The Rise and Decline of General Laws of Capitalism*

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Abstract

Thomas Piketty's (2013) book, *Capital in the 21st Century*, follows in the tradition of the great classical economists, like Marx and Ricardo, in formulating general laws of capitalism to diagnose and predict the dynamics of inequality. We argue that general economic laws are unhelpful as a guide to understand the past or predict the future, because they ignore the central role of political and economic institutions, as well as the endogenous evolution of technology, in shaping the distribution of resources in society. We use regression evidence to show that the main economic force emphasized in Piketty's book, the gap between the interest rate and the growth rate, does not appear to explain historical patterns of inequality (especially, the share of income accruing to the upper tail of the distribution). We then use the histories of inequality of South Africa and Sweden to illustrate that inequality dynamics cannot be understood without embedding economic factors in the context of economic and political institutions, and also that the focus on the share of top incomes can give a misleading characterization of the true nature of inequality.

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Economists have long been drawn to the ambitious quest of discovering the general laws of capitalism. David Ricardo, for example, predicted that capital accumulation would terminate in economic stagnation and inequality as a greater and greater share of national income accrued to landowners. Karl Marx followed him by forecasting the inevitable immizerization of the proletariat. Thomas Piketty's (2013) tome, *Capital in the 21st Century*, emulates Marx in his title, his style of exposition, and his critique of the capitalist system. Piketty is after general laws which will demystify our modern economy and elucidate the inherent problems of the system—and point to solutions.

But the quest for general laws of capitalism is misguided because it ignores the key forces shaping how an economy functions: the endogenous evolution of technology and the institutions and the political equilibrium that influence not only technology but also how markets function and how the gains from various different economic arrangements are distributed. Despite his erudition, ambition, and creativity, Marx was led astray because of his disregard of these forces. The same is true of Piketty's sweeping account of inequality in capitalist economies.

In the next section, we review Marx's conceptualization of capitalism and some of his general laws. We then turn to Piketty's approach to capitalism and his version of the general laws. We will point to various problems in Piketty's interpretation of the economic relationships underpinning inequality, but the most important shortcoming is that, though he discusses the role of certain institutions and policies, he allows neither for a systematic role of institutions and political factors in the formation of inequality nor for the endogenous evolution of these institutional factors. We illustrate this by first using regression evidence to show that Piketty's central economic force, the relationship between the interest rate and the rate of economic growth, is not correlated with inequality (in particular, with the key variable he focuses on, the share of national income accruing to the richest 1 percent, henceforth, the top 1 percent share). We then use the examples of the South African and Swedish paths of inequality over the 20th century to demonstrate two things. First, that using the top 1 percent share may miss the big picture about inequality. Second, it is impossible to understand the dynamics of inequality in these societies without systematically bringing in institutions and politics, and their endogenous evolution. We conclude by outlining an alternative approach to inequality that eschews general laws in favor of a conceptualization in which both technology and factor prices are shaped by the evolution of institutions and political equilibria, and the institutions themselves are endogenous and are partly influenced by, among other things, the extent of inequality. We then apply this framework to the evolution of inequality and institutions in South Africa and Sweden.

We should note at this point that we believe the term "capitalism" not to be a useful one for the purposes of comparative economic or political analysis. By focusing on the ownership and accumulation of capital, this term distracts from the characteristics of societies which are more important in determining their economic development and the extent of inequality. For example, both Uzbekistan and modern Switzerland have private ownership of capital, but these societies have little in common in terms of prosperity and inequality because the nature of their economic and political institutions are so sharply different. In fact, Uzbekistan's capitalist economy has more in common with the avowedly non-capitalist North Korea than Switzerland, as we argued in Acemoglu and Robinson (2012). That said, given the emphasis in both Marx and Piketty on capitalism, we have opted to bear with this terminology.

Capital Failures

Though many important ideas in social science can be traced to Karl Marx's oeuvre, his defining approach was to identify certain hard-wired features of capitalism—what Marx called "general laws of capitalist accumulation." This approach was heavily shaped by the historical context of the middle 19th century in which Marx lived and wrote. Marx experienced first-hand both the bewildering transformation of society with the rise of industrial production, and the associated huge social dislocations.

Marx developed a rich and nuanced theory of history. But the centerpiece of this theory, "historical materialism," rested on how material aspects of economic life, together with what Marx called "forces of production"—particularly technology—shaped all other aspects of social, economic and political life, including the "relations of production." For example, Marx famously argued in his 1847 book *The Poverty of Philosophy*, that "the hand-mill gives you society with the feudal lord; the steam-mill society with the industrial capitalist" (as reprinted in McLellan, 2000, pp. 219-220). Here the hand-mill represents the forces of production while feudalism represents the relations of production, as well as a specific set of social and political arrangements. When the forces of production (technology) changed, this destabilized the relations of production and led to contradictions and social and institutional changes that were often revolutionary in nature. As Marx put it in 1859 in *A Contribution to the Critique of Political Economy* (McLellan, 2000, p. 425):

> [T]he sum total of these relations of production constitutes the economic structure of society – the real foundation, on which rise legal and political superstructures and to which correspond definite forms of social consciousness. The mode of production of material life conditions the general character of the social, political and spiritual processes of life. At a certain state of their development the material forces of production in society come into conflict with the existing relations of production or – what is but a legal expression of the same thing – with the property

> relations within which they had been at work before. From forms of development of the forces of production these relations turn into fetters. Then comes the epoch of social revolution. With the change of the economic foundation the entire immense superstructure is more or less rapidly transformed.

Marx hypothesized that the forces of production, sometimes in conjunction with the ownership of the means of production, determined all other aspects of economic and political institutions—the de jure and de facto laws, regulations, and arrangements shaping social life. Armed with this theory of history, Marx made bold predictions about the dynamics of capitalism based just on economic fundamentals—without any reference to institutions or politics, which he generally viewed as derivative of the powerful impulses unleashed by the forces of production.[1]

Most relevant for our focus are three of these predictions concerning inequality. In Volume 1, Chapter 25 of *Capital*, Marx developed the idea that the "reserve army of the unemployed" would keep wages at subsistence level, making capitalism inconsistent with steady improvements in the living standards of workers. His exact prediction here is open to different interpretations. Though Marx viewed capitalism as the harbinger of "misery, agony of toil, slavery, ignorance, brutality, mental degradation" for working men, it is less clear whether this was meant to rule out real wage growth. Blaug (1997) states that Marx never claimed that real wages would be stagnant, but rather that the share of labor in national income would fall since Marx says "real wages ... never rise proportionately to the productive power of labor." Foley (2008, Chapter 3), on the other hand, argues that Marx did start by asserting that real wages would not rise under capitalism, but then weakened this claim to a falling labor share when he realized that wages were indeed increasing in England. This motivates us to state this law in both a strong and a weak form.

1: *The General Law of Capitalist Accumulation.* **Strong Form**: Real wages are stagnant under capitalism. **Weak Form**: The share of national income accruing to labor would fall under capitalism.

Under its either strong or weak form, this law implies that any economic growth under

[1] There is no consensus on Marx's exact formulation of the relationship between the "substructure," comprising productive forces and sometimes the relations of production, and the "superstructure" which includes what we call political institutions and most aspects of economic institutions. In Chapter I of the *Communist Manifesto*, Marx and Engels wrote that "The history of all hitherto existing society is the history of class struggles". But the idea here, so far as we understand, is not that "class struggle" represents some autonomous historical dynamic, but rather that it is an outcome of the contradictions between the forces of production and the ownership of the means of production. In some writings, such as *The Eighteenth Brumaire of Louis Napoleon*, Marx also allowed for feedback from politics and other aspects of society to the forces of production. But it is clear from his work that he regraded this as second order (see Singer, 2000, Chapter 7 for a discussion of this). Marx never formulated an approach in which institutions play the central role and themselves endogenously change.

capitalism would almost automatically translate into greater inequality—as capitalists benefit and workers fail to do so.

In Volume III of *Capital*, Marx proposed another general law:

2: *The General Law of Declining Profit*: as capital accumulates, the rate of profit falls.

These two laws came along with a third, less often stressed but highly relevant, law presented in Volume I of *Capital*:

3: *The General Law of Decreasing Competition*: capital accumulation leads to increased industrial concentration.

Marx's general laws did not fare well, however. As Marx was writing, real wages, which had previously been falling or constant, had already been rising, probably for about two decades (Allen, 2001, 2007, 2009a; Clark, 2005; Feinstein, 1998). The share of labor in national income, which had fallen to under 50% by 1870, also started to increase thereafter, reaching 2/3 in the 20th century. Allen's (2009a) calculation of the real rate of profit suggests that the profit rate was comparatively low at the end of the 18th century and rose until around 1870 reaching a maximum of 25%, but then fell back to around 20% where it stabilized until World War I. Matthews, Feinstein and Odling-Smee (1982, pp. 187-188) suggest that these rates did not fall in the 20th century, though there is a lot of heterogeneity across sectors. (The third law's performance was no better as we discuss below).

Why did Marx's general laws fail? Mostly because they ignored both the endogenous evolution of technology (despite his great emphasis on the forces of production) and the role of institutions and politics that shape markets, prices and the path of technology. The increase in real wages in Britain, for example, was in part a consequence of the change in the pace and nature of technological change, rapidly increasing the demand for labor (Crafts 1985; Allen 2009b; Mokyr 2012). It was also a consequence of the radical political changes Britain underwent at the time, which both influenced technology and directly impacted wages. The rationalization of property rights, dismantling of monopolies, investment in infrastructure, and the creation of a legal framework for industrial development including the patent system were among the institutional changes contributing to rapid technological change and its widespread adoption in the British economy (Acemoglu and Robinson, 2012; Mokyr, 2012).

The distribution of the gains from new technologies was also shaped by an evolving institutional equilibrium. The Industrial Revolution went hand-in-hand with major political changes, including the development of the state and the Reform Acts of 1832, 1867, and 1884, which transformed British political institutions and the distribution of political power. For example, in 1833 a professional factory inspectorate was set up, enabling the enforcement of legislation on factory employment. The political fallout of the 1832 democratization also led in 1846 to the repeal of the Corn Laws—which were tariffs limiting imports of lower-priced foreign corn, lowering the price of bread, raising real wages, and simultaneously undermining land rents (Schonhart-Bailey, 2006). The Factory Act of 1847 took the radical step of limiting working hours in the textile mills to 10 hours per day for women and teenagers. The Reform Act of 1867 led to the abolition of the Masters and Servants Acts in 1875—which had imposed on workers legally-enforceable duties of loyalty and obedience, and limited mobility—was an example of pro-worker labor market legislation that increased real wages (Naidu and Yuchtman, 2013).

