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A Marxian Reply to Hahnel: The Relative Explanatory Power of Marx's Theory and Sraffa's Theory

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Fred Moseley[1]

Abstract

This paper critically examines Robin Hahnel's 2017 book *Radical Political Economy: Sraffa versus Marx* and especially compares the relative explanatory power of Marx's theory and Sraffa's theory. Hahnel's book argues that Sraffa's theory is superior to Marx's theory with respect to the following six subjects: prices, profit, technological change, crises, the environment, and moral critique (each one considered in a separate chapter). This paper challenges Hahnel's arguments on all six subjects and argues that Marx's theory has greater explanatory power than Sraffa's theory and continues to be the best critical theory of capitalism.

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Keywords

Marx, Sraffa, explanatory power, macro, money, prices, profit, technological change, crises, environment

1. Introduction

This paper critically examines Robin Hahnel's 2017 book *Radical Political Economy: Sraffa versus Marx* and especially compares the relative explanatory power of Marx's theory and Sraffa's theory. Hahnel's book argues that Sraffa's theory is superior to Marx's theory with respect to the following six subjects: prices, profit, technological change, crises, the environment, and moral critique (each one considered in a separate chapter). Hahnel of course pays homage to Marx as a giant intellectual figure who has provided more ideological support for workers than anyone else, but he argues that Marx's economic theory can now be surpassed by Sraffa's theory, and it is "time to move on." This paper challenges Hahnel's arguments on all six points and argues that Marx's theory has greater explanatory power than Sraffa's theory and continues to be the best critical theory of capitalism.

Hahnel's interpretation of Marx's theory is the currently popular Sraffian interpretation. However, I argue that the Sraffian interpretation of Marx's theory is fundamentally erroneous for

[1]Mount Holyoke College, South Hadley, MA, USA

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Corresponding Author:
Fred Moseley, Mount Holyoke College, South Hadley, MA 01075-1489, USA.
Email: fmoseley@mtholyoke.edu

reasons that I discuss at length in my recent book *Money and Totality: Marx's Logical Method in Capital and the End of the "Transformation Problem"* (Moseley 2016). Therefore, I argue that Hahnel's interpretation is a misinterpretation, and as a result his comparison of "Marx's theory" and Sraffa's theory is not valid.

A space constraint does not permit even a brief introduction to my "macro-monetary" interpretation of Marx's theory,[1] but the main difference between Marx's theory and Sraffa's theory (besides the labor theory of value) that I wish to emphasize in this paper is the *logical framework* of the two theories. The logical framework of Marx's theory is the *circuit of money capital*, expressed symbolically by the well-known formula:

$$\mathbf{M} - \mathbf{C} \ldots \mathbf{P} \ldots \mathbf{C}' - (\mathbf{M} + \Delta\mathbf{M}).$$

The circuit of money capital clearly indicates that Marx's theory is a *monetary* theory and that the main phenomenon that Marx's theory is intended to explain is the determination of the increment of money ΔM at the end of the circuit (at the macro level of abstraction of the total economy). The initial money capital M is divided into constant capital advanced to purchase means of production and variable capital advanced to purchase labor power.

By contrast, the logical framework of Sraffian theory is not a monetary circuit but is instead a linear production model of physical quantities of inputs and outputs. In order to compare Sraffa's logical framework with Marx's framework, Sraffa's framework could be represented symbolically as follows:

$$\mathbf{A}, \mathbf{b}, \boldsymbol{l} \ldots \mathbf{P} \ \ldots \ \mathbf{C}',$$

where **A** is an input-output coefficient matrix, **b** is a vector of wage goods, and ***l*** is a vector of labor inputs. The most striking difference between Sraffa's framework and Marx's framework is the complete absence of money in Sraffa's framework, especially the absence of Δ**M**, the most important feature of capitalist economies and the most important phenomenon explained by Marx's theory.[2] Also missing is the first stage of the circuit of money capital—the advance of money capital **M** to purchases means of production and labor power. It is as if firms in capitalism somehow possess means of production and labor without having advanced money capital to purchase them. These two completely different logical frameworks also mean that the currently popular Sraffian interpretation of Marx's theory in terms of Sraffa's logical framework (including Hahnel's) is a fundamental misinterpretation.

One could describe the general difference between Marx's theory and Sraffa's theory in terms of Schumpeter's distinction between Monetary Analysis and Real Analysis (Schumpeter 1954: 276–78). In Monetary Analysis, money is of primary importance for the explanation of phenomena in capitalism and money is introduced on the "ground floor" of the theory (e.g., section 3 of chapter 1 of *Capital*). In Real Analysis, the phenomena in capitalism are explained in terms of goods and services, like a barter economy, and money is mostly missing in the theory (money is "neutral" or a "veil," not essential). Marx's theory clearly fits in Schumpeter's category of Monetary Analysis and Sraffa's theory fits in his category of Real Analysis.

I turn now to the six subjects discussed in Hahnel's book that are the basis of my comparison of the relative explanatory power of Marx's theory and Sraffa's theory in this paper.

[1]See Moseley (2016: ch. 1) for a twenty-page introduction.

[2]The word "money" appears only once in Sraffa's book (33), and "money" is not in the index of the most important advanced textbook on Sraffian economics, Kurz and Salvadori's 570-page *Theory of Production* (1995). How can there be a theory of capitalism without money?

