

**Piketty and Marginal Productivity Theory:
A Superficial Application of a Very Bad Theory**

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The production function has been a powerful instrument for miseducation.

Joan Robinson (1953-54, p. 81)

When it comes to the neo-classical theory of income distribution, you are either in or out with regard to the concept of *marginal product*... However, if *marginal product is an incoherent or unusable concept*, most of neo-classical economics (including its approach to income distribution) disintegrates; hence, the unwillingness to question marginal product analysis.

Thomas Palley (2007; emphasis added)

Piketty and Marginal Productivity Theory: A Superficial Application of a Very Bad Theory

This paper focuses on Thomas Piketty's explanation of the increased capital share of total income in major economies since the early 1980s presented in his blockbuster book. (Piketty 2014a, Chapter 6) Piketty's explanation is presented in terms of the theoretical framework of the marginal productivity theory of distribution. The first section of this paper critically reviews the essential elements of marginal productivity theory; the second section summarizes Piketty's explanation of the increasing capital share in terms of marginal productivity theory; the third section critically evaluates Piketty's explanation; and the fourth section briefly presents an alternative heterodox explanation of the increased capital share in recent decades. An Appendix briefly criticizes Piketty's interpretation of Marx's theory of the falling rate of profit.

I should make it clear at the outset that I consider the empirical work done by Piketty and his collaborators on income distribution to be a major contribution. This empirical work has irrefutably documented the sharp increase in wealth and income inequality in all major economies in recent decades. My criticisms of Piketty's book have to do with his *theoretical explanation* of the increase in the capital share of income.

Another important contribution of Piketty's work is that it has helped to put the question of the distribution of income back on the theoretical agenda of mainstream economics, after a century of neglect. Of course, capitalism itself in recent decades, with its sharply rising inequality, is mainly responsible for this increased interest in income distribution; but Piketty's book has helped to galvanize this interest within mainstream

economics. This heightened interest in distribution presents an opportunity for heterodox economists to engage in dialog and debate with the mainstream on this important issue.

1. Marginal productivity theory: “It all depends on technology”¹

1.1 Production function

The foundation of marginal productivity theory is the *production function*. A production function is a *physical* relation between quantities of inputs and a quantity of output, without prices; it is a technical relation, like an industrial engineering plan. A production function has the mathematical form $Q = f(K, L, M)$, where K stands for capital goods (buildings and equipment), L for labor, and M for material inputs (and intermediate inputs in general).

It is obvious straightaway that an “aggregate production function” for an economy as a whole, with single quantities of K, L, and M, *does not exist* in reality. Most obviously, a single physical quantity of K does not exist, because it is not possible to add together the many thousands (millions?) of different types of buildings and equipment, each measured in terms of its own physical unit, in order to obtain a single physical quantity of “aggregate capital”. The prices of the inputs cannot be used to measure the quantity of the inputs because marginal productivity theory is supposed to *explain* the prices of the inputs. A theory of inputs prices cannot take input prices as given; that would be circular reasoning. Joan Robinson made this criticism a long time ago. This “aggregation problem” in marginal productivity theory is widely recognized and

¹ See Moseley 2012a, 2012b, and forthcoming for previous critiques of marginal productivity theory.

acknowledged by many economists, and yet an aggregate production function continues to be used (without a justifying discussion) in marginal productivity analyses of economy-wide income distribution, including by Piketty.²

1.2 Marginal products

Leaving aside this insoluble “aggregation problem”, there are more insoluble problems in marginal productivity, starting with the fundamental concept of *marginal product*. A marginal product is the extra output that results from an increase of one unit of one of the inputs *holding all other inputs constant*. Mathematically, the marginal product is a *partial derivative* of the production function with respect to the changing input; and a necessary condition for the existence of partial derivatives is that the independent variables (e.g. K, L, and M) *must themselves be mutually independent*, so that an increase in one of the variables does not cause or require an increase (or decrease) in another variable.

However, in many production processes, *this necessary condition is not satisfied*; i.e. it is *not possible* to increase output by increasing one of the inputs and holding all other inputs constant. In these cases, marginal products and partial derivatives *do not exist* even at the level of the individual firm, and marginal productivity theory cannot be used to derive the demand for factors and to determine factor prices and income shares.