Another telling example is the failure of Marx's third general law in the United States: the prediction of increased industrial concentration. After the end of the Civil War came the age of the robber barons and the huge concentration of economic ownership and control. By the end of the 1890s, companies such as Du Pont, Eastman Kodak, Standard Oil and International Harvester came to dominate the economy, in several cases capturing more than 70 percent of their respective markets (Lamoreaux, 1986, pp. 3-4). It looked like a Marxian prediction come true.

Except that this situation was only transitory and was duly reversed as popular mobilization, in part triggered by the increase in inequality, changed the political equilibrium and the regulation of industry (Sanders, 1999). The power of large corporations started being curtailed with the Interstate Commerce Act of 1887 and then the Sherman Anti-Trust Act of 1890, which were used in the early 20th-century trust-busting efforts against Du Pont, the American Tobacco Company, the Standard Oil Company and the Northern Securities Company, then controlled by of J.P. Morgan. The reforms continued with the completion of the break-up of Standard Oil in 1911, and the ratification of the Sixteenth Amendment in 1913, which introduced the income tax, and the Clayton Anti-Trust Act in 1914 and the founding of the Federal Trade Commission. These changes not only stopped further industrial concentration but reversed it (Collins and Preston 1961; Edwards 1975). White (1981) shows that U.S. industrial concentration in the post-World War II period changed little (see White, 2002, for an update).

Crucially, the political process that led to the institutional changes transforming the British economy and inequality in the 19th century was not a forgone conclusion. Nor was the rise in inequality in the United States after the Civil War an inevitable consequence of capitalism. Its reversal starting in the early 1900s was equally dependent on an evolving institutional equilibrium. In fact, while the power of monopoly and inequality were being curtailed in the United States, inequality continued to increase rapidly in neighboring Mexico under the authoritarian rule of Porfirio Diaz, culminating in revolution and civil war in 1910, and demonstrating the central role of the endogenous and path-dependent evolution of institutions.

The failure of Marx's general laws was for the same reason that other previous general laws by economists performed poorly. These laws were formulated in an effort to compress the facts and events of their times into a grand theory aiming to be applicable at all times and places—with little reference to institutions and the (partly institutionally-determined) changing nature of technology. For example, when David Ricardo published the first edition of *On the Principles of Political Economy and Taxation* in 1817, and predicted that a rising share of national income would accrue to land, he had indeed been living through a period of rapidly rising land rents in Britain. But soon thereafter, the share of national income accruing to land started a monotonic decline, and by the 1870s real rents started a rapid fall which would last for the next 60 years (Beckett, Turner and Afton 1999; Clark 2002, 2010).

In short, Marx's general laws, like those before him, failed because they relied on a conception of the economy that did not recognize the endogenous evolution of technology and the role of changing economic and political institutions, shaping both technology and factor prices. In fact, even Marx's emphasis on the defining role of the forces of production, so emblematic of his approach, was often inadequate not only as the engine of history, but also as a description of history, including his paradigmatic example of hand-mills and steam-mils. For example, Bloch (1967) argued persuasively that the hand-mill did not determine the nature of feudal society, nor did the steam-mill determine the character of the post-feudal world.

Seeking 21st-Century Laws of Capitalism

Thomas Piketty is also an economist of his milieu, with his thinking heavily colored by increasing inequality in the Anglo-Saxon world and more recently in continental Europe—and in particular compared to the more equal distribution of labor and total incomes seen in France in the 1980s and 1990s. A large literature in labor economics had done much to document and dissect the increase in inequality that started sometime in the 1970s in the United States (see the surveys and the extensive references to earlier work in Katz and Autor, 1999, and Acemoglu and Autor, 2011). This literature has demonstrated that the increase in inequality has taken place throughout the income distribution, and that it can be explained reasonably well by changes in the supply and demand for skills and in labor market institutions. Piketty and Saez (2003) brought a new and fruitful perspective to this literature by using data from tax returns, confirming and extending the patterns the previous literature had uncovered, and placing a heavy emphasis on rise in inequality at the very top of the income distribution.

In *Capital in the 21st Century*, Piketty goes beyond this empirical and historical approach to offer a theory of the long-run tendencies of capitalism. Though Piketty's data confirm the finding of the previous literature that widening inequality in recent decades, at least in advanced economies, had been driven by rising inequality of labor incomes, his book paints a future dominated by capital income, inherited wealth and rentier billionaires. The theoretical framework used to reach this conclusion is a mix of Marxian economics with Solow's growth model. Piketty defines capitalism in the same way that Marx does, and has a similarly materialist approach linking the dynamics of capitalism to the ownership of the means of production (in particular capital) and the ironclad nature of technology and exogenous growth dynamics. It is true that Piketty sometimes mentions policies and institutions (for example, the wealth tax and the military and political developments that destroyed capital and reduced the ratio of wealth to income during the first half of the 20th century). But their role is ad hoc. Our argument is that, to explain inequality, these features and their endogenous evolution have to be systematically introduced into the analysis.

This approach shapes Piketty's analysis and predictions about the nature of capitalism. *Capital in the 21st Century* starts by introducing two "fundamental laws," but the more major predictions flow from what Piketty calls a "fundamental force of divergence" (p. 351) or sometimes the "fundamental inequality" (p. 25), comparing the (real) interest rate of the economy to the growth rate.

The first fundamental law is just a definition:

$$\text{capital share of national income} = r \times \frac{K}{Y},$$

where r is net real rate of return on capital (the real interest rate), K is the capital stock, and Y is GDP (or equivalently, national income as the economy is taken to be closed).

The second fundamental law is slightly more substantial. It states that

$$\frac{K}{Y} = \frac{s}{g},$$

where s is the saving rate and g is the growth rate of GDP. As we explain in the online appendix (available with this paper at http://e-jep.org), a version of this law does indeed follow readily from the steady state of a Solow-type model of economic growth (but see Krusell and Smith, 2014, and Ray, 2014). At an intuitive level, the growth rate of the capital stock K will be given by net investment, which in a closed economy is equal to saving, sY. Thus the ratio K/Y will reflect the change in K to the change in Y over time due to economic growth, s/g.

Let us follow Piketty here and combine these two fundamental laws to obtain

$$\text{capital share of national income} = r \times \frac{s}{g}.$$

Piketty posits that, even as g changes, r and s can be taken to be approximate constants (or not change as much as g). This then leads to what can be thought of as his first general law, that when growth is lower, the capital share of national income will be higher.

This first law is not as compelling as one might at first think, however. After all, one must consider whether a change in the growth rate g might also alter the saving rate s or the rate of return r since all these are all endogenous variables which are linked in standard models of economic growth. Piketty argues that r should not change much in response to a decline in g, because the elasticity of substitution between capital and labor is high, resulting in an increase in the capital share of national income.[2]

However, the vast majority of existing estimates indicate a short-run elasticity of substitution significantly less than one (for example, Hamermesh, 1993, Mairesse, Hall and Mulkay, 1999, Chirinko, Fazzari and Meyer, 1999, Krusell, Ohanian, Rios-Rull, and Violante, 2000, Chirinko, 1993, Antras, 2004, Klump, McAdam and Willman, 2007, Oberfield and Raval, 2014). This is also the plausible case on intuitive grounds: given technology, the ability to substitute capital for labor would be limited (for example, if you reduce labor to zero, for a given production process, one would expect output to fall to zero also). Though this elasticity could be higher in longer horizons, Chirinko (2008) and Chirinko and Mallick (2014) find it to be significantly less than one also in the long run. One reason why the long-run elasticity of substitution might be greater than 1 is the endogeneity of technology (e.g., Acemoglu, 2002, 2003). In this context, it is worth noting that the only recent paper estimating an elasticity of substitution greater than 1, Karabarbounis and Neiman (2014), uses long-run cross-country variation related to changes in investment prices, making their estimates much more likely to correspond to endogenous-technology elasticities. Nevertheless, as Rognlie (2014) points out, even an elasticity of substitution significantly greater than 1 would not be sufficient to yield of the conclusions that Piketty reaches.

Moreover, though it is true that there has been a rise in the capital share of national income, this does not seem to be related to the forces emphasized in *Capital in the 21st Century*. In particular, Bonnet, Bono, Chapelle and Wasmer (2014) demonstrate that this rise in the capital share is due to housing and the increased price of real estate, shedding doubt on the mechanism Piketty emphasizes.

The second general law of *Capital in the 21st Century* is formulated as

$$r > g,$$

stating that the (real) interest rate exceeds the growth rate of the economy. Theoretically, in an economy with an exogenous saving rate, or with overlapping generations (e.g., Samuelson, 1958, Diamond, 1965), or with incomplete markets (e.g., Bewley, 1983, Aiyagari, 1994), the interest rate need not exceed the growth rate. It will do so in an economy that is *dynamically efficient*, meaning in an economy in which it is impossible to increase the consumption at all

[2] However, the interest rate and the growth rate are linked from both the household side and the production side. For example, with a representative household, we have that $r = \theta g + \rho$, where θ is the inverse of the intertemporal elasticity of substitution and ρ is the discount rate. The fact that the representative household assumption may not be a good approximation to reality does not imply that r is independent of g. On the production side, g affects r through its impact on the capital stock, and it is the second channel that depends on the elasticity of substitution between capital and labor.

dates (thus achieving a Pareto improvement). Whether an economy is dynamically efficient is an empirical matter (Geerolf, 2013, for example, suggests that several OECD economies might be dynamically inefficient), and dynamic inefficiency becomes more likely when the capital-output ratio is very high as *Capital in the 21st Century* predicts it to be in the future.

Finally, Piketty's third and most important general law is that whenever $r > g$, there will be a tendency for inequality to diverge. This is because capital income will tend to increase at the rate of interest rate, r, while national income (and the income of non-capitalists) increases at the rate g. Because capital income is unequally distributed, this will translate into a capital-driven increase in inequality, taking us back to the age of Jane Austen and Honoré Balzac. In the words of Piketty:

> "This fundamental inequality [$r > g$]... will play a crucial role in this book. In a sense, it sums up the overall logic of my conclusions.
>
> When 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." (pp. 25-26).

