Let's Get Metaphysical

The Value-form and Input-Output Modelling

Philip Dunn

February 2001

Abstract

This paper investigates the structure which the value-form imposes on input-output tables. It is argued that the value-form does not allow any process to have the same commodity both as input and output. Further, it is shown that the treatment of fixed capital as an input of a machine of a certain age and an output of a one year older machine, regarded as different commodities, is forbidden by the value-form. The younger and the older machines are the same commodity and hence cannot be both input and output. A stock-flow model, for the purposes of labour-content accounting in the presence of fixed capital, is presented which is consistent with the value-form. It has the characteristic that only product commodities can have stocks. There can be no stock of labour-power; in other words, variable capital does not exist. The model exhibits commodity capital as a stock of outputs that must be financed at full value. This has the implication that there is no expansion in the circuit of money capital. The self-expanding property of capital must be sought elsewhere. Finally, a value-form analysis of fixed capital is given, leading to the conclusion that at no stage in its use can a machine commodity either increase its own labour-content or transfer to the product more labour-content than it originally contained. It is shown that the method of linear depreciation is correct in the context of simple reproduction.

Affiliation : Independent

Contact Address : 55 Bonnington Square, London, UK, SW8 1TF

Phone : +44 (0) 207 564 0662

E-mail : pscumnud@dircon.co.uk

Introduction

A building firm builds a house and then sells it. The firm has an output flow. But the house doesn't move, except through time. What, then, is flowing?

For there to be a flow some thing must cross some boundary. The house does not cross any spatial boundaries. A spatial boundary could, however, cross the house. On this view, the space of the building firm retreats and no longer encompasses the house when the house is sold. Further, it is not even necessary for the house to be sold for there to be an output flow. It is enough for the house to be there on a certain date, the end of the production period, for an output flow to take place. If the house is not sold, it is immediately an input flow for the succeeding period of production.

Pasinetti (1980, pp. xii-xv) traces the history of this scheme of physical flows from Sraffa back though Marx, Malthus, Ricardo and Torrens to the Physiocrats. Let us call this scheme the point-input-point-output (PIPO) joint production model. According to it everything to be used in production, including partially used up items and partially completed items from the previous period as well as articles purchased, flows in at the beginning of the period of production. Everything resulting from production, partially used up items and partially completed items as well as articles for sale and waste products, flows out at the end. It is clear that the boundary involved is, primarily, a temporal one. Spatial boundaries enclose a process. Nothing physical is allowed to cross them within the period of production. At the period end items sold cross the spatial boundary. During the period this boundary has to be very flexible to keep waste, such as smoke, inside it. At period end the boundary contracts, releasing the smoke. Waste release is just like a sale except that it has a zero price.

This period of production, notionally taken as a year, is the same for all processes. Opening stocks are equal in magnitude to annual inflows and closing stocks to annual outflows. It is not possible to have a flow without a corresponding stock or vice versa. The PIPO system is an open invitation to confuse stocks and flows. It is so profoundly flawed, leading to incorrect results even in favourable cases, that it must be abandoned completely.

Approached from the perspective of the value-form what flows is a commodity and the boundary it must cross is the market. Neither the commodity nor the boundary are physical in nature. The flow is of a valued-formed entity across a value-forming boundary. Outputs are flows of sales, inputs are flows of purchases. Since no firm can buy from itself, the value-form requires that no process has the same commodity both as input and output. Hence the diagonal elements of the input matrix must be zero. Further, since a new machine and the same machine a year later are, in fact, one and the same commodity, the older machine cannot be treated as an output. In other words, the value-form forbids the treatment of fixed capital as a joint product. Proper stock-flow accounting must be used.