² The theoretically invalid aggregate production function is also widely used other fields of economics, most notably macroeconomic growth theory, development economics and economic history.

Fixed proportions

The best known “disqualifier” for the existence of marginal products is production processes with *fixed proportions* between the inputs, usually discussed as fixed proportions between K and L. In many production processes, machines must be used with a fixed number of workers; adding an extra machine does not increase output unless an extra worker is also added to run the extra machine. Miller (2000) discusses and cites a wide range of empirical studies (including by Edwin Mansfield, Joe Bain, A.A. Walters, the NBER, and joint studies by the Fed and the Census Bureau) that generally conclude that capital and labor in US manufacturing are usually employed in fixed proportions:

In short, manufacturing firms generally adjust output in the short run by increasing or decreasing the time in which capital and labor are used together. Fixed proportions seem more suited to describing short-run manufacturing processes than do variable proportions. (Miller 2000, p. 123)

However, fixed proportions means that the marginal products of capital and labor *cannot be separated*, and thus the demand for capital and the demand for labor cannot be derived independently and the prices of capital and labor cannot be determined independently.

Material inputs

A lesser known, but equally devastating “disqualifier” for the existence of marginal products is the existence of *material inputs* in goods-producing industries (the M in production functions). In these industries, it is *not possible* to increase output by increasing capital (or labor) *without also increasing material inputs* (e.g. it is not possible to produce another car without adding more windows, tires, etc.). In this case, K (or L) and M are *not* mutually independent. An increase of K (or L) requires a complementary

increase of M in order to produce more output, and thus the necessary condition for the existence of marginal products is not satisfied. It is another kind of “fixed proportions”, except that in this case it is not a necessary fixed proportion between two inputs (capital and labor), but rather a necessary fixed proportion between material inputs and output.

The main way that the problem of material inputs has been dealt with – especially in empirical work – has been to *assume away the problem*, i.e. to assume that the production functions are “*value added* production functions”, without material inputs. However, this attempted solution does not work, because a production function is a *physical* concept and value added is a *nominal price* concept – the difference between the *price* of the output and the *prices* of intermediate inputs. Prices and nominal value added do not exist in engineering production plans. One can subtract the *price* of material inputs from the price of the output to calculate nominal value added, because both prices are in nominal terms which are commensurable. However, one cannot subtract the *physical quantity* of material inputs from the physical quantity of output, because materials and output in a given firm are different kinds of physical goods which are not commensurable (e.g. what is the “value added product” of a car? a car without wheels?). There is no common unit of measure in terms of which this subtraction of physical quantities of inputs and outputs could be made. Therefore, a “value added production function” is an *oxymoron*.

A more sophisticated attempt to solve the problem of material inputs is to assume that the production function is “separable”, in such a way that capital and labor are separable from material inputs, which allows for sequential optimization – first materials are held constant and firms optimize quantities of K and L to produce “net output”

(sometimes called “real value added”), and then firms optimize quantities of materials and “net output” to produce gross output (Berndt and Christensen 1973, Arrow 1985, Frondel and Schmidt 2004). However, the condition for separability is that the marginal rate of substitution between capital and labor must be independent of the quantity of materials (first articulated by Leontief 1947 and often called the “Leontief condition”), which in turn requires that the production functions must be *twice differentiable* (because the marginal rate of substitution is a ratio of partial derivatives of capital and labor; see below). But production functions with material inputs are not even differentiable *once*. Therefore the condition for separability is obviously not satisfied in production functions with material inputs, and separability does not solve the problem of material inputs in marginal productivity theory.³

Another sophisticated attempt to solve the problems of fixed proportions and intermediate inputs has been the argument that, even though some factor proportions are fixed within industries, the same set of factors are used in different industries, and in different proportions; so that in this case changes in factor prices will lead to changes in relative output prices and thus to changes in the demands for output, which feed back to changes in the demand for inputs. In this way, “substitution via consumption” can play

