A Descriptive and Analytic Look at Marx's Own Explanations for the Falling Rate of Profit

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Abstract: Marx's conclusions about the falling rate of profit have been analysed exhaustively. Usually this has been done by building models which broadly conform to Marx's views and then showing that his conclusions are either correct or, more frequently, that they can not be sustained. By contrast, this paper examines, both descriptively and analytically, Marx's arguments from the Hodgskin section of Theories of Surplus Value, the General Law section of the recently published Volume 33 of the Collected Works and Chapter 3 of Volume III of Capital. It also gives a new interpretation of Part III of this last work. The main conclusions are first, that Marx had an intrinsic explanation of the falling rate of profit but was unable to give it a satisfactory demonstration and second, that he had a number of subsidiary explanations of which the most important was resource scarcity. The paper closes with an assessment of the pedigree of various currents of Marxian thought on this issue.

I. Introduction.

Marx's conclusions about the falling rate of profit have been analysed exhaustively. Usually this has been done by building models which broadly conform to Marx's views and then showing that his conclusions are either correct or, more frequently, that they can not be sustained. By contrast, the detail of Marx's own arguments has not been looked at closely. This is partly because they are often obscure and difficult and partly because an important segment of them has only recently become available. This paper examines, both descriptively and analytically, Marx's arguments from the Hodgskin section of Theories of Surplus Value, the General Law section of the recently published Volume 33 of the Collected Works and Chapter 3 of Volume III of Capital. It also gives a new interpretation of Part III of this last work. The main conclusions are first, that

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Marx had an intrinsic explanation of the falling rate of profit but was unable to give it a satisfactory demonstration and second, that he had a number of subsidiary explanations of which the most important was resource scarcity. The paper closes with an assessment of the pedigree with respect to this issue of various currents of Marxian thought.

The paper is organised as follows: Section II covers the writing of the 1862-3 period; section II provides formalisations; section IV gives a new interpretation of Part III of Volume III; section V deals with Chapter 3 of Volume III which was written in the 1870s; section VI contains the assessment and section VII concludes.

II.   The Arguments of 1863-3.

The problem Marx faced was the following: In a one sector model the rate of profit is

$$= \frac{S/V}{C/V + 1}$$

where S, C and V are surplus value, constant capital and variable capital.[1] Marx thought that the composition of capital C/V would increase over time, but he had it very clear that this would raise the rate of surplus value S/V. He had to explain why this would not be sufficient to cause the rate of profit to increase.

In October and November of 1862 Marx was writing out his comments on Thomas Hodgskin for the manuscript that would become Theories of Surplus Value (TSV). Hodgskin believed that the rate of profit would be forced to fall if capital grew faster than labour. Marx tried to set out this conclusion in a logical form and appeared to be surprised to find he could not. He broke off work on the manuscript and filled two hundred notebook pages mainly attempting to deal with this. In January of 1863 he returned to the Hodgskin section and then finished the rest of the manuscript. In English, TSV became available in 1971 but the two hundred notebook pages only appeared in 1991 with the publication of Volume 33 of the Collected Works (CW). This section covers the Hodgeskin section of TSV III pp.263-319 and the central section of the notebook pages, called the General Law for short, from the CW 33, pp.104-53.

1. Hodgskin.

[1] The notation throughout is that of Roemer (1981).

Starting on p.298, Marx outlines Hodgskin's position on the falling rate of profit and then suddenly sets out his own theory. He starts with a paragraph for the case in which the rate of surplus value is constant and another for the case in which it increases because the working day increases. Then, in what are arguably the three most important three paragraphs in all of Marx's writing on the falling rate of profit, he sets out his argument for the case in which the rate of surplus value rises because of the rise in the composition of capital has increased labour productivity, that is, the case of relative surplus value:

"3) If the normal working-day remains the same, surplus labour can be increased relatively by reducing the necessary labour time by[2] reducing the prices of the necessaries which the worker consumes, in comparison with the development of the productive power of labour. But this development of productive power reduces variable capital relative to constant. It is physically impossible that surplus labour-time of, say, two men, who displace twenty, can, by any conceivable increase of absolute of relative [surplus] labour-time, equal that of twenty. If each of the twenty men only work 2 hours of surplus labour a day, the total will be 40 hours of surplus labour, whereas the total life-span of two men amounts only to 48 hours in one day.

The value of labour-power does not fall in the same degree as the productivity of labour or of capital increases. This increase in the productive power likewise increases the ratio between constant and variable capital in all branches of industry which do not produce necessaries (either directly or indirectly) without giving rise to any kind of alteration in the value of labour. The development of productive power is not even. It is the nature of capitalist production that it develops industry more rapidly than agriculture. This is not due to the nature of the land, but to the fact that land requires different social relations. Capitalist production turns towards the land only after its influence has exhausted it and after it has devastated its natural qualities. An additional factor is that, as a consequence of land ownership, agricultural products are expensive compared with other commodities, because they are sold at their value and not reduced to their cost-price. They form, however, the principal constituent of the necessaries. Furthermore, if one-tenth of the land is dearer to exploit than the other nine-tenths, these

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[2] The actual text has "and" rather than "by".

later are likewise hit "artificially" by this relative barrenness, as a result of the law of competition.

The rate of profit would have to grow if the productivity of capital[3] is to remain constant while accumulation of capital is taking place. <u>The same worker</u>, as long as capital yields 10 of surplus labour must, as soon as interest accumulates on interest and thus increases the capital employed, produce three fold, fourfold, five fold in progression of compound interest, which is a nonsense."(pp.300-1).

These three paragraphs are obscure in the extreme. The reason, I think, is that Marx is trying to give form to his intuition rather than setting out a formal analysis. However it is possible, it seems to me, to detect the argument that Marx was groping for. The general structure is as follows. In the first paragraph Marx sets out an argument for the falling rate of profit based on the reduction of labour causing a fall in surplus value. However he senses that the argument is defective. In the second he announces a condition for the rate of profit to fall and gives four separate arguments that the condition will be satisfied in the real world. Finally, in the short third paragraph he affirms that the rate of profit will, indeed, fall.

A formal model is needed to follow the detail. It is a one sector circulating capital model with fixed coefficients and one basic factor, labour. *A, L, b* and   are the capital and labour coefficients, the real wage, and the value of the good. In addition $\tilde{L}$ and K are the number of workers and the constant capital in physical units.

$$ = L/(1 - A), \; S = \tilde{L} - \; bL\tilde{L}, \; C = \; K, \; V = \; b\tilde{L}.$$

First one can see the argument that Marx was trying for in the first paragraph and its weakness.

$$= \frac{1 - \dfrac{L}{1 - A} b \; \tilde{L}}{\dfrac{L}{1 - A} K + \dfrac{L}{1 - A} b\tilde{L}} \tag{1}$$

It is clear that a reduction of $\tilde{L}$ will lower surplus value and, if nothing else changes, (that is the denominator remains unchanged) the rate of profit will fall. This was the line Marx was following. But Marx emphasised that the reduction of $\tilde{L}$ would cause an increase in labour productivity and a fall in capital productivity, that is a fall in *L* and an increase in *A*, total capital may be lowered proportionally more than surplus value and

the rate of profit may rise. Thus Marx needs both a condition that gives a limit to the permissible fall in L relative to the rise in A and an argument that the condition will be satisfied.

