Value from Nowhere: a response to Dumenil and Levy (first submission)

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Abstract

This article was submitted in 1999 to the *Review of Radical Political Economy* but was rejected. It responds to Gérard Duménil and Dominique Lévy's (1999) "The conservation of value: a rejoinder to Alan Freeman". This was a critique of the *Temporal Single-System* (TSS) interpretation of Marx's value theory presented in my (1996) *Marx and non-Equilibrium Economics.*

In this response, I show that the paradoxes which Duménil and Lévy found in the TSS approach arose from a dogmatic adherence to the *simultaneist* paradigm which imposes, *a priori* and without reference to real phenomena, a distinct ontology from which change is absent. I show that when the supposition of a static economy is dropped, simultaneism creates value out of nowhere, and cannot thus support the elementary economic distinction between production and circulation. A uniform treatment of fixed capital, and the formation of social values, eliminates the alleged paradoxes. I show their own approach to be incoherent, generating negative values from its own assumptions.

This is the first of two responses to this article which were rejected by the RRPE board. I have placed the second response in the public domain at the same time as this response.

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VALUE FROM NOWHERE: A RESPONSE TO DUMÉNIL AND LÉVY

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1. Introduction

This is a reply to Gérard Duménil and Dominique Lévy's[1] (1999) "The conservation of value: a rejoinder to Alan Freeman", in turn a critique of Freeman's (1996) general formulation of the *Temporal Single-System* (TSS) interpretation of Marx's value theory.[2] In contrast to the dominant account, which TSS scholars term *dualist* and *simultaneist*, this non-equilibrium interpretation finds that Marx's two equalities both hold for all market prices; that the organic composition of capital rises as long as accumulation continues, and that the 'inconsistencies' attributed to Marx by both detractors and supporters, do not exist.[3] This does not show Marx is the source of all truth; it does conclusively overturn the mainstream justification for suppressing his work. The approach confirms many heterodox results value-theoretically, providing a simple account of the growing inequality between nations (Freeman 1997) and a refutation of the quantity theory of money (Freeman 1998).

A near-universal silence reigns in economics with regard to this long-standing body of work, involving some seventeen authors and dating back to 1980. Every serious engagement with it can only alter this circumstance and we welcome DL's intervention without reservation.

2. A short illustration of the pitfalls of simultaneism

Much of this paper concerns the way that theories from different paradigms should be assessed. DL's 'productivity paradox', in which values rise while unit inputs are falling, is an excellent starting point. It can be illustrated in only two periods. DL do not specify the scale of production, so to clarify matters I supply this by supposing the output of each period is entirely invested in the next period,[4] giving table 1:

Period	Consumed(C)	Labour applied (L)		Produced (X)
1	22	44	$\Rightarrow$	44
2	44	96	$\Rightarrow$	100

Table 1: Use-value consumption and output over two periods, DL's example

In the second period, the output of use-values, both per unit of input and per unit of labour, is greater than in the first. DL suppose an initial value of $\lambda_1 = 1.2$. The *temporal* value for period 2 is given by

(1) $$22\lambda_1 + 44 = 44\lambda_2$$

[1] Henceforth DL

[2] See the bibliography in Freeman and Carchedi (1996) and papers from the annual conferences of the International Working Group on Value Theory (IWGVT). Other work in the same general framework has come to our notice since 1996 by Eduardo Maldonado Filho, Sungur Savran, and Michel Husson. In 1996 we called the approach 'sequential' and 'non-dualist' but the words 'temporal' and 'single-system' have since entered more general use.

[3] This is a brief summary of our findings, some of which are reproduced by other approaches, notably the *Simultaneous Single-System* (SSS) and *New Interpretation* approaches (see section 5 for references). Kliman(1996) lists Marx's main contentious assertions and summarises the findings of the main variants of value theory in respect of them.

[4] This introduces the assumption of a zero wage, which makes the arithmetic clearer but can be abandoned without changing the conclusion..

giving $\lambda_2 = 1.6$, which is higher than λ_1. The *simultaneous* value for period 2 is given by the formula

(2) $$44\lambda_2 + 96 = 100\lambda_2$$

giving $\lambda_2 = {}^{12}/_{7}$. This too is higher than λ_1: however the simultaneous calculation cannot tolerate an initial value of $\lambda_1 = 1.2$; the only λ_1 it can accept is given by

(3) $$22\lambda_1 + 44 = 44\lambda_1$$

that is, $\lambda_1 = 2$. Consequently with the given initial condition, temporal values rise while unit inputs are falling, whereas with a different initial condition, simultaneous values fall.

The most basic question is: why should this be a paradox? DL's argument, which rests on the classical fallacy of proof by acclaim, reduces to the following: 'tradition' tells us that when unit physical inputs fall, values must rise. Freeman contradicts tradition; therefore he must be wrong. *Eppur si muove:* actual prices can and do rise when unit inputs are falling, and so must values if they exert any influence on prices.

Their paradox is only one instance of a general result: temporal values vary independently of use-values. No sophisticated mathematics is needed to see that circumstances must then arise where goods get dearer while unit inputs fall, or cheaper while they rise. The 'paradox' arises because exchange-value is not identical to use-value.[5] This excellent result disposes of the most powerful argument against the 'traditional' concept of value, namely that it is redundant. By showing that that use-value and exchange-value diverge quantitatively, we prove they are irreducible and independent aspects of the commodity, a fact stressed at great length by Marx.

DL's 'tradition' however yields the result that exchange-values at any moment are uniquely determined by use-values at the same moment, independent of the past history of either. This idea is so at variance both with everyday experience and Marx's writings, that we must ask why DL consider any result which diverges from it 'paradoxical', that is, literally inconceivable? This fact demonstrates that the 'tradition' is no mere calculation. It sets a standard of *what is allowed to exist*. Its function is not just operational, but ontological.

2.1. A first encounter with conservation

DL carry out an exercise typical of economics in general: they exhibit a limitation of their own concept, as if this constituted a refutation of a different concept. To illustrate this we start with the *same* initial value for both approaches, that is $\lambda_1 = 2$. The temporal calculation is shown in table2:[6]

Period	Consumed(^{h}C)	Labour applied (^{h}L)		Produced (^{h}X)	Unit value (λ)
1	^{h}44	^{h}44	$\Rightarrow$	^{h}88	2
2	^{h}88	^{h}96	$\Rightarrow$	^{h}184	1.84

Table 2: Value consumption and output over two periods, temporal calculation

What happens over both periods, taken together? We began with ^{h}44; we added ^{h}140 units of labour over both periods, and ended up with a product worth ^{h}184. The new value precisely equals the original value plus the total labour, as it should since nothing has been destroyed or added to the product. Now consider the simultaneous presentation, in table 3. In period 1 the value is 2 throughout, and in period 2 it is ${}^{12}/_{7}$ throughout.

[5] DL(1991a:361) themselves write "Value must be seen as a *third* concept, distinguished both from quantities (physical bundles) and the prices of these quantities of goods". Then why is it so paradoxical that this distinction should find a quantitative expression: that quantity, value, and price, should *vary independently*? *Only* because this result does not emerge from the 'traditional' calculation, a fact which the surplus approach school has exploited without mercy, for the valid reason that the idea of a conceptual distinction with no quantitative expression is close to meaningless.

[6] We designate *x* hours thus: $^h x$. This is explained in section 5.1.

Period	Consumed(^{h}C)	Labour applied (^{h}L)		Produced (^{h}X)	Unit value (λ)
1	^{h}44	^{h}44	$\Rightarrow$	^{h}88	2
2	^{h}75.43	^{h}96	$\Rightarrow$	^{h}171.43	1.7143

Table 3: Value consumption and output over two periods, temporal calculation

Over the whole period, we began as before with a value of 44 and added 140 units of labour. But our product is worth only 171.43; value has been lost. DL suppose that this presents no problems because value has been destroyed, but not created. In section 2 they write: "Within the traditional concept of value, the extra labour embodied in the past is no longer acknowledged as socially necessary labour time, and vanishes." Exactly *where* does it vanish? In section 1.1 they say:

> "(1) Circulation does not *per se* create or destroy value, but redistributes it within the economy"
>
> "(2) Value is increased in production by the amount of socially-necessary labour time incorporated. The value of inputs is transferred to that of outputs."

