

A Post-Keynesian Response to Piketty's "Fundamental Contradiction of Capitalism"¹

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Abstract: In *Capital in the Twenty-First Century*, Thomas Piketty presents a rich set of data that deals with income and wealth distribution, output-wealth dynamics, and rates of return. He also proposes some "laws of capitalism". At the core of his argument lies the "fundamental inequality of capitalism", an empirical regularity stating that the rate of return on wealth is greater than the growth rate of the economy. This simple construct allows him to conclude that increasing wealth (and income) inequality is an inevitable outcome of capitalism. While we share some of his conclusions, we will highlight some shortcomings of his approach based on a Cambridge post-Keynesian growth-and-distribution model. The paper makes four points. First, $r > g$ is not necessarily associated with increasing inequality in functional distribution. Second, Piketty succumbs to a fallacy of composition when he claims that a necessary condition for $r > g$ is that capitalists save a large share of their capital income. Third, post-Keynesians can learn from Piketty's insights about personal income distribution and incorporate them into their models. Fourth, we reiterate the post-Keynesian argument that a well-behaved aggregate production function does not exist and cannot explain income distribution.

Keywords: Rate of return, income distribution, post-Keynesian growth and distribution models, Cambridge equation, Pasinetti's theorem.

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1. Introduction

Since its translation to English, *Capital in the Twenty-First Century* (Piketty, 2014; *Capital* hereafter) has become an intensely debated topic among economists. It has also become a bestseller (it was number one on Amazon.com's for some time) well beyond this circle. The book has received generally favourable reviews² and it has already been compared by some commentators to the major works of Smith, Marx and Keynes.

The book is the outcome of years of fruitful collaboration between many researchers who collected data on the distribution of income and wealth across several countries, the characteristics of this wealth and its evolution (Piketty, 2003; Atkinson & Piketty, 2006; Alvaredo & Saez, 2009; Atkinson *et al.*, 2011). Not only is this data novel, it often goes back well into the 19th century. The book's sweeping historical approach stands out in the field of economics, which otherwise treats economic history as a distraction rather than a source of economic knowledge. The English translation of the book is timely, given the contemporary interest in these topics in the US and other countries. That reason, together with the fact that it is written in an accessible style, has contributed to the resounding success of the book – especially the English version.

Capital not only presents new data; it also uses this empirical evidence to develop a theoretical framework that, at the risk of simplifying, comprises “two fundamental laws” as well as an additional one, labelled by Piketty as the “fundamental contradiction of capitalism” (FCC). The focus of this paper is exclusively on the latter, but the other two deserve some brief comments. The first fundamental law states that the share of capital income in total income, $\frac{P}{Y}$, equals the rate of return on wealth, r , times the capital stock (wealth)-to-income ratio, k , so $\frac{P}{Y} = r \cdot k$.³ Several commentators (Homburg, 2014; Milanovic, 2013; Ray, 2014) have noted that this “law” is simply an accounting identity and that, unless one posits some causality from the right-hand side to the left-hand side of the equation, the expression is empty of any behavioural content. Commentators have also highlighted the imprecise nature of k , which Piketty sometimes calls “capital” but at times “wealth” – and which is measured at market value. We agree with both points, but we will not need them here for the following discussion. On the other hand, the second fundamental law shows that the wealth-income ratio, k , is equal to the (average) propensity to save, s , divided by the growth rate of income, g , so $k = \frac{s}{g}$. This expression is not an accounting identity, but rather a possible rearrangement of the Harrod-Domar equilibrium solution and hence it will only be fulfilled in a long-run equilibrium. Krusell & Smith (2014) have expressed reservations about the way Piketty takes depreciation into account depreciation (rightly so in our view), but we will not enter into this debate either. Finally, the FCC states that empirically the rate of return on capital has been higher than the growth rate of the economy. Because Piketty amalgamates very different assets (equities, bonds, gold, real estate) into the notion of wealth, it should be noted that this rate of return is neither a rate of interest nor a rate of profit, but rather an average rate of return on the total capital of the economy.

² For some unfavourable reviews, see Galbraith (2014) and Harvey (2014).

³ We have changed Piketty's notation (regarding the wealth-capital ratio and the share of capital in total income) in order to be consistent with the notation of the rest of the note.

