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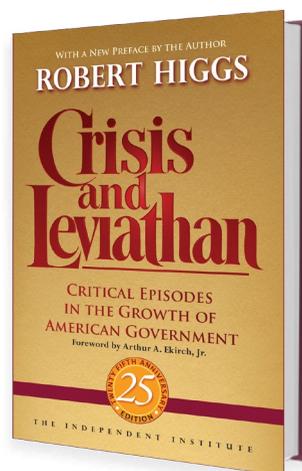
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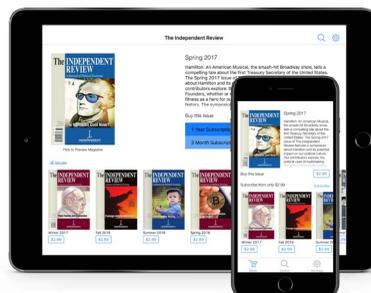
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# Some Fundamental Problems with Thomas Piketty's *Capital in the Twenty-First Century*

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JUAN RAMÓN RALLO

**T**he publication of *Capital in the Twenty-First Century* by Thomas Piketty in 2014 has intensified the debate on the relationship between capitalism and inequality. The French economist's fundamental thesis is that the capitalist economic system unleashes a series of processes that will normally lead to an increase in income and wealth inequality:

The overall conclusion of this study is that a market economy based on private property, if left to itself, contains powerful forces of convergence, associated in particular with the diffusion of knowledge and skills; but it also contains powerful forces of divergence, which are potentially threatening to democratic societies and to the values of social justice on which they are based. The principal destabilizing force has to do with the fact that the private rate of return on capital,  $r$ , can be significantly higher for long periods of time than the rate of growth of income and output,  $g$ . The inequality  $r > g$  implies that wealth accumulated in the past grows more rapidly than output and wages. This inequality expresses a fundamental logical contradiction. (Piketty 2014, 571)

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More precisely, Piketty argues that within capitalism the net rate of return on capital ( $r$ ) tends to be higher than the rate of economic growth of aggregate income ( $g$ ), so that the wealth accumulated in the past increases at a higher rate than aggregate production and, in turn, than wages. That is why the share of net capital incomes within net domestic product (NDP) tends to increase by reducing the wage share. And to the extent that the distribution of net capital income is usually more unequal than that of labor income, the larger share of net capital income would lead to an increase in income inequality.

Piketty bases his conclusion on his own theoretical model and on the empirical evidence he has been collecting throughout his academic life.

His theoretical model is formed by what he calls “the two fundamental laws of capitalism.” According to the first fundamental law (Piketty 2014, 52–55), the share of net capital income within NDP ( $\alpha$ ) is equal to the net rate of return on capital ( $r$ ) multiplied by the ratio between capital and NDP ( $\beta$ ):

$$\alpha = r * \beta \quad (1)$$

As a result of this first fundamental law, the progressive capitalization of the economy (measured by  $\beta$ ) will lead to an increase in the share of net capital income within NDP.

According to the second fundamental law (Piketty 2014, 166–68), the ratio between capital and NDP is determined in the long run by the ratio of the net saving rate ( $s$ ) to the growth rate of the economy ( $g$ ):

$$\beta = \frac{s}{g} \quad (2)$$

That is, the greater the domestic savings and the lower the economic growth, the greater the capitalization of the economy.

Combining these two fundamental laws, we can arrive at the conclusion that the share of capital income within NDP is directly proportional to the net rate of return on capital and the rate of net savings and inversely proportional to the rate of economic growth:

$$\alpha = r * \frac{s}{g} \quad (3)$$

As a consequence, if the net saving rate is kept constant, an increase of  $r$  or a reduction of  $g$  will result in an increase of  $\alpha$ . Also, if the relative difference between  $r$  and  $g$  remains constant, any increase in the net saving rate will, in turn, increase  $\alpha$ .

On the basis of this simplified economic model, Piketty provides abundant historical evidence in his book that, apparently, shows increases in inequality coincide with

a widening of the spread between  $r$  and  $g$ , while reductions in inequality coincide with a narrowing of the spread between  $r$  and  $g$ .