The first sentence of the second paragraph gives this condition although it requires a bit of an effort to see it. $P \quad 1/L$ is the productivity of labour and $\tilde{V} \quad b$ is the value of labour power. Using $K = (A/L)\tilde{L}$, (1) reduces to

$$= \frac{1}{A + bL} - 1. \tag{2}$$

Solving for A in terms of P and $\tilde{V}$ gives $A = 1 - b/\tilde{V}P$, substituting this in (2) gives

$$\left(P, \tilde{V}\right) = \frac{1}{1 - \dfrac{b}{P} \dfrac{1}{\tilde{V}} - 1} - 1$$

so that $\dfrac{}{P} < 0$ and $\dfrac{}{\tilde{V}} < 0$[4]. Thus if $\tilde{V}$ does not fall "in the same degree" as P rises the rate of profit will fall.[5]

The sense is the following. A rise in productivity of labour with the value of labour constant implies a fall in the productivity of capital which is strong enough to lower the rate of profit. If the rise in the productivity of capital caused by the fall in the value of labour power is not sufficiently strong, the net effect will be a fall in the rate of profit. Thus the first sentence is a complicated way of expressing a limit to the fall in L relative to the rise in A. Marx doing partial differentiation in his head strains ones credulity but I see no other interpretation.[6]

The rest of the paragraph sketches four distinct reasons why the condition may be satisfied. They concern, briefly, luxury goods, exhaustion of natural resources, monopoly in agriculture, and the development of less fertile land. All of these require a model of at least two sectors for their formal presentation. They are examined in section III below.

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[3] The actual text has "it" in place of "the productivity of capital".

[4] $\tilde{V} < 1$ from (1) if $\quad > 0$ is assumed.

[5] The rise in the productivity of capital is a slip which Marx corrects in the third paragraph.

[6] My descriptions can be located in terms of Blaug's (1999) concepts of rational and historical reconstructions. Blaug defines these in a multifaceted way that, according to Kurz and Salvatori (2000), make them inconsistent. One facet of the distinction between the reconstructions is that the rational one attributes to a historical author the belief in the entirety of a logic model while the historical one demands textual evidence. I think that this formalisation and those of the third paragraph of b) of this section and of section V are close enough to the structure of Marx's thought to qualify as historical while those of section III are not.

The third paragraph just expresses the conclusion, albeit in an indirect way: " the rate of profit would have to grow… which is a nonsense."

Marx now returns to Hodgskin, attempts to describe his ideas via an example and disturbingly finds he can not do it. The example on p.304 is not carefully set out but can be reconstructed. There are initially two cases, I and II.

	C	V	S
I	£25	£25	£25
II	£175	£25	£25

The working day is 12 hours so that the worker produces £25 for his subsistence in 6 hours and £25 of surplus value in the other 6 hours. In each case the constant capital reproduces itself. Now Marx asks how many hours would have to be worked to maintain the 50% case I rate of profit in case II? The worker would have to produce £25 of subsistence plus £100 of surplus value. Since this would take 30 hours it is impossible and so the rate of profit must fall. Then Marx notes that this is assuming constant productivity, but that if the productivity rose so that the worker could produce £125 in 12 hours then the rate of profit would not fall.[7] Marx reacts to this by supposing productivity only rises so that the worker can produce £50 in 12 hours. Then, even if he worked 24 hours he could not produce the £125 so the rate of profit must fall.[8]

Marx clearly realises this is unsatisfactory because he immediately starts going over the example again but can find no way to make the argument stronger. After this he metaphorically backs up and makes another run at the problem but can make no headway. He then refers back to the three key paragraphs (p.312), makes three and half pages of random comments and, at this point, the break occurs.[9]

My interpretation of what happened is the following. When he started writing the section on Hodgskin, Marx thought that he could easily make the argument that the rise in the composition of capital would cause the rate of profit to fall. When he set out his

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[7] In this case the value of labour-power falls from 5/10 of a day to 2/10 of a day, a fall of 60% rather than the 75% that Marx claims.

[8] These figures ate different from Marx's. He seems to think the rate of profit was 100% so that £200 of surplus value is needed. He allows the worker to produce £75 in 12 hours so that it is impossible to produce the required £225 in 24 hours.

[9] The method here and in some of the following sections is to give my interpretation of the structure of Marx's argument rather than lots of quotes. This seems to be only way to deal with all the material in a limited space. (The working paper Petith (2001) covers the material more intensively.) However it requires an act of faith on the part of the reader who, if he finds himself in disagreement, will have to turn to the original text.

position he sensed that there might be a weakness and hastily sketched the reinforcing arguments, but he was still confident that he could make his argument without excess effort. Then as he struggled to set out his argument in Hodgskin's form it slowly dawned on him that the problem was much deeper than he had suspected and he decided to break off the writing of TSV and sort out the problem of the falling rate of profit once and for all,

2. The General Law.

Marx has two types of explanations for the falling rate of profit: an intrinsic one which is based on the rising composition of capital and a number of subsidiary ones which involve phenomena like the worsening quality of resources. This section contains what I think is Marx's most sustained attempt to provide a justification for the intrinsic explanation. He first argues that the problem can be addressed in terms of a one sector model. After this he formulates the model first in value terms and then in terms of labour units. At last, following his deepening intuition, he tries to construct a model that combines both of these but fails because he can not handle the technical difficulties. The section ends with Marx, as it were, taking refuge in the subsidiary explanations.

a) The Intrinsic Explanation.

In the opening paragraph of the General Law on p.104, Marx summarises the preceding section as a justification that the falling rate of profit can be dealt with in terms of a one sector model. He then sets out the problem in value terms, just as in the Hodgskin section and then appears to be surprised that, once again, he can not make the argument (pp.114-7). This impression is heightened because he then proceeds to glue in four large pages which start with the statement "let us first assemble the facts"(p.117).[10]

These four pages contain three separate attacks on the problem. The first is merely a continuation of the previous argument in terms of value categories. He sets out a number of examples in which he increases constant capital and discovers that the condition for constancy of the rate of profit is that surplus value and total capital grow at the same rate and that this implies that the rate of surplus value grow at this rate as well (pp.117-9).

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[10] The transcription of these four pages is difficult to read since it has frequent gaps because the pages themselves have been damaged. Appendix 1 of Petith (2001) is a version of these pages with the gaps filled in. It is clear that this may distort what Marx wrote but there seems no other way to make the pages intelligible.

Finally convinced that this attack will not work, he shifts to the second. He lowers variable capital, either absolutely or relative to constant capital, and claims that surplus value will fall faster than total capital. He gives two reasons: first he equates a fall in variable capital to a fall in labour which will eventually reduce surplus value and second the development of the productive power is not uniform across sectors (p.120). The first reason is incomplete since he doesn't even mention the effect on total capital, while the second is only mentioned. Once again the style of the writing gives no indication that Marx is aware of these problems but it seems likely that he is.