How do all these laws fit into a coherent explanation of capitalism? Summers (2014) provides a concise summary about the place of the laws in Piketty's argument: '[h]is argument is that capital or wealth grows at the rate of return to capital, a rate that normally exceeds the economic growth rate. Thus, economies will tend to have ever-increasing ratios of wealth to income, barring huge disturbances like wars and depressions. Since wealth is highly concentrated, it follows that inequality will tend to increase without bound until a policy change is introduced or some kind of catastrophe interferes with wealth accumulation.' Therefore, in the first step the fundamental inequality causes a rise in the wealth-income ratio, which in a second step induces a rise in the share of capital in total income. Finally, because 'wealth is highly concentrated', personal income distribution becomes more inegalitarian due to these macroeconomic forces.⁴ As we will explain below, these conclusions are in part given by the fact that Piketty is reasoning within the neoclassical growth model, where the rate of profit is given by a "production function" and, implicitly, full employment is assumed. Therefore, there is no role for demand in determining the rate of profit.

Therefore, the importance of the FCC for the argument of the book is unquestionable, and it can arguably be regarded as its most important *theoretical* tenet: '[t]his fundamental inequality, which I will write as $r > g$ [...] will play a crucial role in this book. In a sense, *it sums up the overall logic of my conclusions*' (Piketty, 2014, p. 25, emphasis added). In fact, the FCC makes its appearance very early in the book: '[w]hen the rate of return on capital exceeds the rate of growth of output and income [...] capitalism *automatically* generates arbitrary and unsustainable inequalities' (p. 1, emphasis added). However, unlike the "two fundamental laws", it is not clear whether the FCC is a logical or an empirical argument. Sometimes Piketty argues as if it were a logical argument: '[w]hen the rate of return on capital significantly exceeds the growth rate of the economy [...] then it logically follows that inherited wealth grows faster than output and income' (2014, p. 26). But these passages are mixed with others where he adduces empirical reasons: '[t]o be clear, I take this to be a historical fact, not a logical necessity (2014, p. 353)'.

In this paper, we will deal with the theoretical aspect of Piketty's argument and we will not discuss the empirical contribution of the book. We make four points. First, $r > g$ is not necessarily associated with increasing inequality in functional distribution. Second, Piketty falls prey to the fallacy of composition when he says that the necessary condition for $r > g$ is that capitalists save most of their capital income. Third, post-Keynesian economists can learn from Piketty's insights about personal income distribution and incorporate them into their models. Finally, we reiterate the post-Keynesian argument that a well-behaved aggregate production function does not exist and it therefore cannot explain the distribution of income.

Many of the previous conclusions arise from the fact that Piketty does not give sufficient consideration to the issues of aggregate demand and its effects on income distribution. In other words, there is no indication of the work of Keynes or Cambridge post-Keynesians informing the argument of this book. The absence of post-Keynesian theory is, if frustrating, perhaps not surprising, given that contemporary mainstream economics, which is Piketty's point of

⁴ We will argue against the first two steps of the logical argument presented above: while we are quite sympathetic to Piketty's prediction about unequal personal distribution (both as a matter of fact and as a matter of logic), we will show that there is no reason why this has to be tied to the FCC.

departure, has become theoretically increasingly narrow. Post-Keynesian growth models and the Cambridge Capital Controversies have been expunged from the canon of economic knowledge.⁵ The absence of Keynes in his book is more surprising, because Piketty and Keynes share a basic social liberal vision. Both defend the market system and private property. In short, for both Piketty and Keynes, capitalism is the best economic and social system, but both think that strong government intervention is needed. Still, we find hardly any mention of Keynes in Piketty's book and, indeed, there is no discussion of effective demand, which the book seems to consider relevant for the short run only.⁶ While Keynes regarded unemployment and the instability of effective demand as the main problem of capitalism, Piketty regards the polarisation of income distribution as the main issue. While both want to improve capitalism, Keynes tried to save capitalism from itself (by stabilising the level of employment), but Piketty tries to save society from the rising wealth inequality arising from unfettered capitalism.

The structure of the paper is as follows. Section 2 introduces a simple Cambridge model and shows why Piketty's FCC does not prove anything about the dynamics of the profit share in total income. Section 3 digs into the intuition as to why the FCC is compatible with a constant profit share, showing how Piketty succumbs to the fallacy of composition when he explains the importance of the macroeconomic rate of return as if it were a rate of reinvestment. Section 4 carries the analysis a step further by considering what happens to personal income distribution. It shows that Piketty's intuition is correct and that traditional post-Keynesian models have already considered the possibility of a group of individuals accumulating faster than others – even in a steady-state. Section 5 questions whether assuming an aggregate production function is useful in the context of explaining income distribution. Finally, Section 6 concludes.