According to (1) value cannot vanish in circulation and according to (2) it cannot vanish in production. Presumably it falls into the void between the periods.

2.2. Value from nowhere

The problem does not end here. If productivity *decreases*, the same reasoning creates value from nothing. Moreover, DL's temporal paradox arises from this fact, since they start their producers with an artificially low unit value of 1.2, which can arise only if in a previous period, productivity was higher.

DL do not apply the standard scientific procedure when comparing two theories, which is to test them under the same conditions. To this end, since in the temporal framework the input prices λ_1 are the output prices λ_0 of the previous period, we must ask how a simultaneous λ_0 of 1.2 could have arisen. This is presented in table 4.

Period	Consumed(C)	Labour applied (L)		Produced (X)
0	11	13.2	$\Rightarrow$	22
1	22	44	$\Rightarrow$	44

Table 4: Physical consumption and output over two periods, falling productivity

Other combinations of *C* and *L* could give rise to the same λ_0 but physical productivity of either *L* or *C* must necessarily have been higher than in period 1. The concealed assumption is not a continuous rise in productivity but a sudden fall, followed by a steady rise.

Now we can contrast the two accounts under common conditions. The temporal account recognises that in period 0 the producers buy their inputs at the prices for which they were sold at the end of period 1, substantially lower because labour productivity was higher. They therefore enjoy an advantage which DL fail to make clear: they acquire their inputs more cheaply than they produce them.

The 'paradox' accounts for an observable phenomenon: the effect of technical change on prices takes time. Products become cheaper only after inputs themselves have cheapened, which takes place with a delay which is longer, the more indirect the impact of the technical change and the longer the turnover time of the input. The impact of infrastructural changes such as electrical power last an entire Kondratieff. TSS values account for a real-world phenomenon which simultaneous values cannot. This is not a paradox but a scientific advance.

Period	Consumed(^{h}C)	Labour applied (^{h}L)		Produced (^{h}X)
0	^{h}13.2	^{h}13.2		^{h}26.4
1	^{h}44	^{h}44	$\Rightarrow$	^{h}88

Table 5: Value from nowhere in the similtaneous paradigm

Now consider the simultaneous valuation of table 4, shown in table 5: Starting with 13.2 hours of value, and applying 57.2 hours, we end up with 88 hours. Value totalling 17.2 hours has *appeared from nowhere*, even though output per unit of labour has decreased. Moreover, the sharper the fall in productivity, the more value-added-from-nowhere, until, if the workers stop growing the product and watch it jointly produce itself, value-added-from-nowhere becomes infinite. In summary, temporal valuation contradicts neither itself nor observed reality: it conflicts only with tradition. Tradition, however, produces an internally incoherent result: it creates value out of nothing, while claiming that labour alone is the source of value.

3. Temporalist and simultaneous views: a paradigm difference

It is time to ask what this mysterious tradition actually consists of. It is a specific definition of value, the *equilibrium* or *simultaneous* definition. Originating with Bortkiewicz's integration of Walras' equilibrium methodology into Marxism,[7] it was developed by Sweezy, May, Winternitz, Seton, Morishima and many others, and found its resting place in the work of Sraffa and his successors. This neither makes it bad or good *per se*, but if a tradition is invoked we are entitled to know its content.

Its content is this: it defines value as a special price which can equalise supply to demand in an economy with no profits. This definition presupposes that the market works perfectly and to ensure this, eliminates all motion from it. If any of these conditions are violated the calculation no longer yields meaningful results.

This is not just a calculation. It is an ontology: a definition of what exists. Like temporalism, it defines an accompanying paradigm. It gives a distinct meaning to the concepts it employs, expresses the laws governing their mutual relations distinctly, and hence conducts their empirical study using distinct methods. This is why it cannot be used to comprehend results from a different paradigm. Thomas Kuhn (1962:149) writes:

> Consider, for another example, the men who called Copernicus mad because he proclaimed that the earth moved. They were not either just wrong or quite wrong. Part of what they meant by 'earth' was fixed position. Their earth, at least, could not be moved. Correspondingly, Copernicus' innovation was not simply to move the earth. Rather, it was a whole new way of regarding the problems of physics and astronomy, one that necessarily changed the meaning of both 'earth' and 'motion.' Without those changes the concept of a moving earth was mad.

DL write that "Freeman's approach diverges from the traditional analysis in only one respect: its definition of value". One might as well say Galileo diverged from Aristotle only in his definition of force. Precisely because value is defined differently, so is everything else – price, profit, capital, productivity, technical change, money, inflation, output, not to mention cause and effect. The results contradicts 'tradition' because, though we use the same words, we do not mean the same thing. DL's failure to recognise this produces a systematic departure from scientific method, characteristic of the tradition they endorse, as we shall now see

[7] "Alfred Marshall said once of Ricardo: 'He does not state clearly, and in some cases he perhaps did not fully and clearly perceive how, in the problem of normal value, the various elements govern one another *mutually*, not *successively*, in a long chain of causation'. This description applies even more to Marx … [who] held firmly to the view that the elements concerned must be regarded as a kind of causal chain, in which each link is determined, in its composition and its magnitude, only by the preceding links … Modern economics is beginning to free itself gradually from the successivist prejudice, the chief merit being due to the mathematical school led by Léon Walras." (Bortkiewicz 1952:23-24)

3.1. The abuse of paradox

Because they do not recognise that distinct paradigms are involved, DL act like a man who wants to divorce his wife for being incompatible. They think that proving we cannot co-exist is sufficient ground to exclude us. Incompatibility, however, is a two-way relation. The 'productivity paradox' does not prove temporalism cannot be true; merely that it is incompatible with the determination of value by use-values. An alternative conclusion is possible, namely, value might not be determined by use-values. Genuine science never discards a theory because its implications are paradoxical to previous ways of thinking, or quantum theory and relativity would be mouldering in a museum of scientific curiosities. To the contrary, any new theory forces us to challenge old ways of thinking, and its paradoxes lay bare the concealed meanings of the concepts at issue.

The acid test is not whether a theory seems strange but whether it explains reality better. Temporalism says that value varies independent of technology: tradition says that value can appear from nowhere. These two conclusions are incompatible, but we cannot deduce from this alone which theory is superior. We must ask the entirely different question, 'which corresponds best to the world we live in?'

3.2. The abuse of authority

DL write (p1):

> All advocates of the traditional approach are under violent attack in Freeman's analysis. The first sentence of his paper is illustrative: '[…] the simultaneous equations approach [i.e. the traditional definition of values] of General Equilibrium theory […]'. We are familiar with this criticism: it means that all Marxist economists who used in the past, or are still using, the traditional conception of values, are actually neoclassicals.

Economics makes such elisions: I do not. I am extremely careful not to make the deduction which DL attribute to me. Marxists are persons who choose to define themselves as such, and if they employ a simultaneous ontology they do not become neoclassicals, but marxists using neoclassical concepts. It is a classical *ad hominem* error to apply a characterisations to a *person* instead of a *theory*. Unfortunately, it is an error which DL make. In effect they say *because* these economists are marxists, nothing they say can be neoclassical. Good people hold the views that Freeman attacks, so he must be wrong, because they are good people.

This converts *authority* and, worse still, *allegiance*, into sources of truth: Freeman is wrong not because he fails to explain the world we live in, but because he conflicts with an exalted, unspecified tradition. The case reduces to a five-part syllogism: (a) Our tradition swears allegiance to Marx; (b) Anyone who swears allegiance to Marx is a Marxist; (c) No Marxist can be wrong; (d) Freeman contradicts our tradition; (e) Therefore, Freeman is wrong.

This all serves the single anti-scientific purpose of preventing a *variety* of theoretical approaches, each equally coherent in itself, being tested by direct observation. Each 'Marxism', including Marx's own, is a distinct theory and has the right and obligation to be measured against the observed facts. Once *any* 'tradition' or authority is elevated to a source of truth, science gives way to schismatic disputes over who belongs to it.