³ Arrow 1985 has said that real value added is a “latent concept” which cannot be directly observed. I would go further and say that real value added in physical terms is a *does not exist*. Arrow continued: “Without the separability assumption, however, it is hard to assign any definite meaning to real value added, and probably the best thing to say is that *the concept should not be used* when capital and labor are not separable from materials in production.” (p. 458; emphasis added) However, Arrow seems to have forgotten that capital and labor are generally *not separable* from materials in production functions because production functions with material inputs are not twice differentiable. Thus, following Arrow’s advice, we should “not use the concept” of real value added or net output. Value added cannot be reasonably deflated because it is not the product of a price and an existing quantity of output.

the same role as input substitution within industries, and downward-sloping factor demand curves can be derived. This argument was pioneered by Cassel in 1924.⁴

However, Stakelberg's critique of Cassel showed that the necessary condition for this "substitution via consumption" to yield determinant input prices (sometimes called the Cassel Condition) is that every set (or combination) of n inputs that are used in fixed proportions within industries must also be used in at least n different industries.

Otherwise, some of the input prices will not be determined. However, once all the specific machines and equipment and intermediate inputs used in fixed proportions in many modern production processes are specified, it is highly unlikely that this stringent condition will be fulfilled. Therefore, this more sophisticated defense of marginal products and marginal productivity theory is also a failure.

Furthermore, even if the Cassel condition is miraculously satisfied for all sets of fixed proportion inputs in the economy, it would still not be true that the prices of these inputs are equal to (or determined by) their marginal products, because the marginal products of these fixed proportion inputs *do not exist*. At best (i.e. assuming the Cassel condition is satisfied), one could derive an inverse relation between the prices of inputs and the demand for these inputs; but one cannot say that the prices of inputs are determined by their marginal products. Marginal productivity theory continues to be invalidated by the non-widespread existence of marginal products.

⁴ This summary of Cassel's argument and Stakelberg's critique (next paragraph) is based on Mandler 1999, Chapter 2.

1.3 Diminishing returns

Another important concept in marginal productivity theory, and in Piketty's explanation of the increasing capital share, is the "*law of diminishing returns*" and diminishing returns to capital in particular, which means that the marginal product of capital will diminish over successive increases of one unit of capital, *holding all other inputs constant*. This "law" of diminishing marginal products is necessary in marginal productivity theory for the derivation of the demand for capital (and labor) as downward-sloping curves. However, we have seen above that marginal products do not exist in many production processes; therefore diminishing marginal products also do not exist and this so-called "law" is in fact not an empirical law.

Diminishing returns was first introduced by the classical economists who usually had agriculture in mind. Diminishing returns made some sense in 18th and early 19th century agriculture – adding workers to a fixed quantity of land with a fixed amount of seed – although even in this case an additional worker would probably require an additional hoe or some other agricultural tool in order to produce additional output. But diminishing returns does not make any sense in modern industry in which machines and workers are usually combined in fixed proportions and also additional output usually requires additional material inputs.

In his review of Piketty's book, Lawrence Summers stated:

Economists universally *believe* in the law of diminishing returns. As capital accumulates, the incremental return on an additional unit of capital declines. (Summers 2014; emphasis added)

However, Summers and mainstream economists in general either do not realize that marginal products often don't exist in many production processes (i.e. the incremental

return of an additional unit of capital is zero unless accompanied by additional labor and/or additional material inputs) or (more likely) they choose to ignore this “inconvenient truth” and maintain their “belief” in diminishing returns.

It should also be emphasized that diminishing returns assumes that *technology remains constant* (i.e. a production function characterized by diminishing returns is given and constant). Diminishing returns is a short-run concept that does not apply over decades in which technology is changing significantly. According to marginal productivity theory, technological change is supposed to *offset* diminishing returns, so that returns generally do not diminish. With technological change, the return to capital should increase, not decrease. The assumption of constant technology makes the concept of diminishing returns even more unrealistic and inapplicable to real capitalist economies in which technological change is pervasive and continuous.

1.4 Elasticity of substitution

Another important concept in marginal productivity theory, and in Piketty’s explanation of the increasing capital share, is the “*elasticity of substitution*” between capital and labor, which is defined in terms of the marginal products of capital and labor and thus the non-existence of marginal products also applies to the elasticity of substitution. The elasticity of substitution is a measure of the curvature of an isoquant (which shows all the different combinations of K and L that can be used efficiently to produce a given level of output).