He elaborates this later, writing: "The primary reason for the hyperconcentration of wealth in traditional agrarian societies and to a large extent in all societies prior to World War I... is that these very low-growth societies in which [sic] the rate of return on capital was markedly and durably higher than the rate of growth" (p. 351), and proposing an explanation for the rise in inequality over the next several decades:

> "... The reason why wealth today is not as unequally distributed as in the past is simply that not enough time has passed since 1945" (p. 372).[3]

As with the first two general laws, there are things to quibble with in the pure economics of the third general law. First, as already mentioned, the emphasis on $r - g$ sits somewhat uneasily with the central role that labor income has played in the rise in inequality. Second, as we show in the online appendix, $r > g$ is fully consistent with constant or even declining inequality. Third, $r - g$ cannot be taken as a primitive on which to make future forecasts, as both the interest rate and the growth rate will adjust to changes in policy, technology and the capital stock. Finally, in the presence of a modest amount of social mobility, even very large

[3] It is unclear whether $r > g$ is a force towards divergence of incomes across the distribution of income, or towards convergence to a new and more unequal distribution of income. In many places, including those we have already quoted, Piketty talks of divergence. But elsewhere, the prediction is formulated differently, for example, when he writes: "With the aid of a fairly simple mathematical model, one can show that for a given structure of ... [economic and demographic shocks]..., the distribution of wealth tends towards a long-run equilibrium and that the equilibrium level of inequality is an increasing function of the gap $r - g$ between the rate of return on capital and the growth rate." (p. 364). In the online appendix, we discuss a variety of economic models linking $r - g$ to inequality.

values of $r-g$ do not lead to divergence at the top of the distribution (as we show in the online appendix).

But our major argument is about what the emphasis on $r>g$ leaves out—institutions and politics. Piketty largely dismisses the importance of institutions against the crushing force of the fundamental inequality, writing

> "... the fundamental inequality $r>g$ can explain the very high level of capital inequality observed in the nineteenth century, and thus in a sense the failure of the French revolution.... The formal nature of the regime was of little moment compared with the inequality $r>g$." (p. 365).

In passing, we should note that the available empirical evidence, however, suggests that the French Revolution not only led to a decrease in inequality (Morrisson and Snyder, 2000), but also profoundly changed the path of institutional equilibria and economic growth in Europe (Acemoglu, Cantoni, Johnson and Robinson, 2011).

If the history of grand pronouncements of the general laws of capitalism repeats itself—perhaps first as tragedy and then farce as Marx colorfully put it—then we may expect the same sort of frustration with Piketty's sweeping predictions as they fail to come true in the same way that those of Ricardo and Marx similarly failed in the past. We next provide evidence suggesting that this is in fact quite likely as even the existing evidence goes against these predictions.

Cross-Country Data on $r>g$ and Top-Level Inequality

The major contribution of Piketty, mostly together with Emmanuel Saez, has been to bring to the table a huge amount of new data on inequality (Piketty and Saez, 2003). The reader may come away from these data presented at length in Piketty's book with the impression that the evidence supporting his proposed laws of capitalism is overwhelming. However, Piketty does not present even basic correlations between $r-g$ and changes in inequality, much less any explicit evidence of a causal effect. Therefore, as a first step we show that the data provide little support for the general laws of capitalism he advances.

We begin by using as a dependent variable the top 1 percent share (see Atkinson and Piketty's World Top Incomes Database at http://topincomes.parisschoolofeconomics.eu/). We combine this variable with GDP data from Madison's dataset. For the first part of our analysis where we do not use explicit data on interest rates this gives us an unbalanced panel spanning 1870-2012, and thereafter our panel covers the post-war period (and uses GDP data from the Penn World Tables).[4]

[4] The number of countries varies depending on the measure of the interest rate used and specification. In

We use three different measures of $r-g$. First, we assume that all capital markets are open and all of the countries in the sample have the same (possibly time-varying) interest rate. Under this assumption, cross-country variation in $r-g$ will come only because of variation in the growth rate, g. The first three columns in Panel A of this table then simply exploit variation in g using annual data (that is, we set $r-g=-g$ by normalizing $r=0$). Throughout, the standard errors are corrected for arbitrary heteroscedasticity and serial correlation at the country level, and because the number of countries is small (varying between 18 and 28), they are computed using the pairs-cluster bootstrap procedure proposed by Cameron, Gelbach and Miller (2008), which has better finite-sample properties than the commonly-used clustered standard errors. (The same results with 'traditional' standard errors that assume no heteroscedasticity and residual serial correlation are reported in Appendix Table A1 and show very similar patterns). In column 1, we look at the relationship between annual top 1 percent share and annual growth in a specification that includes a full set of year dummies and country dummies—so that pure time-series variation at the world level is purged by year dummies and none of the results rely on cross-country comparisons. Piketty's theory predicts a positive and significant coefficient on this measure of $r-g$—in countries with higher g, the incomes of the bottom 99 percent will grow more, limiting the top 1 percent share.[5] Instead, we find a negative estimate that is statistically insignificant.

In column 2, we include five annual lags of top 1 percent share on the right-hand side to model the significant amount of persistence in measures of inequality. Though specifications that include the lagged dependent variable on the right-hand side are potentially subject to the Nickel (1981) bias, given the length of the panel here this is unlikely to be an issue (since this bias disappears as the time dimension becomes large). The test at the bottom of the table shows that lagged top 1 percent share is indeed highly significant. In this case, the impact of $r-g$ is negative and significant at 10 percent—the opposite of the prediction of *Capital in the 21st Century*. Column 3 includes five annual lags of GDP as well as five lags of top 1 percent

columns 1-3 Panel A, we have 27 countries, Argentina, Australia, Canada, China, Colombia, Denmark, Finland, France, Germany, India, Indonesia, Ireland, Italy, Japan, Malaysia, Mauritius, Netherlands, New Zealand, Norway, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, United Kingdom, and United States. In column 2 Panel B, we lose China and Colombia, and additionally Portugal in column 3. In column 4 Panel A, we lose the non-OECD countries, China, Colombia, India, Indonesia, Malaysia, Mauritius and Singapore relative to columns 1-3, and additionally Germany in columns 5 and 6. In Panel B, we additionally lose Portugal in columns 4 and 5, and Portugal in Germany in column 6. In column 7 Panel B, we have Uruguay in addition to the 27 countries in column 1. In columns 8 and 9, we lose Germany and Uruguay. In Panel B, we lose Uruguay in column 7 relative to Panel A, and additionally China and Colombia in column 8, and Argentina, China, Colombia, Indonesia and Portugal in column 9.

[5] With returns to capital income determined in the global economy, i.e., $r_{it}=r_t$ (where i refers to country and t the time period), variation in r_t is fully absorbed by the time effects in these regression models, making the $r=0$ normalization without any loss of generality. Note, however, that what determines the dynamics of inequality in a country according to Piketty's general law is that country's growth rate, supporting the methodology here, which exploits country-specific variation in growth rates (conditional on country and time fixed effects).

share simultaneously. There is once more no evidence of a positive impact of $r - g$ on top inequality. On the contrary, the relationship is again negative, as shown by the first lag and also by the long-run cumulative effect reported at the bottom.

What matters for inequality may not be annual or five-year variations exploited in Panel A, but longer-term swings in $r - g$. Panel B turns to investigate this possibility by looking at 10-year (columns 1 and 2) and 20-year data (column 3).[6] These specifications do not provide any evidence of a positive relationship between this measure of $r - g$ and top 1 percent share either.

In columns 4-6 in Panel A, we work with a different measure of $r - g$ based on the realized interest rate constructed from data on nominal yields of long-term government bonds and inflation rates from the OECD. The relationship is again negative and now statistically significant at 5 percent in columns 4 and 5 and at 10 percent in column 6. In Panel B, when we use 10- and 20-year panels, the relationship continues to be negative but is now statistically insignificant.

One concern with the results in columns 4-6 is that the relevant interest rate for the very rich may not be the one for long-term government bonds. Motivated by this, columns 7-9 utilize the procedure proposed by Caselli and Feyrer (2007) to estimate the economy-wide marginal product of capital minus the depreciation rate using data on aggregate factors of production, and construct $r - g$ using these estimates. Now the relationship is more unstable. In some specifications it becomes positive, but is never statistically significant.

Appendix Tables A2 and Ay show that these results are robust to including, additionally, GDP per capita (as another control for the business cycle and its impact on the top 1 percent share), population growth, and country-specific trends, and to the use of the top 5 percent measure of inequality as the dependent variable. Appendix Table A4 verifies that the results are similar if we limit the analysis to a common sample consisting of OECD countries since 1950, and Appendix Table A5 shows that focusing on the capital share of national income, rather than the top 1 percent share, leads to a similar set of results, providing no consistent evidence of an impact from $r - g$ to inequality.[7]

Though this evidence is tentative and obviously we are not pretending to estimate any sort of causal relationship between $r - g$ and the top 1 percent share, it is quite striking that such basic conditional correlations provide no support for the central emphasis of *Capital in the*

[6] To avoid the mechanical serial correlation that would arise from averaging the dependent variable, we take the top 1% share observations every 10 or 20 years. If an observation is missing at those dates and there exists an observation within plus or minus two years, we use these neighboring observations. The results are very similar with averaging.

[7] This table uses two alternative measures of the capital share of national income from the Penn World Tables and from the OECD. We do not present regressions using the marginal product of capital from Caselli and Feyrer (2007) as this measure is computed using the capital share of national income, making it mechanically correlated with the dependent variable in this table.

21st Century.[8] This is not to say that a higher r is not a force towards greater inequality in society—it probably is. It is just that there are many other forces promoting inequality and our regressions suggest that, at least in a correlational sense, these are quantitatively more important than $r - g$.

A Tale of Two Inequalities: Sweden and South Africa

We now use the histories of inequality during the 20th century in Sweden and South Africa to illustrate how the dynamics of inequality appear linked to the institutional paths of these societies—rather than to the forces of $r > g$. In addition, these cases illustrate that the share of national income going to the top 0.1 percent or top 1 percent can give a distorted view of what is actually happening to inequality more broadly. Indeed, this focus on inequality at the top inevitably leads to a lesser and insufficient focus on what is taking place in the middle or the bottom of the income distribution.

Figure 1 shows the evolution of the share of the top 1 percent in national income in Sweden and South Africa since the early 20th century.

There are of course some differences. Sweden started out with a higher top 1 percent share than South Africa, but its top 1 percent share fell faster, especially following World War I. The recent increase in the top 1 percent also starts earlier in Sweden and is less pronounced than what we see in South Africa in the 1990s and 2000s. But in broad terms, the top 1 percent share behaves similarly in the two countries, starting high, then falling almost monotonically until the 1980s, and then turning up.