3.3. The abuse of empirical evidence

DL justify the loss of value that arises from simultaneous valuation as an explanation for the sudden fall of all prices in a crisis. The argument is in its essence facile; it pairs off an isolated unexplained phenomenon with a theoretical loose end and calls the offspring an insight. It has the same status as saying that since everyone can see the sun rises, it must go around the earth. It is wrong firstly because no *other* explanation for the fall in asset prices is considered. But it is wrong also because they consider this single phenomenon in isolation and do not

enquire into the many other phenomena that accompany it. The simultaneous calculation implies that technical change should bring *instantaneous* crisis; the more rapid the change, the deeper the crisis. It removes any movement in profit rate from the explanation of crisis; and it cannot account for transfers of value between monetary and real assets. TSS (see Freeman 1998) offers a comprehensive alternative: in crisis, the collapse of investment demand brought about by the falling profit rate leads to a régime of falling prices which produces a *speculative profit in value terms* to the holders of abstract purchasing power – monetary assets. The resulting migration of capital from production into circulation turns this secular movement into a sudden and sharp one, brings about a cyclical reduction in value production, and as capital is converted into revenue, lowers the organic composition of capital and reconstitutes a new basis for reproduction. This idea not only integrates the falling rate of profit but accounts for liquidity preference in value-theoretic terms.

Science consists in selecting the *best* explanation for *all* the facts. The entire effect of DL's argument is to *prevent such a selection* by ruling out the temporal alternative on the spurious grounds that 'tradition' finds it paradoxical. This is not the method of science but method of dogma.

4. The conservation of reality

We now address DL's objections, beginning with the main assertion that the "conservation of value" is inappropriate for economics and unnecessary for dynamics. My response is simple: any attempt to model dynamic behaviour without this principle must omit indispensable aspects of reality.

Conservation is an ontological concept which every genuine science needs as soon as it enquires into persistence through change: how something that is transformed endlessly, nevertheless exists. A tornado never stops moving, but throughout its life it remains a tornado. No atom in our bodies remains in the course of a year; nevertheless, the 'body', the 'person' is the same, an identity-through-difference conserved by living. Genuine science comes of age when it stops supposing that this identity must consist of something unalterable.

This remains true when the conserved things are quantitative. If I own £10,000, then 10,000 is the identity-through-difference of my capital. It is that which remains despite an endless variety of forms, that which allows it to move from one end of the planet to the other at the click of a mouse. If Gérard placed FF100,000 in a bank and found FF80,000 there the next day, I do not think he would dismiss this loss as an abusive analogy with physics. More likely, he would say that FF20,000 had been stolen; he would want to account for it. We are forced to explain, when the things in our world come into existence or pass out of it, *by how much* and *why*. This is a universal principle of thinking, not just of physics.

In this sense I suspect that when DL say value does not behave like energy, what they really mean is it does not behave like *money*: one cannot account for it. The very fact that they need to justify this accounting failure betrays their unease with a fundamental flaw in the value concept which they seek to defend: value, according to this concept, disappears without trace and appears without explanation.

Ours doesn't. It is churlish not to concede that this is an improvement. A value concept is needed precisely because though money may seem to come from nowhere, it always in fact comes from somewhere. The history of economics is driven by the need to say *where* it comes from: this is the purpose of value theory. If we cannot show where value itself comes from then we do not have an explanation but a mystical incantation.

4.1. The unreality of equilibrium

DL's first conclusion is that "even if the economy is always in disequilibrium, it does not mean that the theory of

equilibrium is irrelevant". This is a philosophical amalgam, equivalent to saying 'even if the world is alive, the theory of death remains relevant'; but we cannot study death without first explaining life. One may study equilibrium using non-equilibrium concepts, but not the other way around. Marx uses his value concept to study reproduction: he does not use reproduction to study value. Otherwise Volume II would have come first.

The words 'even if' are superfluous; the world *is* self-evidently not in equilibrium. The issue is the analysis of reality, and the underlying question is at what point we can abstract from the motion which is visibly and necessarily present in it, as has been known from the time of Heraclitus.

DL's tradition is not just a 'theory of equilibrium'. It is a theory of *value*, and outside of equilibrium its value concept is undefined. The objection is not that it studies stationary states; but that it derives its categories from the assumption of stationarity. It defines profit supposing that technical change has ceased; it derives value supposing stasis in the absence of capital and price supposing stasis in its presence. One may not do this and hope to explain any meaningful features of the real world.

4.2. On the use of comparative statics

This leads us to DL's third and most challengeable conclusion: that "a dynamic framework can assume equilibrium as is the case in a sequence of Walrasian temporary equilibria" – that is, comparative statics. The word 'can' is again ambiguous. If it means 'comparative statics is logically possible' then this is undeniable. Astrology is also logically possible: this does not mean it is true.

TSS produces different *numerical results*, which account better for what goes on in the world. Where statics finds that the profit rate rises without limit, TSS finds that it falls until accumulation is interrupted. Where statics produces value from nowhere, TSS finds it only in production. Where statics finds that money is a veil, TSS coherently explains liquidity preference. Where statics predicts factor equalisation, growing inequality arises as a natural and endogenous consequence of the TSS interpretation.

These two accounts cannot both be true; we have to judge between them. It isn't enough to assert that comparative statics is possible; one must also show that it is a better explanation of the world. By interposing 'tradition' between theory and the world, DL evade the scientific requirement of testing each theory, on a level playing field, against all the observed facts.

5. A restatement of the TSS approach

My main argument restates the TSS interpretation in a *period-independent* framework to illustrate the different conceptions of fixed capital involved and show that the treatment of time is decisive.

TSS is not the only temporal value theory (Cf Kristjansen (1998), Naples(1996)). It combines temporalism with the single-system approach, an innovation with a strong family relation to the New Interpretation (NI).[8] There are also simultaneous single-system (SSS) approaches. (See Wolff, Roberts and Callari (1982), Moseley (1993), Ramos and Rodriguez (1996) and Lee(0000)). Both SSS and TSS logically extend NI to constant capital, a heritage we are happy to acknowledge. TSS extends SSS to the general, non-stationary case.

In the New Interpretation, variable capital is measured not by the value of wage-goods, but by the value expressed in the money wage itself. Any sum of money represents value not by virtue of the labour in it, but because in circulation it expresses social labour directly by virtue of being absolutely exchangeable for all other

[8] See the references in DL's paper. The approach is variously termed the New Interpretation, the New Approach and the New Solution.

goods. If £1000 represents 100 hours, we may define a coefficient, following Ramos and Rodriguez (1996) termed the *Monetary Equivalent of Labour* or MEL: £10 per hour is the rate of exchange between value measured in hours, and value measured in money. In effect it is the inverse of the New Interpretation 'value of money'.[9] In all single-system approaches this is extended to constant capital, which is represented not by the value of inputs, but by the value expressed in the sum of money that pays for them.

TSS further generalises the MEL by dropping all assumptions of stationarity. NI defines the MEL as the *flow* ratio of new money value added, divided by new labour. I define it as the *stock* ratio between the money price and labour content of all social capital.[10] Every sum of money then represents an aliquot part of the total value in existence and hence a definite number of past hours; if 100 hours are embodied in a total social capital priced at £1000 then each £1 represents $^1/_{10}$ hour.

If the MEL is stationary, these definitions are the same. But if it is changing, the NI definition does not distinguish the increment in price that results from the addition of new labour, from the changes in price that result from changes in the monetary expression of labour between the beginning and end of the period (see Freeman 1999). Thus in the extreme case where the MEL rises without any additional labour, the flow definition becomes infinite. Stationarity enters the NI and SSS definitions because they treat this additional term, a pure result of circulation, as a genuine increment or decrement in value – value from nowhere. The effect equally arises if technical change, during the period, changes the amount of labour embodied in any product that figures both as an input and as an output, thus modifying the MEL.

5.1. A small amount of notation

The time at which any variable is measured is represented with a superscript: V^t is variable capital at time *t*. For period (discrete) systems *t* indicates a measurement made at the beginning of period [*t*, *t*+1].

To track the units in which a quantity is measured I extend normal money symbols in an obvious way, by writing h100 for 100 hours of labour-time. This is easier to follow if the unit is superscripted thus: $^b100$ means 100 bushels of corn. If omitted, the implicit unit is use-value.

5.2. Determining the magnitude of value

Suppose a capitalist consumes £100 in constant capital (C), employing workers who add $^h10$ of living labour (L) to the product. Suppose the MEL is 10. From this and the single-system calculation, it follows that we can restate the production process in hours. The £100 in constant capital represents $^h10$, and the workers add another $^h10$. The value passing into the stock of social value is

(4) $$^h10(C) + {}^h10(L) = {}^h20$$

This is determinate whether or not there are other producers of the same thing, or stocks of the same thing, or joint products. It simply says that *L* is added and *C* transferred to the whole of social value.