Production tables

A gross joint production table may be represented as follows:

a : **A** -> **B**

where, in convection notation, **a** is the labour-power input vector, **A** the input matrix and **B** output matrix. Let us consider such a table, one taken from Steedman (1977, p. 151) and reproduced here as Table 1. Here two commodities are jointly produced by two different processes. In each process with one unit of labour-power is bought and expended over the period. (Labour-power is not a stock but is left in the table for convenience). As is well known, Table 1 yields a negative labour-content for commodity 1. This property of the *net* product table (**a** : -> **B** - **A**) that can be formed from Table 1 is not what is at issue here. We could change the output of commodity 2 in process 1 from 1 to 3 to obtain positive labour-contents without affecting our problem which is concerned with the *form* of the *gross* production table (**a** : **A** -> **B**). The question is whether a commodity can be both an input and an output of the same process.

	Labour -power		Commodity 1	Commodity 2		Commodity 1	Commodity 2
process 1	1	:	5	0	->	6	1
process 2	1	:	0	10	->	3	12

Table 1
Opening and Closing Stock Table

In the PIPO model firms must start the year with sufficient supplies to last out the period. It does not, therefore, seem permissible to transfer those "inputs" for which there is also output over to the output side to obtain Table 2 as a *gross* production table.

	labour -power		commodity 1	commodity 2		commodity 1	commodity 2
process 1	1	:	0	0	->	1	1
process 2	1	:	0	0	->	3	2

Table 2
Gross Production Table

But the apparent invalidity of this is an artifact of the PIPO model. The initial need to acquire stocks is a start-up problem only. Where production is day after day the same, firms that produce a commodity have no recurrent need to buy supplies of it. They will certainly have it in stock but this stock will be internally generated. Nothing prevents physical feedback from the end to the beginning of a process but such flows should not be entered into the input-output accounts as if, to no particular purpose, the firm sold and then bought back its own product. Capitalist production is, after all, production for exchange. If a farmer keeps back part of the annual crop for planting next year, only what is sent to market counts as gross product, not the whole harvest. It is vital to be clear about what boundary has to be crossed for there to be an input or output flow of commodities. That boundary is the market, the point at which money changes hands. Of course, it remains possible to recognise a flow of corn at sowing time from the granary to the ground. Certainly, corn used as seed is used up. However, this is merely a physical flow of the use-value corn. The point is that there is no output flow of a commodity unless corn is sold and no input flow unless corn is bought.

What difference does this make? Although the way the gross product is defined makes no difference to the unit labour-content of a commodity, it does affect the division of this labour-content into direct and indirect parts. The products in Table 2 have direct parts -1 and 2 with no indirect parts, whereas from Table 1 the direct parts are 11/69 and 3/69 with the indirect parts -80/69 and 135/69. The PIPO model gets the division between dead and living labour wrong.

Not only is it permissible to represent processes as in Table 2, it is mandatory to do so on fundamental grounds. Outputs are flows of commodities sold; inputs are flows of commodities purchased. We shall call *improper* any gross table, such as Table 1, in which a commodity appears on both sides. In a table of *proper* flows, on the other hand, a product can appear only once either as article sold or as an item purchased. The whole harvest will be present as a closing stock and retained seed corn will appear as an opening stock. It should be clearly noted, however, that these are stocks, not flows. Moreover, stock tables will only be the same as PIPO tables, such as Table 1, in the over simple world of circulating capital systems, e.g. an agriculture in which there is a common repetition period of one year for all inputs and outputs. But even in such favourable cases the PIPO model will fail whenever there is any feedback, since stocks are not then equal to flows.

Productive Capital and Commodity Capital

The foregoing has a dramatic impact on the traditional treatment of capital. In even the simplest circulating capital case with feedback it is not possible to take capital as the collection of inputs. In our earlier example from farming that part of the crop kept back for replanting is not a proper input but is certainly part of the capital stock. Authorities disagree on whether it is to be called fixed or fluid:

> In [Adam Smith's] conception, the seed is fixed capital because there is no 'change of masters', i.e. the seed is directly replaced out of the annual product, subtracted from it. It would be circulating capital, however, if the entire product were sold and new seed corn were bought with part of the product's value. In one case there is a 'change of masters', in the other case not.