Since Piketty published his book, numerous papers have been written with the purpose of analyzing and contrasting the model and the evidence he presents. This article summarizes the main conclusions that the economic literature has found in this respect. Its contribution consists in offering a combined discussion of the problematic hidden assumptions in Piketty's model.<sup>1</sup>

## The Problems of the Theoretical Model

The essential problems of Piketty's simple theoretical model derive from the need to complement the two fundamental laws of capitalism with other hypotheses he does not expressly mention, in particular:

1. For  $\alpha$  to increase, it is not enough that  $r > g$ . The gross rate of saving by capitalists must also be sufficiently high (Acemoglu and Robinson 2015).
2. The net saving rate is not independent of the rate of economic growth (Krusell and Smith 2015).
3. The net rate of return on capital,  $r$ , is not independent of the net saving rate (Rognlie 2014).
4. An increase in the share of net capital income within NDP,  $\alpha$ , is not enough to increase inequality (Milanovic 2016).

First, the inequality  $r > g$  does not necessarily mean that capital income will grow faster than labor income. Because the stock of capital depreciates over time, and because the net rate of return on capital may be reduced as more capital accumulates, it will be additionally necessary to save a sufficiently large portion of gross capital income to replace and increase the stock of capital so that net capital income keeps increasing higher than wage income.

In this regard, it is important to emphasize that when we speak about capital depreciation, we are referring not only to the physical wear and tear of the capital equipment but also to the equipment's economic obsolescence: in other words, a given capital good can be perfectly functional from a technical point of view but completely worthless from an economic point of view. The economic obsolescence of a capital good may arise for many reasons, but I focus on two: on the one hand, changes in the structure of capital goods that take place as a consequence of a change in savers' time preference; on the other hand, economic progress. First of all, a reduction in the time

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1. I do not pretend to summarize all important critiques of Piketty's theories in general, such as his backward-looking view on capital (Holcombe 2014) or his mistaken view on the pay of "supermanagers" (Boudreaux 2015), but rather just the hidden assumptions in the model derived from his two fundamental laws of capitalism.

preference (materialized as a fall in interest rates) will shift the economy into more roundabout structures of production. In contrast, an increase in the time preference (materialized as an increase in interest rates) will shift the economy into less-roundabout structures of production (Cachanosky and Lewin 2014). The transition from one type of structure of production to the other causes certain capital goods to become totally or partially obsolete from an economic point of view: that is, it causes an acceleration in the depreciation rate of some part of the capital equipment. Second, economic progress will make obsolete some combinations of capital goods, thereby leading to a reshuffling of some of those combinations and to concomitant capital losses. That is to say, all re-combinations of capital goods, due either to changes in time preference or to economic progress, will tend to increase economic obsolescence and consequently capital depreciation (Lachmann [1956] 1978, 51–52).

Therefore, as Daron Acemoglu and James Robinson (2015) explain, if capital incomes are to grow faster than labor incomes, a more restrictive expression than  $r > g$  must be fulfilled: capitalists must save a sufficiently large proportion of their gross capital incomes to offset any depreciation of their capital equipment and any reduction in the net rate of return on capital derived from the increase in the stock of capital. Formally, if  $\hat{s}_c$  is the gross saving rate of the capitalists,  $\delta$  the depreciation rate of the capital equipment, and  $\dot{r}$  is the variation of the net rate of return on capital over time, it is necessary that

$$\hat{s}_c * (r + \delta) - \delta + \frac{\dot{r}}{r + \delta} > g \quad (4)$$

In other words, because the capital stock depreciates over time ( $\delta$ ) and the rate of return on capital may be reduced as more capital is accumulated ( $\frac{\dot{r}}{r + \delta}$ ), then capital incomes will grow faster than labor incomes only if the rate of economic growth ( $g$ ) is smaller than the proportion of the gross rate of return on capital ( $r + \delta$ ) that is saved and reinvested ( $\hat{s}_c$ ) after offsetting capital depreciation and diminishing returns on capital equipment. Acemoglu and Robinson argue that, given equation (4), capital income will grow persistently faster than labor income only if two conditions in addition to  $r > g$  are met: (a) capitalists' rate of savings is close to 100 percent of their gross capital incomes ( $\hat{s}_c = 1$ ), especially if the spread between  $r$  and  $g$  is small; and (b) there is a constant rate of return on capital ( $\dot{r} = 0$ ).