No particular time-period is indicated. Goods that appear in a long time-period as being consumed entirely during production, are in a shorter time-period consumed only partially. It is impossible to make an artificial distinction between fixed and circulation capital based on duration.

[9] A number of authors claim a *dimensional* incompatibility between price and value, beginning with Abraham-Froix and Berrebi(1979). As Rodriguez (1996) notes, value has two measures, its *intrinsic* (labour-time) measure and its *extrinsic* (money) measure. Both value and price may be expressed in either unit, at all times and in all forms.

[10] In a one-period model this reduces to the ratio between the value and price (respectively) of the gross product; however here I will define the temporal approach without reference any definite period, to indicate its generality.

5.3. Temporal closure: total social value and the MEL

In section 5.2 we supposed the MEL to be given. However from any initial value, it is defined at all subsequent points, so that the value transferred to every product is determinate. To show this suppose all capitals, taken together, consume over any period £C in constant capital and employ workers who add ${}^{h}L$ of living labour to the product. We can restate this in hours as before; the capitalists cause a value to pass into the total stock of social capital which is equal to

$$ {}^{h}C + {}^{h}L = m^{£}C + L \tag{5}$$

where m is the inverse of the MEL. This does not yield any price information. Prices are *data*, to be observed. We can add up, at any moment, the total price of all goods in society, including all forms of capital such as money, work-in-progress, machinery, and so on.

But we can also ascertain the value of this same stock in hours, provided only that its value at the start of the process is known. Equation (5) then tells us how much new value has been added to it. What is lost to it in the same period? Value diminishes as goods are consumed. This loss has three elements that we are interested in: £V, the consumption of the workers, £B, the consumption of the bourgeoisie, and £C which is just the used-up constant capital already referred to. But as we have seen, £C is exactly replaced in the product. Net value consumption is therefore £($V + B$), again known from price data.

Consequently we now know the total value in hours and in money of the new social stock. Dividing one by the other gives the new MEL. This closure renders all magnitudes so far defined determinate, without placing any equilibrium constraints on any of them.

6. The conservation principle in practice

6.1. Conservation in circulation

We now illustrate how the conservation principle, embodied in the interpretation just given, reproduces the main, generally-accepted qualitative requirements not only of Marx's theory but of economic theory in general. We begin with the most fundamental question of all: what distinguishes circulation from production?

Chapter 5 of Volume I of *Capital* entitled "Contradictions in the General Formula of capital" systematically investigates what happens when price departs from value. The central conclusion is that total value must be an invariant of circulation. Specifically, it must be the same for all possible sets of market prices: no mere price change can create or destroy value. Is this an obscurantist fetish? No, all economic theory distinguishes production from circulation. The moment one draws a line, even abstractly, between activities that 'create' and activities that 'circulate', one implicitly stipulates a concept of value which cannot be modified in circulation, or the distinction itself is meaningless. Without a quantitative measure of social wealth which arises external to circulation, and does not vary as a result of it, we don't actually have a concept of circulation.

Marx's 'first equality' is not an arbitrary numéraire but the mathematical expression of the invariance of value in circulation. This is the real 'fundamental marxian theorem'. It logically precedes all further development, including the categories of production, profit and reproduction; it is historically general, applying to all societies in which commodities exist, and is the axiomatic foundation of everything else in value theory.

It is completely inadequate to confine this invariance property to special cases such as prices of production. A general property must hold generally, that is, for all market prices – and hence out of equilibrium. Chapter 5

accomplishes this; the TSS interpretation formalises it. Suppose a product whose value is $^{h}6$ has a price of £5, and that the MEL is $^{£}_{h}1$. The seller then receives $^{h}5$ in return for $^{h}6$: that is, s/he loses $^{h}1$ (or £1, the same thing expressed in money) by converting the product into money. The buyer gains this lost hour. In other words

(a) Every set of market prices effects a system of transfers of pre-existing values, created in production, between the owners of these values.

(b) The total of labour-hours in society is unaffected by this redistribution.

To achieve this, any money sum must at any point in time represent a definite number of hours which is universal throughout the economy, and defined uniquely at every point in time.

6.2. Conservation in production

It may be thought that conservation applies only in circulation. But circulation and production divide the activities of humankind in two. If production yields more than the sum of the value consumed and added, then additional value is unaccounted for. We can either say this arises in circulation, or that it arose in fact in production but was not accounted for. In the first case, we again destroy the distinction between production and circulation. In the second, additional factors of production must be invented to account for the difference.

This leads vulgar economics to attribute value-creating powers to capital and land. Since the total product of society sells for more money than its inputs cost, the difference gets called the cost of capital or land. This doesn't work because these factors straddle the boundary between production and circulation. If land and capital add value in their own right inside of production, they can do it outside too. Interest and rent collection become additions to value, regardless of whether they correspond to any new use-value, and we arrive back at the conclusion that value arises outside of production. Exactly the same applies when use-value is made the measure of value. If use-values can add value inside production then they can do so outside, and value can literally grow on trees.

The unique status of labour, in comparison with these spurious factors, is that as the purposive human creation of new use values it constitutes the *definition* of production. In making labour the sole source of value, we do nothing more mysterious than recognise this definition quantitatively and indeed, if like the physiocrats we consciously decide on a different definition of production, then we get a different definition of value.

What we can't do is adopt a definition of value inconsonant with our definition of production. Labour is the universal substance of value because production *consists* of the application of labour: the conscious transformation of nature by humans for humans. It is neither the unaided activity of nature, nor the passive self-motion of machines, nor the ceaseless immaterial recycling of 'titles to property' effected by the market, and least of all is it the mere existence and persistence of use-values. Machines do not 'produce' machines; *labour* produces machines, when it transforms one use-value into another. New value arises only at this point.

The true paradox of modern value theory is that outside an ideal state of rest, 'tradition' creates and destroys value without accounting for it. This is the real origin of all the errors that are laid at Marx's door. This paradox is not grounds for rejecting tradition but does require us to track down the concealed origin of this failure, which ultimately lies in an inadequate separation of the sphere of production from the sphere of circulation.

6.3. Conservation and time

From the above considerations, we can see why all theories of value from Ricardo onwards have recognised that anything consumed in production transfers its own value to the product. If £100 of iron is used to make steel, but we suppose it transfers only £50 to it, the remaining £50 has to attributed to some other source. If we suppose it

transfers £150 then iron itself becomes a source of value. If we wish to isolate, and exactly quantify, a source of value independent of how much iron we use, then it must transfer exactly its cost to the product.

Does this therefore mean that when iron changes in price between purchase and use, the value is created or destroyed? No, precisely because price changes are a phenomenon of circulation. If our iron has fallen to £50 when it is used, the capitalist has suffered a speculative loss of £50 which some *other* capitalist has gained.

Thus, however, the question of time rears its head. Hardly any productive input is used at the time it is purchased. Between purchase and use, it rises or falls in price and/or value. What is the relation between the initial cost of an input and the value it transfers to the product? Three views are known to me:

(1) the view attributed to us by DL and many others, is that the value transferred is the initial cost – so-called 'historical cost'. TSS does not assert this.

(2) the simultaneist calculation, somewhat miraculously, transfers the *future* cost to the product: what it will cost to repurchase the inputs after their product has emerged.

(3) the TSS view is that the value transferred is given by the price at the *time of use*. This, *pace* tradition, was also Marx's explicit view.[11]

The value associated with consumed constant capital passes into the product neither before, nor after, its elements are used up but at the precise point in time *when* they are used up. Because of this temporal definition, production cannot contribute any new value to society except *L*. The value transferred to the product is whatever the value of *C* happens to be when it is used, and the same sum is removed by its use. The failure of value conservation in simultaneist accounts arises because they separate these two aspects of production *in time*. Constant capital is made to give up its old value at the beginning of a period, and add its new value at the end.

Summing over all of society the total value added to the stock of social capital in production must always equal the time worked over any period, because at each point in the trajectory, no matter what the current value of constant capital, what goes in is what comes out. Always and inviolably, $m\times£C$ is removed by use, and $m\times£C$ is transferred back in by the labour process. The two can never separate, because they happen at the same time.