> Here Smith confuses fluid capital with commodity capital. The product is the material bearer of commodity capital but of course only that part of it that actually enters circulation, and does not directly re-enter the production process from which it emerged as a product.
>
> Whether the seed is directly subtracted from the product, or whether the whole product is sold and a part of its value is replaced by the acquisition of new seed, what occurs in both cases is no more than a replacement, and no profit is made by this replacement. In the one case the seed passes into circulation as a commodity along with the rest of the product, while in the other case it figures only in the book-keeping as a component of the value advanced. In both cases, however, [the seed] remains part of fluid capital. (Marx 1885, p. 280)

Retained corn is, for Marx (1885, pp 246-7), productive capital and the distinction between fixed and fluid capital applies only to productive capital . Fixed capital preserves its natural form while its value is transferred to the product, whereas fluid capital does not (Marx 1885, p. 238). Smith is here more sensitive than Marx to the importance of commodities changing hands. Retained corn going, as Smith (1776, p. 375) puts it, "backwards and forwards between the ground and the granary" cannot appear in a proper production table as an input flow. The two cases are quite different methods of production. New seed acquired by purchase is, as a commodity, distinct from the crop, even if the two are biologically indistinguishable. Instead of one there will be two components of capital stock, one of seed, which is a stock of a proper input, and the other of crop awaiting sale, which is stock of a proper output.

In the case of retained corn Marx overrides the value-form in favour of a physical model of reproduction.:

> But in so far as a part of his product again directly serves the same capitalist producer as means of production, the producer appears as selling this to himself; this is how the matter figures in his book-keeping. This part of reproduction is then not mediated by circulation, but directly. The part of the product that serves again in this way as means of production replaces fluid capital, not fixed, in so far as (1) its value goes completely into the product and (2) it is itself replaced completely in kind by a new item from the new product. (Marx 1885, p. 281)

The point is that the value of retained corn is *not* transferred to the product. It is already the product. How can it be transferred? Retained corn is part of commodity capital, not productive capital. The confusion arises from the PIPO model, in which an opening stock must be equal to an input flow. There is, however, no input flow of corn, although there is an opening stock of it.

In a Marxian theory it is vital not to proceed as if purchases and sales occurred when in fact they did not, even though Marx (1885, p. 144) commits this error:

> A part of C' ... may directly re-enter, as means of production, the same labour process from which it emerged as a commodity; all this does is circumvent the need to transform its value into real money or money tokens; in other words the only independent expression it receives is as money of account.

Money of account is no more an expression of value than '1 coat = 1 coat'; book-keeping cannot be considered as honorary exchange. Steedman has a particularly lax attitude over this. Although one of his underlying assumptions is that "the only economies considered are commodity economies, in which all products are produced for exchange" (Steedman, 1977, p. 16) it turns out that contradicting this assumption causes only terminological problems to arise if "the term 'commodity' is restricted to a product produced for sale: semi-finished products can perhaps reasonably be regarded as latent, or honorary, 'commodities'" (Steedman, 1977, p. 182n). The problem is, however, terminal, rather than terminological, for the Sraffian treatment of capital.

Variable Capital

What variable capital cannot be is a stock of workers's consumption goods. The values-form rules this out since such goods are bought by workers, not by firms. It cannot be a stock of unexpended labour-power since as a power, a capacity, it cannot be stored up.

It could be part of work-in-progress. But what is work-in-progress? An accountant would say that it is partially finished goods and would value it at the lower of cost and net realisable value. Part of the cost is

wages and so, on this view, variable capital is the accumulated labour-power expended in bringing the goods to their present condition. The labour-power expended is valued at its cost. The problem with this is that labour-power expended is labour-content added. How can the necessary part of labour-content added exist without the surplus part of labour-content added also existing? Well, perhaps the surplus part does exist but has zero cost. But now we must ask why we are attempting to value something to which labour-content has been added, i.e. an output, at input cost. Is work-in-progress an input or an output? Work-in-progress, conceived as a halfway house between inputs and outputs, falls between two stools. Stocks are either of inputs or of outputs and labour-power is never part of a stock.

Work-in-progress is two things, not one thing. We shall use the term input work-in-progress to denote stocks of input products which have lost their natural form as a result of work having been done on them but whose labour-content has not yet been transferred to a product. Similarly output work-in-progress consists of stocks of output products, on which revenue has been recognised, which have yet to reach their natural form.

