Relative Surplus Value and Expanded Reproduction

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THE PROBLEM STATED

In the early part of this century a debate erupted among Russian and German economists. It was started by Rosa Luxemburg's *Accumulation of Capital*, which asked the question: how can capitalism reproduce itself? It was continued by many, including Nikolai Bukharin, whose reply, seven years after her death and widely considered definitive, sums up the modern approach to this question. In essence, he asserted an equilibrium growth condition which the equations would have to satisfy in order for capitalism to exist on the basis of Marx's equations for simple and for expanded reproduction.

The debate is not confined to Marxists: in essence, the same solution as Bukharin's is to be found in von Neumann's growth theory and in most accounts of expansion with constant proportions including modern post-Sraffian writings.

If one confines oneself to the constant proportions of inputs, it is however impossible to represent the most fundamental phenomenon of capitalism, namely technical change as the driving force of accumulation. The effect of technical progress is not only to increase the output achieved by a given mix of inputs but also to change the mix. The difficulty is hence that we cannot reproduce, within the confines of expansion in constant proportions, one of the most central features of the way capitalism actually accumulates and expands.

This process of accumulation is moreover 'temporal': an economy does not skip seamlessly from one technical structure to another, as envisaged in the equilibrium studies of this question. Instead, the surplus left over at the end of any given period in fact constitutes the stock available for investment in the next. If it is not made available, it cannot be invested, and conversely, if it is not invested (or consumed) it cannot be sold. The 'condition of reproduction' proposed by Marx in Volume II of Capital is built around this identity: it asks how (and to what extent), at the end of a period of reproduction, society can produce the outputs that are to be consumed in the next. This is a temporal, not an equilibrium, condition. It states the logical prerequisite of transition from one period to the next, and does not require the presupposition that the proportions of production are preserved through this transition. Marx succeeded in demonstrating that this transition could be achieved under the limited circumstances where proportions are constant, and all subsequent development (except Luxemburg) imposed this condition. It is however not only unnecessary but incapable of exhibiting how reproduction can combine with technical change – that is, it cannot exhibit or explain the most fundamental fact of capitalism.

This article attempts to expand and generalise the discussion by combining 'reproduction' with Marx's category of relative surplus value – in essence, the investment of accumulated surplus to raise the productivity of capital.

It provides a detailed numerical example which combines technical change with growth, applying the toolbox of analytical constructs which Marx constructed in the early 1860s to study technical

change – relative surplus value, the release and tie-up of capital, and moral depreciation – and arrive at a fuller and more general statement of the question.

The status of 'simple' and 'proportional' reproduction in modern economic thought.

In the mind and writings of most modern commentators Marx's basic analytical abstraction is the concept of simple reproduction. Its original intention was to show how capitalism creates the preconditions for its own existence, on the prior assumption of exchange at values. It has been extended far beyond this to a *definition* of value, and beyond this a representation of capitalism as it might really exist, the basic construct from which to derive all Marx's categories and findings.

Marx's own view of simple reproduction was blunt and to the point:

> 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. (CII:p199)

If half the attention devoted to establishing – falsely – that Marx believed the profit rate was everywhere and unformly equalised, had been set aside to explain why simple reproduction is a completely unviable abstraction, the world of economics today would be a great deal healthier.

Simple reproduction is incompatible with capitalism for a simple reason: a system founded on the self-expansion of value is founded on *accumulation*, the expansion of productive capital. Unless the surplus value created by the workers is not merely realised but re-invested, the capitalist system as we know it could not exist. Nevertheless, Marx's 'correctors' have proceeded to reconstruct a virtual world on the basis of the assumption that this does not happen. They have converted an abstract analysis into a definition.

The value-price relationship then becomes a relation between two independent sets of simultaneous equations referring to two different societies, both engaged in simple reproduction but with the first exchanging at prices equal to values and the second at equal profit rates. This translates into the assumption that society exactly and proportionately reproduces the *same* inputs each year. The very idea of a 'physical surplus' *à la* Surplus School depends upon it.