The second critique against Piketty's theoretical model refers to his incorrect view of saving behavior. According to economists Per Krusell and Anthony Smith Jr. (2015), Piketty's saving theory assumes that the net saving rate is constant and independent of both the rate of economic growth ( $g$ ) and the depreciation rate of capital ( $\delta$ ): in other words, according to Piketty, the faster capital stock depreciates and the slower the economy grows, the larger portion of gross incomes will be saved by individuals, including capitalists. One should realize that to assume that capitalists will always be willing to save more in a low-growth economy than what is strictly necessary to replace

their stock of capital is tantamount to assuming that in the long run their gross saving rate will end up reaching 100 percent of gross domestic product (i.e., the whole production of the economy would be saved and used to replace the depreciated capital equipment). As Krusell and Smith point out,

Without growth, to require a positive net saving rate means that the capital stock must go up in every period by a fraction of net output. This is the sense in which saving is particularly aggressive: the capital stock is forced to grow until net output is zero, that is, until the depreciation of the capital stock is as large as output itself. Then consumption is literally zero, assuming a standard production function in which the marginal product of capital goes to zero as the capital stock goes to infinity. At that point, capital accumulation has been so aggressive that all of output is used to replace the depreciation of the large stock, and there are no resources left for consumption. Net output is zero, and hence capital accumulation has stopped at that point. (2015, 732–33)

Therefore, Piketty's theory of saving leads us to some fairly unlikely scenarios: under a stagnant economy, capitalists would keep decreasing their present consumption not to increase their future consumption but just to increase their capital holdings up to the point at which depreciation takes up their whole gross capital incomes. Less would be consumed at the present in order to avoid all consumption in the future. In other words, capitalists' time preference would decrease over time until reaching a zero level (at which point all consumption would be delayed indefinitely into the future). A more reasonable assumption is that economic agents determine independently their gross savings rate according to their time preference and risk aversion. In that case, as Krusell and Smith note, if the agents' gross incomes grow at a high rate, their net savings rate will increase: that is, their net investment rate will increase provided that the depreciation rate of their capital stock remains the same. In contrast, if the rate of growth of their gross incomes decreases, their net saving rate will fall over time: that is, their net investment rate will decrease over time as more capital is accumulated and the depreciation of that growing capital stock increases relative to their gross incomes. In the limit, if growth were to totally stop, their net savings rate would become zero because their gross savings would end up being totally devoted to offset capital depreciation. (However, if their gross savings rate were less than 1, consumption could be kept permanently at a positive level.) Under this more realistic assumption, Piketty's economic model would face serious difficulties: capitalists' gross saving rate ( $\hat{s}_c$ ) would not necessarily approach 1 under low-growth scenarios, and, therefore, equation (4) would not necessarily be fulfilled.

Certainly, the hypothesis of an independent net savings rate is in itself doubtful, but even if Piketty were right in assuming that capitalists' net saving rate is constant and independent of general economic conditions, their unlimited propensity to accumulate new capital would not necessarily guarantee them a larger portion of NDP because the

progressive accumulation of capital can also negatively affect the net rate of return of that capital. That is, Acemoglu and Robinson's additional condition (*b*) does not necessarily hold. This is precisely the third criticism that Piketty's economic model has received from Matthew Rognlie (2014). According to Rognlie, increases in the capital stock do not need to translate into increases in the share of capital incomes within NDP ( $\alpha$ ) because the net rate of return on capital depends on the volume of already accumulated capital: therefore, if an additional increase in the stock of capital results in an overproportional reduction of the net rate of return on capital, what will end up increasing is the wage share within NDP (i.e.,  $1 - \alpha$ ).

To determine how accumulated capital affects  $r$ , it is necessary to analyze the elasticity of substitution between capital and labor—that is, the sensitivity with which a change in the relation between capital and labor alters the relation between the marginal productivities of labor and capital. If the elasticity of substitution between capital and labor is greater than or equal to 1, capital accumulation will reduce infraproportionally the net rate of return on capital, and, consequently, the share of capital incomes within NDP will increase; if the elasticity of substitution is strictly less than 1, capital accumulation will reduce overproportionally the net rate of return on capital, and therefore the share of capital incomes within NDP will decrease.

But let us note that the elasticity of substitution that must be greater than or equal to 1 for  $\alpha$  to increase is the net substitution elasticity between labor and capital (because Piketty is analyzing the evolution of the share of net capital incomes within NDP). Rognlie (2014) recalls that the current empirical evidence on the elasticity of substitution (Chirinko 2008) could be interpreted as supporting the view that the *gross* elasticity of substitution between capital and labor is greater than 1, but there are no factual grounds to suggest that the *net* elasticity of substitution is greater than 1.

