabit. To ignore this most characteristic feature of our age is a profoundly apologetic treatment of actually-existing capitalism.

Finally, we now rework the material reproduction scheme given above, for the first two periods, according to the 'replacement cost' or simultaneous method to illustrate the contradictions to which it gives rise under conditions of technological change. Values (and use values) in the second period concerned now appear as follows:

Period 1 is no different from before:

```
I (pI = £50)      36I [£1800C] + £1200 V+S  =>    60 I [£3000C+V+S]
II(pI I= £100):   18I [£900C]  + £600V+S     =>    15II [£1500C+V+S]
========================================================================
Total             54I [£2700C] + £1800 V+S  =>         [£4500C+V+S]
Less the wage:                  - £900V  gives £900S

 Period 2, however, must satisfy the constraint that input prices and output
prices are the same:
 I (pI = £30)     40I [£1200C] + £1200 V+S  =>    80I [£2400C+V+S]
 II(pI I= £60):   20I [£600C]  + £600V+S     =>    20II [£1200C+V+S]
 Total            60I [£1800C] + £1800 V+S  =>         [£3600C+V+S]
 Less the wage:                 - £540V  gives £1260S

 Likewise period 3 yields:
    I (pI = £24):    50I [£1200C]  + £1200 V+S  =>    100I [£2400C+V+S]
    II(pI I= £43):   30I [£720C]   + £600V+S    =>    30II [£1320C+V+S]
 Total               80I [£1920C]  + £1800 V+S  =>         [£3720C+V+S]
 Less the wage:                    - £387V  gives £1413S
```

Two assumptions are possible; either the outputs of each period are sold at the prices of that period, or at the prices of the succeeding period. Take the second assumption first: the outputs of period 1 are sold at the prices of period 2 and the outputs of period 2 are sold at the prices of period 3. The following questions then arise:

Question 1) According to the calculation of period 1, the value (and price) of outputs totals £4500. How can then they then sell for 60I × £30 = £1800 in department I and 15II × £60 = £900 in department II, totalling £2700?

Question 2) Continue with the assumption that in period 1 sales are £2700. But total costs were £2700+£900=£3600. Profit in period 1 is therefore negative at –£900, a fact that may evoke memories for some. Where did the surplus

value go?

In effect we have two sets of estimates for S and for gross sales. The first are perfectly and legitimately Sraffian and indicate that, regardless of any subsequent change in prices, a physical surplus worth £900 arises from sales of £4500. But the second are perfectly and legitimately capitalist and indicate that, since prices do change, sales are only £2700 and a profit of – £900 is made. These two sets of magnitudes are in flat contradiction.

Question 3) It gets worse: What now is the profit of period 2? Sales are £1920+£860 = £2780, using period 3 prices. But inputs to production cost the capitalists £1800. Profits are £980, which is satisfyingly positive but unfortunately a tad short on the replacement cost estimate of £1260. It gets a little hard to maintain that the physical approach provides an 'explanation' for the relation between surplus value and profit.

Alternatively, take the second assumption: suppose that the inputs to period 2 are purchased (and hence sold) at their period 1 prices. The same dilemma, however, now presents itself in reverse:

Question 4) What is the profit of period 2? Sales are £3600 But the cost of inputs to the capitalists must now be reckoned at period 1 prices, £4000C + £900V= £4900C+V . A surplus value of £1260 has been transformed into a loss of £1300.

In conclusion, it is perhaps unfair to refute the replacement cost theorists using a calculation which I impute to them without knowing what they themselves would do, although there has been little hesitation in interpreting Marx in a similar manner. But a bit of fun does no more than set the record straight: I therefore leave this section with a challenge, because challenges have become part of the tradition.

Let any defender of the surplus approach, or of replacement cost calculations, consider the physical reproduction schema outlined here, which is a completely unexceptional possibility, and explain how prices may be assigned consistently to the successive periods of reproduction so that:

1. A simultaneous equation system is satisfied in each period;
2. Gross output in each period decomposes into the cost of raw materials, labour costs, and profits;
3. These costs are equal to the money price of the commodities identified as comprising raw materials, wage goods and capitalist consumption.
4. Surplus value is equal to profit in each period.

7 STOCKS AND VALUE FORMATION

Finally we come to the proposed resolution of the issue. The reader should refer straight away to chapter 6 of Volume III of Capital dealing with the effect of changes in price. Here Marx on p207 re-iterates the position already established in Volume I:

> If the price of a raw material rises – cotton for example – the price of cotton goods rises as well: both semi-finished goods such as yarn, and finished goods such as cloth, etc which are produced with this more expensive cotton. And cotton that has not yet been worked out, but is still in the warehouse, rises just as much in value as cotton that is in the course of manufacture. As the retrospective expression of more labour-time, this cotton adds a higher value to the product which it goes into as a component than it possessed originally and the capitalist paid for it.