2. Chapter 1: Prices—and Money[3]

In Marx's theory, there are two levels of prices: the total price of the total commodity product that is determined in the macro theory of volume 1 and individual industry prices of production that are determined in the micro theory of volume 3. The total price in volume 1 consists of three components: constant capital, variable capital, and surplus value. Thus we can see that the components of the total price are components of *capital* (and capital is defined in terms of *money*). As Marx put it, commodities are analyzed in his theory as *products of capital*, not as commodities in general without reference to capital.

Hahnel's presentation in this chapter of Marx's theory of price in volume 1 is completely different from this. In the first place, Marx's theory in volume 1 is presented as a micro theory of the unit price of individual commodities, rather than the total price of the total product of the economy as a whole. Furthermore, nothing is said about *capital* and the *circuit of money capital* in this chapter. Most of the five-page section on Marx's theory of prices is about the determination of *labor values*; price is mentioned in only one paragraph, in which it is stated that prices are proportional to labor times, without saying anything about the factor of proportionality and without breaking down price into its components or even specifying what the unit of measure of prices is. One would never know that Marx's labor theory of value is primarily a macro theory of the total profit (i.e., the total $\Delta\mathbf{M}$).

Hahnel interprets Marx's theory of prices to be based on the same logical method as Sraffa's theory—a linear production model of physical quantities of inputs and outputs; in other words, he presents the currently popular Sraffian interpretation of Marx's theory. Marx's theory is interpreted to first derive labor values from given physical quantities and then to "transform" labor values into prices of production on the basis of the same physical quantities. Sraffa's theory, on the other hand, derives the same prices of production *directly* from the same given physical quantities. Therefore, Hahnel concludes (like so many) that labor values are unnecessary and redundant ("why bother?") and are misleading about the determination of prices; labor values in fact play no role in the determination of prices of production. But this conclusion follows only from the mistaken Sraffian interpretation of Marx's theory, not from Marx's theory itself, correctly understood, as a macro-monetary theory of capital and total profit.

With respect to the Sraffian theory of prices, Hahnel states that "we are only interested in relative prices" (11).[4] It would be more accurate to say that if the rate of profit is to be determined by Sraffa's theory, then the theory can only determine relative prices and cannot determine absolute prices because the Sraffian system of equations contains n equations in $n + 2$ unknowns (n prices, the wage rate, and the rate of profit).[5] If the wage rate is taken as given in order to determine the rate of profit, that still leaves one-too-many unknowns. One commodity (any commodity) must be chosen as the numeraire (good 2 in Hahnel's examples) and its price set $= 1$ and the relative prices of all other commodities are expressed as quantities of the arbitrarily chosen numeraire commodity.[6] The numeraire could be gold (both Sraffian and Marx assumed a commodity money economy), and in that case, relative prices would be in units of gold. However, setting the price of gold $= 1$ means that the actual level of prices is not determined, in contrast to

[3]"Money" is added to Hahnel's title of chapter 1 for reasons that are clear in this section.

[4]Page numbers without an author and date refer to Hahnel (2017).

[5]Hahnel uses a two-sector model to illustrate Sraffa's theory, so there are two equations and four unknowns.

[6]If the rate of profit is also taken as given (along with the wage rate) in order to determine absolute prices, then the rate of profit would not be determined by the Sraffian system of production equations and Hahnel's Fundamental Sraffian Theorem discussed in the next section (profit is positive because of the surplus product produced by workers) would not be relevant to the determination of the rate of profit in Sraffian theory in this case. Thus, the Sraffian system of equations can explain either the rate of profit or absolute prices, but it cannot explain both together.

Marx's theory in which the actual price level in a commodity money system is determined by the labor time required to produce a unit of gold. Furthermore, the numeraire does not have to be gold, and it seldom is in Sraffian writings. The numeraire could even be a composite of commodities, not a single commodity that actually functions as a medium of exchange in the actual economy. Sraffa himself assumed that the numeraire is the entire net product of the economy! These hypothetical numeraire prices are obviously not actual money prices. Marx's theory, on the other hand, is always about actual prices in terms of actual money.

Another advantage of Marx's theory in terms of actual money in a commodity money system is that it can also determine the *quantity of money in circulation*, and Sraffian theory cannot explain this important macroeconomic variable. Even if gold is chosen as the numeraire, Sraffian theory considers only the quantity of gold produced in the current period and does not consider the much greater quantity of gold produced in previous periods and still in circulation many periods after its production. The quantity of gold produced in the current period is just taken as given and there is no relation between the quantity of gold in circulation and the gold prices of all commodities.

Incorporating prices in terms of today's monetary system of inconvertible credit money is a challenge for Marx's theory but is not even possible in Sraffa's theory. In Marx's theory, the price level is no longer determined by the labor value of a unit of gold. Marx discussed inconvertible fiat money on several occasions, and I have extended Marx's theory to inconvertible credit money in Moseley (2011). I argue (following Marx) that the price level is determined by the aggregate ratio of the total quantity of money in circulation (adjusted for the velocity of money) and the total labor required to produce the commodities in circulation (i.e., MV / L).