This is precisely what simultaneism violates: the product in section 2.2 grows in value because it gets two valuations from two different periods at once. As the output of period 1 it has one value, and as the input to period 2 it has another. This circle is not squared, and value pops out of nowhere.

6.4. Conservation in consumption

A tempting way out of this simultaneist dilemma is to elevate consumption to the status of a special sphere distinct from both production or circulation – or, more desperate still, to make 'waste' into a fourth sphere. DL defiantly pronounce lost value 'no longer recognised as socially necessary'. Unless we treat excretion as productive, this argument breaks down when the discrepancy appears as an addition to value rather than a loss.

Marx himself did not take this course and we do not find, in the circuit M-C-P…C′-M′, any special period for consumption or waste. Consumption is coterminous with production: the personal part of this consists of the reproduction of humans, which takes place alongside and as part of the remainder of production.

Human reproduction falls into two great categories: the reproduction of the commodity labour-power, which costs society *V*, variable capital, and the reproduction of the capitalist class which costs society the amount we

[11] Freeman (1999) provides extensive textual evidence

have designated B. A part of profits re-enters production as investment, which we designate I.[12]

Marx's 'second equality' connects these magnitudes. It arises as a genuine, non-tautological deduction from the TSS interpretation. In any period, the value added to the total in society is exactly equal to the living labour expended in that period. The value consumed by workers is exactly V, variable capital. Everything else ($B + I$) falls to the capitalists since gross output over any period is

$$C + L$$

and gross consumption is $C + V + B + I$

giving the second equality $L = V + B + I$

Value conservation is therefore of immense social and political significance; without it, since we must suppose value can arise other than from labour; by the same token so can profit. Since labour is merely the human transformation of nature for other humans, we must then admit of a source of profit other than humans. It is then perfectly valid to argue that a special class is required to organise this source of profit for the benefit of humans – that is, capitalists or landlords – and it would be illogical or even dangerous to eliminate this class.

6.5. Neither production nor circulation: the world of phantom values

The ambiguity in DL's tradition arises because when the price of an input changes, it cannot say whether this takes effect in circulation or in production. Why is constant capital constant? Because variations in the price of inputs – such as moral depreciation – belong strictly to the sphere of circulation, a fact recognised even by temporal formulations that do not respect value conservation, such as Kristjansen (1998).

Simultaneous approaches include, in the calculation of C, events that occur after C has in fact been determined. This destroys Marx's precise formulation of the temporal succession of production and circulation. If therefore there is any general change in the interim, whether technical change, inflation or relative price changes, the value transferred to the product is retrospectively modified. It becomes impossible to say if this modification belongs to circulation or production. It is consigned to some hyperspace from which value commutes, without challenge from the mortal world. Charon turns banker, returning his obols with interest to the dead souls which weigh on the brains of the living.

7. Objections to the temporal value concept

We now consider DL's objections to this value concept, and in the process indicate how it generalises.

7.1. Objection 1: socially necessary labour time

DL argue that the temporal definition defies Marx's concept of socially necessary labour time. On the contrary, it restores it. Marx's concept refers to the time needed to make something with the existing instruments of production, in the society that we live in. If someone invents a new process for making bricks which makes cheaper chip factories, hence cheaper chips, hence cheaper computers which raise office productivity, the labour that is socially necessary to write a letter does not, and cannot, diminish until the computers actually arrive in the offices. Before that the bricks must be laid, the cheap chips must roll, and the computers must hit the shops. The mere existence of a new technology cannot of itself alter the time that society is actually obliged to expend on

[12] Noting it can be negative (disinvestment), which Marx terms the conversion of capital into revenue. In this case $B+V$ is greater than current profits.

production; only its use can materially alter what is objectively necessary.

DL's presentation perpetuates a linguistic legerdemain. They write (p1):

> the value of inputs must be estimated on the basis of their present conditions of production, independently of the amount of labour actually required for their production in the past. What is transferred to the outputs of the period is the present value of inputs.

But this is not what their 'tradition' – simultaneous valuation – achieves. Any normal notion of the word 'present' refers to what now exists. But when the new brick technology is devised, the kilns, factories, chips, computers, and offices to which it will later lead, have yet to be constructed. The process of making them 'present' takes time. The new, highly productive offices *do not belong to the present. They do not exist*.

Simultaneous valuation, in a nutshell, acts as if they do exist: as if the entire causal chain linking the new brick process to the letter-writer were already accomplished from the moment the brick patent is committed to paper. This is not 'present' but *future* valuation. Moreover, it is not even an actual but a hypothetical future valuation, since by the time the new computers are rolling, further changes elsewhere will have transformed the general circumstances of society. It determines what is socially necessary, by constructing in the imagination a complete ideal society, which will never actually exist. A concept alien to both Marx and reality has been smuggled in: Platonically necessary labour time.

7.2. Objection 3: market clearing

Under the heading *The equations of sequential values assume market clearing,* they say that "if markets do not clear (one aspect of disequilibrium) it becomes necessary to consider stocks of inventories," and calculate social values as the average of current production and left-over stocks, as if this were a difference with me. But I have no difference with this: under the heading 'Why supply does not match demand, and where the difference goes' I wrote (Freeman 1996:251):

> If the economy reproduced perfectly and identically, stocks could not differ from flows because they would neither rise nor fall. In reality reproduction is incessantly interrupted or capitalism would not exist. The gap between supply and demand appears as changes in stock levels, providing the signals that drive price changes and tell producers what is socially necessary. This is the pulse of capitalism.

The real issue is the following: why not extend this generalisation to fixed capital? Stocks arise from two sources, of which DL acknowledge only one: they suppose that stocks arise *only* from disequilibrium, accepting that social value is formed from an average including them. But when stocks take the form of fixed capital, they let fall the curtain, dim the stage lights, and usher in Sraffa's ghost under the cloak of tradition.

7.3. Objection 4: individual and social values

The divergence between 'tradition' and Marx now becomes steadily more apparent. DL seem uncertain about where I stand on the formation of social from individual averages. They state:

> One problem for the value conservation approach is the possible coexistence on a market of commodities produced at different periods. This issue is not clearly discussed by Freeman, but we can surmise his view from his equation.(p3)

Their surmises are correct, but it is simpler to proceed from what I wrote (Freeman 1996:255):

> Once a unified market is established, value and price emerge as an average over all the output of society. Marx concentrated his attention on the relation between individual producers and this market value. But everything he wrote logically applies to the entire stock of society; it would not make sense to exclude any portion of this on the

basis of an arbitrary accounting separation which adjudges it an output of the 'last period' and therefore ineligible to take part in the formation of a uniform market price.

The social or market value of every commodity at each point in time is formed as an average of the individual values of every portion of that commodity in existence, including unsold stocks, consumer durables, speculative holdings, fixed capital, work in progress, and anything else I forgot. *Everything*. The reason is that price is formed on that basis; in the course of establishing a uniform price, the market establishes a uniform value.[13]

This resolves the exact determination of the magnitude of value for individual commodities, left over from section 5.2. Suppose there are ${}^{t}K$ tons of a given commodity in existence, with value ${}^{h}K$. Suppose in a given time interval Δt a further ${}^{t}\Delta K$ tons are produced whose value is ${}^{h}\Delta K$ hours as specified by (4). The new market value of the commodity is then

$$\frac{{}^{h}K + {}^{h}\Delta K}{{}^{t}K + {}^{t}\Delta K} \tag{6}$$

Why is this stock different from all other stocks?

The substance of the dispute is straightforward and there is no need to be shy about it: I think values are averaged over all stocks including fixed capital, and DL exclude fixed capital. A series of red herrings arise because they have not take full cognisance of the fact that I propose a completely uniform principle.

My proposal conforms exactly to their (p3) principles: a good formalism must "avoid excessive complexity" and "be susceptible to generalisation." Nothing could be simpler, and nothing more general, than treating all stocks in the same way, since no stocks are excepted. It is DL who want to treat a specific kind of stock differently, namely fixed capital. But they should then offer a positive reason for an extra, and less general, complication. Something more than 'tradition' is required to justify departing from an obvious and simple idea.