Such common dynamics for the top 1 percent share in two such different countries—a former colony with a history of coerced labor and land expropriation, ruled for much of the 20th century by a racist white minority, on the one hand, and the birthplace of European social democracy, on the other—would seem to bolster Piketty's case that the general laws of capitalism explain the big swings of inequality, with little reference to institutions and politics. Perhaps one could even claim that, just like the French Revolution, the effects of apartheid and social democracy are trifling details against the fundamental force of $r > g$.

Except that the reality is rather different. In South Africa, for example, the institutionalization of white dominance after 1910 quickly led to the Native Land Act in 1913 which allocated 93 percent of the land to the 'white economy' while the blacks (around 59% of the population), got 7 percent of the land. In the white economy it became illegal for blacks to own property or a business, and many types of contractual relations for blacks were explicitly banned. By the

[8] One important caveat is that the ex post negative returns that may have resulted from stock market crashes and wars are not in our sample, because our estimates for r are from the post-World War II sample. Nevertheless, if $r - g$ is indeed a fundamental force towards greater inequality, we should see its impact during the last 60 years also.

1920s the 'Color Bar' blocked blacks from practically all skilled and professional occupations (van der Horst, 1942; Feinstein, 2005, Chapters 2-4). After 1948 the 'apartheid' state became even stronger, implementing a wide array of measures to enforce social and educational segregation between whites and blacks. Finally, in 1994, the apartheid institutions collapsed as Nelson Mandela became South Africa's first black president. However, a naïve look at Figure 1 would seem to suggest that South Africa's apartheid regime, which was explicitly structured to keep black wages low and to benefit whites, was responsible for a great decrease in inequality, while the end of apartheid caused an explosion in inequality!

How can this be? The answer is that measuring inequality by the top 1 percent share can give a misleading picture of inequality dynamics in some settings. Figure 2 shows the top 1 percent share together with other measures of inequality in South Africa, which behave quite differently. To start with, Wilson's (1972) series for real wages of black workers in gold mines, a key engine of the South African economy at the time, shows that during the first half of the 20th century, inequality between black workers and whites was massively widening (a continuation of 19th-century trends, see de Zwart, 2011). This is confirmed by the white-to-black per capita income ratio from census data, which does have some ups and downs but exhibits a fairly large increase from about 10-fold to 14-fold until 1970. Thereafter, it shows a rapid decline. Even the top 5 percent share behaves somewhat differently than the top 1 percent share (though available data for this variable start only in the 1950s).

If one wanted to understand economic inequality in South Africa, changes in labor market institutions and political equilibria appear much more relevant than r and g. Indeed, the alternative measures of inequality in Figure 2 show that during the time that the share of the top 1 was falling, South Africa became one of the most unequal countries in the world. As we will discuss in the next section, the turning points in inequality in South Africa in fact have institutional and political roots.

In Sweden, the decline in the top 1 percent share is accompanied by a much more pervasive fall in inequality. Figure 3 shows that for Sweden, other measures of inequality, including two series for the Gini index, have similar trends to the top 1 percent and the top 5 percent share.

However, in the Swedish case as well, the story of inequality seems related not to supposed general laws of capitalism and changes in r and g, but rather to institutional changes. The initial fall in the top 1 percent share coincided with large changes in government policy: for example, a rapid increase in redistribution in the 1920s, from practically nothing in the 1910s (Lindert, 1994), and an increase in top marginal tax rates from around 10 percent in 1910 to 40 percent by 1930 and 60 percent by 1940 (Roine, Valchos and Waldenström, 2009, p. 982). The expanding role of the government and of redistributive taxation plausibly had a negative impact on the top 1 percent share. The data in Figures 1 and Figure 3 are for pre-tax inequality, but these are likely to be impacted by taxes, which influence effort and investment (see the evidence is Roine, Valchos and Waldenström, 2009, on this), and also directly by the wage compression created by Sweden's labor market institutions. Indeed, union density rose rapidly from around 10 percent of the labor force during World War I to 35 percent by 1930 and over 50 percent by 1940 (Donado and Wälde, 2012).

Piketty emphasizes the role of the destruction of the capital stock and asset price falls in the aftermath of the world wars as key factors explaining the decline of top inequality during much of the 20th century. But such factors can hardly explain the trends in Sweden or South Africa. Sweden was neutral in both wars, and though South Africa provided troops and resources for the Allied powers in both, neither economy experienced any direct destruction of their capital stock.

Towards an Institutional Framework

A satisfactory framework for the analysis of inequality should take into account both the impact of different types of institutions on the distribution of resources and the endogenous evolution of these institutions. We now flesh out such a framework and then apply it to the evolution of inequality—and institutions—in Sweden and South Africa. The framework we present is based on the one we proposed in Acemoglu, Johnson and Robinson (2005). Adapting Figure 1 from that paper our framework can be represented schematically as follows:

$$
\left.\begin{array}{ccc}
\text{political institutions}_t & \Longrightarrow & \begin{array}{c}\text{de jure}\\ \text{political}\\ \text{power}_t\end{array} \\
 & & \& \\
\text{inequality}_t & \Longrightarrow & \begin{array}{c}\text{de facto}\\ \text{political}\\ \text{power}_t\end{array}
\end{array}\right\}
\begin{array}{l}
\Longrightarrow \begin{array}{c}\text{economic}\\ \text{institutions}_t\end{array} \Longrightarrow \left.\begin{array}{c}\text{technology}_t,\\ \text{skills}_t, \&\\ \text{prices}_t\end{array}\right\} \Longrightarrow \left\{\begin{array}{c}\text{economic}\\ \text{performance}_t\\ \&\\ \text{inequality}_{t+1}\end{array}\right. \\
\Longrightarrow \begin{array}{c}\text{political}\\ \text{institutions}_{t+1}\end{array}
\end{array}
$$

In this approach, the prevailing political institutions at a certain time determine the distribution of de jure political power (see Acemoglu and Robinson, 2000, 2008; Acemoglu, 2008; Acemoglu, Egorov and Sonin, 2012, 2014): for example, which groups are disenfranchised, how political power is contested, and how constrained the economic and political elites are, and so on. Political institutions also affect, together with inequality in society, the distribution of de facto political power. For instance, de facto power (which designates political power and constraints generated by access to the means of violence, collective action, informal institutions and social norms) depends on the extent to which different social and economic groups are organized and how they resolve their collective action problems and how resources influence their ability to do so. De facto and de jure power together determine economic institutions, and also the stability and change of political institutions.

In turn, economic institutions affect the supply of skills—a crucial determinant of inequality throughout history and even more so today. They also influence, through regulation of both prices and market structure, by taxation, or by impacting the bargaining power of different factors of production and individuals, goods and factor prices. Finally, economic institutions impact technology, including whether and how efficiently existing technologies are utilized, as well as the evolution of technology through endogenous innovations and learning by doing. For example, Zeira (1998) and Acemoglu (2010) show how low wages, resulting from either supply or institutional factors, can sometimes reduce technology adoption or even technological progress, and Hornbeck and Naidu (2014) provide evidence consistent with this pattern. Through their joint impact on technology, the supply of skills and relative prices, economic institutions affect not only r and g, but more importantly, inequality. In this approach, inequality should not be thought of as always summarized by a single statistic, such as the Gini index or the top 1 percent share. Rather, the economic and political factors stressed here determine the distribution of resources more generally.

We do not mean to suggest that this framework determines the evolution of institutions, technology and inequality deterministically. The arrows designate influences, which are mediated by various stochastic events and political economy interactions, and as our brief discussion of the contrast of Mexico and the United States indicates, similar economic developments will result in very different institutional responses depending on the prevailing political equilibrium. Nor do we imply that the framework captures all economic implications of import—or all of those that are relevant for inequality. Most centrally, technology will evolve over time not only because of institutional factors, but also due to scientific developments and because it responds to other economic changes, including factor prices, the abundance and scarcity of different types of skills and market structure (for example, Acemoglu, 2002, 2003, 2010). It is possible as well that technological developments could in turn the impact institutional dynamics (for example, Acemoglu, Aghion and Violante, 2001, and Hassler, Rodriguez-Mora, Storlessten and Zilibotti, 2003). Nevertheless, this simple framework is useful for highlighting the potentially important role of institutional equilibria, and their changes, in shaping inequality.

Let us now apply it to South Africa. Before 1910, non-whites could vote in the Cape and Natal as long as they fulfilled certain wealth, income or property restrictions (though this was more heavily restricted in Natal). After 1910 a specifically white franchise was established in the Transvaal and Orange Free State, and then gradually extended to the rest of the country with blacks finally being definitively disenfranchised in the Cape in 1936. The formal institutions of the apartheid state cemented the political power of the white minority, and segregationist laws and other aspects of the regime created economic institutions, such as the skewed distribution of land and the 'color bar,' aimed at furthering the interests of the white minority. So then why did this and the flourishing of social apartheid after 1948 lead to a fall in the top 1 percent share?

The primary reason is that political dynamics in South Africa at this time cannot be fully captured as a conflict between monolithic groups of whites and blacks. Rather, apartheid should be viewed as a coalition between white workers, farmers and mine-owners—at the expense of blacks, but also white industrialists who had to pay very high wages for white workers (Lundahl, 1982; Lipton, 1985). Thus, one reason for a reduction in the top 1 percent share was that profits were squeezed by wages for white labor. Moreover, by depriving industrialists of a larger pool of skilled workers, and tilting the price of white labor higher (because the supply of labor was artificially restricted), these rules further stunted South African economic development.

In addition, there were forces within apartheid for redistribution from the very rich towards poorer whites. Indeed, South Africa's political discussions in the 1920s that led to the further spread of the 'color bar' and subsequently to the victory of the National Party in 1948 were related to what was called the 'poor white problem,' highlighting the importance of the specific coalition underpinning apartheid (see Alvaredo and Atkinson, 2010, for discussion of other factors such as the gold price).