A series of fundamental flaws pervade this interpretation. In our recent *Capital and Class* article we singled out some. Here we choose to concentrate on the following two:

(I) what if society fails to reproduce an input? Then there *is* no identifiable part of the product which can be said to 'contain' or 'consist of' the surplus. If society uses up its steam engines forever, replacing them with diesels then these engines serve as inputs but simply do not appear as an output. Thus the concept of 'net product' on which so much modern 'marxism' depends is a radically false conception.

(II)what if society in a given period fails to sell an output? Then the simultaneous equations on which the deduction of both Marx's value and price of production categories has been made to depend, no longer hold.

Technical change and the transformation of money into capital

Marx's opposed perspective emerges as early as the *Grundrisse*:

> 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* (*Grundrisse* 720, emphasis in original).

The '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)[1]

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, as we shall see, 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. It is therefore no part of Marx's approach at all to assume the perfect or proportionate material reproduction of society.

Even if material inputs appear as a subset of outputs, any departure from simple reproduction poses serious difficulties for the traditional derivation of value. Divide society into departments I and II in line with tradition and suppose they consume and produce the use values in Table 1:

	I	II	Labour power	Outputs of I	Outputs of II
Department I	20 tons	0	£100	30 tons	
D_{II}	10 tons	0	£50		30 bushels

Table 1 Simple reproduction with equal organic composition and no surplus

where £100 of labour-power means that the labour employed has a value-creating capacity of £100.[2] The money-expression of the value of I is supposedly given by

$$20p_1 + £100 = 30\,p_1$$

so that $10\,p_1 = £100$ and hence $p_1 = £10$ per ton. Hence the 10 tons consumed in D_{II} cost £100 and so wage-goods cost £5 a bushel.[3] We might try to 'justify' the fact that these goods sell at prices equal to values by pointing to the equal organic composition of the sectors. From this point of view, the fact that goods sell at values is a 'consequence' of choosing proportions with this happy mutual relation. But suppose the output of department I changes as in Table 2:

	I	II	Labour power	Outputs of I	Outputs of II
D_I	20 tons	0	£100	45 tons	

D_{II}	10 tons	0	£50		30 bushels

Table 2 Simple reproduction with equal organic composition and a surplus of investment goods

What happens to the extra 15 tons? It is surplus to requirements; there is no demand for it unless either D_I or D_{II} changes the structure or scale of its inputs. Consequently, unless the interaction of demand and supply are suspended, its price falls below its value. This arises *in spite of* identical organic compositions, with no migration of capital, and expresses a mechanism which if anything affects petty commodity producers even more wildly than industrial producers.

Those who deduce values from simultaneous equations – nearly everyone who writes in the Marxist tradtion – must hence assume either explicitly or implicitly that deviations of supply from demand either do not happen, or happen purely accidentally and temporarily. It must be assumed that no systematic process causes society to produce more or less than the demand it has already generated.

In general we term this the assumption of *proportionate material reproduction* or simply *material reproduction*. This consists of either simple reproduction in kind, or at most *proportionate expanded reproduction*, sometimes called 'balanced growth' or a 'von Neumann ray', in which production expands in constant proportions with no change in labour productivity. This is the operational basis of the simultaneous method. Its prices and values, as we have explained elsewhere, are deduced from this assumption, inverting Marx's own analytical procedure. This gives rise to the almost universal belief, for which Sraffa is mainly responsible, that values and prices are completely fixed once the system of material reproduction is given; that is, 'technology determines values'. This is not true, and is neither Marx's starting point, his end point, nor a primary abstraction. All but seventeen pages of Volume I, most of Volume II and all of Volume III are rooted in a conception radically at odds with the above idea, namely that capitalism is a system which *converts surplus value into capital*. As we shall show, this is incompatible with proportional material reproduction and obviates all the above traditional procedures and conclusions.