2. The simple Cambridge model

The post-Keynesian school already developed a theoretical framework that dealt with the problems of income distribution, economic growth and the determination of the profit rate in the 1950s and 1960s (Kaldor, 1955; Robinson, 1956; Kahn, 1959; Pasinetti, 1962).⁷ Although the model was originally developed as the Keynesian answer to Harrod and Domar's challenge about the instability of the long-run growth path,⁸ it was later refined and augmented with new features (Kaldor, 1966; Steedman, 1972; Palley, 1996; Lavoie, 1998) that have confirmed the validity of the main insights of the basic model.⁹

The other well-known answer to the Harrod-Domar problem was the neoclassical solution, put forward in a couple of seminal papers by Solow (1956) and Swan (1956). For our purposes, the neoclassical explanation of income distribution envisions the whole economy working as an

⁵ For instance Acemoglu (2009), which can be regarded as the reference in neoclassical economic growth, does not have a chapter to address the debate – and it is certainly not a short book.

⁶ On page 135 Piketty (2014) discusses Keynes' euthanasia of the rentier; p. 220 notes that Keynes regarded the wage share as stable and p. 232 refers to Keynes in passing when discussing the development of growth theory.

⁷ For an analysis of the post-Keynesian framework with Marxist features, see Harris (1975).

⁸ However, it should be noted that these contributions do not really address Harrod's concerns about the instability of the warranted growth path and discrepancies between warranted and natural growth rates. These Harrodian concerns have been addressed elsewhere – e.g. Skott (1989).

⁹ For a thorough survey, see Baranzini & Mirante (2013).

“aggregate production function”, where total output is related in a precise mathematical way to several inputs or “factors of production” – labour and capital. Given perfectly competitive markets (and assuming full employment), the price of every factor is determined by scarcity (supply and demand) and the factors are paid their marginal product – given by the technology of the economy. Finally, because of the behavioural assumption that investment equals to savings, no problem of effective demand arises in the model.

Piketty uses neoclassical growth theory. Assuming an aggregate production function, he argues that the return on capital is given by technology.¹⁰ We will return to his theory of income distribution in section V and replicate the post-Keynesian criticism of the very existence of an aggregate production function.

In the Cambridge model the rate of profit and the functional income distribution are given by an entirely different set of conditions. It differs from the neoclassical models because there is an investment function distinct from the savings function. Investment is determined independent of savings; not all savings are automatically reinvested. Post-Keynesians often think of investment as driven by “animal spirits” (i.e., some considerations not reducible to rational optimisation) and argue that because of fundamental uncertainty these animal spirits also matter in the long run. The second ingredient is a dual-class structure, with capitalists and workers. Capitalists make investment decisions and have different savings propensities from workers. While the class structure is a major difference to the representative agent approach of neoclassical theory, it is clearly recognised by Piketty, who, however, does not indicate a belief in the notion that changes in distribution matter for saving or investment decisions.

This basic model abstracts from government and a foreign sector, which is in line with Piketty, who also ignores these sectors on empirical grounds for his long-run analysis.¹¹ In this economy, workers receive both wages and profits, while capitalists receive only profits, so the investment-saving identity can be written as:

$$I = s_w \cdot (W + P_w) + s_c \cdot P_c$$

In this equation I is investment, W is wages, P_w is workers’ profits, P_c is capitalists’ profits and s_w and s_c are the propensities to save of workers and (pure) capitalists respectively, and $0 \leq s_w < s_c \leq 1$. It can be shown¹² that the previous equation can yield expressions both for the rate of profit, r , and the profit share in total income, $\frac{P}{Y}$:

$$r = \frac{1}{s_c} \cdot \frac{I}{K}$$

¹⁰ Most of these references can be found from pages 212 to 217 and 220 to 222. Piketty & Zucman (2014) discuss these issues in length.

¹¹ Regarding the net position of foreign capital, ‘when we compare the structure of national capital in the eighteenth century to its structure now, we find that net foreign assets play a negligible role in both periods [...] the total capital stock has remained more or less unchanged relative to national income (p. 122). On the other hand, ‘the history of the ratio of national capital to national income in France and Britain since the eighteenth century [...] has largely been the history of the relation between private capital and national income’ (p. 126).