Variable capital cannot be found in productive capital and in commodity capital it is always accompanied by "surplus capital". When labour-power is expended value-added is created. Some time will elapse before this value-added is realised. There is a stock of unrealised value-added on top of the stock of inputs transferred, together making up commodity capital. Corresponding to this asset is a liability. Suppose wages and profits were paid out immediately on the creation of value-added; then borrowing would be required to finance the cash payouts. To the extent that the payouts can be delayed, the need for borrowing is reduced but liabilities for wages payable, interest payable and dividends payable, etc. arise. The "stake-holders" are financing unrealised value-added.

The circuit of money capital stubbornly refuses to expand when the timing of capitalists' consumption is considered:

> So far as individual consumption is concerned, surplus value is anticipated. Funds for this must be advanced. (Marx 1885, p. 395)

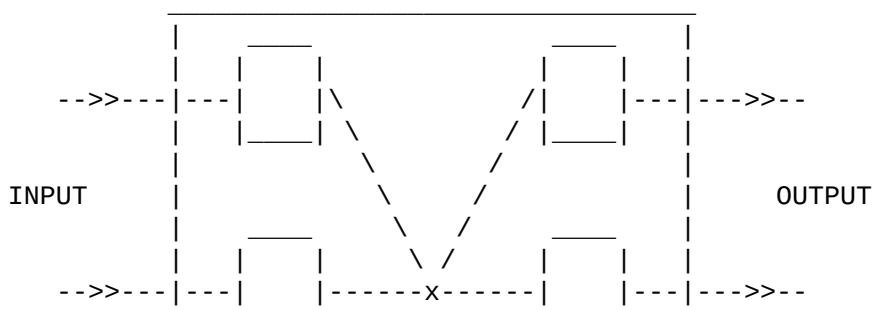
Marx later takes this up in terms of the question of "how the capitalist always managed to withdraw more money from circulation than he cast into it. ... where does this money come from" (Marx 1885, pp 404-410). It turns out that:

> In point of fact, paradoxical as it may seem at first glance, the capitalist class itself casts into circulation the money that serves towards the realization of the surplus value contained in its commodities. But note well: it does not cast this in as money advanced, and therefore not as capital. It spends it as means of purchase for its individual consumption. (Marx 1885, p. 409)

The consequence, no expansion in the circuit of money capital, is resisted by Marx here on the grounds that the money which capitalists live on while variable capital turns over is money spent rather than advanced as capital. But capitalists only need this money because they are not being paid their portion of value-added as it is created. They are, in fact, financing unrealised value-added while living off their consumption fund.

A stock flow model

Capital, in the restricted sense of operating assets involved in production, is a collection of stocks of product commodities. It can be divided into input and output capital according to the positions in the proper production table occupied by the products held in stock. Figure I illustrates the model.