I have no hesitation in accepting that this, like the Volume I passage, runs completely counter to a 'simplistic' sequential assertion that the value transferred to the product by the cotton is simply equal to the value it possessed when it was purchased. But here Marx makes the position even clearer: the revaluation applies to cotton 'that has not yet been worked out', that is, which exists in the form of stocks awaiting production. As such, these commodities still function as commodities, and therefore possess both use-value and exchange value. Why? Because they can just as easily be removed from the production lines and sold off just as if they had just been produced. They are still part of the total stock of commodities in circulation. This stock does not consist only of commodities which actually trade at any given time, but all commodities which are available for trading, in short all commodities to which a price attaches.

A new question then arises: how do such stocks of commodities enter into the formation of market values? Suppose, for example, there are 100,000 lb of cotton worth £1 per lb lying either in warehouses or at the entry to the spinning mills, and to this is added 1 lb of cotton costing 50p per lb. Does anyone imagine for an instant that either the value or the price of cotton will sink to 50p per lb? If it did so, from where would the cotton be found to meet the new demand that would inevitably arise from such a dramatic price reduction? From the 1 lb of new cotton? Or from the 100,000lb of stocks which have already been designated to enter the production of perfectly saleable yarn? What could possess the capitalists, apart from a terminal attack of neoricardianism, to sell off their perfectly usable stock of raw materials at a 50% loss?

This is, in fact, exactly what Marx states:

> The smaller the amount of stock to be found in the production sphere and on the market at the end of the business year, at the time when raw materials are supplied afresh on a massive scale (or, in the case of agricultural production, after the harvest, the more visible the effect of a change in raw materials (ibid p208)

There is an exact parallel with Marx's approach to the formation of market values, as a social average of the individual values produced by each producer in the market for a commodity. And indeed, this makes perfect sense. Consider the quantity of cotton on the market in any given period, and suppose there are two producers of whom one supplies 20,000 lbs at an individual value of £1 per lb, one of whom supplies 40,000 lbs at 50p per lb. Then as Marx says, the market value of this cotton will be the weighted average of the two, namely its total value of £40,000 divided by its total mass of 60,000lbs, or 75p.

We cannot here rehearse the important debate about whether, because of the operation of supply and demand, the actual market value lies above or below this magnitude. For our own part we are satisfied that the market value is a strict, arithmetic, weighted average taken over all commodities in circulation. Even those who depart from this must surely acknowledge that the market value is in general not equal to the individual value of the most efficient producer, and that some kind of averaging process locates it between the least efficient £1 and the most efficient 50p.

But there is no possible way to distinguish a new producer who has just made 20,000 lbs of new cotton, and a stockist who happens to have stored up the same quantity at the same value. As far as the market is concerned, these are just amounts of cotton available for consumption, and there is no way the process of formation of market values can effectively distinguish stocks from new production. It follows that as far as this formation of market values is concerned, stocks of constant capital count exactly as if they had just been produced.

We now near the solution to the problem in hand. Suppose, to take one extreme, that from the moment production of yarn begins, a new set of circumstances begins to release new cotton onto the market with a value of one-sixth of the former. The value that already-existing cotton transfers to the yarn will then depend on the market-value of cotton in general, and this will begin to fall below its old value. But the extent to which it sinks below this old value will depend on the relative weight of the stocks of cotton purchased at the old value, and the stocks of value produced at the new value. Exactly as Marx says: if the stocks of cotton produced and purchased at the old value are large in relation to the stock of cotton as a whole, then the value of cotton will be close to this old value. Therefore, at the beginning of the period of reproduction, the value transferred to the yarn will be close to the old value. Only as production proceeds, and the total stocks of cotton begins to change its proportions, will the value of cotton sink to the new value. And only with the last pound of yarn, when the old cotton is almost totally replaced by new cotton on the market, will the value transferred to the yarn fall to its new value.

But then the total value transferred to the yarn is an average over the whole period of reproduction. This is neither equal to the value which the cotton possessed when it was purchased, nor the individual value of new cotton at the time when the yarn is sold. Neither 'extreme' solution will do; a new synthesis, which properly accounts for the existing stocks of cotton, is required.