All this does not mean that Piketty is necessarily wrong in assuming a net substitution elasticity equal to or greater than 1. There are good reasons to believe that the net elasticity of substitution between capital and labor in the very long run is greater than the net elasticity of substitution in the short run and that it might even be greater than 1: capital accumulation could lead to increasing returns to scale due to a greater specialization of capital and to the discovery of new recombination opportunities of capital goods (Young 1928; Lachmann [1956] 1978, 80–81); furthermore, the investment in new capital goods could be directed toward promoting an endogenous technological change that increases the substitutability between capital and labor (Acemoglu 2003). That said, it must be clearly stated that Piketty's theoretical model can explain inequality only by assuming a wholly unrealistic behavior of savings and some values of the elasticity of substitution between capital and labor that are left out of any generally accepted estimation (Lepage 2017).

Finally, even if the share of capital income within NDP were to increase, this would not necessarily lead to an increase in income inequality. For the latter effect to materialize, two other conditions must be met, as Branko Milanovic (2016) has recently indicated. On the one hand, capital incomes must be more unequally distributed than

labor incomes; on the other hand, those who receive the largest portion of capital incomes must be the rich. If capital incomes were more equally distributed than labor incomes, a larger  $\alpha$  would tend to reduce global inequality. Moreover, even though capital incomes were more unequally distributed than labor incomes, if they were received especially by the poorest citizens, a larger  $\alpha$  would also tend to reduce inequality.

It is true that in most developed economies the latter two conditions are easily met: in that case, it would seem that this fourth criticism against Piketty is not truly relevant. However, these conditions can be really useful in designing alternative proposals to the ones advocated by Piketty as a way of reducing inequality. As is well known, the French economist advocates a global tax on wealth to counter the inequality derived from  $r > g$  (Piketty 2014, 515–39). But as Tyler Cowen (2014) has pointed out, if Piketty's model were realistic, a more effective public policy would be the privatization of Social Security to extend capital rents to the whole population (Holcombe 2017): because under that scenario capital incomes would become more evenly distributed, a larger  $\alpha$  pushed by  $r > g$  may help to reduce inequality without discouraging capital accumulation. However, Piketty rejects the privatization of Social Security even at the expense of contradicting himself (Rallo 2017).

## The Problems of the Empirical Evidence

Piketty's explanation of inequality depends, as we have seen, on capitalists being willing and able to reinvest a large proportion of their net capital income at net rates of return that barely experience any reduction in a context of general stagnation. The conditions on which this model is based are unlikely to occur simultaneously. Even so, we cannot dismiss a priori the notion that those conditions might hold under some contexts: therefore, it is certainly useful to test whether Piketty's theoretical model is able to explain past inequality dynamics.

Piketty's book is rich in data, although they are of a highly controversial nature (Magnez and Murphy 2015; Sutch 2017), and the book contains no formal empirical testing of his theoretical model. The latter exercise has recently been performed by economist Carlos Góes (2016): to verify econometrically what the relation is between the spread between  $r$  and  $g$  and, on the one hand, the concentration of income in the top percentile and, on the other hand, the share of capital incomes within NDP. Góes's results directly contradict Piketty's thesis: in 75 percent of the countries analyzed, an increase in the spread between  $r$  and  $g$  leads to a reduction in the concentration of income in the top percentile of the income distribution for the next five years. Likewise, a positive shock on the spread between  $r$  and  $g$  leads to reduction of  $\alpha$  during the following two years. Góes states, "I found no evidence to corroborate the idea that the  $r-g$  gap drives the capital share in national income. There are endogenous forces overlooked by Piketty—particularly the cyclicity of the savings rate—which balance out predicted large increases in the capital share. On inequality, the evidence against

Piketty's predictions is even stronger: for at least 75% of the countries, the response of inequality to increases in  $r - g$  has the opposite sign to that postulated by Piketty" (2016). Góes's analysis, therefore, seems to validate the theoretical critiques against Piketty's model: capital exhibits diminishing marginal returns in the short run, and the net saving rate presents a strong cyclical component.

This is not tantamount to denying either the surge in inequality within developed countries that has taken place in the past few decades or the scientific importance of studying the surge's causes: it only means that the explanation offered by Piketty,  $r > g$ , within the context of its two fundamental laws of capitalism, is not a good explanation. In fact, even Piketty himself has come to recognize that  $r > g$  hardly serves to explain the main historical trends of inequality: "I do not view  $r > g$  as the only or even the primary tool for considering changes in income and wealth in the twentieth century, or for forecasting the path of inequality in the twenty-first century. Institutional changes and political shocks—which to a large extent can be viewed as endogenous to the inequality and development process itself—played a major role in the past, and it will probably be the same in the future" (2015, 48).

In light of these deep problems with Piketty's analysis, we must look for better explanations of trends in inequality. Such trends will probably be linked with the importance of social institutions, technology, and political shocks—as Piketty himself has begun to recognize.

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