¹² See Kaldor (1955-56), Moore (1974) and Pasinetti (1974, pp. 270–272). The original proof, proposed by Kaldor (1955-56), was corrected by Pasinetti (1962) taking into account properly the share of profits accrued to workers. However, Pasinetti assumes in this proof that the rate of interest equals the rate profit. Moore (1974) has shown that such an assumption is not needed for the argument.

$$\frac{P}{Y} = \frac{1}{s_c} \cdot \frac{I}{K} \cdot \frac{K}{Y}$$

In a steady-state situation, where all variables grow at the same rate, the growth of the economy, g , has to equal the growth rate of capital, $\frac{I}{K}$.¹³ Substituting in both expressions and letting κ to be the capital-output ratio, we get:

$$r = \frac{g}{s_c} \tag{1}$$

$$\frac{P}{Y} = \frac{g}{s_c} \cdot \kappa \tag{2}$$

These expressions have become known as the “Cambridge post-Keynesian theory of distribution”. For our purposes here, equation (1) says that the rate of profit depends on the growth rate of income and the capitalists’ propensity to save. It is interesting to note that the previous expression is independent of technology (i.e., the capital-output ratio or “production function”) and the workers’ propensity to save.¹⁴ Therefore, the return on capital is something not ‘unpredictable and arbitrary’ (Piketty, 2014, pp. 26–27), but can be explained with respect to particular factors of a capitalist economy.

The remarkable aspect of the Cambridge formulation is that it shows that the famous inequality $r > g$ is not just a possible outcome in a capitalist economy, but rather an outcome which is to be expected; except for the limit case $s_c = 1$, the rate of profit will always be higher than the growth rate of the economy, casting well-founded doubts about alternative theories (Diamond, 1965) where the opposite inequality, $r < g$ (called in these formulations *dynamic inefficiency*)¹⁵ is theoretically equally valid and stands on the same footing.¹⁶

Of course, one can still argue that this inequality between the rate of return and the growth rate is a “fundamental law of capitalism” (and we think it is!), but its implications for the functional income distribution between wages and profits are weaker than Piketty claims. In fact, equation (1) holds for any steady-state equilibrium, where both the share of wages and the share of profits in national income remain constant, as equation (2) shows; in other words, it is perfectly possible to have, at the same time, a permanently constant income distribution with a rate of profit higher than the growth rate of the economy. The economic intuition for this outcome will be explained in the following section, but in the meantime we can try to readjust Piketty’s inequality to show the true interval under which a certain rate of profit will be *unequivocally* associated with an increasing divergence between the profit and the wage share. This will happen when equation (3) holds:

¹³ Many people implicitly assume that these conditions are only valid for a full-employment situation. However, this assumption is misleading: this condition can be fulfilled even in a situation of less than full employment, as long as all the individual components of the economic system keep a constant proportion between them through time.

¹⁴ This result (the Independence of the profit rate to the workers’ propensity to save) is known as Pasinetti’s theorem.

¹⁵ For a treatment of the dynamic inefficiency in a Keynesian framework with demand problems and secular stagnation, see Skott & Ryoo (2012).

¹⁶ The fact that the rate of profit is greater than growth rate of the economy will hold even in an economy with government activity, where the relevant profit rate is now *net* of taxes. See Steedman (1972), Pasinetti (1989) and Dalziel (1991) for a summary of the points. See Piketty (2014, pp. 356-357) for the empirical evidence presented there.

$$r > \frac{g}{s_c} \quad (3)$$

Therefore, as long as the profit rate is higher than the growth rate of the economy divided by the capitalists' propensity to save, we can claim *categorically* that there will be a redistribution of income from wages to profits, because wages and profits will grow at the same rate only when equation (1) is fulfilled. Note that this new "hurdle rate" is higher than Piketty's, because now the growth rate is divided by a variable whose value is less than one – one could think, as a rough empirical approximation, that with $s_c = 0.5$ the new hurdle rate will be double the original one.¹⁷ What would happen in this scenario is that the profit rate (the main source of savings in this economy) would be too high to finance all the required investments, g , to keep a steady-state equilibrium position. Indeed, from the previous remarks it follows that even a falling profit share is compatible with Piketty's inequality $r > g$, as long as the profit rate falls in the following interval:

$$g < r < \frac{g}{s_c}$$

We would like to highlight again that we are criticising Piketty's FCC simplistic logic that '[w]hen the rate of return on capital significantly exceeds the growth rate of the economy [...] then it *logically follows* that inherited wealth grows faster than output and income' (2014, p. 26, emphasis added). It is just in this case (when someone wants to claim a unequivocal outcome in Piketty's inequality) when Piketty's inequality $r > g$ has to be replaced by our inequality (3). Simply put, Piketty's inequality is a weak, *non sequitur condition* (for instance, we could observe a rate of return higher than the growth rate and still not to give a verdict about functional distribution), while inequality (3) delimits the unequivocal range under which the mechanisms for a changing income distribution between wages and profits begin to operate.