Material preconditions for the conversion of surplus value into capital

The system of Table 1 cannot convert surplus value into capital. Although there is positive surplus value and a surplus product provided the real wage is less than ½ bushel per £1 of added value; no surplus of means of consumption remains after capitalists have paid for their expenses. However much they want to invest their surplus they can't, because it is in the form of means of consumption.

Only a system like Table 2, which produces capital goods in excess of what is required to restart reproduction, permits the conversion of surplus value into capital, as Marx recognises:

> It is presupposed, therefore, that there has in fact already been reproduction on an expanded scale, for in order to be able to transform the money (the surplus-value hoarded up in money) into elements of productive capital, these elements must be available on the market as commodities (CII:566)[4]

This has a necessary counterpart in the hoarding of money, the creation of a reserve fund which makes purchases not continuously but periodically:

> It [absence of hoarding] is moreover technically impossible. The capitalist must not only form a

reserve capital to guard against price fluctuations, and in order to be able to await the msot favourable conjunctures for buying and selling; he must accumulate capital, in order to extend production and incorporate technical advances into his productive organism.

To put it bluntly, simple reproduction is incompatible with the premise of Marx's work, namely accumulation. But this in turn is compatible with exchange at values only under exceptional and very limited circumstances.

EXPANDED REPRODUCTION WITHOUT STOCKS

In the special case of simple or proportionate reproduction, two conditions are met which Marx never assumed to be the full basis of capitalist accumulation and which are not, in fact, the basis of capitalist accumulation. These are:

(I) there is no technical change

(II) no stocks are left over at the end of a period of production

An essential consequence of this, the basis for the entire possibility of the surplus approach, is that the replacement of exchange value coincides with the replacement of use value. However, in all Marx's extensive works on accumulation, and many of the passages in Volume II itself, neither of these two basic assumptions hold and the conclusion itself is held up to ridicule. We will provide extensive examples of this in the longer paper available at the conference session on this issue. Marx's framework, *Relative Surplus Value,* assumes that technical changes is built into the process of accumulation, which means that in each period, the technical coefficients and hence the quantities consumed and produced in each department, will not only change in magnitude but in their relative proportion. Marx never furnished examples in which this took place though he signalled his clear intention to do so. Nor did any of the protagonists in the accumulation debate at the turn of the century, nor the growth debate in the Soviet Union. This is an extraordinary omission, and has dogged the evolution of economic thought throughout this century.

But once we depart from this and take into account relative surplus value and hence expanded reproduction, the assumptions must be dropped and the conclusion does not follow. It turns out that the reproduction of society, as well as Marx's basic categories – surplus value, profit, surplus – can only be studied by treating the commodity, as it indeed is, as an integrated totality of use value and exchange value. we must choose: Marx, or Sraffa; fact or fiction. They are not the same and they lead to different results.

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.

£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.[1] 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.

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:

$$\text{I:} \quad 36_I \quad £1200(V+S) \quad => \quad 60_I$$
$$\text{II:} \quad 18_I \quad £\,600(V+S) \quad => \quad 15_{II}$$

Here the subscript I means 'commodities serving as means of production' and the subscript II means 'commodities serving as means of consumption' (Marx's departments I and II respectively). The term £1800(V+S) in the first circuit means that labourers are employed for a time that creates new value equal to £1800.