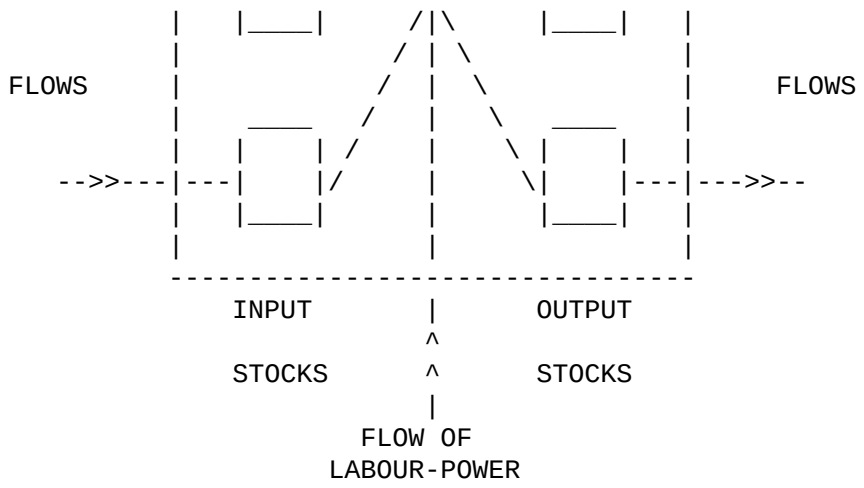


Figure I

Labour-content Accounting Model

In Figure 1 the outer box represents the market boundary. The inner boxes represent input and output stocks. These stocks are measured by the quantity of labour-content present, not by the quantity of use-value perceived. Input flows are the source of input stocks. Output flows are the sink of output stocks. The sink of input stocks and the source of output stocks is production. Production is driven by the expenditure of labour-power, which both transfers and adds labour-content. The moment of production is also the moment of purchase of labour-power. There can be no stock of labour-power. It is not something that can be stored up. Labour-power is modelled as flowing continuously so that, internally, there is a continuous flow of production. The stocks buffer non-continuous flows of purchases and sales.

Input capital consists of stocks of commodities purchased but not yet transferred to a product, output capital of stocks of commodities produced but not yet sold. Accountancy practice recognises an asset when the firm has possession or control of it. We will call this *use-value dated* accounting. Here, however, we adopt *value-dated* accounting. Labour-content flows only when the money flows. Only paid for inputs count as stock. Likewise, outputs for which payment has not yet been received still count as stock.

Labour-contents have individual identities. That is to say, petrol labour-content and steel labour-content are essentially different individuals of the same, value-formed, kind. The transfer of labour-content which occurs in production destroys its individuality. The petrol or steel labour-content transferred to a product takes on a new individual identity, that of one of the products, say refrigerator labour-content.

Labour-powers also have individual identities. Firstly, there is an identity as a concrete labour-power corresponding, at the material level, to a certain kind of skill. Secondly, there is an identity as a private labour-power, that combination of concrete labour-powers corresponding to the kind of article being produced. If a firm produces both refrigerators and freezers, the mix of concrete labour-powers employed has to be sorted into two private labour-powers, refrigerator producing labour-power and freezer producing labour-power.

The whole of the labour-power expended on any day goes into the commodities produced on that day. The question arises: what, in use-value terms, is produced on that day? Where at least one article is produced a day, it is, in many cases, the articles invoiced that day. This is because the moment of invoicing is the moment at which the product is first accounted for at full selling price. At that moment costs expire and revenue is recognised. The lag between invoicing and receipt of payment gives rise to an output stock (debtors).

Input stocks consists of inventories of input commodities less creditors and accrued expenses plus prepayments and input work-in-progress. Input work-in-progress consists of inputs that have lost their natural form in the production process but whose labour-content has not yet been transferred to an output. Output stocks consist of inventories of output commodities plus debtors, accrued revenue and output work-in-progress. Stocks of finished goods count as output stocks only if revenue has been recognised on them.

Otherwise they count as input work-in-progress. Where there is an appreciable interval between successive sales, as for example in agriculture, labour-content must be considered to have built up during the interval as output work-in-progress.

Accrued expenses are treated as a negative stock. Consider a firm making widgets using electric power paid for in arrears. There is no physical inventory of this electric power commodity. (We ignore, as too small to consider, the physical stock of electric energy that must be present.) Electric power labour-content is continuously transferred to the product, driving the stock level negative. The transferred labour-content loses its identity as electric power labour-content when transferred and gains an identity as widget labour-content. The material bearer of this is clearly the widget as useful article. But what is the material bearer of the negative electric power labour-content of the stock of accrued expenses? A suitable candidate is the widget on the grounds that it is in the right place at the right time. So, as well as bearing widget labour-content, the widget carries a negative quantity of electric power labour-content equal in absolute magnitude to that part of widget labour-content that originated as electric power labour-content but has now lost that identity. The negative burden on the widget, however, does not lose its identity. The problem now is how to get rid of it. The widget cannot carry it indefinitely. Note that the power company will have a positive stock of electric power labour-content, call it accrued revenue, of an absolute size exactly matching the accrued expenses of the widget company. It has delivered electric power labour-content but has not yet been paid for it. The material bearer for this positive stock is also the widget, neatly cancelling out the negative burden on the widget.