3. Functional income distribution and a fallacy of composition for the rate of return

Even if the reader accepts the previous reasoning in full, the intuition that a rate of profit higher than the growth rate of the economy will not automatically entail a more unequal income distribution may be hard to accept. Nevertheless, we will show now how Piketty, in his arguments concerning this issue, commits a logical slip or falls into the fallacy of composition. Once this is corrected, the dynamics of capital accumulation in capitalist economies can be properly understood.

In its most basic sense, we might say that the error comes from the absence of any role for effective demand. In the history of economic thought, we see that issues surrounding effective demand are possible sources of confusion. The most cited one is probably related to the reduction of wages during a recession and its relationship to unemployment. From a manager's point of view it makes sense to reduce "costs"; from a macroeconomic point of view, it leads to a loss of purchasing power because wages are a cost and a source of purchasing power at the

¹⁷ There is an extensive empirical Kaleckian literature that indicates savings differentials in that order of magnitude. See Naastepad & Storm (2007), Hein & Vogel (2008), Stockhammer & Stehrer (2011) and Onaran & Galanis (2012).

same time (Keynes, 1936, Ch. 19). The fallacy of composition regarding the rate of profit can be regarded as another instance of this paradox.

The argument is as follows. Throughout the book, Piketty (2014) blends explanations about the fate of individual fortunes with explanations that deal with pure macroeconomic logic.¹⁸ Instances of a micro-based logic abound throughout the book, as exemplified in the following two sentences:¹⁹

‘Consider a world of low growth, on the order of, say, 0.5–1 percent a year [...] The rate of return on capital, which is generally on the order of 4 or 5 percent a year, is therefore much higher than the growth rate. Concretely, *this means that wealth accumulated in the past is recapitalized much more quickly than the economy grows*, even when there is no income from labor’ (p. 351, emphasis added).

‘The law of cumulative growth is essentially identical to the law of cumulative returns, which says that an annual rate of return of a few percent, compounded over several decades, automatically results in a very large increase of the initial capital, *provided that the return is constantly reinvested, or at a minimum that only a small portion of it is consumed by the owner of the capital* (small in comparison with the growth rate of the society in question)’ (pp. 75–77, emphasis in the original).

These sentences are true for an individual capitalist (if he saves more he will be able to reinvest at a higher pace), but they are not true for the capitalist class as a whole. If one goes back and inspects equation (1) again one will realise that a higher capitalist saving rate is associated with a *lower* profit rate, and not vice versa. Indeed, it is only when the capitalist class as a whole decides to save all of their income, when $s_c \rightarrow 1$, that the rate of profit will tend to $r \rightarrow g$. Therefore, Piketty’s fears about functional income inequality associated with higher saving rates are unfounded because it is precisely in this case that Piketty’s inequality will not hold.

Another way to state this is that, contrary to what Piketty believes (and the two previous quotations are a clear example of this), *at the macroeconomic level the rate of return is not a recapitalisation rate*. This is because in order to attain such high rates of return, the *sine qua non* condition is that capitalists have to consume a large part of their income – otherwise the profit rate would be equal to the growth rate. The Cambridge equation boils down this idea to its essentials, showing that capital is growing at g but at the same time that it is compatible with a rate of profit of $\frac{g}{s_c}$: the difference is precisely the capitalists’ consumption out of their income.

¹⁸ The best examples of the latter are the graphs presented in several chapters (e.g. graphs 10.7 to 10.11) that deal with the relationship between the growth rate and the rate of return.

¹⁹ We would not like to give the impression that we have picked a couple of sentences out of context. Although the reader can check for himself/herself the context of the statements presented above, we would like to present a small sample of passages that share the same principles: ‘People with inherited wealth need save only a portion of their income from capital to see that capital grow more quickly than the economy as a whole’ (Piketty, 2014, p. 26). ‘If one saves more, because one’s fortune is large enough to live well while consuming somewhat less of one’s annual rent, then one’s fortune will increase more rapidly than the economy, and inequality of wealth will tend to increase even if one contributes no income from labor’ (p. 351) and ‘a more patient society, or one that anticipates future shocks, will of course amass greater reserves and accumulate more capital’ (p. 359).