8 FIXED CAPITAL AND VALUE FORMATION

The interesting question we must now confront is: how does this analysis modify the treatment of fixed capital? In my view decisively. In principle there is no difference between constant capital which exists as a stock of raw materials, and constant capital which exists as a stock of machines. Both are commodities, a unity of use and exchange value. Both can be removed from production and sold on the market. The only difference is that a used machine enters the market not as a new machine but as a used one – in short a secondhand machine. Nevertheless, it remains a machine, and its use value remains to do what machines do. In the market for printing machines, for example, many firms can and do make a decision between a new and expensive printing machine, and a partly-used and cheaper machine, and they do so on the assumption that in either case they will get something whose use-value is to print.

My view, therefore, is that the famous von Neumann construction in which old machines are treated as the result of joint production, so that new machines produce old machines by the simple process of getting older, is essentially too clever by half. In a unified treatment, all that happens is that the machine, like any other commodity stock, gets used up as time goes on. And I think there is ample evidence that this is how Marx saw it.

There is, however, an additional benefit from this treatment: we can gain great additional insight into one of the most important world processes before us today: the process by which technological change 'develops underdevelopment' as Andre Gunder-Frank puts it. Instead of generalising to the third world, new technology constantly regenerates their backwardness. How is this possible? Neoclassical theory has no explanation for it, and the vital marxist debate on unequal exchange which opened up in the sixties seems to have died away. I think it is time to re-open it.

In my view, much technological innovation introduces *new but more efficient machines of the same type* as machines currently in existence – as, for example, the history of the Intel series of x86 computers amply demonstrates. What then happens to the value investment of people – or countries – who own old and more expensive machines? My answer is that the value of their investment is *transferred* to the owners of new and cheaper machines. This is a normal feature of the averaging process. If country A has spent £1000,000 on 1000 computers (£1000 each), and country B now spends £500,000 on 1000 new computers, the average value of a computer is now £750. Every old computer has fallen in value by £250, not because it has been used up, but because of technical change in its rival country.

The most spectacular manifestation of this process has been the reinsertion of Eastern Europe into the world market. About 75% of East Germany's productive capacity was wiped out almost overnight by this single step. It did not *decay*

or get used up overnight; it became worthless overnight, because the socially necessary labour contained in it was instantly drained into the rival countries with whom it now had to compete.

9 DEPRECIATION AND FETISHISED COSTS

The implications of this are theoretically important and open a substantial new field of investigation. To finish the article with just one of them; what *exactly* is the meaning of depreciation? Why is capital stock depreciated over a period of about five years as a normal accounting practice? This is not because of some peculiar physical characteristic of the machinery, so that all fixed things automatically perish after five years. It is a reflection of the general speed of technical innovation. It is an unconscious recognition by capital that the pace of change will exhaust the value of their investment during the boom phase of a business cycle, *whether or not they use up a single particle of the machine's bodily form*. Otherwise, it would be easy to avoid depreciation by placing stock in cold storage, mothballing it, in effect hoarding it. The fact that machines, with the exception of collectors' items, cannot be hoarded – unlike money, unlike minerals with rarity value, and unlike agricultural goods in precapitalist formations – has been less analysed than it deserves.

In my view a substantial part of depreciation – and there is textual evidence in Marx which supports this – is a *fetishised form* of the impact of technical change. Returning to the case of countries A and B above, for example, the accountants advising country A (most of whom are almost certainly trained in country B if not citizens of it) will certainly *not* tell country A that £250 out of every £1000 of its past labour has served to inflate the wealth of country B. Instead, they will inform them according the best accounting practice, that country A has incurred £250 in *depreciation costs*.

This is in part true; to the extent that the natural life of the machine has become shorter. But to the extent that its natural life has been foreshortened by developments in country B, what this instruction amounts to is an edict that the past labour of the technogically-backward must supplement, as if by some natural law, the past and present labour of the technologically advanced. But the law is not natural at all; it is a pure phenomenon of the operation of the market, and country A can evade it if it successfully distances itself from the world market.

10 CONCLUSION

Many people, secure in their lifelong conviction that the simultaneous road is the only road, seem to regard the issue of replacement costs as the definitive refutation of our objections to this road. But, as anyone who studies the standard interpretation with an open mind will discover, it refutes nothing, and throws up more problems than it solves. It is comforting but unedifying to rely on the tried and tested. When the tried is tested and found wanting, it can no longer be relied on. Whatever you, the reader, thinks of the solution I give, I hope I have convinced you of one thing: there is a question to which it corresponds. I think our knowledge can only advance if you try to answer it.