He now draws a horizontal line, writes   and attempts to develop the second attack with more precision. He wants to construct an example in which workers are reduced and machinery increased in a way that keeps the value of total capital constant. First he implies, wrongly, that surplus value is the rate multiplied by the quantity of labour and notes that these two forces will act in opposite directions on surplus value. But then he reverts to surplus value itself rather than the product. His example shows that the reduction in the number of workers has definitely caused a fall in surplus value. The problem is that, since he has no value terms in his example, he can not calculate what has happened to the value of capital. He is forced to end with a limp statement about total capital remaining constant (pp.123-5).

Marx now appears to realise that he will have to have both workers and values in the same example if he wants to make his point. He writes   and begins to construct the model. Since this is Marx's major attempt to show that the rate of profit must fall, I will recount what happened in detail. He starts with an example which is set out in the first four columns of the following table. In case I C is 150 of raw material and 50 of

	V	C	$\tilde{L}$	b	S	
I	400	200	10	40	400	4/6
II	80	520	2	40	80	8/60

machinery while in case II C is 150 of raw material and 370 of machinery. The output in physical terms is the same in both cases. He notes that total capital is the same in both cases but that case II has a higher composition of capital. One can see where he is trying to go. One could finish the example as follows: Suppose that the figures are hours and that each worker works 80 hours a week. Then one could fill in the S and   in the table

and have the rate of profit fall. By specifying b and especially $\tilde{L}$ he can force the surplus value to fall by making $\tilde{L}$ fall. This is the argument that Marx wanted to make.

But there is a problem. With physical output fixed, the value of a unit has fallen. Suppose output is 1000 units, then in case I the value of a unit is 1, and in case II 680/1000=0.68. Thus the case II wage in value terms should be reduced to keep the real wage constant. The simple argument that Marx hoped to make is not viable. But at least, in terms of this framework, the basic problem can be confronted (to last paragraph p.125).

Marx is aware of exactly this problem and reacts by trying to find the values or prices. He makes the natural assumption that machines are fixed capital, but this complicates his task in a way that he never manages to resolve. Specifically he assumes that the machine of case I lasts one year and that of case II ten years. He then calculates the price in case II as

$$326=(37+150+80+0.05\text{x}333)(1.05)$$

where 37 is the straight line depreciation of the machine, 0.05x333 is the interest payment on the un-depreciated part of the machine and (1.05) is the profit margin added by the capitalist.[11] This shows that Marx does not know how to calculate costs for the case of fixed capital[12] and he himself is aware that this method is problematic since he seems to change the method in the next case and is clearly worried, p.128 second full paragraph, by the fact that the interest payment enters into cost but not value. He ends the paragraph by noting that the price is much lower than in case I which should, by his method, be 600x1.05=630. It can not be emphasised too strongly that in this, Marx's main attempt to explain the falling rate of profit, he went to great lengths to keep the real wage constant (to the bottom of p.126).

He now sets out case III where C is composed of 150 of raw materials and a

	V	C	$\tilde{L}$	b
III	80	2150	2	40

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[11] Marx's example, as the editors note, is riddled with errors. The text here is consistent so that the numbers differ from those of the original text.

[12] This is not that straightforward. One way to do this would be to suppose that the capitalist can borrow and lend at the rate of interest, commits the present value of total costs at time 0, reinvests all revenue, and finally sets the price so that the ratio of the accumulated revenue at time 10 to the committed funds is $(1+r)^{10}$ where r is the profit margin.

machine which lasts either 10 or 100 years depending on the way the manuscript is interpreted. Using the same calculation as in case II, the price is either 546 or 366 depending on the interpretation.[13] There is no clear reason for the introduction of case III. If one takes the first interpretation, one possibility is that Marx was surprised by how cheap the good had become and was worried that the rate of profit would not fall so he wanted an example with a smaller fall. If one takes the second interpretation, then Marx wanted to see if lengthening the turnover time could raise the price, once again to get the rate of profit to fall. In any case, with case III, he has lost the line of his argument since total capital is no longer constant (to end of first paragraph on p.127).

Marx seems to realise this since he next gives a verbal discussion of the effect on price of lengthening turnover times when total capital is fixed. He says that there are two types of effects: The first merely lowers wear and tear and thus the price. The second combines this with an increase in machinery and a fall in workers in a way that causes output to fall and the price to rise. This can, perhaps, be interpreted as an attempt to redo the movement from case I to case II and then from case II to case III (second interpretation) but with total capital held constant. In any case, it is unconvincing and so far from the initial example that Marx admits that this discussion actually belongs elsewhere (to end of first full paragraph p.128).

Starting with the third paragraph of p.128, Marx makes a last attempt to revive his argument. But he can make no headway and ends, in the last full paragraph of p.130, talking about an American economist called Wayland. This is the end of what is the high water mark of all of Marx's attempts to provide a demonstration of the intrinsic explanation.

One can trace the stages of Marx's attack and see why it wouldn't have worked even if he had not been detained by technical difficulties. He started only with value terms writing

$$= \frac{S}{C+V} = \frac{S/V}{C/V+1}.$$

He supposed that *C/V* would rise but could not show that this would imply a fall in since he saw with extreme clarity that the rise in *C/V* would cause a rise in *S/V* . Next he tried to use the fall in labour with fixed capital to force a fall in the rate of profit. That is, given

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[13] As noted, Marx calculates this case differently from the preceding one and does it in a way that is impossible to fathom. Since the method of case II is set out clearly, I have used it for this case as well.

$$= \frac{(1 - b)\tilde{L}}{K + b\tilde{L}}, \qquad = \frac{L}{1 - A},$$

Marx wanted to claim that the fall in $\tilde{L}$ with $K + b\tilde{L}$ fixed would cause to fall. However since he did not specify , he could not make the constant capital condition convincing. Finally he set up an example with $C, V, \tilde{L}$ and b specified. If he had proceeded in this way and had not tried to deal with fixed capital, he could have, in principle, completed his argument. But if he had done so he would have discovered that

$$= \frac{1}{A + bL} - 1$$

and that the rise in A and the fall in L can not guarantee the fall in v without further restrictions. In fact he might have convinced himself that this part of his intuition about the falling rate of profit was wrong.

b) The Subsidiary Explanations.

The rest of the section contains three well worked out, essentially two sector explanations of the fall in the rate of profit. The first two concern resources while the third focuses on luxury goods. The first (pp.130-1) is less detailed than the second (pp.133-6). In the latter Marx starts by explaining how an increase in labour productivity in a sector raises surplus value by cheapening the good and thus lowering the value of labour power. But he stresses that the cheapening of a single sector will only have a small effect on the economy wide value of labour power. Following on this, he notes that if productive power grew evenly in all sectors , then surplus value would also grow at the same rate. But this doesn't happen for two reasons: " The anarchy of competition" and natural conditions such as " the influence of the seasons,…, (the) exhaustion of forests, coal seams, mines and the like." He furthermore notes that productivity in agriculture, which is the main component of workers' consumption, grows more slowly than that of industry. He concludes that the growth of surplus value is always smaller than the growth of productive power of capital in all branches of industry.