7.4. Objection 5: joint production

DL argue that the sequential calculation does not deal with joint production and provide the following counter-example which, they say, yields negative values (A = inputs, L = labour, B = output, λ = value):

$$A^1 = \textbf{Error!}; L^1 = \textbf{Error!}; B^1 = \textbf{Error!}\lambda^0 = \textbf{Error!}$$

If one solves the sequential equation $B\lambda^1 = A^0\lambda^0 + L^0$; it yields $\lambda^1 = \textbf{Error!}$, apparently a negative value.

But, just like the examples cited by Steedman and others against the simultaneous value calculation, the derivation contains an illegitimate concealed assumption, as Savran (1984) demonstrated sixteen years ago. Each output is produced by two processes and therefore, two individual values are involved: DL impose, quite arbitrarily, the condition that these must be the same. Their fixed capital paradoxes in section 3.3 depend on the same arbitrary condition. Let the individual values of commodity i as produced by process j (following DL's later notation) be $\lambda_{i,j}$, and from now on drop the time subscript since we are always looking at λ^1. Then the equations of value read

$$1 + 1 = \lambda_{1,1} + \lambda_{2,1} \tag{7}$$

$$2 + 1 = 3\lambda_{1,2} + 2\lambda_{2,2} \tag{8}$$

[13] Hence the only caveat: single market values are formed in a concrete process, hand in hand with the formation of a single price. To the extent that the market is incomplete, that is, does not bring all instances of the same use-value into the same exchange-relation, partially-differentiated and separately-averaged values are formed. In discussing a general theory, like Marx, we begin from a fully-developed market with a single price and a single value, and then modify this to deal with further determinations.

DL impose the condition that the individual value of each commodity must be the *same* in each process, that is, $\lambda_{1,1} = \lambda_{1,2}$; $\lambda_{2,1} = \lambda_{2,2}$, which is exactly how Steedman extracts his contradictions from the simultaneous case. But the system can be solved – for example – with the perfectly reasonable positive values

(9) $$\lambda_{1,1} = 1, \lambda_{2,1}= 1 \; ; \lambda_{1,2} = 1/3; \lambda_{2,2} = 1$$

The total value of commodity 1 now in existence is then 2, its total use-value is 4 and so its market value is ½. By the same token the market value of commodity 2 is 3/3 =1. There is no reason to choose DL's solution over mine. The equations as given are indeterminate, and that is how I put it in my 1991 paper which they cite.

Indeterminacy: insufficient information, or ontological catastrophe?

The problem is that indeterminacy has a different meaning for the two paradigms. DL cannot accept that values might be indeterminate in the normal sense of the word, that is, they exist but we don't happen to know what they are. They can't even conceive some kind of quantum indeterminacy, of a thing that exists but is yet to be fixed. For them, if values are not determined by their equations, they do not *exist*, opening up an abyss. 'Indeterminate' for me simply means that the equations themselves do not determine these values. Extra information is required, in such a situation, to allocate the value of the two processes uniquely to the output. In the case of fixed capital we will see that exactly such an additional determination is easily supplied.

Very little damage is done to the temporal calculation by the indeterminacy, for the following reasons:

(1) The MEL remains determinate. Even though we do not know how value is allocated to the individual outputs, there is no ambiguity about the *total* value output (2 from process 1 and 3 from process 2).

(2) With the MEL known, we can always determine both the magnitude of constant capital and variable capital, since these are given by the money paid by the capitalist, divided by the MEL.

(3) No other part of the value calculation is affected; only the commodities in the DL's rather unlikely example are indeterminate, and this only to the point that though we know the total labour contained in the two commodities together, we do not know how much of this labour is in one, and how much in the other.

(4) Whatever the economists might think, the capitalists *certainly* know how inputs are allocated to outputs. The modern firm has no practical problems in allocating costs to multiple products, constructing precise accounting procedures involving cost centres, subdivision of overheads, and a detailed examination of its own production processes, to supply the very determinations which DL's equations cannot provide.

Finally, a little care in diagnosing the indeterminacy doesn't hurt. Consider Marx's (I:182) example, in which a cow jointly produces meat and manure. Value seems to be indeterminate because we don't know how much labour is in the bull and how much in the bullshit. But everyone who has worked on a farm knows that the by-products are a part of the internal economy: it consumes them. Unlike economics, a farm exports only beef. We know how much labour is in the beef, because it is the only thing that leaves. Like a wave function, the indeterminacy collapses when we observe it.

This provides a vital insight into the following question which arises: why do DL consider joint production important? The answer is that they wish to treat fixed capital in Sraffa's manner, as an intermediate product: so that each year, or each period, it makes an older copy of itself. The value of every intermediate version of the capital must then be determinate or *no* value is determinate.

In the simultaneist paradigm this is the ultimate catastrophe, since nothing now exists. I agree this is a problem:

however, it's not our problem.

8. Fixed Capital

DL's objections flutter like moths around a single candle: the temporal treatment of fixed capital.

Their difficulties arise from two sources. In the first place, they refuse to consider fixed capital as it really is, a simple stock, indistinguishable, as far as social value formation is concerned, from all others. In the second place they confront the results of one paradigm with the interpretations of another. This confusion, however, is a weapon which points in both directions, and matters come to a head in sections 3.2 and 3.3. "The purpose of this section [3.2]," they state, "is to discuss the compatibility of Freeman's definition of value with the traditional model of fixed capital. Can the sequential approach apply in this framework?"

Of course it can't. The whole question should be put the other way around, namely, can the 'traditional' (that is, Sraffian) treatment of fixed capital be made dynamic?

8.1. Whose tradition is it anyway?

Now we approach the heart of the matter, so let us study it with more care. The argument develops out of a subtle progression. In section 3.3 they study a system in which machines are completely used up over two periods. They write this as follows:

(10) a machines + l units of labour $\rightarrow$ b machines + $\frac{a}{2}$ machines

(11) a' machines + l units of labour $\rightarrow$ b' units of consumption good+ $\frac{a'}{2}$ machines

That is, when a machine is used up, we must think of it as 'producing half of itself', along with its true output, (b, b'). This tradition is contrasted with the heretical Freeman's proposal:

(12prod) $\frac{a}{2}$ machines + l units of labour $\rightarrow$ b machines

(12circ) $\frac{a}{2}$ unused machines $\rightarrow$ $\frac{a}{2}$ unused machines

(13prod) $\frac{a'}{2}$ machines + l units of labour $\rightarrow$ b' units of consumption good

(13circ) $\frac{a'}{2}$ unused machines $\rightarrow$ $\frac{a'}{2}$ unused machines

We have labelled the equations to clearly indicate the underlying idea: the mere self-perpetuation of unchanged matter belongs not to the sphere of production, but to circulation. Equations (12circ), (13circ) state we have not used up all the (a, a'): a *stock* of partially used machines survives: (a/2) from capital 1 and (a'/2) from capital 2. This novel idea isn't mine. It's Marx's.

> Suppose a machine to be worth £1000 and to wear out in 1,000 days. Then one-thousandth part of the value is daily

transferred to the day's product. (I: 202)

If a machine lasts 2 periods, then in each period a half of it is *turned over* and half remains to be used. If it lasts k periods, then in each period $(1/k)$ is turned over and $(k-1)/k$ remains.

Just about the one thing that cannot be laid at Marx's door, with absolute certainty, is a failure to consider turnover. Of course he might have got it wrong. The fact that it comes from him is no more a proof than DL's hallowed tradition. But, excuse me, this is not some scatterbrained sequentialist invention; it is integral to the most serious project in value theory since capitalism began, and if we are going to dismiss it then let's think about the implications. If we are going to invoke tradition, let's be clear whose tradition it is.

8.2. Value: a product of things or a product of humans?

In Marx we find nothing of objects producing themselves, which is the very opposite of production. It contradicts the whole historical evolution of the value concept away from physiocracy, for whom the basis of value was *natural*: the reproduction of nature unaided and unorganised by people. Successive refinements by Smith, Ricardo and Marx freed the value concept from its naturalist heritage and located it in specifically human, social, and conscious activity.

The place which Marx's value concept rightfully occupies in the history of economic thought is the completion of this task. In his work for the first and last time production is rigorously and uniformly defined as a specifically human activity, and value is rigorously defined as its quantitative outcome. Economics since his death is not much more than an orchestrated media drive to prove this can't be done.

A careful examination of 'tradition' reveals a regression to the notion that use-values themselves constitutes a source of value when their use consists of the production of other uses. Physiocracy appears in modern dress, as *Robocracy*: instead of corn, machines are now worshipped as a source of value.