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 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:

Department	Unit price in this department	Constant capital consumed		Value added by labour		Result at the end of this period
I	$p_I = £50$	36_I [£1800C]	+	£1200(V+S)	=>	60_I [£3000(C+V+S)]
II	$p_{II}= £100$	18_I [£ 900C]	+	£ 600(V+S)	=>	15_{II} [£1500(C+V+S)]
Total		54_I [£2700C]	+	£1800(V+S)	=>	Heterogeneous use-values with combined value [£4500(C+V+S)]
Memo		*Less the wage*	–	*£ 900(V) leaves £900S*		

Period 1

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[1] Some readers accustomed to the idea that price is measured in money, and value in hours, may be puzzled by this. I would draw their attention to Raomos and Rodriguez' chapter in *Marx and non-Equilibrium Economics* which clearly grounds the method of this article and all TSS material – namely, value has two measures, money and labour-time or as Ramos and Rodriguez call them, extrinsic and intrinsic. Price is a *form of value* and therefore it too has these same two measures. The relation between the two measures has been given the name, among TSS scholars, of 'Monetary Equivalent of Labour Time' or MELT. There is no need, in this paper, to introduce the complication of a changing MELT and it is therefore assumed constant. The reader is free, if it helps, to read £1 as '1 hour' and vice versa.

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. Society as a whole consumed 54_I and 6_{II}, but it produced 60_I and 15_{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:

$$\text{I:} \quad 40_I \quad £1200(V+S) \quad => \quad 80_I$$
$$\text{II:} \quad 20_I \quad £\,600(V+S) \quad => \quad 20_{II}$$

This is a *technological change* from one period to the next, and takes us out of the normal terrain in which this question is discussed. We *drop* the supposition, found in almost all treatments in this discussion, that the ratio between inputs, outputs, and labour time, is the *same* whilst moving from one period to the next. We now have to ask, therefore, how the 'new' round of production with its new technology, is going to make use of the surplus which it inherited from the previous round of production.

However reproduction can still be achieved: the 60 units of Dept I which were produced at the end of period 1 will be exactly consumed in period 2; likewise (on the basis of our assumption about the wage) the 15 units of output from Dept II. We suppose throughout that any output of department II which is not consumed by wage-earners, is consumed by capitalists.

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)[2]; the price of inputs and the price of outputs. It so happens, as a result of our choice of initial technology, that the output price of the first period of production is the same as the input price of that period. This being so, at the beginning of this next period, p_i is still £50 and p_{II} is still £100. As we shall see, these prices do not now remain constant.

Department	Unit price in this department	Constant capital consumed		Value added by labour		Result at the end of this period
I	p_I (input price) = £50	40_I [£2000C]	+	£1200(V+S)	=>	80_I [£3200(C+V+S)]

II	p_{II} (input price) = £100	20_I [£1000C]	+	£ 600(V+S)	=>	20_{II} [£1600(C+V+S)]
Total		60_I [£3000C]	+	£1800(V+S)	=>	Heterogeneous use-values with combined value [£4800(C+V+S)]
Memo		*Less the wage*	–	*£ 900(V) leaves £900(S)*		

Period 2

The new, changed unit price (=value) of outputs from this, the second period, can be *calculated* since we know the quantity of use-value produced (given by the technology) and we know their total value (given by the valorisation process as the sum of consumed constant capital and the new value added by labour) . The output price is the ratio of the two:

$$p_I \text{ (out)} = £3200/80 = £40$$

$$p_{II}\text{(out)} = £1600/20 = £80$$

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 20_I 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

Department	Unit price in this department	Constant capital consumed		Value added by labour		Result at the end of this period
I	p_I (input price) = £40	50_I [£2000C]	+	£1200(V+S)	=>	100_I [£3200(C+V+S)]
II	p_{II} (input price) = £80	30_I [£1000C]	+	£ 600(V+S)	=>	30_{II} [£2100(C+V+S)]
Total		80_I [£3000C]	+	£1800(V+S)	=>	Heterogeneous use-values with combined value [£5300(C+V+S)]
Memo		*Less the wage*	–	*£ 720(V) leaves £1080(S)*		

Period 3

S is larger because wage-goods are now cheaper (we have thus achieved the main objective of the paper which is to combine reproduction and relative surplus-value) Output values are now lower still, but still not as low as the (new) equilibrium.