There are three problems with this as an explanation of the fall in the rate of profit. First, Marx says productive power of capital when he ought to say labour. This, I think, is just a slip; probably Marx was thinking of the growth in the productivity of labour caused by the relative increase in capital. Second, Marx does not say that this is an explanation of the fall in the rate of profit. However it can be taken to be one since, in

the summary on p.148 Marx clearly refers back to this section and states that if the rate of surplus value does not rise in proportion to the growth of productive power the rate of profit will decline. Finally there is the question of whether this condition is valid. The following calculations shows that it is. Let $e=S/V$,

$$e = \frac{(1 - bL - A)}{bL} = \frac{P}{b} - 1 - \frac{P}{b}A$$

$$A = 1 - \frac{b}{P}(1 + e)$$

$$= \frac{1}{1 - \frac{e}{P}b} - 1$$

where the last equation follows from (2). Thus if e/P falls so does the rate of profit. But its correctness (i.e. that the two reasons imply a fall in e/P) can only be accessed in the context of a formal two sector model.

The third explanation (pp.148-9) is that the increase in the composition of capital will also occur in sectors that ate unrelated to worker consumption. This will not increase the rate of surplus value and thus cause the rate of profit to fall. Marx had previously made this point in the section on Hodgskin. Here he adds that the growing cheapness may expand the range of worker consumption and thus weaken the effect.

To summarise, the section on the General Law contains Marx's failed major attempt to demonstrate the intrinsic explanation of the falling rate of profit plus a number of special two sector explanations whose validity remains to be accessed.

3. Conclusion.

One can speculate about how Marx felt about resource scarcity explanations and the intrinsic explanation of the falling rate of profit after he had finished the work on TSV.

With respect to the first, reference must be made to the section on Cherbulitz which Marx wrote as one of the final sections of TSV III. In this, Marx's explanation of the rise in the composition of capital partly consisted of a page long detailed description of growing resource scarcity (p.368). I think it is incontestable that at this point Marx thought that resource scarcity would cause the rate of profit to fall. Its mention in the comments on Hodgskin, and in the sections in the General Law, and finally its emphasis in the Cherbulitz piece allow no other conclusion.

With respect to the intrinsic explanation, on the one hand this argument fitted better with Marx's general view since it was a "barrier" that arose from the nature of capitalism itself. On the other hand Marx had just failed in his protracted attempt to

demonstrate it. At least two positions are possible: first that he had changed his mind and now thought the proposition was incorrect and second, that he still thought the proposition was correct and hoped to demonstrate it in the future. I think the second is more likely for a number of reasons: first his problems were technical so that he could hope to resolve them, second when he came to write Part III of Volume III of Capital he gave the impression that he thought the intrinsic explanation was correct, and finally in the 1870s he had another go at demonstrating it.

III.   The Two Sector Explanations.

In the sections on Hodgskin and the General Law, apart from the intrinsic explanation, Marx gives four subsidiary explanations of the falling rate of profit. The formalisation of any of these requires at least a two sector model. This section provides this minimal formalisation of each of these explanations.

Before this is done, there are three methodological issues that must be resolved. First, the exercise will be performed for both the value and the price rates of profit. These are different in a two sector model but Marx thought they were the same. Thus, since it is not clear which case Marx was considering, both are set out.[14] Second, the value rate of profit depends on the composition of output. This will be taken as fixed since it does not seem to figure in Marx's arguments. Finally Marx's arguments will be judged as to whether they are correct for all, some, or no set of parameter values.

1) Luxury Goods.

In both the Hodgskin and the General Law sections, Marx argued that the existence of luxury goods would weaken the tendency of the rate of profit to rise since the cheapening of these goods would not lower the value of labour power. The simplest model for checking this is a two sector model where good 1 is a capital-consumption good and good 2 is a luxury good. Let $x_1 / x_2 = x$ be the output ratio.

The value rate of profit is

$$= \frac{{}_1\left(1 - A_{11} - bL_1\right)x + {}_2 - {}_1\left(A_{12} + bL_2\right)}{{}_1\left[\left(A_{11} + bL_1\right)x + A_{12} + bL_2\right]} \tag{3}$$

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[14] It would be interesting to set out the single system version initiated by Foley (1986 chap.6) but a line must be drawn somewhere.

where $\lambda_1 = L_1/(1-A_{11})$, $\lambda_2 = A_{12}\lambda_1 + L_2$ and λ_i is the value of good i etc. Capitalist development is interpreted as $dA_{12} > 0$ and $dL_2 < 0$. Clearly $\partial\pi/\partial A_{12} < 0$. Letting D be the denominator of (3), an easy calculation shows

$$\frac{\partial\pi}{\partial L_2} = (1/D^2)\left[\lambda_1/(1-A_{11})\right]\left[(A_{11}x + A_{12})(1 - A_{11} - bL_1)\right] > 0.$$

It follows that $d\pi = \frac{\partial\pi}{\partial A_{12}}dA_{12} + \frac{\partial\pi}{\partial L_2}dL_2 < 0$. The intuition is that the rise in the capital input coefficient causes a fall in the rate of profit and surprisingly the fall in the labour coefficient does as well since the fall in the value of luxury goods dominates all other effects.

However with respect to the price rate of profit, one immediately sees that Marx's argument is wrong. The equations are:

$$p_1 = (1 + \pi)(p_1 A_{11} + p_1 bL_1)$$
$$p_2 = (1 + \pi)(p_1 A_{12} + p_1 bL_2)$$

where p_i is the price of the ith good and π is the price rate of profit. The first equation determines π, which does not depend on either A_{12} or L_2, while the second determines relative prices. Changes in the composition of capital of luxury goods do not effect the price rate of profit. It is well known that this result is generally valid.

These results are summarised as

Result 1. For the luxury good model just described, an increase in the composition of capital in the luxury good sector lowers the value rate of profit but leaves the price rate of profit unaffected.

2. The Degradation of Natural Resources.

Marx merely mentions it in the General Law section but in the Hodgskin section he relates it to capitalism in a way that is not clear. In any case the simplest model in which this can be considered is one with two goods where good 1 is machinery and good 2 is food, and where the degradation is interpreted as $dA_{12} > 0$ and $dL_2 > 0$.

In this case the value rate of profit is

$$\pi = \frac{\left(\lambda_1 - \lambda_1 A_{11} - \lambda_2 bL_1\right)x + \lambda_2 - \lambda_1 A_{12} - \lambda_2 bL_2}{\left(\lambda_1 A_{11} + \lambda_2 bL_1\right)x + \left(\lambda_1 A_{12} + \lambda_2 bL_2\right)}$$

where $\lambda_1 = L_1/(1 - A_{11})$ and $\lambda_2 = L_1 A_{12}/(1 - A_{11}) + L_2$. When x is very large

$$\tilde\pi = \frac{\lambda_1 - \lambda_1 A_{11} - \lambda_2 bL_1}{\lambda_1 A_{11} + \lambda_2 bL_1}$$

with $d\tilde{\ }/d_2 < 0$. In this case, since $_2/A_{12} > 0$ and $_2/L_2 > 0$,

$$d \quad \frac{d\tilde{\ }}{d_2} \quad \frac{_2}{A_{12}} dA_{12} + \frac{_2}{L_2} dL_2 \quad < 0 \ .$$

On the other hand, when x and b are very small $\quad \tilde{\ } = \frac{_2 - _1 A_{12}}{_1 A_{12}} = \frac{L_2}{L_1 A_{12}/(1 - A_{11})}$

so that $\dfrac{d}{\quad} \quad \dfrac{d\tilde{\ }}{\tilde{\ }} = \dfrac{dL_2}{L_2} - \dfrac{dA_{12}}{A_{12}} > 0$ if $\dfrac{dL_2}{L_2} > \dfrac{dA_{12}}{A_{12}}$.