The slope of an isoquant is the “rate of technical substitution” (RTS), and the RTS of capital for labor is equal to the ratio MPL/MPK . Moving along an isoquant both K/L

and the RTS change (the latter due to “diminishing returns”). The “elasticity of substitution” (σ) is the relation between the percentage change in K/L that occurs in response to a given the percentage change in the RTS, which can be expressed in terms of natural logs as follows:

$$(1) \quad \sigma_{K \text{ for } L} = d \ln(K/L) / d \ln \text{RTS} = d \ln(K/L) / d \ln (\text{MPL}/\text{MPK})$$

However, once again, since marginal products do not exist in many production processes, neither does the rate of technical substitution and thus neither does the elasticity of substitution between K and L

It is argued further that in perfect competition equilibrium, the ratio of marginal products is equal to the ratio of factor prices:

$$\text{MPL}/\text{MPK} = P_L / P_K$$

Thus the elasticity of substitution at the equilibrium point on an isoquant can be reformulated as:

$$(1') \quad \sigma_{K \text{ for } L} = d \ln(K/L) / d \ln (P_L/P_K)$$

This formulation of the elasticity of substitution is used to analyze and estimate the substitution of inputs in response to a change in their relative prices. However, this formulation still assumes in the background that marginal products exist (but they often do not) and also adds the unrealistic assumption of perfect competition.

In summary, marginal productivity theory is a very unrealistic theory which cannot reasonably be used to analyze the distribution of income in the real world. Marginal products often do not exist, which means that diminishing returns and the elasticity of substitution also do not exist, and the whole theory falls apart and lacks a coherent logical foundation. In addition, the concept of diminishing returns assumes that

technology remains constant and thus cannot be used of explain trends in the distribution of income in real economies in which technology is constantly changing.

Tom Palley has commented in a recent blog that mainstream economists have “*decided to ignore the logical incoherence of marginal productivity theory*”. (Palley 2014) But this is not acceptable scholarly and scientific practice. We should not let mainstream economists get away with this scientific malpractice.

2. Piketty’s explanation of the increase in the capital share: “Everything depends on technology”

Piketty’s explanation of the significant increase in the capital share in major economies in recent decades is based on marginal productivity theory, but it is not a rigorous application of the theory, as we shall see. The key equation in Piketty’s explanation of the increase in the capital share is his “First Fundamental Law of Capitalism”, which is a decomposition of the capital share into its two accounting factors:

$$(2) \quad \pi/Y = (\pi/K) (K/Y)^5$$

where π/Y is the capital share (i.e. the share of profit in total income), π/K is the rate of return to capital (i.e. the rate of profit, the ratio of total profit in the economy to the total capital invested), and K/Y is the capital-income ratio (or the capital-output ratio).

According to Piketty’s estimates, the K/Y ratio generally increased in the major economies, and his explanation for this increase is that the rate of return on capital was greater than the rate of growth of output (the now famous inequality $r > g$); this conclusion is based on a modified Howard-Domar-Solow growth model that will not be

⁵ Piketty expresses this equation in terms of Greek letters which stand for these ratios: $\alpha = r$ β . I find it clearer to express the equation in terms of the ratios themselves.

examined here. According to equation (2), this increase in the K/Y ratio by itself had a positive effect on the capital share of income.

Piketty then invokes marginal productivity theory and assumes that the rate of return to capital is determined by the marginal productivity of capital and further assumes “diminishing returns to capital” to argue that this increase in the K/Y ratio caused the marginal productivity of capital to decline, which in turn caused the rate of return on capital to decline. Piketty does not provide an explanation or justification of the assumption of diminishing returns, but just asserts it (“too much capital kills the rate of return”; 215-16). He simply states that it is “natural to expect that the marginal productivity of capital decreases as the stock of capital increases.” (215) He gives an example of agriculture and oddly holds the number of workers constant while increasing the quantity of land (the usual assumption is the other way around), and argues that “it is likely that the extra yield [the marginal product of land] of an additional hectare of land will be limited” (Piketty’s definition of capital includes land). Another example is residential housing (Piketty’s definition of capital also includes residential housing; see below for further discussion) whose product is “well-being”, and he argues that “if a country has already built a huge number of new dwellings, then the increase to well-being of one additional building ... would no doubt be very small.” (215) The only comment about modern capitalist industry is the next sentence which asserts: “The same is true for machinery and equipment of any kind: marginal productivity decreases with quantity beyond a certain threshold.” (215)

Piketty does not mention and does not seem to be aware that diminishing returns in marginal production theory *assumes that technology remains constant* and thus cannot

explain the decline in the rate of return to capital in recent decades in which there has been significant technological change.