The compression of the huge wage gaps between South Africa's whites and blacks starting in the 1970s should be viewed within the context of the political weakening of the apartheid regime and its increasing economic problems (see also Wilson, 1980, Mariotti, 2012). The domestic turning point was the ability of black workers to organize protests and riots, and exercise their de facto power, particularly after the Soweto uprising of 1976, which led to the recognition of black trade unions. This process was aided by mounting international pressure, which induced British and U.S. firms based in South Africa to push back against workplace discrimination. Ultimately, this de facto power forced the collapse of the apartheid regime, leading to a new set of political institutions and the enfranchisement of black South Africans. The new set of economic institutions, and their consequences for inequality, flowed from these political changes. Consistent with our framework, the institutions of apartheid may have also fed back into the evolution of technology, for example in impeding the mechanization of gold mining (Spandau, 1980). As the power of apartheid started to erode in the 1970s, white businessmen responded rapidly by substituting capital for labor and moving technology in a labor saving direction (Seekings and Nattrass, 2005, p. 403).

As can be seen from Figure 1, the top 1 percent share in South Africa shows a steep rise after

1994, coinciding with the final overthrow of the formidable extractive institutions of apartheid. No clear consensus has yet emerged on the causes of the post-apartheid increase in inequality, but one reason is related to the fact that after the end of apartheid, the artificially compressed income distribution of blacks started widening as some portion of the population started to benefit from new business opportunities, education, and aggressive affirmative action programs (Leibbrandt, Woolard, Finn, and Argent, 2010). Whatever the details of these explanations, it is hard to see the post-1994 rise in the top 1 percent share as representing the demise of a previously egalitarian South Africa.

The role of de facto and de jure political power in shaping political and economic institutions is no less central in Sweden, where the important turning point was created by the process of democratization. Adult male suffrage came in 1909, but true parliamentary democracy developed only after the Reform Act of 1918, with significant curbs on the power of the monarchy and more competitive elections. Both the 1909 reform and the emergence of parliamentary democracy in 1918 were responses to unrest, strikes and the de facto power of disenfranchised workers, especially in the atmosphere of uncertainty and social unrest following World War I (Tilton, 1974). Collier (1999, p. 83) explains: "[I]t was only after the economic crisis of 1918 and ensuing worker protests for democracy led by Social Democrats that the Reform Act was passed. Indeed, in November 1918, labor protests reached such a point as to be perceived as a revolutionary threat by Sweden's Conservative Party and upper classes."

Swedish democracy then laid the foundations for modern labor market institutions and the welfare state, and created powerful downward pressure on inequality, including the top 1 percent share. However, democratic conflict in Sweden was not a simple contest between monolithic groups of workers and businesses either. As Moene and Wallerstein (1995, 2006) characterize it, social democracy was a coalition of the ends of the income distribution—businessmen and unskilled workers—against the middle class and skilled workers (see also Saint-Paul, 2000; Gourevitch, 1986; Luebbert, 1991, for theories about the emergence of such political coalitions). In consequence, Swedish economic institutions strongly compressed skilled wages relative to unskilled wages, underpinning the rapid decline in broad-based measures of inequality. Some businesses benefitted from these arrangements, particularly those in sectors exposed to international competition, which used centralized wage bargaining as a tool to stop wage push from non-traded sectors, such as construction (Swenson, 1991, 2002). Swedish labor market institutions also likely impacted the path of technology. For instance, Moene and Wallerstein (1997) emphasize that wage compression acted as a tax on inefficient plants and stimulated new entry and rapid technological upgrading. In the face of high unskilled wages and the institutions of the welfare state, it is not a surprise that the top 1 percent share declined in Sweden as well, even if businessmen also did well out of some aspects of Swedish labor market institutions.

What explains the fact that the top 1 percent share appears to increase not just in South Africa and Sweden, but in almost all OECD economies over the last 20 years or so? Factors left out of our framework—globalization, skill-biased technological changes and the increase in the size of large corporations—are likely to be important. But these are themselves forces that are not ironclad, but have likely responded to other changes in the world economy. For example, Acemoglu (2002) argues that skill-biased technological change cannot be understood without the increase in the supply of skilled workers in the United States and the world economy, making these types of technologies more profitable, and globalization and the increasing size of global corporations are themselves consequences of regulatory and technological changes of the last several decades. This simply underscores that the framework presented here cannot capture the dynamics of all dimensions of inequality—or the rich dynamics of political and economic institutions for that matter. Nevertheless, the basic forces that it stresses appear to be important not just in the context of Sweden and South Africa, but much more generally (as argued in Acemoglu and Robinson 2006, 2012).

This framework also helps to clarify the reasons why we might care about inequality at the very top of the income and wealth distributions. Most relevant is that the factors which undergird a high share of income for the top 1 percent might also represent a lack of equality of opportunity, or a lack of a level playing field. Extending the framework presented above, we argued in Acemoglu and Robinson (2012) that lack of a level playing field, including limited social mobility, is likely to hold back countries in their investments, innovation and the efficiency of resource allocation. However, the top 1 percent share may not be the most relevant dimension of the distribution of income for evaluating equality of opportunity and barriers to the efficient allocation of talent and resources in society. For example, if a small number at the top became wealthier—say, if Bill Gates and Warren Buffett became twice as wealthy—at the expense of other rich individuals, would that make U.S. society notably less meritocratic? This seems unlikely. Indeed, Chetty, Hendren, Kline and Saez (2014b) show that social mobility at the commuting zone level in the United States is unrelated to income inequality, especially inequality at the top. Their (2014a) evidence that U.S. social mobility has stayed the same even as the top 1 percent share has increased rapidly over the last several decades further corroborates this intuition. Other types of inequality, such as the gap between whites and blacks as in South Africa or between the bottom and the middle class in the United States, may be more relevant for thinking about whether there have been changes in social mobility and the angle of the playing field.

But one dimension of political economy where the top 1 percent share may be central is the health of political institutions. It may be difficult to maintain political institutions that create a dispersed distribution of political power and political access for a wide cross-section of society in a society in which a small number of families and individuals have become disproportionately rich. A cautionary tale about the dangers created by this type of inequality is discussed in Puga and Trefler (2014) and Acemoglu and Robinson (2012): the story of late medieval Venice. Here, the economic power of the most prosperous and well-established families ultimately made it possible for them to block the access of others to political power, and once they thus monopolized political power, they could change economic institutions for their benefit by blocking the entry of other families into lucrative businesses and banning contracts that had previously made it possible for individuals with limited capital to enter into partnerships for long distance trade. This change in political institutions, feeding into a deterioration of economic institutions, heralded the economic decline of Venice.

Yet if the primary threat from the top 1 percent share is political, then the main response should be related to monitoring and containing the political implications of the increase in top-level inequality—not necessarily catchall policies such as wealth taxes. Such policies should be explicitly related to the institutional faultlines of the specific society, and should be conceived in the context of strengthening institutional checks against any potential power grab.

Conclusion

Thomas Piketty's (2013) ambitious work proffers a bold, sweeping theory of inequality applicable to all capitalist economies. Though we believe that the focus on inequality and the ensuing debates on policy can be healthy and constructive, we have argued that Piketty goes wrong for exactly the same reasons that Marx, and before him Ricardo, went astray: these quests for general laws ignore both institutions and politics, and the flexible and multifaceted nature of technology, which make the responses to the same stimuli conditional on historical, political, institutional and contingent aspects of the society and the epoch, vitiating the foundations of theories seeking fundamental, general laws. We have argued, in contradiction to this perspective, that any plausible theory of the nature and evolution of inequality has to include political and economic institutions at the center stage, recognize the endogenous evolution of technology in response to both institutional and other economic and demographic factors, and also attempt to model how the response of an economy to shocks and opportunities will depend on its existing political and institutional equilibrium.

References

Acemoglu, Daron (2002) "Directed Technical Change," *Review of Economic Studies*, 69, 781-810.

Acemoglu, Daron (2003) "Labor- and Capital-Augmenting Technical Change," *Journal of European Economic Association*, 1, 1-37.

Acemoglu, Daron (2008) "Oligarchic Vs. Democratic Societies" *Journal of the European Economic Association,* 6 (1), 1-44.

Acemoglu, Daron (2010) "When Does Labor Scarcity Encourage Innovation?" *Journal of Political Economy*, 118(6), 1037-1078.

Acemoglu, Daron, Philippe Aghion and Gianluca Violante (2001) "Deunionization, Technical Change and Inequality" *Carnegie-Rochester Conference Series on Public Policy*, 55(1), 229-264.

Acemoglu, Daron and David Autor (2011) "Skills, Tasks and Technologies: Implications for Employment and Earnings," in Orley Ashenfelter and David Card eds. *Handbook of Labor Economics*, Volume 4(B),1043-1171.

Acemoglu, Daron, Davide Cantoni, Simon Johnson and James A. Robinson (2011) "The Consequences of Radical Reform: The French Revolution," *American Economic Review*, 101(7), 3286–3307.

Acemoglu, Daron, Georgy Egorov and Konstantin Sonin (2012) "Dynamics and Stability of Constitutions, Coalitions, and Clubs," *American Economic Review*, 102(4), 1446–1476.

Acemoglu, Daron, Georgy Egorov and Konstantin Sonin (2014) "Political Economy in a Changing World," forthcoming, *Journal of Political Economy.*

Acemoglu, Daron, Simon Johnson and James A. Robinson (2005) "Institutions as Fundamental Determinants of Long-Run Growth" in Philippe Aghion and Steven Durlauf *Handbook of Economic Growth*, Volume 1A, Amsterdam; North-Holland, pp. 385-472.

Acemoglu, Daron and James A. Robinson (2000) "Why Did the West Extend the Franchise? Growth, Inequality and Democracy in Historical Perspective," *Quarterly Journal of Economics*, CXV, 1167-1199."

Acemoglu, Daron and James A. Robinson (2006) *Economic Origins of Dictatorship and Democracy*, New York: Cambridge University Press.

Acemoglu, Daron and James A. Robinson (2008) "Persistence of Power, Elites and Institutions," *American Economic Review*, 98, 267-293.

Acemoglu, Daron and James A. Robinson (2012) *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*, New York: Crown.

Aiyagari, S. Rao (1994) "Uninsured Idiosyncratic Risk and Aggregate Saving," *Quar-*

terly Journal of Economics, 109(3), 659-84.

Allen, Robert C. (2001) "The Great Divergence in European Wages and Prices from the Middle Ages to the First World War", *Explorations in Economic History*, 38, 411-447.

Allen, Robert C. (2007) "Pessimism Preserved: Real Wages in the British Industrial Revolution," http://www.nuffield.ox.ac.uk/users/Allen/unpublished/pessimism-6.pdf

Allen, Robert C. (2009a) "Engels' Pause: A Pessimist's Guide to the British Industrial Revolution," *Explorations in Economic History*, 46(4), 418–435.