In Sraffa's theory, on the other hand, in order to determine the rate of profit, there will always be one too few equations, and therefore one commodity (or bundle of commodities) has to be selected as the numeraire and its price set = 1, in which case the relative prices determined by Sraffa's theory are expressed in terms of quantities of the arbitrary numeraire commodity; in other words, the Sraffian relative prices continue to be *commodity prices* and are not actual prices in terms of today's credit money.[7]

The most common logical criticism of Marx's labor theory of value over the last century, including by Hahnel, is the so-called "transformation problem," which Hahnel discusses in the last section of chapter 1. The alleged problem, succinctly put, is this: in Marx's theory of prices of production in volume 3 of *Capital*, he allegedly "failed to transform the inputs from values to prices of production" and thus there is a logical contradiction between outputs sold at prices of production and inputs purchased at values, especially since many goods are both inputs and outputs.

The "transformation problem" is of course a big subject and too big a subject for the space constraints of this paper. In my recent book (Moseley 2016), the title is intended to suggest that, if Marx's macro-monetary logical method is correctly understood, then *there is no transformation problem* in Marx's theory; that is, Marx did not "fail to transform the inputs" in his theory of prices of production. An introduction to my interpretation is presented in chapter 1 of this book, and chapters 3 and 4 present 180 pages of textual evidence to support this macro-monetary interpretation of Marx's theory. For the purpose of this paper, I hope that readers are willing to set aside this issue for now and focus instead on the *relative explanatory power* of the two theories, that is, on the relative ability of the two theories to explain the most important phenomena of capitalist economies. That is what the rest of Hahnel's book is about and is what this paper is about.

[7]And, as in the commodity money case, if the rate of profit is taken as given in order to determine absolute prices, then the rate of profit is not determined by the Sraffian system of production equations. See Moseley (2020: appendix 1) for a discussion of attempts to incorporate money into Sraffa's theory.

3. Chapter 2: Profits

Marx's theory of profit (or surplus value), succinctly put, is that the quantity of surplus value (S) is determined by the hours of surplus labor of workers (SL), which can be expressed algebraically as

$$\mathbf{\Delta M = S = m\ (SL)},$$

where **m** is the money value produced per hour of labor. This theory is a *macro* theory that applies to the *total surplus value* produced in the economy as a whole. And surplus value is a *monetary* variable that refers to the difference between the total price of all commodities produced in the economy as a whole and the costs of producing these commodities. Surplus labor is the difference for all workers between the length of the working day and the amount of time necessary for workers to produce the equivalent of their money wages.

Hahnel discusses Marx's theory of profit very briefly in 1½ pages (22–23). All the variables are in units of labor hours. Money and money capital, and ΔM, are not mentioned at all; constant capital and variable capital are not mentioned. How can this be Marx's theory? Instead of variable capital as a quantity of money, Hahnel discusses the "exchange value" of labor power, which is defined as the *fraction of an hour* that is required to produce the hourly subsistence real wage ($Vb < 1$). Hahnel puts "exchange value" in quotation marks because he knows that it is not a real exchange value. The real exchange value of labor power is the *money price* of labor power, and the real exchange of labor power is with a *quantity of money capital* (variable capital), not with a fraction of an hour. Surplus value is defined by Hahnel as the remaining fraction of an hour, ($= 1 - Vb$), rather than as ΔM. And the rate of exploitation is defined as $(1 - Vb) / Vb$.

Hahnel discusses Morishima's "Fundamental Marxian Theorem" according to which the rate of profit is positive if and only if the rate of exploitation (as just defined) is positive, which is interpreted to imply that workers are exploited. However, Morishima's theorem is derived on the basis of Sraffa's theory, not Marx's theory; that is, it is derived in a linear production model in terms of physical quantities of inputs and outputs, not from Marx's circuit of money capital and the labor theory of value. Therefore, Morishima's Fundamental "Marxian" Theory does not in fact apply to Marx's theory. In Marx's theory, the exploitation of workers follows in a straightforward way from the equation on the previous page. From this simple but profound equation, it is clear that surplus value (S) is positive only if surplus labor (SL) is positive.

Hahnel emphasizes that Morishima's theorem could be applied to any basic good and there is no reason to privilege labor.[8] This is true of Morishima's theorem because it is based on Sraffa's theory; but it is definitely not true in terms of Marx's theory. In Marx's theory, only labor produces new value and thus only surplus labor produces surplus value. Constant capital (equal to the price of the means of production) is transferred directly to the price of the output, and no additional value (and hence no surplus value) is produced by this transfer of a previously existing given quantity of money constant capital.

Hahnel proposes instead a Fundamental Sraffian Theorem according to which profit is positive "if and only if those who produce goods are deprived of some of the surplus goods they produce" (25). He acknowledges that it could be argued that the surplus product is also the product of the machines and technology that are utilized in production, but he argues that machines and technology are only potentially productive and workers realize this potential and produce the surplus goods. But this is a weaker argument than Marx's theory in which there is no ambiguity. Physical use values could be conceived as produced by both labor and machines, but monetary value is produced by labor alone.

[8]Some have facetiously suggested a "peanut theory of value."

Hahnel also argues that evidence against Marx's surplus labor theory of surplus value is the fact that the same rate of profit is *paid on all the inputs*, not just labor. However, the fact that a markup is paid on all inputs does not contradict Marx's surplus labor theory of surplus value, but is instead explained by Marx's theory by the *two levels of abstraction* in his theory—the production of surplus value and the distribution of surplus value.[9] The markup that is paid on all inputs has to do with the distribution of surplus value, and before the distribution of surplus value can be explained, first the total amount of surplus value produced must be determined, and it is determined in Marx's theory by the total surplus labor of workers. The total surplus value thus determined is then presupposed in the theory of the distribution of surplus value and in particular in the determination of the rate of profit ($R = S / (C+V)$), which is the markup that is paid on all the inputs.