Next consider the price rate of profit. The equations are

$$p_1 = (1 + \ )(p_1 A_{11} + p_2 b L_1)$$
$$p_2 = (1 + \ )(p_1 A_{12} + p_2 b L_2)^{\cdot}$$

Let the matrix be non-negative and indecomposable. Thus by the Frobenious-Perron theorem (See Roemer (1981) p.110.) is decreasing in A_{12} and L_2 so that a fall in the quality of land causes the price rate of profit to fall.

All of this is summarised as

Result 2. In the fall in the quality of natural resources model just described, an increase in the input coefficients for the food industry has the following effects: First, it lowers the value rate of profit if production is concentrated on machines while it raises it in the opposite case if the product wage is low and the labour coefficient rises by proportionally more. Second, it always lowers the price rate of profit.

3. Slower Development of Agriculture.

Marx's third argument is difficult to interpret without using other references. In the comments of Hodgskin he merely notes that agricultural products are sold above their cost price at their values while in the General Law section he notes that agriculture develops more slowly than industry. However in the section on Robertus in Part II of TSV pp.93-4, Marx provides a detailed description of the process. Initially value is equal to cost price in both agriculture and industry. Then the productive forces develop more rapidly in industry. This causes the cost price to rise above value in industry and fall below it in agriculture. However absolute rent appears in agriculture, because of the monopoly power of the landlords, so that the price of agricultural goods doesn't fall as the cost price does but stays equal to the value. Since workers' subsistence does not cheapen, the rate of profit falls.

There is a small surmountable problem in modeling this argument. Suppose a two sector model where sector 1 is machinery, sector 2 is food and both sectors use machinery and labour. The values are

$$\lambda_1 = L_1/(1 - A_{11}) \tag{4}$$

$$\lambda_2 = L_1 A_{12}/(1 - A_{11}) + L_2 \tag{5}$$

The actual cost equals price equations contain both prices and values. To make these compatible let, m with dimension £/hour, be the monetary value of time. The equations of the system are

$$\tilde{p}_1 = (1 + \tilde{r})(A_{11}\tilde{p}_1 + m_2 bL_1) \tag{6}$$

$$m_2 = (1 + \tilde{r})(A_{12}\tilde{p}_1 + m_2 bL_2 + m_2 R) \tag{7}$$

$$\tilde{p}_1 + m_2 = (\lambda_1 + \lambda_2)u \tag{8}$$

where $\tilde{p}_1$ and $\tilde{r}$ are the cost price of machines in money and the rate of profit in the mixed system, R is the absolute rent in terms of food per unit output of food, $u =$£/hour to correct units and (8) is a convenient normalisation for prices. The system consists of equations (6)-(8) with unknowns $\tilde{p}_1$, m_2, $\tilde{r}$ and R with λ_1 and λ_2 given by (4) and (5). The problem is that the system is under-determined, (6)-(8) are not sufficient to determine the prices, the rate of profit and the level of absolute rent. The trouble with Marx's argument is that he defined absolute rent as the difference between cost price and value but didn't take into account that the absolute rent partially determines cost price.

This problem can be got around in the following way that is slightly fanciful but faithful to Marx's argument. Suppose that the landlords calculate the cost prices p_i, that is those that would arise if there was no absolute rent. That is they calculate p_2 from

$$p_1 = (1 + r)(p_1 A_{11} + p_2 bL_1) \tag{9}$$

$$p_2 = (1 + r)(p_1 A_{11} + p_2 bL_2) \tag{10}$$

$$p_1 + p_2 = (\lambda_1 + \lambda_2)u. \tag{11}$$

Then they set the absolute rent equal to the difference between the value and the cost price of food, that is they set $R = \dfrac{u\lambda_2 - p_2}{p_2}$. Once the absolute rent is determined in this manner, it can then be inserted in the equation (7) and $\tilde{p}_1$, m_2 and $\tilde{r}$ can be determined from equations (6)-(8).

One can then check Marx's statement as follows: Start with the initial situation of equal development in both sectors, that is $A_{11} = A_{12}$ A and $L_1 = L_2$ L. Faster development of industry is interpreted as $dA_{11} > 0$ and $dL_1 < 0$. This will effect $\tilde{r}$ directly through equations (4)-(8) and indirectly though its effect on R. The outcome is given by result 3[15].

Result 3. For the model of equations (4)-(11) , starting from the initial situation, $dA_{11} > 0$ and $dL_1 < 0$ imply:

i. $dR > 0$.

ii. $d\tilde{r} < 0$ if $1 > 3(A + bL)$.

iii. $d\tilde{r} > 0$ is possible if $1 < 3(A + bL)$.

That is, the rapid development of industry always raises absolute rent; also it will cause the rate of profit to fall if the input of machines and food to feed workers is low relative to output but may not otherwise.

4. The Movement to Less Fertile Land.

Marx's forth argument seems to be taken directly from the notion that, as less fertile land is used, food becomes more expensive because of the increase in rent. The price equations for the second model can be used to calculate the effect on the price rate of profit. Let A_{12} and L_2 represent the capital and labour inputs on marginal land. Since this land pays no rent, the price of food is determined by this equation. Thus the rise in A_{12} and L_2 as more barren land comes into production, as argued before, causes the rate of profit to fall.

Now consider what happens to the value rate of profit when production expands so that worse land comes into use. The value role of profit is the total of surplus value divided by total capital. Marx emphasised that rent was also a part of surplus value so this should be included in the total of surplus value. On the other hand, when one calculates variable capital, it is true that some of workers consumption is of food grown on good land whose individual value is lower than that grown on marginal land so that it is not clear what value should be assigned to this. Somewhat arbitrarily I will assign to all food the value of food produced on marginal land, that is the socially necessary labour.

Now suppose that there is good land and bad land and that initially only the good land is used. Then production expands and moves on to the bad land. There are two

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[15] The proof is straightforward and is given in appendix 2 of Petith (2001).

distinct phases. In the first one a very small percentage of the land used is bad land. In this movement the only change that occurs is that the social value of food increases. This has two effects: First the value rate of profit falls in both sectors which causes the value rate to fall. But second, the difference in the increase in variable capital between the two sectors changes their weights so that, if the weight of the sector with the higher sectorial profit rate rises, the aggregate rate may rise. If the second effect is strong the value rate of profit may rise in the first phase. In the second phase the percentage of all land that is bad grows. It is possible that the value rate of profit is higher on this than on the good land in which case there is a slow rise in the value rate of profit. This is summarised as result 4.[16]

Result 4. For the model just described with good and bad land, the movement on to bad land will have the following effects: First it will cause the price rate of profit to fall. Second, the value rate of profit may fall, but it is possible that it rises both when the bad land is initially brought into use and during the period when it becomes progressively more important.