Allen, Robert C. (2009b) *The British Industrial Revolution in Global Perspective*, New York: Cambridge University Press.

Alvaredo, Facundo and Anthony B. Atkinson (2010) "Colonial Rule, Apartheid and Natural Resources: Top Incomes in South Africa, 1903-2007," http://www.parisschoolofeconomics.eu/IMG/pdf/DP8155_SouthAfrica.pdf

Antras, Pol (2004) "Is the US Aggregate Production Function Cobb-Douglas? New Estimates of the Elasticity of Substitution" *Contributions to Macroeconomics*, 4(1).

Atkinson, Anthony B. and Salvatore Morelli (2014) "Chartbook of Economic Inequality." ECINEQ Working paper 324.

Atkinson, Anthony B., Thomas Piketty and Emmanuel Saez (2011) "Top Incomes in the Long Run of History," *Journal of Economic Literature*, 49(1), 3–71.

Beckett, J.V., M. Turner and B. Afton (1999) *Agricultural Rent in England, 1690-1914*, New York: Cambridge University Press.

Bewley, Truman F. (1986) "Stationary Monetary Equilibrium with a Continuum of Independently Fluctuating Consumers", in Werner Hildenbrand and Andreu Mas-Colell (eds.): *Contributions to Mathematical Economics in Honor of Gerard Debreu*, North-Holland, Amsterdam.

Blaug, Mark (1997) *Economic Theory in Retrospect*, 5th Edition, New York: Cambridge University Press.

Bloch, Marc (1967) *Land and Work in Medieval Europe*, New York: Harper Tourchbooks.

Bonnet, Odran, Pierre-Henri Bono, Guillaume Chapelle and Etienne Wasmer (2014) "Does Housing Capital Contribute to Inequality? A Comment on Thomas Piketty's Capital in the 21st Century" SciencesPo Discussion Paper 2014-07.

Cameron, A. Colin, Jonah B. Gelbach and Douglas L. Miller (2008) "Bootstrap-Based Improvements for Inference with Clustered Errors" *Review of Economics and Statistics*, 90, 414-427.

Caselli, Francesco and James Feyrer (2007) "The Marginal Product of Capital," *Quarterly Journal of Economics*, 122(2), 535-568.

Chetty, Raj, Nathaniel Hendren, Patrick Kline and Emmanuel Saez (2014a) "Is the United States Still a Land of Opportunity? Recent Trends in Intergenerational Mobility" *American Economic Review: Papers and Proceedings*, 104(5), 141-147.

Chetty, Raj, Nathaniel Hendren, Patrick Kline and Emmanuel Saez (2014b) "Where is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States." forthcoming in the *Quarterly Journal of Economics.*

Chirinko, Robert S. (1993) "Business Fixed Investment: a Critical Survey of Modeling Strategies, Empirical Results and Policy Implications" *Journal of Economic Literature*, 31, 1875-1911.

Chirinko, Robert S., Steven M. Fazzari and Andrew P. Meyer (1999) "How Responsive Is Business Capital Formation to Its User Cost?" *Journal of Public Economics*, 75, 53-80.

Chirinko, Robert S. (2008) "σ: The Long and Short of It" *Journal of Macroeconomics*, 30, 671-686.

Chirinko, Robert S. and Debdulal Mallick (2014) "The Substitution Elasticity, Factor Shares, Long-Run Growth, and the Low-Frequency Panel Model" University of Chicago, Illinois mimeo.

Clark, Gregory (2002) "Farmland Rental Values and Agrarian History: England and Wales, 1500-1912," *European Review of Economic History*, 6(3), 281-309.

Clark, Gregory (2005) "The Condition of the Working-Class in England, 1209-2004," *Journal of Political Economy*, 113(6), 1307-1340.

Clark, Gregory (2010) "The Macroeconomic Aggregates for England, 1209-2008," *Research in Economic History*, 27, 51-140.

Collier, Ruth B. (1999) *Pathways to Democracy*, New York: Cambridge University Press.

Collins, Norman R. and Lee E. Preston (1961) "The Size Structure of the Largest Industrial Firms, 1909-1958," *American Economic Review*, 51(5), 986-1011.

Crafts, Nicholas (1985) *British Economic Growth during the Industrial Revolution*, Oxford: Clarendon Press.

Diamond, Peter A. (1965) "National Debt in a Neoclassical Growth Mode," *American Economic Review*, 55(5), 1126-1150.

Donado, Alejandro and Klaus Wälde (2012) "How Trade Unions Increase Welfare," *Economic Journal*, 122, 990-1009.

Edwards, Richard C. (1975) "Stages in Corporate Stability and the Risks of Corporate Failure," *Journal of Economic History*, 35(2), 428-457.

Feinstein, Charles H. (1998). "Pessimism Perpetuated: Real Wages and the Standard of Living in Britain During and After the Industrial Revolution," *Journal of Economic History*, 58 (3), 625-658.

Feinstein, Charles H. (2005) *An Economic History of South Africa*, New York: Cambridge University Press.

Foley, Duncan K. (2008) *Adam's Fallacy: A Guide to Economic Theology*, Cambridge: Bellknap Press.

Geerolf, François (2013) "Reassessing Dynamic Efficiency," UCLA mimeo https://dl.dropboxusercontent.com/u/7363883/Efficiency_Emp.pdf.

Gourevitch, Peter (1986) *Politics in Hard Times*, New York: Cambridge University Press.

Hamermesh, David S. (1993) *Labor Demand*, Princeton University Press, Princeton.

Hassler, Jon, José V. Rodriguez-Mora, Kjetil Storlessten and Fabrizio Zilibotti (2003) "The Survival of the Welfare state", *American Economic Review*, 93(1), 87-112.

Hornbeck, Richard and Suresh Naidu (2014) "When the Levee Breaks: Black Migration and Economic Development in the American South," *American Economic Review*, 104(3), 963-990.

van der Horst, Shelia T. (1942) *Native Labour in South Africa*, London: Frank Cass & Co. Ltd.

Karabarbounis, Loukas and Brent Nieman (2014) "The Global Decline of the Labor Share" forthcoming *Quarterly Journal of Economics.*

Katz, Lawrence F. and David Autor (1999) "Changes in the Wage Structure and Earnings Inequality," in Orley Ashenfelter and David Card eds. *Handbook of Labor Economics*, Volume 3A, 1463-1555.

Klump, Rainer, Peter McAdam and Alpo Willman (2007) "Factor Substitution and Factor Augmenting Technical Progress in the US," *Review of Economics and Statistics*, 89(1), 183-192.

Krusell, Per; Lee Ohanian and Victor Rios-Rull and Giovanni Violante (2000) "Capital Skill Complementary and Inequality," *Econometrica*, 68, 1029-1053.

Krusell, Per and Anthony Smith (2014) "Is Piketty's "Second Law of Capitalism" Fundamental?" http://aida.wss.yale.edu/smith/piketty1.pdf

Lamoreaux, Naomi R. (1985) *The Great Merger Movement in American Business, 1895-1904*, New York: Cambridge University Press.

Leibbrandt, Murray, Ingrid Woolard, Arden Finn and Jonathan Argent (2010) "Trends in South African Income Distribution and Poverty since the Fall of Apartheid." OECD Social, Employment and Migration Working Papers, No. 101, OECD Publishing.

Lindert, Peter H. (1994) "The Rise of Social Spending, 1880–1930," *Explorations in*

Economic History, 31, 1–36.

Lipton, Merle (1985) *Capitalism and Apartheid*, London: Gower, Temple Smith.

Luebbert, Gregory M. (1991) *Liberalism, Fascism, or Social Democracy: Social Classes and the Political Origins of Regimes in Interwar Europe*, New York: Cambridge University Press.

Lundahl, Mats (1982) "The Rationale of Apartheid," *American Economic Review*, 72(5), 1169-79

Mairesse, Jacques, Bronwyn H. Hall and Benoit Mulkay (1999) "Firm-Level Investment in France and the United States: An Exploration over What We Have Returned in Twenty Years" *Annales d'Economie et Statistiques*, 15, 27-67.

Mariotti, Martine (2012) "Labour Markets During Apartheid," *Economic History Review*, 65(3), 1100-1122.

Mathews, Robin C.O., Charles H. Feinstein, John C. Odling-Smee (1982) *British Economic Growth, 1856–1973.* Stanford: Stanford University Press.

McLellan, David ed. (2000) *Karl Marx: Selected Writings*, 2nd Edition, New York: Oxford University Press.

Milanovic, Branko (2013) "All the Ginies Dataset." The World Bank.

Moene, Karl Ove and Michael Wallerstein (1995) "How Social Democracy Worked," *Politics and Society*, 23, 185-211.

Moene, Karl Ove and Michael Wallerstein (1997) "Pay Inequality," *Journal of Labor Economics*, 15(3), 403-430.

Moene, Karl Ove and Michael Wallerstein (2006) "Social Democracy as a Development Strategy," in Pranab Bardhan, Samuel Bowles and Michael Wallerstein eds. *Globalization and Egalitarian Redistribution*, New York: Russel Sage Foundation.

Mokyr, Joel (2012) *The Enlightened Economy: An Economic History of Britain 1700-1850*, New Haven: Yale University Press.

Morrisson, Christian and Wayne Snyder (2000) "The Income Inequality of France in Historical Perspective," *European Review of Economic History*, 4, 59-83.

Naidu, Suresh and Noam Yuchtman (2013) "Coercive Contract Enforcement: Law and the Labor Market in 19th Century Industrial Britain," *American Economic Review*, 103(1), 107-144.

Nickell, Stephen (1981) "Biases in Dynamic Models with Fixed Effects," *Econometrica*, 1417–1426.

Oberfield, Ezra and Devesh Raval (2014) "Micro Data and Macro Technology" Princeton mimeo.

Piketty, Thomas and Emmanuel Saez (2003) "Income inequality in the United States, 1913-1998, *Quarterly Journal of Economics*, 118(1), 1-39.

Puga, Diego and Daniel Trefler (2014) "International trade and institutional change: Medieval Venice's response to globalization," *Quarterly Journal of Economics* 129(2), 753-821.

Ray, Debraj (2014) "Nit-Piketty," http://www.econ.nyu.edu/user/debraj/

Rognlie, Matthew (2014) "A Note on Piketty and Diminishing Returns to Capital" http://www.mit.edu/~mrognlie/piketty_diminishing_returns.pdf.