Despite these differences, I also want to emphasize that there is an important agreement between these two theories of profit: that there is an *inverse relation between wages and profit* in both theories; which implies that there is an *unavoidable class conflict* between workers and capitalists in capitalism over wages. This conclusion is of course in stark contrast to the mainstream marginal productivity theory of wages and profit in which there is no inverse relation and no class conflict over wages.

4. Chapter 3: Technological Change and the Rate of Profit

Chapter 3 is mainly about the effect of technological change on the rate of profit according to both Marx's theory and Sraffa's theory. Hahnel first summarizes Marx's theory that labor-saving technological change with the real wage constant increases the composition of capital, which causes the rate of profit to fall. He gives Marx credit for recognizing that there is an important "counter-tendency" to this negative effect: technological change also reduces the labor time necessary to produce the workers' means of subsistence (i.e., reduces necessary labor) and thus increases surplus labor and surplus value and the rate of surplus value.

Hahnel then expresses Marx's theory of the rate of profit in algebraic form as follows:

$$r(M) = s' (1 - q),$$

where r(M) is the rate of profit, s′ is the rate of exploitation (defined in the previous section as the ratio of the fraction of an hour workers produce profit for capitalists to the fraction of an hour that workers produce for themselves), and q is the composition of capital (which he defines as the ratio of constant capital to the total capital; that is, $C/(C+V)$) (39).[10] And he argues that it is obviously true from this equation that no matter how much q increases, s′ can always increase enough so that the net effect of technological change is positive, not negative.

However, there is a crucial element of Marx's theory of the falling rate of profit that is missing in Hahnel's summary (and in almost all interpretations of Marx's theory):[11] according to the labor theory of value, there is a *limit* to the positive effect of technological change on the quantity of surplus value produced: a fixed limit to the hours in the working day. Assuming that the number of hours in the working day is fixed, the amount of new value produced per worker (N) itself has a limit, which is equal to the product of the number of hours in the working day (L) multiplied by the money value produced per hour (m): $N = m L$, and this limit applies to all workers.

As a result of this limit to the working day, the percentage increase of surplus labor (and thus the percentage increase of surplus value) that results from a given increase of productivity

[9]See Moseley (2016: esp. chs. 1 and 3) for further discussion and eighty pages of textual evidence to support this interpretation of the two levels of abstraction in Marx's theory—the production and distribution of surplus value.

[10]Hahnel also erroneously defines these variables in terms of labor-time quantities rather than quantities of money capital, but I leave that issue aside here.

[11]Rosdolsky (1977) is a notable exception, in chapter 16 and the appendix to part 5 of his book.

diminishes over time because there is less and less necessary labor to convert into surplus labor. I showed in Moseley (1992: 13–20) that, with a given real wage, the ratio of the percentage increase of surplus labor to a given increase of productivity is equal to 1/(S/V). Thus as the rate of surplus value increases, it gets harder and harder to compensate for an increase in constant capital per worker by increasing surplus value per worker because there are only so many hours in the working day.[12]

The Sraffian theory of the effect of technological change on the rate of profit is of course the Okishio theorem. Hahnel argues that the Okishio theorem proves "beyond a doubt" that labor-saving technological change that reduces costs at prevailing prices (and with the real wage constant) can *never* cause the rate of profit to fall. Hahnel also interprets the Okishio theorem to be a conclusive refutation of Marx's theory of the falling rate of profit. However, that is not true. In the first place, the Okishio theorem is not a refutation of Marx's theory because the Okishio theorem is based on linear production theory (i.e., Sraffa's theory), which is fundamentally different from Marx's theory. There is no value and surplus value produced by labor in linear production theory and thus no diminishing effect of increasing productivity on surplus labor. Therefore, the conclusion of the Okishio theorem does not apply to Marx's theory.

Furthermore, the Okishio theorem on its own terms has an important limitation (which Hahnel does not discuss)—it assumes there is *no fixed capital*; but technological change is almost always accompanied by an increasing proportion fixed capital, which plays an important role in the effect of this change on the rate of profit. Shaikh (1978) criticized this limitation and presented an example with fixed capital in which cost-cutting technological change reduced the general rate of profit. Roemer (1979) tried to generalize the Okishio theorem to include fixed capital, but Shaikh (1980) argued that Roemer assumed the wrong decision-making rule by capitalists regarding whether or not to introduce new technology: instead of *lower cost of production*, Roemer assumed a rule of higher rate of profit. And Shaikh argued that in the case of fixed capital, lower cost of production is still the appropriate decision-making rule because real competition among capitalists within an industry is primarily over costs of production, not the rate of profit. The usual means by which costs of production are lowered is by more expensive machinery, which requires proportionally more fixed capital investment (i.e., the per unit capital invested increases more than the per unit production costs). Competition over costs often forces capitalists to introduce new technology to lower costs even if it results in a lower rate of profit.