These arguments are deeply rooted in the seminal works of the post-Keynesian tradition, especially those of Kalecki (1954, 1962, 1971). When Kalecki derived his famous “profit equation”, he concluded that “[i]t is clear that capitalists may decide to consume and to invest more in a given period than in the preceding one, but they cannot decide to earn more. It is, therefore, their investment and consumption decisions which determine profits, and not vice versa (Kalecki, 1971, p.78-79). So, as a class, capitalists ‘are masters of their fate’ (Kalecki, 1962). In fact, our previous discussion can be regarded as a sort of dynamic version of the Kalecki-Kaldor-Robinson’s insight that ‘workers spend what they earn and the capitalists earn what they spend’. This simple but important “Kaleckian” insight has passed unnoticed so far in the most prominent reviews of Piketty’s book (Krugman, 2014; Milanovic, 2013; Solow, 2014; Summers, 2014). For instance, Solow, who should have first-hand knowledge of these issues from his involvement in the Cambridge Capital Controversies in the 1960s, simply states that ‘[s]o far as I know, no one before him has made this connection [...] [t]his is Piketty’ main point, and his new and powerful contribution to an old topic: as long as the rate of return exceeds the rate of growth, the income and wealth of the rich will grow faster than the typical income from work’ (Solow, 2014). The rest of the commentators follow similar lines.²⁰ Even eminent post-Keynesians economists (e.g., Palley, 2014; Taylor, 2014) have not highlighted the fallacy of composition in Piketty’s analysis.

The next section will present the implications of the argument for personal income distribution.

4. Some implications for personal income distribution

We have presented theoretical arguments explain why Piketty’s FCC does not have the implications derived by the author. However, we should point out that nothing in our reasoning precludes the possibility of increases in the profit share leading to divergences in the fates of individual fortunes (the second logical chain in Summer’s words); in fact, this very possibility was already discussed in the literature of the Cambridge model (Pasinetti, 1974, Chapter 6), although its implications at that time were not appreciated. We will argue that a stable labor-capital split is perfectly compatible with an increasing unequal personal distribution. In other words, we will show how Piketty’s insights can enrich the traditional Cambridge framework.

In the Cambridge model, the term s_c can be regarded as a weighted arithmetic mean of the propensity to save of different capitalist groups, where the weights are the capital shares of each capitalist group in total capital. So, in general, in a system with n capitalist groups, s_c will be different from s_c^n , where the superscript now denotes the propensity to save of the capitalist group n . For a macroeconomic profit rate given by $\frac{g}{s_c}$, individual capitalist groups will be able to reinvest their savings at that rate. But because in general $s_c^1 \neq s_c^2 \neq s_c^3$ and so on, the capitalist group with the highest s_c will be able to accumulate at a faster pace than its peers; its thrifty behaviour will be detrimental to the overall profit rate, but this will be compensated by the less

²⁰ Krugman, who likes to be regarded as “listening to the gentiles”, and cites Kalecki every now and then, does not mention any problem with the FCC (Krugman, 2014). On the other hand, Summers (2014) puts an example about the owner-occupied housing imputed rents, arguing that all these rents are consumed rather than reinvested, which could create problems to Piketty’s FCC – because if they were reinvested we would be back, according to him, in Piketty’s argument.

frugal behaviour of its peers, who will raise the overall profit rate but at the expense of a lower level of accumulation at their individual level.²¹

The previous explanation is in essence Piketty's, and it is at the individual level that it is correct. At this level, the profit rate (if is totally reinvested) is a *recapitalisation rate*, and then it can be argued that people with different initial capital and different saving behaviour will accumulate at different paces. In fact, this debate was a central part of the Cambridge Capital Controversies regarding the range²² in which the Cambridge equation was valid (Pasinetti, 1962; Kaldor, 1966; Samuelson & Modigliani, 1966), but not regarding its implications for the personal income distribution. However, Piketty's conclusion was *already* presented as the theoretical outcome of the Cambridge model at the individual level by, for instance, Pasinetti:

'[T]he analysis may also be generalized to many groups of savers [...] It can be seen immediately that only one group of capitalists will eventually dominate the equilibrium growth path. For, as soon as more than one group of capitalists is introduced [...], the growth rate of the capital stock owned by the thriftiest group emerges as being higher than the growth rate of any other capitalists' group. Therefore, growth being exponential, the thriftiest group of capitalists will in the end dominate all the others' (Pasinetti, 1974, p. 141).