In any case, according to Piketty's equation (2), the reduction in the rate of return to capital by itself had a negative effect on the capital share. Therefore, the net effect of these contradictory changes on the capital share depends on the relative rates of change of the increase in the K/Y ratio and the decrease in the rate of return to capital.

Again invoking marginal productivity theory, Piketty argues further that these relative rates of change depend in turn on the "elasticity of substitution" of capital for labor (216-17), which he defines in terms of equation (2) as the ratio of the percentage change in K/Y to a given percentage change in the rate of return to capital:

$$(3) \quad \sigma_{K \text{ for } L}^* = d \ln (K/Y) / d \ln (r)$$

(We will discuss below the differences between Piketty's definition of the elasticity of substitution and the standard definition in marginal productivity theory in equation (1) above). According to this definition and equation (2), if the "elasticity of substitution" is > 1 , then the capital share will increase as a result of these changes, because firms respond to the lower rate of return on capital by replacing labor with capital on a more significant scale.

Piketty argues that the elasticity of substitution in less developed economies is in general < 1 , and it increases along with development, so that it is in general > 1 in more advanced economies. Technological advancement means that there are more plentiful and more profitable possibilities for substituting machines for labor, and that firms will do so on an increasing scale. Piketty also argues that historical estimates of the variables

in equation (3) for advanced economies suggest that the elasticity of substitution for these economies is in a range 1.3 and 1.6. (220-21)

In sum, according to Piketty (using marginal productivity theory), the increase in the capital share in recent decades was caused by a combination of an increase in the K/Y ratio, diminishing returns, and an elasticity of substitution greater than one, which meant that the increase in the K/Y ratio was greater than the decline in the rate of return to capital, thus resulting (according to equation 2) in an increase in the capital share of income. As Piketty put it: “Everything depends on the *vagaries of technology*.” (216; see also “*The Caprices of Technology*” (234); emphasis added) According to this marginal productivity explanation, if the elasticity of substitution in recent decades had been less than one, rather than greater than one, then the capital share of income would have decreased, not increased.

3. Critique of Piketty’s explanation: a superficial application of a bad theory

Piketty’s explanation of the increase in the capital share accepts marginal productivity theory at face value and without mentioning any of the well-known problems discussed in Section 1: the aggregation problem (Piketty assumes an aggregate production function without comment); fixed proportions between capital and labor and fixed proportions between material inputs and output in many production processes, both of which render the fundamental concept of the marginal product of capital (or labor) invalid, which in turn implies that the elasticity of substitution between capital and labor does not exist in the real world; and the unrealistic assumption of constant technology in the concept of diminishing returns. Because of all these unaddressed problems, Piketty’s

explanation of the increasing capital share in terms of marginal productivity theory is a *non-starter* – such a problematic theory cannot be accepted as the basis for a valid explanation.

Not only does Piketty assume an aggregate production function, but he also assumes a *value added* aggregate production function, which (as discussed above) is a contradiction in terms. Although an aggregate value added production function is widely used by neoclassical economists, it is logically incoherent and the form of marginal productivity theory that has the *least* theoretical foundation (that is to say, none).

Although Piketty employs the concepts and logic of marginal productivity theory (production function, marginal product of capital, diminishing returns, elasticity of substitution) in his explanation of the increase in the capital share, the variables in Piketty's equation (1) and his explanation of the increase in the capital share *are in fact not the same* variables in marginal productivity theory. Piketty does not discuss these differences and does not seem to be aware of them.