One problem that arises is due to the irritating fact that wages are paid a week or so in arrears. This lag would lead to a negative stock of labour-power if it were treated in the same way as non-labour inputs. In the case of non-labour inputs we associate the input flow with the moment of payment rather than with the moment at which possession changes. This implies that "creditors" were treated as negative assets, a subtraction from the inventory, corresponding to the current cost accounting practice of including the part of net current assets known as monetary working capital (roughly debtors minus creditors) in net operating assets. It is clear that "creditors" are not true liabilities at all. In the case of labour-power, however, it is open to us to place wages payable on the liability side. For labour-power use-value-date and value-date coincide. Workers are not extending trade credit to their employers. The delay in payment gives rise to a positive liability, not a negative asset.

Linear Depreciation

Steedman (1977, pp. 142-145) gives two examples of machine-using processes, one with rising and the other with falling efficiency. I shall concentrate mainly on the first, which is set out in Table 3.

The first process produces new machines using corn and labour; the second and third produce corn from labour and corn using new and one-year old machines respectively. One-year old machines are treated as outputs of process 2 and inputs to process 3. The machines are scrapped after the second year. We can interpret these "inputs" and "outputs" as stock quantities physically present at the beginning and end of the year as well as physical flow quantities. The new machine is physically used up and a physically changed one-year-old machine results. These aged machines are to be seen as momentary physical states, stages, of a single entity, the machine as object or article, which endures over time. Such stages qualify as independent commodities in the Sraffian system.

	Labour	Corn	New	Old		Corn	New	Old	Sales
process 1	5	1	0	0	->	0	5	0	
process 2	10	9	5	0	->	10	0	5	-5
process 3	25	15	0	5	->	25	0	0	16

Table 3
Opening and Closing Physical Stocks
Balanced Mode

We are dealing with two levels of form here. The physical matter of the machine can change through rust and wear but these are merely accidental changes to the machine object, which only undergoes substantial change when it is constructed and when it is broken up for scrap. In its turn this object is the matter of the machine-commodity, whose individual substance is machine labour-content. The machine-commodity undergoes substantial change when its labour-content is converted into corn labour-content by the activity of corn-producing labour-power. Its matter, the machine object, is substantially unchanged by any of this, i.e. the machine commodity undergoes no accidental changes beyond those also undergone by the machine object. However the corn commodity can suffer such changes; an accidental change for a product commodity is a change in or of the articles in which its labour-content resides. We have seen already that output work-in-progress is corn labour-content residing in articles other than corn.

As a further preliminary we must deal with a certain peculiarity of this example. It seems natural to take the fall in the stock of corn stock between the end of a process and the start of its successor to be equal to the quantity sold. The fall from the end of process 3 to the start of process 2 is 25-9=16 units of corn. Unfortunately, the fall from the end of process 2 to the start of process 3 is 10-15=-5 units of corn. Not only is there no corn to sell, there is not even enough to start up process 3. The upshot is that the process sequence 2,3,2,3... cannot operate by itself but must be operated in balanced mode together with the sequence 3,2,3,2... The balancing sequence then can top up the opening stock of the process 3 of the first sequence from the closing stock of its own process 3. Effectively, the harvests from both processes go into a pool from which the quantities of corn needed to restart processes 2 and 3 are withdrawn and the remainder sold. Sales cannot be assigned to particular processes in these circumstances. We should not expect this since sales are made by firms, not processes. However, if sales cannot be assigned to processes then neither can purchases. In balanced mode operation there is no basis for associating the 10 purchased units of labour-power with the new machine using process and 25 purchased units with the old. In balanced mode operation the value-form provides no boundary between processes 2 and 3. It demands their collapse into one process. In this situation it is not possible to solve for the unit labour-content of the old machine.