In summary, we are in favour of Piketty's conclusion about the dynamics of personal income distribution, but as long as no logical connection is made to his macroeconomic theory. We have shown in Section 3 that even a declining profit share is compatible with $r > g$, and that this in turn is compatible with an increasing unequal personal distribution.

5. The theory of income distribution and the need for a fourth "Capital Controversy"

Piketty argues that the functional distribution of income is ultimately determined by technological factors. Following the neoclassical theory of income distribution, the return to capital is the marginal product of capital. Piketty's relation to the marginal productivity theory of income distribution, however, is a complicated one. While he endorses it as an explanation of functional income distribution, he devotes a whole chapter (chapter 9) to criticising it as an explanation of personal income distribution, in particular the income of the super-rich. Rather than changes in technology, changes in taxation, in corporate governance and in labour market institutions have been driving personal inequality. But when it comes to factor shares and the return to capital, technology and marginal products rule again.^{23 24}

²¹ Over time, if this dynamic persists, the relevant propensity to save will be then that associated with the thriftiest capitalist group, which behaviour dominates in the expression of the Cambridge equation. See Pasinetti's explanation below.

²² When originally formulated, the Cambridge model was based on the assumption that $s_w < \frac{1}{Y} < s_c$. Samuelson & Modigliani (1966) argued that $s_w \geq \frac{1}{Y}$ could be another theoretical possibility, an assumption that would undermine the main results of the Cambridge model. For a summary of the debate, see Pasinetti (1974, Chapter 6)

²³ The reader may wonder how the two arguments go together. Presumably, if minimum wages have a substantial impact on the lower end of wage, they also would affect the wage share (Piketty argues the elasticity of substitution is not equal to one). There are several recent studies that highlight the role of institutional changes as determinants of the wage share (Kristal, 2010; Stockhammer, 2013; Bengtsson, 2014).

There are several problems with Piketty's use of the aggregate production function that have not been raised by commentators on the book. First, Piketty uses the term 'wealth' and 'capital' synonymously and lumps together business capital (i.e., machinery) and the housing stock. For wealth that is straightforward, but as a factor of production housing is very different from machinery. Second, in any argument that uses a production function to explain income distribution the elasticity of substitution plays a key role. Piketty assumes that this elasticity is larger than one. Rowthorn (2014) questions the empirical validity of this and demonstrates that Piketty's argument critically depends on this assumption. Third, Piketty values capital at market prices, and thereby potentially conflates quantity and price changes. In his discussion he downplays the role of valuation changes over longer periods. However, his data show that for many countries for several decades valuation changes are as important as accumulated savings in explaining the growth of the wealth-income ratio (Rognlie, 2014).

Piketty's (2014, p. 220) stand on the issue is best exemplified in the following sentence, where a theoretical argument is blended with empirical reasoning:

Over a very long period of time, the elasticity of substitution between capital and labor seems to have been greater than one: an increase in the capital/income ratio β seems to have led to a slight increase in α , capital's share of national income, and vice versa. Intuitively, this corresponds to a situation in which there are many different uses for capital in the long run. Indeed, the observed historical evolutions suggest that it is always possible—up to a certain point, at least—to find new and useful things to do with capital.

This framework, which tries to derive income distribution from an aggregate production function, has been under attack at least at three different times. Two Capital Controversies took place at the beginning of the twentieth century. The first one was between Böhm-Bawerk, Clark, Fisher and Veblen; the second one, in the 1930s, was between Knight, Hayek and Kaldor.²⁵ The third one, known as the "Cambridge Capital Controversies" (Cohen & Harcourt, 2003) took place in the 1950s and 1960s between Cambridge, UK, and Cambridge, Massachusetts.

The Cambridge Capital Controversies are briefly mentioned with condescension by Piketty (2014, pp. 230-232), where he argues that 'the virulence [...] of the Cambridge capital controversy was due in part to the fact that participants on both sides lacked the historical data needed to clarify the terms of the debate' (Ibid. p. 232). This is misleading, because the debate was on logical grounds. It was about the question whether different machines and intermediate goods can be added up in value terms as 'capital. More technically the question was, whether a multi-sector economy with a rich set of possible input technologies, which profit-maximising capitalists can choose from, can in a meaningful way be described by a (well behaved) aggregate production function. The main result was that it cannot: the same technology can be used by a profit-maximising economy at both high and low wages (known as *capital reswitching* and *capital reversal*). A rise in wages can lead to a decrease or an increase in the observed capital-labour ratio. No general negative relationship between techniques (capital-labour ratio) and the

²⁴ However, in an email exchange to the authors, Piketty himself has made very clear his position regarding the use of the neoclassical production model: '[a]ll I am saying is that even if the world was working as in the one-sector neoclassical model with perfect competition, then this would certainly does not imply that we live in an harmonious or desirable place in any meaningful sense.'