Hahnel states in the conclusion of this chapter that "Marxists and Sraffians are in agreement that if and only if a new technology *reduces costs* of production will profit-making capitalists adopt it" (46, emphasis added). And yet he adds in the next paragraph, "All Sraffians recognize the validity of the Okishio theorem." But if the decision-making rule is lower costs, then the Okishio theorem cannot be reasonably generalized to fixed capital, and of course fixed capital plays an important role in Marx's theory of the falling rate of profit as a result of technological change.[13]

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[12]For a review of Marx's discussions of this diminishing effect of an increase of productivity on surplus value in the various drafts of *Capital* (the *Grundrisse*, the *Manuscript of 1861–*63, and in volume 3 of *Capital*), see Moseley (2018).

[13]It should also be noted that Sraffa's theory of fixed capital goods as joint products has other serious deficiencies beyond not being able to generalize the Okishio theorem to fixed capital. These deficiencies include that it assumes that the rate of profit is equalized across all ages of a machine, even though used machines are seldom sold on markets, and therefore there is no market competition to enforce equalization of the profit rate, and even though machines generally decline in efficiency as they get older; it produces a pattern of depreciation (small in early years and increasing over time) that is the opposite of actual depreciation patterns; it cannot realistically incorporate more than one machine or fixed capital good in each industry; and it cannot explain the actual reproduction of fixed capital goods from one period to the next. See Moseley (2020: appendix 2) for a further discussion of these deficiencies of the Sraffian theory of fixed capital and attempts by Sraffian economists to overcome these deficiencies. Marx's theory of fixed capital (as quantities of money capital advanced at the beginning of the circuit of money capital) has none of these difficulties.

There is also another important point that has to do with another determinant of the rate of profit in Marx's theory besides technological change that Hahnel does not discuss—the *turnover time of the total social capital*—which is defined as the amount of time on average between the advance of money capital at the beginning of the circuit and the recovery of money capital at the end of the circuit. According to Marx's theory, the annual rate of profit varies inversely with the turnover time of the total social capital. A reduction in the turnover time reduces the amount of capital that has to be advanced in order to produce the same quantity of surplus value in a year and thus increases the annual rate of profit.[14] Foley (1986: ch. 5) has worked out this inverse relation in detail. Marx's theory is able to analyze the effects of changes of the turnover time on the rate of profit because its logical framework is the circuit of money capital and the turnover period is a key characteristic of this circuit.

Sraffa's theory, on the other hand, is not able to analyze the effect of the turnover time on the rate of profit because its logical framework is a physical input–output coefficient matrix, with no money capital advanced and recovered and with no time period specified by the coefficient matrix. It is usually assumed that the production period is one year, but if it were assumed that the production period were half a year (or any other time period), the rate of profit would be the same because the rate of profit is determined by the physical input–output coefficients, and these physical coefficients are not affected by a change in the production period. Thus, the rate of profit in Sraffa's theory is not the actual rate of profit because it does not take into account the turnover time of capital.[15]

Another argument that Hahnel discusses on the last several pages of this chapter (44–46) is that Sraffa's theory can explain why capitalists do not always adopt the most efficient technology, and Marx's theory cannot explain this important inefficiency in capitalism. Hahnel argues that, according to Sraffa's theory, if the wage is low enough, capitalists will not adopt labor-saving technological change even if it increases the overall productivity of labor.

However, Hahnel does not seem to realize that Marx himself made a similar argument in chapter 15 of volume 1 of *Capital* (Marx [1867] 1977: 515). As an important example of this inefficiency of capitalism, Marx mentioned in the rest of this paragraph that many machines are invented in England but are employed only in America, and he concluded, "Hence we nowhere find a more shameless squandering of human labor power for despicable purposes than in England, the land of machinery" (Marx [1867] 1977: 517). And, Marx also made the same point in chapter 15 of volume 3 (Marx [1894] 1981: 371).

The fundamental reason for this failure to adopt the most productive technology, as Marx explained, is that capitalists base their choice of technology on relative *costs*, including especially the cost of labor, and capitalists pay workers for only a part of the working day and do not pay workers for the surplus labor portion of their working day. Therefore, a new labor-saving technology might not reduce costs enough even though it increases productivity.

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[14]See *Capital* volume 2, chapters 15–16 and volume 3, chapter 4. Chapter 4 mentions important nineteenth-century innovations that reduced the turnover time of capital—railroads, steamships, telegraph, and the Suez Canal. Such innovations have of course continued in the twentieth and twenty-first centuries—automobiles, airplanes, telephones, the Internet, etc. Empirically, over the last two centuries, there has been a general downward trend in the turnover time of capital, which has had a positive effect on the annual rate of profit.

[15]It should also be noted with regard to turnover time that, because Sraffa's theory is based on the simultaneous determination of inputs prices and output prices, it almost always assumed that *all industries have the same turnover time* and it is not possible to realistically incorporate unequal turnover times into Sraffian theory. But of course in reality different industries have different turnover times. See Moseley (2020: appendix 3) for a further discussion of this deficiency of Sraffian theory. Marx's theory does not have to make such an unrealistic assumption because it is based on sequential determination of money capital flows (the preexisting M is taken as given in the determination of M' and ΔM at the end of the circuit).

So Hahnel is quite wrong that Marx's theory cannot explain this inefficiency in capitalists' choice of technology. Marx was the first to explain this inefficiency in capitalism a long time ago. Marx's theory and Sraffa's theory are similar in this respect because the issue has to do with *labor as a cost only*, and not labor as a producer of value.