To begin with (as just discussed), all the variables in equation (1) are *nominal* variables, in terms of prices, rather than *physical* variables as in the production function of marginal productivity theory. Piketty's K is in terms of the *price* of capital goods, rather than the *quantity* of capital goods. Thus, an increase in the price of capital goods would by itself (without any change in the physical ratio) increase Piketty's nominal K and nominal K/Y ratio, but would not increase the standard physical K/L ratio. Similarly, Piketty's Y is in terms of the *price* of output [nominal income], rather than the *quantity* of output. (From now on, I will use K* and Y* to stand for Piketty's nominal capital and nominal income). Piketty argues that nominal variables are more relevant for income

distribution than physical variables. But according to marginal productivity theory, nominal income variables are supposed to be determined by the physical properties of the physical production function.

Rognlie (2014) has discussed this difference between Piketty's nominal K^* and the standard neoclassical physical K and has argued that increases in the relative price of capital (i.e. "capital gains") accounted for 84% of the increase in Piketty's nominal K^*/Y^* in the eight countries in Piketty's sample. (p. 15) Thus very little of Piketty's significant increase in the K^*/Y^* ratio was due to the quantity of physical capital goods, which is what marginal productivity theory is supposed to be about.

Another problem with Piketty's definition of "capital" is that he equates capital with "wealth" which also *includes residential housing*. Since most of housing is "owner-occupied", it *does not belong in a production function* for capitalist firms. According to Rognlie, if the value of housing is excluded from the definition and estimates of capital, this correction alone eliminates 80% of the increase in the capital-income ratio in the eight countries in Piketty's sample during this period. Thus very little of Piketty's significant increase in the K^*/Y^* ratio was due to an increase in the buildings and equipment utilized by capitalist firms to produce output, which again is what marginal productivity theory is supposed to be about.⁶

⁶ Solow (2014) has noted this difference between Piketty's broad definition of "capital/wealth" and the neoclassical concept of capital as a factor of production, but he calls it a "small ambiguity" which should not affect the long-run trends in the capital/income ratio. But Solow should look again at the estimates.

In addition, the price variable in Piketty's equation (1) is different from the usual price variables in marginal productivity theory. The price of capital goods in marginal productivity theory (P_K) is a *unit price*, the price per unit of capital goods (whatever that unit might be); but the rate of return to capital (r) in Piketty's equation (1) is not the unit price of capital goods, but is instead the *ratio of two aggregate nominal prices*: the total profit in the economy as a whole divided by the total capital invested.

There is also a logical problem with Piketty's definition of the rate of return to capital. The elasticity of substitution is supposed to measure the response of capitalist firms to a change in the relative unit prices. P_K is a *cost* to firms, the cost that firms have to pay to purchase (or rent) capital goods; a reduction in P_K is supposed to induce firms to substitute cheaper capital goods for labor. However, the aggregate ratio in Piketty's equation is a *profit* variable, not a cost variable. It does not make sense that a reduction in this profit ratio would induce firms to substitute capital goods for labor. In this case, capital goods have *not become cheaper*, but rather have become *less profitable*.

We can see from these differences that Piketty's definition of the elasticity of substitution (equation 3) is also different from the standard neoclassical definition (equation 1). Both the numerators and the denominators in these respective definitions are different. The numerator in the standard definition is the K/L ratio in *physical* terms, whereas the numerator in Piketty's definition is the K^*/Y^* ratio in *nominal terms*. Thus (as mentioned above), an increase in the price of capital goods by itself (without any change in the physical ratio) would increase Piketty's nominal K^* and nominal K^*/Y^* ratio, but would not affect the standard physical K/L ratio. In the denominator, the ratio of the standard elasticity of substitution is the ratio of marginal products (MPL/MPK)

which in perfect competition equilibrium is supposed to be equal to the ratio of relative unit prices (P_L/P_K). On the other hand, the denominator of Piketty's definition of the elasticity of substitution is a ratio of aggregate magnitudes (total profit / total capital).