Balanced mode operation is the way simple reproduction is imposed in the PIPO model. The economy repeats itself with a common annual cycle. However, because we are using an underlying continuous flow production model rather than a PIPO model, such a universal cycle must be viewed with deep suspicion. We shall therefore treat processes 2 and 3 as operating in unbalanced mode. This requires a modification to prevent negative sales. We can do this without changing unit labour-contents by adding at least 5 but not more than 16, units of corn to the opening and closing stocks of process 2. To decide exactly how much must be added we must specify how simple reproduction is imposed on unbalanced processes.

A simple. but perhaps too strong, condition for simple reproduction is that all sales and purchases take place with *regularity,* that is to say, the same quantity is bought or sold at the same price at equal intervals. The interval will be different for different commodities. For those inputs that are modelled as continuously flowing, this simple regularity requires the flow to be constant. Labour-power is such an input. This creates a problem for the rising efficiency example in which purchases of labour-power differ in each year. Ultimately the example must be disallowed under simple regularity, but it it useful to continue with it to discover the difficulty caused by non-constant labour-power inputs.

	Labour		Corn	New	Old		Corn	New	Old	Sales
process 1	5	:	1	0	0	->	0	5	0	
process 2	10	:	19.5	5	0	->	20.5	0	5	5.5
process 3	25	:	15	0	5	->	25	0	0	5.5

Table 4
Opening and Closing Physical Stocks
Unbalanced Mode

Regularity requires that we add either 5 or 10.5 or 16 units of corn, making the sales of process 2 equal to 0 or 5.5 or 11 units of corn, with the sales of process 3 would equalling 11 or 5.5 or 0. We take the middle option so that the sales from processes 2 and 3 are equal. This gives Table 4.

Table 5 is the proper flow table, in which old machines cannot appear. From it we can calculate the labour-content of a unit of corn (uC) to be 4 and that of a new machine (uN) to be 1.8. These are the only product commodities in the system.

	Labour -power		Corn labour-content	Machine	Sales
process 1	5	->	-1	5	
process 2/3	35	->	11	-5	11

Table 5
Net Production Flow Table

To calculate a labour-content, u0, of 3 for an old machine Steedman uses Table 3. An old machine has more labour embodied in it than a new machine. This is undoubtedly correct. The one year old machine object is the material bearer of 3 units of labour-content. However, this labour-content cannot be identified as “old machine labour-content”, for there is no such substance. Further, it is impossible for machine labour-content to be generated in the corn labour-content generating processes 2 and 3. Machine labour-content can only be generated by process 1. The 3 units of labour-content cannot, therefore, be identified in its entirety as machine labour-content. I shall argue that the old machine object is the material bearer of corn labour-content as well as machine labour-content.

Consider the effect of moving 2.625 units of corn from the harvest of process 3 to that of process 2. Modifying Table 3 in this way we obtain the solution uC = 4 , uN = 1.8 , uO = 0.9, which is a linear depreciation case with corn and the new machine having the same labour-contents as in the unmodified table. The modified case is, of course, a quite different method of production.

Nevertheless, the number 2.625 looks interesting and maybe a way can be found to move it about the production table without changing the method of production while still keeping linear depreciation. We try the following: as before we add 2.625 units of corn to the closing stock of process 2 but now, instead of subtracting it from the closing stock of process 3, we add it to the opening stock of that process. What is the interpretation of the mobile 2.625 units of corn? Remember that Table 3 was drawn up by a physical quantities accountant who would miss any corn that was not present in its natural form. In particular, they would miss output work-in-progress which is what the 2.625 units are. Some of the corn labour-content generated in process 2 does not appear in natural form as the harvest but is retained within production and handed on as work-in-progress to process 3. The old machine is the material bearer of this corn labour-content. From the point of view of a labour-content accountant the old machine counts as half a new machine plus 0.525 (a fifth of 2.625) units of corn. The corrected stock table is shown in Table 6. The figures are quantities of corn and machine labour-content expressed in physical unit equivalents.

Steedman’s falling efficiency example can be treated in the same way by equalising sales and then identifying output work-in-progress in order to obtain linear depreciation. The work-in-progress in this case turns out to be negative.

The solution of the rising efficiency case needs closer examination. Let us look at the net production flows for processes 2 and 3 separately, shown in Table 7.