5. Chapter 4: Theories of Capitalist Crises

The first section of this chapter ("Marxian Crisis Theory") discusses four different Marxian theories of crises: money and financial crises, underconsumption, profit squeeze, and the falling rate of profit. The theory of the falling rate of profit is discussed first and focuses mainly on the defense of Marx's theory by the proponents of the Temporal Single System Interpretation (TSSI—which I do not discuss because I disagree with the TSSI on this point). I have already discussed my defense of Marx's theory in the previous section. I also do not discuss underconsumption theory and the profit squeeze theory because I regard these interpretations to be minor aspects of Marx's theory.

Hahnel begins the subsection on Marx's theory of money and crises as follows:

> It did not take Marx long to get to the subject of *money* in *Capital*. In chapter III of part I in volume I, he explains how monetized exchange. . . creates the possibility of a discrepancy between supply and demand in the aggregate. (55, emphasis added)

But Hahnel does not seem to realize that it took Marx even less time to "get to money" in *Capital*. As discussed above, Marx "got to money" in the *very first chapter* of *Capital*, in section 3, in which he derived the fundamental function of money as the measure of value and the universal equivalent of all commodities; and then the rest of Marx's theory is in terms of monetary variables. This is in striking contrast to Sraffa who *never* "got to money." Hahnel is correct to emphasize the importance of Marx's critique of Say's Law in section 2 of chapter 3, which demonstrates the *possibility* of crises arising from the separation of sale and purchase due to the function of money as means of exchange, although it does not demonstrate the necessity or actuality of crises. Sraffa's theory, on the other hand, has nothing to say even about the possibility of crises arising from money as means of exchange because there is no money and no actual exchange in Sraffa's theory.

I would also add another important element of Marx's theory of the rate of profit and crises that is not discussed by Hahnel: the *necessary conditions for recovery* from a crisis due to the falling rate of profit. Since according to Marx's theory, the cause of the falling rate of profit is an increase in the composition of capital, the primary necessary condition for a restoration of the rate of profit and a recovery from crises is a *reduction in the composition of capital*. The increase of the composition of capital during the expansion was caused by technological progress, but surely a reduction in the composition of capital is not accomplished by technological regress. Instead, a reduction in the composition of capital during crises is due to a *devaluation of capital*, which is itself the result of the widespread bankruptcies of capitalist firms during depressions. When a company goes bankrupt, its productive assets are usually auctioned off to surviving companies at a small percentage of their book value. In this way, the constant capital that must be invested to purchase these assets and to produce surplus value is significantly reduced and the rate of profit is increased. Therefore, Marx's monetary theory provides the basis for a comprehensive theory of the boom-bust cycle in capitalist economies, which explains both the recurring crises and the recovery from crises.

This is another important example of the superior explanatory power of Marx's theory over Sraffa's theory. Since the inputs in Sraffa's theory are quantities of physical goods (or physical input–output coefficients) and not the actual price paid for these inputs, Sraffa's theory has no

way to take into account the monetary devaluation of the initial capital, which is an important aspect of the restoration of the rate of profit and recovery from crises in capitalism. The devaluation of capital does not affect the physical coefficients.

At the beginning of the section in this chapter on "Sraffian Crisis Theory," Hahnel acknowledges that Sraffa's theory is a microeconomic theory that *does not provide any theory of crises* in capitalism. So "Sraffian crisis theory" is really an oxymoron. And since crises are very important phenomena that we want to explain, the failure of Sraffian theory to provide a theory of crises is a very serious weakness. To make up for the lack of a theory of crises in Sraffa's theory, Hahnel asserts that Sraffa's theory has "allies" of several heterodox macroeconomic theories such as Minsky's theory, post-Keynesian theory, and post-Kalecki theory that do provide theories of crises and (he argues) these theories of crises are better than Marx's theory of crises.

Hahnel argues that the reason that these heterodox macro theories are "allies" of Sraffa's theory is that they also focus on "the physical surplus and its distribution." But this is not true; *none* of these heterodox macro theories includes the physical surplus and its distribution. Hahnel provides no examples of the role of the physical surplus in these heterodox theories because there are none. These theories do not take physical quantities of inputs and outputs as given, but instead take *money costs* as given, similar to Marx's theory in this respect. All their theories of price are monetary "cost-plus" theories (Lavoie 2006: 44–49). Marx's theory of prices could be described as "monetary cost plus the labor theory of value."[16]

Therefore, crisis theory is another important area in which Marx's theory clearly provides much greater explanatory power than Sraffa's theory; indeed there is no Sraffian crisis theory. The micro physical quantities framework of Sraffa's theory precludes a macro crisis theory.