8.3. What is the use-value of a machine?

The two systems defined above, in DL's section 3.2, are formally identical despite the different presentation, as they themselves concede. We get the same sequential values whether we write their two equations or my four. This is because the 'joint output' of their system is a machine *of the same type* – to be precise, half a machine of the same type. In consequence, whether we solve the system (10), (11) or the system (12a,b), we get the same answer.

These 'jointly produced' machines are so far treated as having the same use-value and hence must share the same market value. So far, an old machine is just like a new machine, except there's less of it. Our two treatments produce the same result in this case because DL allow us to treat an old machine as identical to a new machine, but with less life in it. The real question is why they withdraw this concession when they retreat back into their tradition. At the beginning of section 3.2 they state:

> He [Freeman] first considers the example of an imperishable raw material: copper. We certainly agree that for this category of good, it would be impossible to abstract from age. However, Freeman's analysis breaks down when he extends this assumption – not a simplifying assumption, but the establishment of a new approach – to all constant capital, circulating or fixed. In our view age matters. This seems obvious for some perishable inputs, for example cheese, but is also true for fixed capital. In Freeman's approach, machines are treated like imperishable raw materials. Old and new machines are different quantities of a same good. During the production process, a 'fraction' of the machine is consumed.

The distinction between perishable and imperishable goods is secondary. I am unfamiliar with cheese as a means of

production: but the decisive point is that in production, everything perishes. The lifetime of a production good is not given by its innate nature but by its role in production. Steel perishes not because it goes rotten but because it is converted into something else. Marx simply says the same thing happens to machines, but more slowly. There is no qualitative difference between circulating and fixed capital, merely the time in which they turn over.. A perishable good is nothing more or less than an inefficiently-used good, some of whose being gets destroyed outside of production proper.[14] Indeed, DL's treatment of machines is inconsistent in the following respect: if machines were *truly* imperishable, then an old machine could not be distinct from a new one, since a change of form is precisely what perishing consists of. [15]

The great merit of Marx's treatment is that it brings all means of production, of whatever type, into a single conceptual framework, and – most important – categorically imposes the requirement that the only way any element of the constant capital may pass value into the product is by being used up.

This is the ambiguity in Smith's treatment of stock, which lingers on in Ricardo and was reconstituted by Walras. The 'Capital Controversy' understood quite well that neoclassical theory tries to make society pay for its capital twice: once for the price of its elements, and again for the privilege of owning it. With circulating capital this is clear; with fixed capital it is not, since it presents the illusion of permanence, and becomes a 'factor of production'.

DL regress to a pre-Marxian absolute distinction between fixed and circulating constant capital, assigning to each a distinct role in the process of value formation. This merely reintroduces the 'price of capital' by the back door; we pay not for using *up* the capital, but merely for having the use of it; that is, for possessing it.

The use-value of a machine is that of being used to produce things.[16] In this respect we cannot distinguish a new machine from an old one any more than a piece of copper. Take an almost universal means of production, the lightbulb; its use-value is to give light. Light from a new bulb is just like the light from an old one. Steel from an old furnace is the same as steel from a new one; the effects of electricity do not depend on the age of the power station; and so on. The *only* universal differences between old machines and new machines are, on the one hand, their physical productivity, and on the other the amount of life in them; the length of time for which they can be used in an 'average process'. This is likewise not a new idea:

> The lifetime of an instrument of labour, therefore, is spent in the repetition of a greater or less number of similar operations. Its life may be compared with that of a human being. Every day brings a man 24 hours nearer to his grave, but how many days he has to travel on that road, no man can tell by merely looking at him. This difficulty, however, does not prevent life insurance offices from drawing, by means of the theory of averages, very accurate and at the same time very profitable conclusions. So it is with the instruments of labour. It is known by experience how long on the average a machine of a particular kind will last. Suppose its use-value, in the labour-process, to last only six days. Then, on the average, it loses one-sixth of its use-value. (p204)

The market itself recognises this by forming second-hand prices. This is a concrete process. If the market estimates partly used machines too cheaply, smart entrepreneurs snap up the older machines and actually out-produce those foolish enough to fetishise new things for the sake of it. In the process they drive down the prices of new machines. The market *itself* constantly compares machines of the same type and forms a common price for the use-value of being a machine, in the process forming a common market value.

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[14] *Waste*, however, is treated clearly by Marx. If a portion of use-value is discarded without being used, the value in it passes into the product with those parts that are used. This is incidentally far more realistic than the 'traditional' treatment of joint production (See Farjoun and Machover (1984)), for which as soon as any excess appears of a product at all, its price sinks to zero. The labour that society puts into a wasted product is distributed over the part that is used properly, which becomes pro tanto more valuable.

[15] Ironically, the only truly imperishable good is software, for the very opposite reason than machinery; not because of its solidity but because of its lack of it; its very immateriality renders it indestructible. Exactly how new software is supposed to jointly produce old software is just one of those mysteries the Sraffian outlook has not so far addressed. From a temporal point of view software is easy to understand. Its value-contribution is zero; it provides only differential technical rent, which is why its price collapses to nothing when universally available. This loss of value is a pure moral depreciation.

[16] I am indebted to Paolo Giussani for clarifying this.

Nothing prevents us treating this *material* depreciation more subtly. A straight-line decline is just the simplest approximation to a reality that differs from machine to machine. We might find, through empirical study, that a station-wagon loses more functionality in the first year and becomes less productive. In that case we can draw up a more sophisticated schedule of material depreciation based, for example, on the scrupulously-compiled lists of second-hand prices that appear in the trade magazines and which, effectively, measure in monetary form the proportion of the use-value which remains in any vintage of any marque of vehicle. This is so precisely because the use-value and the value march together; value can pass into the product *only* through the loss of use-value, because they are embodied in the same material thing.

8.4. Moral depreciation

Of course the machine can lose value for other reasons such as technical change and suffer moral depreciation. DL seem to miss the point of this: moral depreciation is precisely that part of the loss of value which does not pass into the product:

> It is thus strikingly clear, that means of production never transfer more value to the product than they themselves lose during the labour process by the destruction of their own use-value (Marx 1979:204)

Indeed, merely to use the words 'moral' depreciation, as a distinct category, already implies that it is not the same as 'material' depreciation. If one seeks to use it as a distinct term, one must clearly specify that from which it is distinct. Material depreciation is the loss of exchange value in step with and as a consequence of the loss of use-value. Moral depreciation is a change in value independent of the destruction of use-value and arises therefore *in circulation* as a consequence of technical progress. Precisely because social value is formed over all stocks of a commodity in existence including those engaged in production, value is transferred from users of older versions of the same use-value, which at one time cost more, to the more efficient modern producers of the same use-value. Possessors of fixed capital experience this as what Marx terms the 'tie-up' of capital – a deduction from their profits that appears as a cost but which is a disguised transfer, permitting the current producers to charge a premium for their product.[17] This is why, for example, the new version of any computer or central processor always first appears on the market at a premium and is then rapidly marked down as it penetrates the market. This is also the origin of the continuous divergence between the technologically-advanced nations and the rest of the world; their *monopoly of technical innovation* secures for them vast superprofits, via this simple market mechanism, which they can then use to maintain this monopoly.

Far from failing to explain this phenomenon, this integrated treatment of fixed capital provides the only quantitatively coherent account of it.

8.5. Old but not sold, new but not true

When we reach the next section, section 3.3, which produces the 'paradox' of negative and explosive recursion, values, we find a different system:

(14) a new machines + l units of labour $\rightarrow$ b new machines + a old machines

(15) a old machines + l units of labour $\rightarrow$ b new machines

and the comment 'the sequential value approach does not provide an ability to consistently treat this case'. 'This case' has changed. The words 'new' and 'old' have made their appearance. For good measure the treatment has

[17] Maldonado-Filho (1997,1998) has extensively developed the category of release and tie-up of capital.

grown from merely traditional to become 'standard'.

An old machine is now distinguished from a new one. It has a distinct use-value; it is a distinct thing with a distinct exchange-value also. Old machines and new machines are not compared in the market, do not form a uniform price and hence a uniform value. Indeed, old machines are not really commodities at all; they have a value, but you can't buy them. The only way to get an old machine is to buy a new one and wait.