5. Conclusion.

A summary of these results is provided in tabular form. In some cases the movement of the rate of profit depended on the values of the parameters and the size of the movements of the input coefficients. This is indicated by the expression "In some cases".

	Correct	In some cases	Incorrect
Luxury goods: value	x		
price			x
Degradation : value		x	
price	x		
Slower development		x	
Movement: value		x	
price	x		

In assessing this one should note that Marx's own aim was to show that the rate of profit must eventually fall. Thus he was successful only when correct appears. In this sense

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[16] The proof is again straightforward and is given in appendix 3 of Petith (2001).

Marx's arguments are valid[17] in three out of four cases for at least one of the rates of profit.

IV. Part III of Volume III of Capital.

Part III, for short, is generally taken to be the main source for Marx's explanation for the falling rate of profit. This section of the present paper gives a somewhat different interpretation. I will argue 1) that Part III does not contain an explanation of why the rate of profit falls, 2) that it contains clear references to previous work in which resource scarcity figured as a cause of the falling rate of profit and 3) that its purpose is to describe the consequences of the fall. The section finishes with a hypothesis about Marx's beliefs that makes these three points part of a consistent whole.

1. The Absence of Explanations.

At first glance, the point that the section contains no explanations of the falling rate of profit is hard to sustain since there are three clear candidates. First, the rise in the rate of profit of the innovator and the eventual fall of the general rate that is mentioned in the last paragraph of p.233 and set out clearly starting on p.264. second, the constant rate of surplus value, rising composition of capital argument that opens the section on pp.211-6. And, finally, the falling maximum surplus value argument[18] which is mentioned many places like lines 7-13 p.235 and stated forcefully on p.247.

The first two are easily disposed of: the innovation argument is merely stated as a claim and no justification what so ever is given. The constant rate of surplus value rising composition of capital argument first appears as a formal demonstration. But immediately afterward it is admitted that the rate of surplus value may rise and it is merely claimed that this will be insufficient to overturn the result. Thus the first arguments reduce to unjustified claims.

The third, falling maximum surplus value argument, is more difficult to discard since the reasoning that supports it is apparently presented. However we know from the General Law section that Marx was aware that the reasoning he presented here was

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[17] Valid here means in terms of the framework that Marx was using. The question of whether capitalists would introduce a technique which lowered the profit rate does not seem to have occurred to him at this point. In any case this is more relevant for the intrinsic explanation rather than for the subsidiary ones. For example, if resources degrade, capitalists cannot return to the more profitable technique.

[18] By this I mean the argument that, if the labour supply is reduced, surplus value must eventually fall in spite of an increase in productivity.

faulty. Thus this properly should be taken as an indication of the way Marx thought the eventual demonstration would go rather than a correct demonstration itself.

2. References to Resource Scarcity.

There are a number of sections of Part III that are taken virtually verbatim from longer sections in either TSV or the General Law section where the longer sections are arguments for the falling rate of profit based, usually, on resource scarcity.

First, in Part III Marx writes "Outside a few cases (for instance, if the productiveness of labour uniformly cheapens all elements of constant and variable capital) the rate of profit will fall, in spite of the higher rate of surplus value" p.226. But in the General Law he wrote "Only if productive power were to increase evenly in all branches of industry which directly of indirectly provide products for workers consumption could a proportional growth in surplus value correspond to a proportional increase in productive power" p.135. Marx later states correctly, as noted above[19], that this is a condition for the rate of profit not to fall.) He then gives a number of reasons that this doesn't happen, one of which is the deterioration of the resource base.

Next, in Part III on p.236 Marx wants to argue that the composition of capital will increase. Certainly the mass of capital increases relative to the number of workers but this may be outweighed by the fall in value of the constant capital. Specifically he takes the case of the modern spinner who works up more cotton with more machinery than his predecessor with a spinning wheel. However both the cotton and the machinery now have lower value. Marx states without argument that this will only slow the rise in the composition of capital. But on pp.365-9 of TSV III Marx deals with exactly the same spinners in much greater detail. He gives a complicated explanation about why the mass of machinery grows faster than the value falls. And then goes on for a full page about how growing resource scarcity means that the value of the raw materials can not fall as fast as their mass rises.

Finally there is a long section in Part III p.260, lines 7-19, that has been copied virtually verbatim from the General Law section, p.135, lines 10-22. The quote from Part III appears as the first paragraph of section IV, supplementary remarks. It is followed by another unconnected paragraph and then a long interposition by Engels. On

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[19] See II.2.b) first paragraph.

the other hand, as I argued above[20], the section in the General Law is part of a coherent argument that resource scarcity is one of the causes of the fall in the rate of profit.

In general it is difficult to escape the feeling that Marx make a conscious effort to avoid emphasising the role of resource scarcity.

3. The Consequences of the Falling Rate of Profit.

I support the claim that Part III is about the consequences of, rather than the reasons for, the fall in the rate of profit with a brief sketch of the three chapters. Chapter XIII, The Law a Such, opens with a five page claim that the rate of profit will fall. Then for the next fifteen pages, with the exception of one paragraph, it busies itself with a description of how the various value quantities change as the rate of profit falls with capitalist development. Chapter XIV, Counteracting Influences, then spends eight pages explaining why the rate of profit falls only slowly. Finally Chapter XV, Exposition of the Internal Contradictions of the Law, with the exception of two paragraphs, uses 19 pages to describe crises and the role played by the falling rate of profit. It finishes, in a somewhat raised tone, by saying that the falling rate of profit is the barrier that shows that capitalism is only a transitory mode of production.

4. Conclusion.

If one supposes that Marx still hoped to be able to demonstrate the intrinsic explanation satisfactorily then these three aspects coalesce into a consistent view of Part III. First the absence of a demonstration and the frequent reassurances follow immediately from the supposition. Second, that the topic was sufficiently important for Marx to set out the consequences before he had a firm demonstration is shown by his final conclusion. Finally, he occasionally drifted toward explanations which involved resource scarcity but pulled himself back since this explanation would have considerably weakened the main point he wanted to make. Moreover this was not dishonest since Marx believed that he would be able to give a proper demonstration of the intrinsic explanation. All this, it must be stressed, is based on supposition; but it does afford a coherent explanation of the main characteristics of Part III.

V. The Argument of the 1870s.

Marx made another attack on the falling rate of profit in his Mathematical Investigations of the 1870s. These were left in a disordered state and contained a large

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[20] See paragraphs 2 and 3 of section II.2.b).

quantity of mathematical calculation.[21] Engels got a Cambridge mathematician friend to put the parts that were relevant in order and inserted them as Chapter 3 of Volume III of Capital. In it Marx takes the formula $= S/C = S/(C+V)$ and for twenty pages systematically varies individual variables or combinations of them and, in each case, observes the effect on the rates of profit and surplus value. The tediousness of the exercise makes it understandable that the chapter has lain un-discussed for over a hundred years, but there is gold buried beneath the detail.