6. Chapter 5: Environment

This chapter begins with a paragraph on Marx's theory of rent in which Hahnel states,

> *What little Marx had to say* about the inputs from nature appears mostly in part VI at the very end of volume III of *Capital*. However, Marx's discussion of "differential" and "ground" rent there differs little from the theory of rent Ricardo had elaborated before him. (56, emphasis added)

This is a very inaccurate description of Marx's theory of rent. Marx's theory of rent is in part 6 of volume 3 because it has to do with the *distribution of surplus value* (at the second micro level of abstraction of Marx's theory); that is, rent is analyzed as a component part of the predetermined total surplus value, along with the other component parts of industry profit (part 2), commercial profit (part 4), and interest (part 5). Part 6 is two hundred pages long and includes a detailed theory of absolute rent (rent on the least fertile land) as well as differential rent, and differential rent is divided into two main categories: differential rent I (due to unequal fertilities of land) and differential rent II (due to unequal investments of capital); and differential rent II is divided further into three cases (prices of production constant, rising, and falling), and the case of falling prices of production is further subdivided into three subcases. This is a considerable advance over Ricardo's theory of rent, especially the theory of absolute rent and many of the details of differential rent. (Marx also wrote another two hundred pages in the *Theories of Surplus Value* volume II, on the theories of rent of Ricardo and other classical economists and a first draft of his own theory.) Sraffa's chapter on rent is five pages.

[16]There is a literature not mentioned by Hahnel that is called a Sraffian demand-led theory of growth, led by Garegnani (e.g., 1992), which emphasizes that the main driver of growth is autonomous expenditure; but this literature does not depend on the Sraffian system of equations and theory of the distribution of income. The main common factor between Sraffa's theory and this literature is emphasis on the long run. Thanks to Gary Mongiovi for calling my attention to this literature.

Hahnel's paragraph on Marx's theory of rent is followed by several paragraphs in which he briefly discusses recent work by "ecological Marxists," which he describes as being mainly concerned with the inevitable conflict between capitalism's imperative to grow without limit and limited natural resources. But the arguments of "ecological Marxists" are about much more than just the exhaustion of resources; their arguments are also and more fundamentally about the inevitable conflict between the *profit maximization motive* of capitalists and sustainable environmental practices. The title of chapter 2 of *Ecology against Capitalism* by John Bellamy Foster is "The Ecological Tyranny of the Bottom Line." *Hungry for Profit* is the title of a book edited by Foster and others. To take an obvious example, it costs more (and is therefore less profitable) to dispose of waste in an environmentally sustainable way than to dump waste in a river. Capitalists left on their own will always choose the most profitable method of production and waste disposal, which is usually environmentally destructive, as the world has discovered over the last century. Perhaps government regulations can rein in the environmentally destructive profit-maximizing practices of capitalists to some extent, but the underlying systemic conflict is always there. Trump's deregulation policies in the United States will give freer rein to capitalists' goal of profit maximization, which will cause more environmental destruction in the United States in the years ahead. The "ecological Marxists" argue that the only way to eliminate this systemic conflict between the environment and the profit motive is to eliminate capitalism.[17]

The section of this chapter on Sraffa's theory of rent begins with the assertion that Sraffa's theory can easily incorporate the rent of natural resource inputs into its theory of prices and income distribution (and by implication rent can be incorporated into Sraffa's theory more easily than into Marx's theory). He adds land as an input and rent as a distribution variable to his two equation model and assumes that land in the two processes is homogenous (i.e., equal natural fertilities) and thus receives the same rent. So along with two prices there are now three distribution variables: wages, the rate of profit, and rent. However, because a variable has been added, but not an additional production equation (because land is not a produced commodity), now *two* of the distribution variables must be exogenously given (and one commodity chosen as numeraire and its price set = 1) in order to determine the third distribution variable. If the wage is taken as given, then the rate of profit must also be taken as given in order to determine rent. Sraffa's theory in this case is not able to determine both the rate of profit and rent (and is still not able to determine absolute prices). This indeterminant theory is clearly inferior to Marx's theory in which both the rate of profit and rent are determined (along with absolute prices); the rate of profit is determined at the first macro level of abstraction and then rent is determined at the second micro level of abstraction.

Hahnel does not discuss the more complicated case of heterogenous land (unequal fertilities), in which case there would be two rent variables. In this case, not only must the wage and the rate of profit be taken as given, but also the rent of the least fertile land must be assumed to equal 0. However, this means that Sraffa's theory also *cannot explain absolute rent* (rent on the least fertile land) and thus Sraffa's theory of rent (like Ricardo's theory) is also inferior to Marx's theory in this respect as well.

In sum, I conclude that it is not as easy as Hahnel claims to incorporate rent into Sraffa's theory because rent adds more variables than it adds equations and thus Sraffa's theory is indeterminant in the important respects discussed above. On the other hand, it is much easier to incorporate a complete determination of the various kinds of rent into Marx's theory, as Marx himself demonstrated 150 years ago.

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[17]The "ecological Marxists" present a rich interpretation of Marx's theory of the relation between capitalism and the environment that includes such concepts as metabolic rift (violations of ecological sustainability conditions), entropic degradation, and the natural-material basis of use value—all of which Hahnel ignores. For example, see Burkett (2006 and 2014).

As mentioned above, Hahnel's main concern in this chapter is to argue against the Marxists' view of the inevitable conflict between the growth of capitalism and the exhaustion of natural resources. Hahnel argues that this conflict *can be avoided* if what he calls "throughput efficiency" increases as fast as the productivity of labor. Throughput efficiency is *the quantity of a natural resource that is used up in order to produce a unit of each good* (so an increase of throughput efficiency is a *reduction* in the quantity of natural resource inputs per unit output). It is argued that certain types of technological change (no specific examples are given) would reduce the quantity of natural resources used up and would therefore increase throughput efficiency. Hahnel presents a detailed example that includes both types of technological change—changes that increase productivity and changes that increase throughput efficiency. In his example, throughput efficiency is assumed to *increase faster* than productivity, so the annual environmental throughput is *reduced*.