A number of commentators have criticized Piketty's estimates of the elasticity of substitution (between 1.3 and 1.6, as discussed above), and have argued that the consensus of the empirical literature on estimates of the elasticity of substitution in the US economy is that it is much lower than 1 (the critical value). In a review article, Chirinko (2008) concludes that most estimates are in the range of 0.4 to 0.6. Most of the critics have argued that the main problem with Piketty's estimates is that the rate of return to capital (in the denominator) is defined as a *net* concept (net of the depreciation cost of capital goods) and the appropriate definition should be a *gross* concept (including depreciation cost). However, no one (that I have seen) has discussed the more fundamental difference between Piketty's rate of return to capital as an aggregate price ratio and the standard price of capital goods as a unit price. The standard empirical literature tries to estimate the responsiveness of the physical K/L ratio to changes in the relative unit prices of K and L (P_K/P_L). Piketty's estimates, on the other hand, are calculated from the nominal estimates of K^*/Y^* and the rate of return to capital (π/K) in equation (2), and are supposed to estimate the responsiveness of K^*/Y^* to the rate of return. It is not surprising that the estimates of these two very different definitions of the elasticity of substitution have such different magnitudes.

In sum, Piketty's explanation of the increase in the capital share in recent decades is a flawed application of a very bad theory. Piketty seems to accept marginal productivity theory, but marginal productivity theory is not a logically coherent theory,

especially with a value added aggregate production function. Marginal products do not exist in many production processes and diminishing returns is based on the unrealistic assumption of constant technology.

Furthermore, even though Piketty seems to accept marginal productivity theory and employs the concepts of marginal productivity theory, it is a very superficial and non-rigorous application of marginal productivity theory, as discussed in this section. These fundamental differences essentially leaves Piketty's explanation of the increased capital share in recent decades *without any theoretical foundation at all* and reduces his explanation to a set of assertions about the aggregate nominal ratios in equation (2), based mainly on extrapolation from recent past trends.

One could say perhaps that Piketty is just using marginal productivity theory (or a bastardized version of it) to demonstrate to mainstream economists that, even within their own theory, there is no natural tendency for income shares to remain constant over time (constant shares have been believed by many economists for a long time). I think there may be something to that speculation. But if true, it is a bad tactical decision. One does not need marginal productivity theory (or any other theory) to demonstrate that incomes shares do not remain constant over time; all one needs to do is look at the data. And then the task is to provide the best possible explanation of the increase in the capital share in recent decades, which would provide insights into the types of government policies that would be the most effective in offsetting the increase in the capital share. One could still demonstrate that within marginal productivity theory there is no natural tendency for income shares to remain constant *without endorsing the theory*; and one could also discuss at least some of the well-known criticisms of marginal productivity theory, and at

the same time present an *alternative theory* which would provide a *better explanation* of the increase in the capital share in recent decades. By uncritically employing marginal productivity theory to (try to) explain the increase in the capital share, Piketty reinforces the hegemony of marginal productivity theory, which is a major piece of capitalist ideology; and, worst of all, it does not provide a valid explanation of this important phenomenon.

Therefore, if we want to understand the underlying causes of the increasing capital share in recent decades we have to look elsewhere besides Piketty and marginal productivity theory. And in fact we don't have to look far. The next section will briefly discuss a heterodox explanation of the increasing profit share presented in various forms by a number of authors, and based on the increasing economic and political *power* of capitalists over workers in recent decades (e.g. Duménil and Lévy 2011, Mishel et al 2013, Bernstein and Baker 2013, Kotz 2014).

4. Heterodox theory of the increased profit share: economic and political power

There is an alternative and much more persuasive heterodox explanation of the increase in the profit share (capital share) in advanced economies in recent decades. The profit share is equal to 1 minus the wage share, and this heterodox theory usually focuses on the wage share. According to this heterodox theory, the wage share depends mainly on the *balance of power* between capitalists and workers – economic power and political power. If the balance of power shifts away from workers toward and capitalists, then the wage share will decline and the profit share will increase, and vice versa. The balance of economic power between capitalists and workers in turn depends primarily on: (1) the

rate of unemployment and the threat of unemployment, (2) the mobility of capital, and (3) the prevalence of unions. The higher the rate of unemployment or the threat of unemployment and the greater the mobility of capital, the greater will be the power of capitalists over workers and the lower will be the wage share of income. The existence of unions increases the countervailing power of workers. Political power can be used to influence labor laws and especially the minimum wage. Economic power is translated into political power, which in turn protects and enhances economic power, all of which leads to an increasing profit share.