$$p_I \text{ (out)} = £3200/100 = £32$$

$$p_{II}\text{(out)} = £2100/20 = £70$$

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:

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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
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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:

Department	Unit price in this department	Constant capital consumed		Value added by labour		Result at the end of this period
I	$p_I = £50$	36_I [£1800C]	+	£1200(V+S)	=>	60_I [£3000(C+V+S)]
II	$p_{II} = £100$	18_I [£900C]	+	£ 600(V+S)	=>	15_{II} [£1500(C+V+S)]
Total		54_I [£2700C]	+	£1800(V+S)	=>	Heterogeneous use-values with combined

							value [£4500(C+V+S)]
Memo		*Less the wage*	−	*£ 900(V) leaves £900(S)*			

Period 2, however, must satisfy the constraint that input prices and output prices are the same:

Department	Unit price in this department	Constant capital consumed		Value added by labour		Result at the end of this period
I	p_I = £30	40_I [£1200C]	+	£1200(V+S)	=>	60_I [£2400(C+V+S)]
II	p_{II} = £60	18_I [£600C]	+	£ 600(V+S)	=>	15_{II} [£1200(C+V+S)]
Total		54_I [£1800C]	+	£1800(V+S)	=>	Heterogeneous use-values with combined value [£3600(C+V+S)]
Memo		*Less the wage*	−	*£ 540(V) leaves £1260(S)*		

Likewise period 3 yields:

Department	Unit price in this department	Constant capital consumed		Value added by labour		Result at the end of this period
I	p_I = £24	50_I [£1200C]	+	£1200(V+S)	=>	60_I [£2400(C+V+S)]
II	p_{II} = £43	30_I [£720C]	+	£ 600(V+S)	=>	15_{II} [£1320(C+V+S)]
Total		80_I [£1920C]	+	£1800(V+S)	=>	Heterogeneous use-values with combined value [£3720(C+V+S)]
Memo		*Less the wage*	−	*£ 387(V) leaves £1413(S)*		

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 assumed to sell 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. These outputs are all purchased before period 2 begins. This would mean that, immediately prior to the commencement of period 2, expenditure should be (according to this assumption) $60_I \times$ £30 = £1800 in department I and $15_{II} \times$ £60 = £900 in department II, totalling £2700. The capitalists have thus received £4500 at the end of period 1, but have spent only £2700 at the beginning of period 2. What happened to the missing £1500?

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.

FIXED CAPITAL AND VALUE FORMATION

So far we have presented, for simplicity, an illustration in which all capital is consumed in each period, that is, there is no fixed capital. To a certain extent, therefore, this illustration is no more than a prelude. The final question to confront, which will be dealt with in greater length in the conference session, is this: 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.

A flavour of the importance of this issue can be given by considering its implications for 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.

DEPRECIATION AND FETISHISED COSTS

The implications of this are theoretically important and open a substantial 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 technologically-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.

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[1] cf 30:167: 'In the case of absolute surplus value the *matières brutes* and the *matières instrumentales* must grow in the same proportion as the absolute amount of labour grows' *matières instrumentales* are a form of circulating constant capital, the regular requirements of the machinery such as oil. In *Capital* the two categories of *matières brutes* and the *matières instrumentales* are generally assimilated to circulating constant capital. cf also (33:296) 'this unconsumed part of constant capital does not bring about a *growth in the amount of products*. It helps to produce a greater output in a given labour time...the growth of products is physically identical with the growth of this part of capital'.

2   If anyone wants to read this in hours, then in Marx's words 'suppose £1 represents 1 hour.' You are all welcome to argue till the cows come home about what this actually means and it doesn't change the argument a jot.

3   This deduction is independent of the real wage which fixes, not the output of value but its distribution.

4   Throughout we refer to Volume I of *Capital* as CI, etc, to Volume I of *Theories of Surplus Value* as TSVI, etc., and to Volume 34 of the collected works (English translation) as V34, etc.