²⁵ Further discussion can be found in Cohen & Harcourt (2005).

profit rate can be derived – i.e., the demand curve for capital is not always downward sloping (Harcourt, 1969; King, 2002, Ch. 4). Post-Keynesians concluded that the theory of growth and distribution should not be premised on an aggregate production function.

There is another strand of the literature beginning with Klein (1946), which investigates under what conditions it is possible to aggregate well-behaved micro production functions at the level of the firm (assuming they exist) into a macroeconomic production function.²⁶ The main result is that '[e]ven under constant returns, the conditions for aggregation are so very stringent as to make the existence of aggregate production functions in real economies a non-event' (Fisher, 2005, p. 490).

While the aggregate production function lost popularity in the neoclassical literature in the decade after the Cambridge Controversies, a new generation of growth models in the 1990s resurrected it without concern (or presumably knowledge of) the controversies. In part this may be due to the fact that empirical studies regularly show that aggregate production functions fit the data quite well. However, this is, plainly put, because studies using value data are estimating an accounting identity. This argument has an old pedigree (Phelps Brown, 1957; Shaikh, 1974; Simon & Levy, 1963), but has been proposed again several times since the 1990s (Felipe, 2000; Felipe & Adams, 2005). Felipe & McCombie (2003, 2006, 2013) argue that estimates of the aggregate production function are 'not even wrong' in the sense that is impossible to falsify the theory.

The broader implications of the critique are serious because it 'affects all of neoclassical applied aggregate work that relies in some way on well-behaved production functions and profit-maximizing conditions: labour demand functions and NAIRU measures; investment theory; measures of multifactor productivity or total factor productivity growth; estimates of endogenous growth; theories of economic development; theories of income distribution; measures of output elasticities with respect to labour and capital; measures of potential output; theories of real business cycles; estimates of the impact of changes in the minimum wage, social programs, or in tax rates' (Lavoie, 2008, p. 31).

Admittedly, Piketty does not use the standard neoclassical theory of production, as his concept of capital is broader than that usually used by neoclassical economists (Rognlie, 2014; Rowthorn, 2014). However, the problems of the aggregate production functions also extend to Piketty as far as he uses the concept. He does not refer to empirical estimates of the production function, but does claim that return to capital is technologically determined.²⁷ If we can never identify an aggregate production function and we know that it cannot be derived from standard micro production functions, this is not a useful explanation.

6. Conclusions

The present paper has presented some reservations regarding Piketty's "fundamental contradiction of capitalism" from a post-Keynesian point of view. It has been argued, firstly, that

²⁶ For a detailed literature review on the subject, see Felipe & Fisher (2003, 2006).

²⁷ Moreover, the empirical estimation of elasticities of substitution is empty of content, because as Fisher *et al.* (1977, p. 312) remind us: 'the elasticity of substitution in these production functions is an "estimate" of nothing; there is no true aggregate parameter to which it corresponds.'

the observation $r > g$ is not simply an empirical matter. It emerges as a standard property of long-standing Cambridge growth models; even then it does not automatically entail a more uneven functional income distribution over time. Secondly, we have shown that Piketty falls victim to the fallacy of composition when he equates the overall macroeconomic rate of profit with the rate at which wealth grows. This simple logical mistake is the most serious objection to the theoretical structure of *Capital in the Twenty-First Century*, one that invalidates his claim that this inequality is necessarily tied to an increasing capital share in income. We have shown that, in fact, this inequality is compatible with an increasing, constant or decreasing profit share. Thirdly, we have explored how several of Piketty's ideas on personal income distribution could be fruitfully incorporated into the Cambridge model. Finally, we have raised serious concerns about the validity of the neoclassical explanation of the determination of the rate of profit and income distribution (and Piketty's use of these concepts) both theoretically and empirically.

The rejection of specific theoretical arguments does not diminish the achievements of Piketty's work. *Capital* has brought issues of wealth and income distribution to the centre stage of public discussion. It has also put together, and made readily available, an invaluable data set, and it allows future researchers to analyse macroeconomics in the context of a much broader time horizon, covering much of the history of capitalism rather than the last few decades. We suggest, however, that the analysis of the book would have been strengthened had Piketty developed it in a post-Keynesian framework alongside, or instead of, a neoclassical one.

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