	Labour -power	Corn labour-content	Machine		Corn labour-content	Machine	Sales
process 1	5	1	0	->	0	5	
process 2	10	19.5	5	->	23.125	2.5	5.5
process 3	25	17.625	2.5	->	25	0	5.5

Table 6

Adjusted Opening and Closing Stock Table
in physical unit equivalents

	Labour -power		Corn labour	Machine -content		Corn labour	Machine -content
process 1	5	:	1	0	->	0	5
process 2	10	:	0	2.5	->	3.625	0
process 3	25	:	0	2.5	->	7.375	0

Table 7
Net Production Flows
in physical unit equivalents

It must be stressed that these are flows of the commodity corn produced, not sold, and of the commodity machine used up, not bought. Only in the combined flow table, Table 5, will quantities bought or sold equal quantities used up or produced. It is easily checked that invariance (labour-power expended equals labour-content added) holds in all processes, but we can observe that the proportions of labour-power to machine flow, of direct to indirect labour, are unequal in processes 2 and 3. Since three equations can be derived from Table 7 but there are only two unknowns (uC and uN) to solve for, the three processes cannot be linearly independent. In fact, process 3 is the sum of 0.6 of process 1 and 2.2 of process 2. The involvement of process 1 here leads to a problem if we make a change to the technical specification of process 1 or if we use abstract labour instead of concrete labour as the measure. Linear dependence is lost and inconsistency results. Let us take as the unit abstract labour-contents of machine and corn as vN=4 and vC=5. In processes 2 and 3 we choose to keep the power of corn-making labour-power to create abstract corn labour-content numerically equal to its power to create concrete corn labour-content. In process 1 machine-making labour-power creates three times more abstract machine labour-content than concrete machine labour-content. With abstract labour as a measure invariance can still hold for process 1, and for processes 2 and 3 combined, but not for them separately.

The source of the problem is clearly the unequal proportions of labour-power to machine flow. Invariance can only be guaranteed if the separated flows are simply a division of the combined flow, with the same ratio of direct to indirect labour in each. Only processes 2 and 3 should be linearly dependent. This is easily achieved by altering the depreciation schedule from linearity with respect to calendar time to linearity with respect to labour time. Behind this is the simple thought that it is the expenditure of labour-power that converts input labour-content into output labour-content. We shall assume, for the moment, that both concrete and abstract labour time yield the same depreciation schedule. The effect is shown in Table 8.

	Labour -power		Corn labour	Machine -content		Corn labour	Machine -content
process 1	5	:	1	0	->	0	5
process 2	10	:	19.5	5	->	317/14	25/7
process 3	25	:	120/7	25/7	->	25	0

Table 8
Stock Table with labour-time depreciation
in physical unit equivalents

Finally we must deal with the problem that the depreciation schedule derived from abstract labour time could differ from that derived from concrete labour time if the composition of labour-power in terms of individual labour-powers was different the two years. This cannot be allowed; the composition of labour-power expended must be kept the same from year to year. The conclusion is that we are limited to having a fixed composition of labour-power. Further, since it would be a fluke if the composition were fixed but the total labour time varied from year to year, we are effectively restricted to cases where the labour-power input is constant in composition and size. However, this is what regularity requires when applied to each individual labour-power. Hence Steedman's rising efficiency example must be disallowed. It cannot operate in unbalanced mode in simple reproduction. Additionally, depreciation linear with respect to calendar time is reinstated since calendar time and labour time are now proportional.

It is not inconceivable that the somewhat narrow definition of regularity used here could be relaxed, so that Steedman's example would be permitted. In that case it would be necessary, in order to have a unique depreciation schedule, to envisage a fixed composition of individual labour-powers in the presence of a varying mix of skills.

References

Marx, Karl (1885) Capital II, Harmondsworth, 1978
Pasinetti, Luigi (1980) Essays on the Theory of Joint Production, London
Smith, Adam (1776) The Wealth of Nations, Harmondsworth, 1970
Steedman, Ian (1977) Marx after Sraffa, London