My approach is straightforward. An old machine is the same general type of use value as a new machine but has half as much use-value. Equation (14) should therefore read

(14a) $$a \text{ machines} + l \text{ units of labour} \rightarrow b \text{ machines} + \frac{a}{2} \text{ machines}$$

and equation (15) should read

(15a) $$\frac{a}{2} \text{ machines} + l \text{ units of labour} \rightarrow b \text{ machines}$$

But 'production' does not consist of mere survival and equation (14a) should be broken up into production proper, and circulation, the survival of $a/2$ unused units of machine-use-value:

(14prod) $$\frac{a}{2} \text{ machines} + l \text{ units of labour} \rightarrow b \text{ machines}$$

(14circ) $$\frac{a}{2} \text{ machines} \rightarrow \frac{a}{2} \text{ machines}$$

Because of our stand on the formation of market from individual values, the unused capital simply enters the general averaging of individual values along with newly-produced machines of this type. Each period, $2b$ such machines are produced and $\frac{a}{2}$ survive as old machines. There are $a/2 + 2b$ machines in existence whose total value is the sum of value added and transferred in production, namely $a\lambda^t + 2l$, and the value of the unused machines, $\frac{a}{2}\lambda^t$. Their market value may be calculated accordingly as

(16) $$\frac{3a\lambda^t + 4l}{a + 4b}.$$

No contradiction arises and the values thereby calculated are completely determinate.

DL are rather coy about what the traditional approach consists of. On the one hand the machine has "the same use-value during the two periods" but on the other, "two 'goods' must be distinguished in the formalism." Their value equations show an old machine as having an unambiguously different value from a new machine: it is a different commodity, that is, a different *use-value* from a new machine. Therefore, it has a different price, a different value, etc: it is a different thing.[18] The concept is the following: in each period the machine becomes something different.

[18] John Ernst, in private correspondence, uses the term'old machine' in a different context: machines which perform the same function but are produced at different times. An 'old' machine in DL's terminology is the *same* machine at a different point in time, with exactly the same properties as the new machine, playing the same role in the production process, with all characteristics identical except a bit further down the road to its death.

DL generate the paradox of explosive and negative oscillations in the same way as the paradox of negative values, by imposing the artificial requirement that a new machine have the same individual value whether produced by an old or a new machine. They write:

(14b) $$a\lambda_1^{t} + l = b\lambda_1^{t+1} + a\lambda_2^{t+1}$$

(15b) $$a\lambda_2^{t} + l = b\lambda_1^{t+1}$$

This insists that the *b* new machines coming out of (14) must have the same individual value as those coming out of (15), even though the *a* machines going into (14) have not only a different use-value but a different market value from those going into (15). This is startling achievement for an old machine: it is a completely different use-value from a new machine, and doesn't even cost the same, but it manages to communicate an identical amount of value to its final product.

The paradox vanishes if we recognise the distinct individual values of the machines from the two processes:

(17) $$a\lambda_1^{t} + l = b\lambda_{1,1}^{t+1} + a\lambda_2^{t+1}$$

(18) $$a\lambda_2^{t} + l = b\lambda_{1,2}^{t+1}$$

The market value of a new machine is now $(\lambda_{1,1}^{t+1} + \lambda_{1,2}^{t+1})/2$. As before, the individual values are not yet determinate. However, with the problem stated they can indeed be determined.

For a start, they cannot have the *same* individual value, or we will get DL's paradox. The paradox arises not from the sequential method but from the 'traditional' attempt to treat joint production as producing identical individual values in every sector. Second, the method of averaging over stocks precisely provides the missing determinations, further demonstrating that the indeterminacy of joint production is a non-issue. In each *definite* situation (like this one) we may find the requisite determinations by analysing that specific situation.

λ_1 and λ_2 now have a clear relation. They are the value of a machine with two years to live and the value of a machine with one year to live. This relation is no different to that between two tons of steel and one ton of steel; one is half the other. $\lambda_2 = ½\lambda_1$, at all times. This gives rise to the perfectly determinate system

(19) $$a\lambda_1^{t} + l = b\lambda_{1,1}^{t+1} + \frac{a}{2}\,\lambda_{1,3}^{t+1}$$

(20) $$\frac{a}{2}\,\lambda_1^{t} + l = b\lambda_{1,2}^{t+1}$$

where the 'old' machines on the right-hand side of (19) are a third individual value since they represent yet another way of 'making' the same thing. We can then sum to get

(21) $$\frac{3a}{2}\,\lambda_1^{t} + 2l = b\lambda_{1,1}^{t+1} + b\lambda_{1,2}^{t+1} + \frac{a}{2}\,\lambda_{1,2}^{t+1}$$

and since we have now assembled all sources of the market value of new machines we can simply write this as

(22) $$\frac{3a}{2}\,\lambda_1^{t} + 2l = (2b + \frac{a}{2})\,\lambda_1^{t+1}$$

which is the normal sequential relationship, $\frac{3a}{2}$ being consumed constant capital, $(2b + \frac{a}{2})$ the output and $2l$ the living labour. Multiplying by two yields

(23) $$3a\lambda_1^t + 4l = (4b + a)\,\lambda_1^{t+1}$$

which yields the same λ_1 as (16); λ_2 is then half of this. Temporalism thus supplies a determinate system with positive values on the basis of their production system and our principle of valuation. How about 'tradition'?

8.6. Negative values

Even though DL assign a quite separate existence to an old machine, with a distinct price, they suppose arbitrarily that it must produce the same output as a new one. But it is perfectly reasonable to suppose that an old machine might produce less than a new one. Let us modify their scheme as follows:

(24) a new machines + l units of labour $\rightarrow$ $a+b_1$ new machines + a old machines

(25) a old machines + l units of labour $\rightarrow$ $a+b_2$ new machines

Thus the output of new machines is different, depending on the age of the machine used to make them; however, in both cases there is a 'physical surplus' since each process makes at least as many machines as it consumes. Adding together the two systems and inserting values yields

(26) $$a\lambda_1 + a\lambda_2 + 2l = (2a+b_1+b_2)\lambda_1 + a\lambda_2$$

whence

(27) $$2l = (a+b_1+b_2)\lambda_1 \text{ so } \lambda_1 = \frac{2l}{a+b_1+b_2}$$

substituting using (25) yields

(28) $$a\lambda_2 + l = 2\,\frac{a+b_2}{a+b_1+b_2}\,l = 2l\textbf{Error!}$$

(29) hence $$\lambda_2 = \frac{l}{a}\ \textbf{Error!}$$

This will be positive if $\frac{2b_1}{a+b_1+b_2} < 1$, that is $2b_2 < a + b_1 + b_2$ or $b_1 - b_2 < a$.

Where $b_1 = b_2$, that is, the material productivity of old and new machines is the same, this must always be so and the Sraffa calculation of fixed capital yields positive values. But why should an old machine be just as productive as a new machine? DL insist that an old machine is qualitatively different from a new one, stressing how preposterous it is to treat machines like imperishable goods. In that case, we have no reason to suppose that an old machine will produce as much as a new machine and indeed we should expect that as machines get older they become less physically productive and, therefore, $b_1 < b_2$. It is then perfectly conceivable that λ_2 may be negative; for example with $a = 2$, $b_1 = 7$, $b_2 = 3$ which yields, for *any* labour input

(30) 2 new machines + l units of labour $\rightarrow$ 9 new machines + 2 old machines

(31) 2 old machines + l units of labour $\rightarrow$ 5 new machines

for which

(32) $$\lambda_1 = \frac{l}{6} \; ; \lambda_2 = \frac{-l}{12}$$

This system is fully productive and makes a surplus of everything in all sectors, yet yields negative values. Moreover, 'traditional' explanations do not help. In the literature (see for example Schefold 1977:179) the argument of *truncation* applies; if old machines were sold at negative prices they would yield zero or negative profits and processes using them would cease. But a machine can, according to the above, have a positive price and a negative value, and there is no reason for it to be truncated; for example for a wage of 2.217 we have a profit rate of 115.79% and the price of an old machine is 1/20 the price of a new machine, both positive.

Unlike DL's paradox, this was derived entirely within one paradigm – the simultaneist paradigm. We thus arrive at the following result: temporal values stand accused though they yield a coherent general treatment of fixed capital, because when applied to a different treatment of fixed capital which is not coherent and is not general, they produce contradictory results.

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