In the final section of this chapter, Hahnel uses this completely unreal and hypothetical example to argue against the alleged Marxist view that capitalism's goal of unlimited growth will eventually exhaust natural resources. He argues that his model of throughput efficiency shows that if throughput efficiency increases as fast as the productivity of labor, then capitalism would not exhaust natural resources and capitalism would be environmentally sustainable.

Aside from the fact that he misses the main point of the Marxists (the profit motive vs. the environment), Hahnel does not attempt to demonstrate the relevance of his hypothetical calculations of throughput efficiency to the actual capitalist economy. Most importantly, there is no discussion of the likelihood that capitalists would adopt technologies that increase throughput efficiency even if they are available. These methods are likely to cost more and therefore be less profitable and are unlikely to be adopted by capitalists (once again the systemic conflict).

Finally, Hahnel's estimates of throughput efficiency are not actually based on Sraffa's theory of prices and the rate of profit as discussed in the first four chapters of this book (and in the first part of this chapter on Sraffa's theory of rent). Hahnel's estimates are based on a similar linear production model as Sraffa's theory, but there are *no prices* and *no rate of profit* in Hahnel's "throughput equations"; these equations are solely in terms of *physical quantities* of the input nature and the two outputs. One could accept Hahnel's physical argument about throughput efficiency, but this would not imply anything about the validity of Sraffa's theory of prices and the rate of profit. Sraffa's theory with the standard commodity as numeraire does away with prices, but at least it retains the rate of profit (as a ratio of physical quantities); Hahnel's throughput equations do away with both prices and the rate of profit. The variable that is determined in Hahnel's throughput equations is the net quantity of "nature" used up in production.

7. Chapter 6: Moral Critique of Capitalism

This chapter begins by arguing that neither Marx nor Sraffa presented a moral critique of capitalism in the sense that neither argued that the distribution of income in capitalism is unfair. Hahnel is correct about Sraffa (he also laments that followers of Sraffa also have not made this moral critique of capitalism), but he is wrong about Marx.

Hahnel argues that Marx did not present a moral critique of the distribution of income in capitalism because he assumed that workers are paid the full value of their labor power. It is true that in chapter 6 of *Capital* volume 1, Marx assumed that capitalists pay the prevailing value of labor power and thus the relation between capitalists and workers *appears* to be a relation of equality. However, Marx soon dispelled that illusion by his theory of surplus value in parts 3 and 4, according to which surplus value is produced by the surplus labor of workers ($S = m(SL)$). In chapter 24 of volume 1, Marx summarized his analysis of the relation between capitalists and workers and emphasized that the exchange of capital for labor power in the sphere of circulation is only the *first phase* of the relation between capitalists and workers. This first phase is followed

by a second phase, the production process, in which workers *produce more money value than they are paid*. In production, the apparent relation of equality between capitalists and workers is turned into its opposite—the exploitation of workers by capitalists.

Hahnel argues that even though Sraffa and the Sraffians have not used Sraffa's theory to present a moral critique of capitalism, a moral critique is clearly implied by his Fundamental Sraffian Theorem—that profit is positive because workers are *deprived* of the surplus product that they produce. And he argues that this Sraffian moral critique of capitalism is superior to the Marxian moral critique for two reasons: because it uses concepts that economists are familiar with (input-output model rather than the labor theory of value) and because it avoids the pejorative word "exploitation" and uses instead the word "deprived" (82–83).

I argue that Hahnel's two reasons for the superiority of the Sraffian moral critique of capitalism are not good reasons, especially the avoidance of the word "exploitation." Exploitation is the essential nature of capitalism, just as the other class societies of the past (feudalism, slavery) were also based on the exploitation of workers. The unique feature of exploitation in capitalism is that it is not as obvious as it is in other class societies because of the payment of wages to workers. Marx's theory is necessary in order to reveal the reality of exploitation beneath the surface appearance of a relation of equality in the labor market. The fact that economists don't like the word "exploitation" (or more generally don't like the labor theory of value) is not a good reason to sugarcoat reality.

8. Conclusion

My conclusion is that Marx's theory provides a stronger critical theory of capitalism than Sraffa's theory, both because Marx's theory provides a stronger theory of exploitation and also because it provides greater explanatory power, especially regarding phenomena that have to do with money and the circuit of money capital and crises.

That said, I am all for joining forces with Sraffian economists in critical engagement with mainstream economics, especially the marginal productivity theory of distribution, as suggested by Camarinha Lopes (2013). Criticism of mainstream economics has been a priority of mine for years, especially marginal productivity theory and the teaching of marginal productivity theory (e.g., Moseley 2015). Sraffa's theory provides the best framework for criticizing marginal productivity theory, and I am happy to use Sraffa's theory for this purpose. But for developing our own critical theory of capitalism, I think Marx's theory provides the best framework, especially for understanding exploitation and the all-important monetary phenomena of capitalism.

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ORCID iD

Fred Moseley https://orcid.org/0000-0002-5420-010X

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Author Biography

Fred Moseley is Professor Emeritus of Economics at Mount Holyoke College. His latest book is *Money and Totality: A Macro-Monetary Interpretation of Marx's Logic in Capital and the End of the "Transformation Problem"* (Brill 2016).