Roine, Jesper, Jonas Valchos and Daniel Waldenström (2009) "The long-run determinants of inequality: What can we learn from top income data?" *Journal of Public Economics*, 93, 974–988.

Saint-Paul, Gilles (2000) *The Political Economy of Labor Market Institutions*, New York: Oxford University Press.

Samuelson, Paul A. (1958) "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money," *Journal of Political Economy*, 66(6), 467-482.

Sanders, Elizabeth (1999) *Roots of Reform: Farmers, Workers and the American State, 1877-1917*, Chicago: University of Chicago Press.

Schonhardt-Bailey, Cheryl (2006) *From the Corn Laws to Free Trade*, Cambridge: MIT Press.

Seekings, Jeremy, and Nicoli Nattrass (2005) *Class, Race, and Inequality in South Africa*, New Haven: Yale University Press

Singer, Peter (2000) *Marx: A Very Short Introduction*, New York: Oxford University Press.

Spandau, A. (1980) "Mechanization and Labour Policies on South African Mines," *South African Journal of Economics*, 48(2), 110–120.

Swenson, Peter A. (1991) "Bringing Capital Back In, or Social Democracy Reconsidered," *World Politics*, 43(4), 513-544.

Swenson, Peter A. (2002) *Capitalists against Markets: The Making of Labor Markets and Welfare States in the United States and Sweden*, New York: Oxford University Press.

Tilton, Timothy A. (1974) "The Social Origins of Liberal Democracy: The Swedish Case," *American Political Science Review*, 68(2), 561-571.

White, Lawrence J. (1981) "What Has Been Happening to Aggregate Concentration in the United States?" *Journal of Industrial Economics*, 29(3), 223-230.

White, Lawrence J. (2002) "Trends in Aggregate Concentration in the United States," *Journal of Economic Perspectives*, 16(4), 137-160.

Wilson, Francis (1972) *Labour in the South African Gold Mines, 1911-1969*, New York: Cambridge University Press.

Wilson, Francis (1980) "Current Labor Issues," in Robert M. Price and Carl G. Rosberg eds. *The Apartheid regime : political power and racial domination*, Berkeley: Institute for International Studies.

Zeira, Joseph (1998) "Workers, Machines, and Economic Growth," *Quarterly Journal of Economics*, 113(4), 1091-1117.

de Zwart, Pim (2011) "South African Living Standards in Global Perspective, 1835-1910" *Economic History of Developing Regions*, 26, 48-73.

Online Appendix for "Rise and Decline of General Laws of Capitalism"

In this Appendix, we discuss the core theoretical claims of Piketty's *Capital in the 21st Century*, in an effort to clarify the relationship between $r-g$ and inequality. The emphasis will be on four issues: (1) what types of models and economic forces lead to a divergence of inequality when $r>g$; (2) the role of social mobility in this process; (3) what types of models lead instead to a relationship between $r-g$ and the (right) tail of the stationary distribution of income and wealth; (4) how does $r-g$ respond to policies and capital accumulation.

Divergence of Inequality when $r-g>0$ (without Social Mobility)

The first possible reading of the theoretical core of *Capital in the 21st Century* is that if $r-g$ is positive (or sufficiently large) it will lead to a divergence of wealth between the very rich and the rest of population. The approach of the book here builds on ideas proposed by Nicholas Kaldor, in particular, Kaldor (1955). As we will see, this model gives a formalization of the various intuitions and statements made in *Capital in the 21st Century* in a rather straightforward manner, but also shows what the limitations of some of these intuitions and claims are.

The prototypical Kaldor-type economy consists of "capitalists" and workers (and no land), and an important dimension of inequality is between these two groups and is fueled by the assumption that capitalists have a high saving rate (and workers have a saving rate of zero), and all of the income of the capitalists come from capital. As we will see, there is no need to assume that workers do not have any capital income; it is sufficient to allow different saving rates between these two groups.

Suppose that the economy comprises a single good, so that there is no relative price for installed capital (relative to final output and consumption). We also focus on a continuous-time economy for notational convenience. Let us denote the capital stock held by capitalists by K_C. For future reference, we also denote the fraction of capitalists in the population by m, and thus the fraction of workers is $1-m$, and without loss of generality, we take these to be the numbers of capitalists and workers (thus normalizing total population to 1). For now, there is no social mobility between capitalists and workers, but we will relax this below.

Since all of the income of the capitalists comes from capital, their total income is simply given by the capital stock times the rental price of capital. Assuming that capital depreciates at the rate δ and the interest rate is r, total income accruing to capitalists can be written as

$$I_C = (r+\delta)K_C, \tag{A1}$$

where we are suppressing time indices.[9]

[9] Piketty specifies everything, including the saving rate in net of depreciation units. But as Krusell and

Now supposing that capitalists have a constant saving rate of s_C out of their income, the evolution of the capital stock held by capitalists can be written as

$$\begin{aligned} \dot{K}_C &= s_C I_C - \delta K_C \\ &= [s_C(r+\delta) - \delta] K_C, \end{aligned}$$

where the first line simply uses the fact that a constant fraction s_C of capitalists' income, I_C, is saved, but then a fraction δ of their existing capital stock depreciates. The second line simply substitutes for I_C from (A1).

To obtain the growth rate of capitalists' income, we also need to know how the interest rate varies over time. In particular, the growth rate of capitalists' income can be obtained by differentiating (A1) with respect to time as

$$\begin{aligned} g_C^I &= \frac{\dot{K}_C}{K_C} + \frac{\dot{r}}{r+\delta} \\ &= s_C(r+\delta) - \delta + \frac{\dot{r}}{r+\delta}. \end{aligned}$$

Now returning to workers, their income is

$$\begin{aligned} I_W &= (r+\delta)K_W + wL \\ &= (r+\delta)K_W + Y - (r+\delta)(K_C + K_W) \\ &= Y - (r+\delta)K_C, \end{aligned}$$

where K_W is the capital stock held by workers, w the real wage, L total employment and where the second line simply uses the fact that labor income is equal to national income minus capital income. Then, the growth rate of the income of workers can be obtained by straightforward differentiation with respect to time and by rearranging terms using the expression for the income of the capitalists from (A1):

$$g_W^I = \frac{\frac{\dot{Y}}{Y} - \frac{\dot{K}_C}{K_C}\frac{I_C}{Y} - \frac{\dot{r}}{r+\delta}\frac{I_C}{Y}}{1 - \frac{I_C}{Y}}.$$

One advantage of this expression is that it is written without reference to the saving rate of workers, s_W, because of the national income accounting identity. But this is also a disadvantage, because, as we discuss below, it masks that comparisons of r to g are implicitly changing the growth of labor income and the saving rate of workers.

Denote the fraction of national income accruing to capitalists by ϕ $(= I_C/Y)$. If capitalists correspond to the richest 1 percent in the population, then ϕ is the top 1 percent share measure

Smith (2014) emphasize, this is a difficult assumption to motivate and leads to the unpleasant and untenable implication of all of national income being saved at low growth rates. In light of this, it is more appropriate to think of Piketty's results as being supported by assuming that $\delta \approx 0$.

used extensively by Piketty. Using this definition and denoting the growth rate of GDP (and national income) by g, we can then write

$$g_W^I = \frac{g - [s_C(r+\delta) - \delta]\phi - \frac{\dot{r}}{r+\delta}\phi}{1-\phi}.$$

Let us now compare this to the growth rate of the income of the capitalists. A simple rearrangement gives that

$$\begin{aligned} g_C^I &> g_W^I \text{ if and only if} \\ s_C(r+\delta) &> g + \delta - \frac{\dot{r}}{r+\delta}. \end{aligned} \tag{A2}$$

This expression thus states that there will be divergence between the incomes of the capitalists and the workers when (A2) holds.[10] Note, however, that this sort of divergence, by definition, must be temporary, because if capitalists' incomes are growing faster than the rest of the population, at some point they will make up the entire income of the economy.[11]

It is now straightforward to observe that the claim in *Capital in the 21st Century* about $r - g > 0$ leading to expanding inequality will hold under two additional conditions:

1. $s_C \simeq 1$, which would follow if the very rich save a very large fraction of their incomes. In practice, though the very rich save more of their incomes than the poor, s_C is significantly less than 1, especially once one takes into account charitable contributions and donations by the very rich.

2. $\dot{r} = 0$, so that the interest rate is constant. Here, as discussed in the text, much of growth theory suggests that the interest rate is quite responsive to changes in the capital stock (and other factors of production as well as technology).

Under these two assumptions, (A2) boils down to

$$g_C^I > g_W^I \text{ if and only if } r > g,$$

as asserted by Piketty. However, (A2) also makes it clear that without the two simplifying assumptions above, the evolution of top inequality depends on the saving rate and changes in the interest rate as well as $r > g$.

[10] See also Homburg (2014) for an explanation for why $r - g$ does not translate to divergence in overlapping generations models.

[11] In particular, when (A2) holds for an extended period of time, then all of national income will be in terms of capital income, so it is impossible for $r > g$ and thus for (A2) to be maintained forever.

Divergence of Inequality with Social Mobility

The simple Kaldor-type model presented in the previous subsection enables us to present a transparent illustration of how social mobility affects inequality. We will now show that even under the assumptions enumerated above, modest amounts of social mobility can significantly change the conclusions. Though the United States is not one of the highest social mobility countries in the world, it still has a fairly sizable likelihood that those at the top of income distribution will lose their position, and as mentioned in the text, recent evidence by Chetty, Hendren, Kline and Saez (2014a,b) suggests that this rate of social mobility has not declined over time, even though overall inequality has increased sharply.

Let us now incorporate the possibility of social mobility into this simple framework. To simplify the exposition, let us suppose that $\delta = \dot{r} = 0$ for this part of the analysis.

We model social mobility as follows. We assume that at some flow rate ν, a capitalist is hit by a random shock and becomes a worker, inheriting the worker's labor income process and saving rate. At this point, he (or she) of course maintains his current income, but from then on his income dynamics follows those of other workers. Simultaneously, a worker becomes a capitalist (also at the flow rate ν), keeping the fraction of capitalists in the population constant at $m \in (0, 1)$.