In the US economy in recent decades, all of these factors have contributed to the observed decline in the wage share and increase in the profit share. The rate of unemployment since 1970 has been generally higher than in the early postwar period, and the threat of unemployment has been much greater due to globalization and the enhanced mobility of capital, and these factors have weakened the power of workers and increased the power of capitalists in the conflict over wages. The percentage of the labor force that are union members has declined sharply from 29% in 1975 to 11% today. In addition, capitalists have used their increased political power (since Reagan) to weaken labor laws (e.g. “right to work” laws) and to block minimum wage increases, which has resulted in a 25% decline in the real minimum wage since 1970, which contributed significantly to the declining wage share.

I argue that this heterodox explanation of the declining wage share and increasing profit share based on economic and political power is much more realistic and persuasive than Piketty’s explanation based on logically incoherent marginal productivity theory and non-existent marginal products of a non-existent aggregate value added production

function and the implicit assumption of constant technology. Contrary to Piketty, income shares do *not* depend primarily on *technology*, but instead depend primarily on economic and political *power*.

The policy recommendations that follow from this heterodox explanation of the declining wage share include: expansionary fiscal and monetary policy to reduce unemployment, a significant increase in the minimum wage so that the real wage is increased at least to the level of the 1970s, and more favorable labor laws to enable union organization. Piketty's policy recommendation of a tax on wealth (especially inherited wealth) is also a good idea, but it does not address the root causes of the decline of the wage share and the increase of the profit share.

Conclusion

I conclude that the profit and wage shares of income are not determined by technology (marginal products, diminishing returns, elasticity of substitution), but are instead determined by the balance of power and the class conflict between capitalists and workers. If the wage share is to be increased in the years ahead, then the working class and its allies will have to organize better and exert more economic and political power in this ongoing class conflict with capitalists over wages and the distribution of income.

Appendix: Piketty's ignorance of Marx's theory of the falling rate of profit

Piketty makes the outrageous claim that Marx's theory of the falling rate of profit neglected technological change and is based on the assumption that technology remains constant!

Like his predecessors, Marx totally neglected the possibility of durable technological progress and steadily increasing productivity ... (10)

That is, Piketty interprets Marx's theory of the falling rate of profit as similar to the "diminishing returns" in marginal productivity theory. But Piketty's interpretation is completely wrong and is evidence of Piketty's ignorance of Marx's theory. Marx's theory of the falling rate of profit is focused precisely on *technological change* and the effects of technological change on the rate of profit.

Marx argued that technological change tends to be labor-saving, and since (according to the labor theory of value) labor is the source of profit, *labor-saving technological change causes the rate of profit to fall* for the economy as a whole (even though profit increases for the innovative capitals, at least temporarily). From Chapter 13 of Volume 3 ("The Law as Such"):

The **progressive tendency for the general rate of profit to fall** is thus simply *the expression, peculiar to the capitalist mode of production, of the progressive development of the social productivity of labour.* (C.III. 319; italics emphasis in the original, bold emphasis added)

I have discussed this key aspect of Marx's theory of the falling rate of profit (caused by labor-saving technological change) in detail in a recent paper (Moseley 2014).

Piketty admitted in an interview in the *New Republic* (entitled "I Don't Care for Marx") that he has never really studied Marx's theory because it is so difficult, and he

even sought sympathy from the interviewer because of its difficulty. An excerpt from the interview went like this:

Interviewer: Can you talk a little bit about the effect of Marx on your thinking and how you came to start reading him?

Piketty: Marx?

Interviewer: Yeah.

Piketty: *I never managed really to read it. I mean I don't know if you've tried to read it. Have you tried?* (Piketty 2014b; emphasis added)

But if this is true, then Piketty should not have said anything about Marx's theory of the falling rate of profit in his book, and he would not have made such an egregious error.

The irony is that Piketty's *own* explanation of the decline in the rate of return to capital is based on marginal productivity theory and its "*law*" of *diminishing returns*, and this "*law*" *does* assume constant technology. Piketty (and marginal productivity theory in general) is guilty of what he accuses Marx of! On the other hand, Marx's theory of the falling rate of profit is not based on marginal products and diminishing returns, and does not assume constant technology; but is instead based on the labor theory of value and analyzes at great length the effects of technological change on the rate of profit.

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