The key example is on pp.56-8.

"Now, the variable capital may either rise of fall. Let us first take an example in which it rises. Let a certain capital be originally constituted and employed as follows:

$$I. \qquad 100_c + 20_v + 10_s; \; C = 120, \; s = 50\%, \; p = 8\tfrac{1}{3}\%.$$

Now let the variable capital rise to 30. In that case, according to our assumption, the constant capital must fall from 100 to 90 so that total capital remains unchanged at 120. The rate of surplus-value remaining constant at 50%, the surplus-value produced will then rise from 10 to 15. We shall then have:

$$II. \qquad 90_c + 30_v + 15_s; \; C = 120, \; s = 50\%, \; p = 12\tfrac{1}{2}\%.$$

Let us first proceed from the assumption that wages remain unchanged. Then the other factors of the rate of surplus-value, i.e., the working-day and the intensity of labour, must also remain unchanged. In that event the rise of *v* (from 20 to 30) can signify only that another half as many labourers are employed. Then the total value produced also rises one-half, from 30 to 45, and is distributed, just as before, 2/3 for wages and 1/3 for surplus-value. But at the same time, with the increase in the number of labourers, the constant capital, the value of the means of production, has fallen from 100 to 90. We have, then, a case of shrinkage of constant capital. Is such a case economically possible?

In agriculture and the extractive industries, which a decrease in labour productivity and, therefore, an increase in the number of employed labourers is quite comprehensible, this process is-on the basis and within the scope of capitalist production-attended by an increase, instead of a decrease, of constant capital. Even if the above fall of *c* were due merely to a fall in prices, an individual capital would be able to accomplish the transition from I to II only under very exceptional circumstances. But in the case of two independent capitals invested in different countries, or in

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[21] The original work is available in German and French but not English. See Marx (1974) and Alcouffe

different branches of agriculture of extractive industry, it would be nothing out of the ordinary if in one of the cases more labourers (and therefore more variable capital) were employed and worked with less valuable or scantier means of production than in the other case."

Marx now supposes the rise in v is due to a rise in wages and at the same time the working day increases proportionally. Then he returns to the original situation. " Now let us assume that the variable capital falls, instead of rising. Then we have but to reverse our example, taking II as the original capital, and passing from II to I.

II. $90_c + 30_v + 15_s$ then changes into

I. $100_c + 20_v + 10_s$, and it is evident that this transposition does not in the least alter any of the condition regulating the respective rates of profit and their mutual relation.

If v falls from 30 to 20 because 1/3 fewer labours are employed with the growing constant capital, then we have before us the normal case of modern industry, namely, an increasing productivity of labour, and the operation of a larger quantity of means of production but fewer labourers. That this movement is necessarily connected with a simultaneous drop in the rate of profit will be developed in the third part of this book."

I will make all my comments in terms of the second part of the example in which the composition of capital grows and the number of workers falls. This means that Marx's comments on the first part must be transposed. At first glance Marx's worries at the end of the third paragraph are difficult to understand. The constellation of a fall in labour, a rise in capital and a rise in labour productivity seems entirely natural. But if one supposes that Marx had the assumed constancy of the rate of surplus value in his mind, the source of his disquiet is clear. The rise in capital per man which raises productivity ought to increase the rate of surplus value.

One can also see the answer he is groping for. In the next paragraph he immediately mentions agriculture and the extractive industries. He then notes that it is unlikely that the change could occur in a given sector but that, for example, one might observe it between the same sector in two countries. It would seem that he is thinking of the following. If we compare agriculture in a country with fertile land and labour intensive cultivation with one with less fertile land and mechanised production, the rate of surplus value has not risen in spite of the mechanisation because of the lower fertility. The following formal analysis confirms the precision of Marx's intuition.

 The structure of the argument is as follows. The value magnitudes are known, from these the physical magnitudes can be calculated, then a relation between output per man and capital per man is supposed and this shows that the rate of surplus value determines the composition of capital. The only way in which the composition can increase with the rate of surplus value constant is if a resource parameter is introduced into the production relation which degrades as the composition increases.

 The details are as follows: the basic model consists of the four equations:

$$C = Ax$$
$$V = bLx$$
$$S = (1 - bL - A)$$
$$= L/(1 - A)$$

where C, V and S are known, b is given, x ,the activity level, can be set to 1, and the unknowns are L, A and . The first three equations reduce to

$$k = \frac{A}{bL}$$

$$e = \frac{1 - bL - A}{bL}$$

where $k=C/V$. These give

$$L = \frac{1}{b(e + k + 1)}$$

$$A = \frac{k}{e + k + 1}$$
$$= \frac{1}{b(e + 1)}.$$

Write $A=K/Y$ and $L=\tilde{L}/Y$ where K, $\tilde{L}$, and Y are machines, labour and output in physical units. Set $b=1$, $K/\tilde{L}=A/L=k$. $Y/\tilde{L}=e+k+1$. Suppose there is a technical relation between $Y/\tilde{L}$ and $K/\tilde{L}$, i.e. $Y/\tilde{L}=f(K/\tilde{L})$, or

$$e = f(k) - k - 1.$$

Note that *df/dk > 1* because the model is one of circulating capital. Thus the composition of capital can not vary if the rate of surplus value is fixed. The way to make the model conform to Marx's description is to redefine the technical relation to include a fertility parameter r, $\tilde{f}(k,r)$ with $\partial\tilde{f}/\partial r > 0$. Then the condition that e is constant gives

$$\frac{dr}{dk} = -\frac{\partial\tilde{f}/\partial k - 1}{\partial\tilde{f}/\partial r} < 0$$

that is, fertility falls as the composition of capital increases to allow the rate of surplus value to remain constant. The constancy of e ($=S/V$) and the rise of k ($=C/V$) then imply that the rate of profit falls.

The point that gives this section its importance is that Marx associates the example with the fall in the rate of profit described in Part III. If one accepts the interpretation given here, it means that by the 1870s Marx interpreted, for example, the fall in the rate of profit portrayed in the opening five pages of Part III as being caused by growing resource scarcity. And by implication, that he accepted that there was no intrinsic reason for the rate of profit to fall. I think this is overstated, but it hard to avoid the impression that Marx was drifting in this direction.

VI. The Pedigree of Various Treatments of the Falling Rate of Profit.

One can divide the various treatments of the falling rate of profit into four: those associated with the Okishio Theorem, the falling maximum surplus value argument, the rising wage mechanism and, finally, increasing resource scarcity.

1. The Okishio Theorem.

There is a long sequence of demonstrations, including that of   Okishio (1961), that show that Marx's rising innovational rate and eventually falling general rate of profit argument is wrong in terms of a linear, one basic factor model. But various authors append to their demonstrations the statement that Marx did not believe that resource scarcity would be responsible for the fall in the rate of profit. Roemer (1981 pp.87-8) contrasts Marx's view with that of Ricardo, Steedman (1977 pp.129) qualifies his statement with a reference to TSV and most strangely Samuelson (1957 p.894) says that Marx could not introduce land because it would conflict with his belief in the labour theory of value. The earlier part of this paper has shown that these claims are wrong in a straight forward sense, but they do contain an element of truth.

I have argued that Marx hoped that he would be able to provide a demonstration of his intrinsic explanation. What the Okishio authors have actually shown is that it is very unlikely that a demonstration can be provided and that virtually the only one of Marx's explanations of the falling rate of profit that remains viable is that which involves growing resource scarcity.

2. The Falling Maximum Surplus Value Argument.

Many authors mention this argument and justify it by citing Marx as an authority. Examples are Rosdolsky (1977 pp.408-10), Shaikh (1978 pp.240) and Okishio (1977). It is true that one can find this argument referred to many times in Marx's work. But, as has been detailed above, the one time that Marx attempted a rigorous demonstration of the falling rate of profit by this route, he failed. I have interpreted Marx's numerous references to the argument that appear after this failure as indications that he still thought the explanation could be demonstrated. If one accepts this interpretation, then it is a misrepresentation of Marx's position to cite him as an authority for this result.

3. The Rising Wage Argument.

There are a number of authors who have constructed Marxian models in which the mechanism that produces a long run falling rate of profit involves a rising wage. Examples are Laibman (1977), Foley (1986), Skillman (1997) and Dumènil and Lèvy (2001). Foley (pp.138-9) and Dumènil and Lèvy have actually argued that this reflects Marx's thought.

The principle source for this is the opening five pages of Part III where the rate of surplus value is held constant while the composition of capital rises. It has been know since the writings of Natalie Moszkowsha in the late 1920s that this implies a rise in the real wage if the rise in the composition of capital increases labour productivity. However the pedigree of this mechanism is undercut by two arguments. First Marx says in the next chapter of Part III "Nothing is more absurd… than to explain the falling the rate of profit by a rise in the wage" (p.240). Of course this does not carry much weight because he apparently has done exactly that in the preceding chapter. Second, and of much more importance, is that the rising real wage undermines one of Marx's basic building blocks, the value of labour power. Thus the argument in favour of the rising wage is problematic.

The contribution of this paper is to add two more negative points. The first is that in the General Law section, when Marx was trying to rigorously demonstrate the falling rate of profit, he was at great pains to keep the real wage constant. This is strong evidence that he did not associate the falling rate of profit with a rising wage. The second is that later, when Marx was reworking the arguments of Part III, he gave an explanation of the constant rate of surplus value in terms of increased resource scarcity rather than rising wages. I think that these four reasons make it very unlikely that Marx had in mind a rising wage as a cause of the long run fall in the rate of profit.

4.The Resource Arguments.

The arguments of those writers who hold that resource scarcity was an important aspect of Marx's position on the rate of profit are not well known. For example, of the nine economists who responded to Brewer's (1995) purposely polemical attack, Hollander (1995) alone cited this as a factor. For this reason I will set out the views of this group in slightly greater detail.[22] There are at least six: Rosdolsky (1977) (The idea first mentioned in Rosdolsky (1956).), Meek (1967) (First appeared in (1960).), Lebowitz (1982), Perelman (1985), Moseley (1991) and Clarke (1994). Of these, Meek refers to Rosdolsky and Moseley to Lebowitz so only four have to be considered. It is convenient to compare these works to the present paper via three questions: How is their argument substantiated? Is it claimed that this was Marx's main idea? And finally, why was there only a brief mention of resources in Part III? The answer of this paper to these questions has already been set out.

With regard to the first question, Lebowitz does not attempt to find Marx making a specific argument, rather he merely makes a general argument himself and then shows by quotations that Marx would have agreed with the suppositions of his argument.[23] Perelman does not try to find an argument by Marx for a reason that will be given below. Rosdolsky was reacting to the criticisms by Joan Robinson and Paul Sweezy that Marx did not explain either the rise in the composition of capital or the fall in the rate of profit in spite of the rise in the rate of surplus value (pp.405-7). He cites the Cherbolitz and Hodgskin sections to answer these charges (pp.407-10). The only differences with the present paper is that he treats the first and second paragraphs of the quoted section as separate arguments and does not supply a formal analysis. Finally Clarke was reacting to the same two types of criticisms plus the one that capitalists would not introduce a profit lowering technique. He seems to accept this last criticism, cites the Cherbolitz section as a defence against the first and gives a mixture of quotes from the Hodgskin and General Law sections to counter the second.

With regard to the second question, only Rosdolsky cites additional arguments. Perelman has a reason for not doing so. Clarke is the only one of the authors who had access to the General Law section. Thus the absence of any reference to Marx's titanic 20 page struggle to establish the intrinsic explanation must be seen as a gap in this very

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[22] Although Hollander's main paper on the theme (1991) includes many quotes concerning resources, he does not appear here. The reason is that his conclusion, if I understand it correctly, is that Marx does not convincingly link resource scarcity to the falling rate of profit.

high quality description of Marx's thought. Finally Rosdolsky expounds the falling surplus value argument of the first paragraph of the quote for three pages. If there is a fault to be found, it is that he is not aware of Marx's own doubts about the validity of the argument.

Finally, with respect to the third question, Lebowitz and Rosdolsky do not attempt to explain the absence of any emphasis on resources in Part III. However, concerning Rosdolsky, his tone implies that any reader worth his salt should have been aware of all the TSV material. Clarke specifically argues that, in Marx's plan, TSV would have appeared as an earlier part of the complete work and that Marx would have assumed that the reader would refer back to the relevant material (p.217). Perelman gives a more complex argument. He starts by noting Marx's view that the role of capitalism was to bring the economy to a sufficient level for socialism to be viable. Initially Marx was confident that capitalist organisation of agriculture would banish the Ricardian problem, but after the cotton famine, he began to have doubts. In order not to be confronted with having to explain how socialism could cure the resource problem, he hid it behind the facade of the rising composition of capital. Thus, although in Marx's mind resource scarcity was the basic reason for the falling rate of profit, one would not expect to find the argument explicitly made at all, let alone in Part III.

With respect to this literature, the contributions of the present paper are: the analytic presentations of Marx's explanations, the new reason for the absence of emphasis in Part III and the discovery of the Chapter 3 argument.

VII. Conclusion.

The principle conclusions, which have been summarised in the introduction, indicate a direction for further research. The ideal Marxian model would be one in which the rate of profit fell, the composition of capital increased, the rate of surplus value rose and the wage was equal to the value of labour power; all this generated by some mechanism related to what I have called the intrinsic explanation. However this may not be possible. The attempts involving the temporal single system are in their infancy and look like facing extreme technical difficulties. The recent models involving rising real wage are further advanced and are interesting descriptions of the actual economy. But viewed as Marxian, the rising real wage makes their pedigree doubtful. In this context there is a justification for developing models with Marxian characteristics that involve

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[23] This is a good example of a rational reconstruction.

resource scarcity. Even though they would not be based on the intrinsic explanation that Marx had hoped for and thus are, one might say, second best, their key element would be one which figured strongly in Marx's accounts of the falling rate of profit.

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