We can now write the dynamics of the total income of capitalists as

$$\dot{I}_C = s_C r I_C - \nu \left[\frac{I_C}{m} - \frac{I_W}{1-m} \right], \tag{A3}$$

where we are exploiting the fact that, on average, a capitalist leaving the capitalist class has income I_C/m (total capitalists' income divided by the measure of capitalists), and a worker entering the capitalist class has, on average, income $I_W/(1-m)$. This significantly facilitates the characterization of inequality between capitalists and workers (though the determination of the exact distribution of income is more complicated because of the slow growth dynamics of the income of individuals that change economic class).[12]

Now rearranging (A3), we obtain

$$\begin{aligned} g_C^I &= s_C r - \nu \left[\frac{1}{m} - \frac{1}{1-m} \frac{I_W}{I_C} \right] \\ &= s_C r - \nu \left[\frac{1}{m} - \frac{1}{1-m} \frac{1-\phi}{\phi} \right]. \end{aligned}$$

With a similar reasoning, the growth rate of the total income of workers is

$$g_W^I = \frac{g - s_C r \phi}{1-\phi} + \nu_W \left[\frac{1}{m} \frac{\phi}{1-\phi} - \frac{1}{1-m} \right].$$

[12] This also means that the comparison of the incomes of capitalists and workers in this world with social mobility is only an approximation to the top 1 percent inequality measures (even when capitalists make up 1 percent of the population), because workers who become capitalists will join the top 1 percent only slowly.

Combining these expressions and rearranging terms, we can write

$$\begin{aligned} g_C^I &> g_W^I \text{ if and only if} \\ s_C r - g &> \nu \frac{\phi - m}{\phi m(1-m)}, \end{aligned} \tag{A4}$$

where the term on the right-hand side is strictly positive in view of the fact that $\phi > m$ (i.e., the share of top 1 percent in national income is greater than 1%). This expression thus shows that even when $s_C r - g > 0$ (or, fortiori, when $r - g > 0$), it does not follow that inequality between capitalists and workers will increase. Whether it does will depend on the extent of social mobility. In fact, the quantitative implications of social mobility could be quite substantial as we next illustrate.

From Chetty, Hendren, Kline and Saez's data, the likelihood that a child with parents in the top 1 percent will be in the top 1 percent is 9.6%.[13] If we take the gap between generations to be about 30 years, this implies an annual rate of exiting the top 1 percent approximately equal to 0.075 (7.5%). There are many reasons why this may be an overestimate, including the fact that children are typically younger when their incomes are measured and also that in practice, families exiting the top 1 percent tend to remain at the very top of the income distribution (rather than follow the income dynamics of a typical worker as in the simple model here). But there are also reasons for underestimation, including the fact that within-generation transitions in and out of the top 1 percent are being ignored. For our illustrative exercise, we take this number as a benchmark (without any attempt to correct it for these possible concerns). This number corresponds to ν/m in our model (the probability that a given capitalist is hit by a shock and becomes a worker), so we take $\nu = 0.00075$. Using the top 1 percent's share as 20%, we can compute that the right-hand side of (A4) is approximately 0.072 (72%). This implies that for the left-hand side to exceed the right-hand side, the interest rate would have to be very high. For example, with a saving rate of 50% and a growth rate of 1%, we would need the interest rate to be greater than 15%. Alternatively, if we use the top 10 percent so as to reduce exits that may be caused by measurement error, the equivalent number from Chetty, Hendren, Kline (2014) is 26%, implying an annual exit rate equal to 4.4%. Using a share of 45% of income for the top 10 percent, the right-and side of (A4) can be computed as 0.038, again making it very difficult for realistic values of $r - g$ to create a natural and powerful force for the top inequality to increase. For example, using again a saving rate of 50% and a growth rate of 1%, the interest rate would need to be over 8.5%. We therefore conclude that incorporating social mobility greatly reduces any "fundamental force" that may have existed from $r - g$ towards mechanically greater inequality at the top of the distribution.

[13] We thank Nathan Hendren for providing us with the data.

$r - g$ and the Stationary Distribution of Income and Wealth

As discussed in the text, *Capital in the 21st Century* sometimes posits a relationship between $r - g$ and the stationary distribution of wealth instead of the relationship between $r - g$ and divergence of incomes and wealth. Empirically the Pareto distribution (with distribution function $1 - \Gamma a^{-\lambda}$ with Pareto shape coefficient $\lambda \geq 1$) appears to be a good approximation to the tail of the income and wealth distributions. For this reason, existing models have focused on stochastic processes for wealth accumulation that generate a Pareto distribution or distributions for which the right tail can be approximated by the Pareto form. Such models have a long history in economics, and are discussed in the context of the issues raised in *Capital in the 21st Century* in Jones (2014), and we refer the reader to this paper for more extensive references. Some recent papers that derive Pareto wealth distributions include Benhabib, Bisin and Zhu (2011), Aoki and Nirei (2013) and Jones and Kim (2014).

In this part of the appendix, we show that a Pareto tail in the wealth distribution emerges from certain classes of models, and will, under some conditions, correspond to greater top inequality when $r - g$ is higher, but we also highlight why these models are often not a good approximation to the type of top inequality we observe in the data and/or rely on implausible assumptions.

To give the basic idea, consider an economy consisting of a continuum of measure 1 of heterogeneous individuals. Suppose that each individual i is infinitely lived and consumes a constant fraction β of her wealth, A_{it}. She has a stochastic (possibly serially correlated) labor income Z_{it} (with $\mathbb{E}Z_{it} \in (0, \infty)$ and finite variance), and has a stochastic rate of return equal to $r + \varepsilon_{it}$, where ε_{it} is a stochastic, return term that is also possibly serially correlated (with the unconditional mean $\mathbb{E}\varepsilon_{it}$ equal to zero as a normalization). Thus, the law of motion of the assets of individual i is given by

$$A_{it+1} = (1 + r - \beta + \varepsilon_{it})A_{it} + Z_{it}.$$

Dividing both sides of this equation by GDP (also average income per capita), Y_t, we obtain

$$\tilde{a}_{it+1} = \frac{1 + r - \beta + \varepsilon_{it}}{1 + g}\tilde{a}_{it} + \tilde{z}_{it},$$

where $\tilde{a}_{it} \equiv A_{it}/Y_t$ and $\tilde{z}_{it} \equiv Z_{it}/Y_t$. A further normalization is also useful. Suppose that $\tilde{a}_{it}$ converges to a stationary distribution (we verify this below). Then let $\mathbb{E}\tilde{a}$ be the average (expected) value of $\tilde{a}_{it}$ in the stationary distribution. Then dividing both sides of this equation by $\mathbb{E}\tilde{a}$, we obtain

$$a_{it+1} = \frac{1 + r - \beta + \varepsilon_{it}}{1 + g}a_{it} + z_{it}, \tag{A5}$$

where $a_{it} \equiv \tilde{a}_{it}/\mathbb{E}\tilde{a}$ and $z_{it} \equiv \tilde{z}_{it}/\mathbb{E}\tilde{a}$, and of course $\mathbb{E}a_{it+1} = \mathbb{E}a_{it} = 1$ in the stationary distribution. This also implies that $\mathbb{E}z_{it} \in (0, 1)$.

Equation (A5) is an example of a Kesten process (Kesten, 1973), discussed, for example, in Gabaix (1999). Kesten shows that provided that $\frac{1+r-\beta}{1+g} < 1$, (A5) converges to a stationary distribution with a Pareto tail—meaning that the right tail of the distribution, corresponding to $a \geq \bar{a}$ for $\bar{a}$ sufficiently large, can be approximated by $1 - \Gamma a^{-\lambda}$ for some endogenously-determined Pareto shape parameter $\lambda \geq 0$.

To obtain the intuition for why (A5) generates a Pareto tail in the stationary distribution, we consider the following heuristic derivation, which follows Gabaix (1999). Let us focus on the case in which z and ε are iid. Let us also define the counter-cumulative density function of (normalized) wealth in this economy to be $\mathbb{G}(a) \equiv 1 - \Pr[a_{it} \leq a]$. Then

$$\begin{aligned} \Pr[a_{it+1} \geq a] &= \mathbb{E}\left[\mathbf{1}_{\{\gamma a_{it}+z \geq a\}}\right], \\ &= \mathbb{E}\left[\mathbf{1}_{\{a_{it} \geq (a-z)/\gamma\}}\right], \end{aligned}$$

where $\mathbf{1}_{\{\mathcal{P}\}}$ is the indicator function for the event $\mathcal{P}$, we have defined $\gamma \equiv \frac{1+r+\varepsilon-\beta}{1+g}$ for notational convenience, and we have dropped the indices for z and γ since the stochastic laws for these variables do not depend on time and are identical across individuals. Then, by the definition of a stationary distribution $\mathbb{G}$, we have

$$\mathbb{G}(a) = \mathbb{E}\left[\mathbb{G}\left(\frac{a-z}{\gamma}\right)\right].$$

Now let us conjecture a Pareto tail with shape parameter λ, i.e., $\mathbb{G}(a) = \Gamma a^{-\lambda}$ for large a. Then for large a, we have

$$\Gamma a^{-\lambda} = \Gamma \mathbb{E}(a-z)^{-\lambda}\left[\gamma^{\lambda}\right],$$

or

$$1 = \mathbb{E}\left(\frac{a-z}{a}\right)^{-\lambda}\left[\gamma^{\lambda}\right].$$

Since $\mathbb{E}z < \infty$ and has finite variance, we can write $\lim_{a\to\infty} \mathbb{E}\left(\frac{a-z}{a}\right)^{-\lambda} = 1$, which confirms the conjecture and defines λ as the positive solution to

$$\mathbb{E}\left[\gamma^{\lambda}\right] = 1. \tag{A6}$$

This equation also explains why $\mathbb{E}\gamma = \frac{1+r-\beta}{1+g} < 1$ is necessary for convergence to a stationary distribution (as otherwise the wealth distribution would diverge).

Once pinned down, this Pareto shape parameter of the right tail, λ, determines wealth inequality, as well as income inequality, at the top of the distribution. For example, if the entire wealth distribution were Pareto, then the top k's percentile's share of total wealth would be simply: $\left(\frac{k}{100}\right)^{\frac{1-\lambda}{\lambda}}$. This expression makes it clear that a lower λ corresponds to a "thicker tail" of the Pareto distribution and thus to a greater share of aggregate wealth accruing to households in the higher percentiles of the distribution.

The question of interest is whether an increase in $r-g$ (or in $r-g-\beta$) corresponding to a rightward shift in the stochastic distribution of γ will reduce λ, thus leading to greater inequality in the tail of the wealth distribution. Though in general this relationship is ambiguous, in a number of important cases such rightward shifts do reduce λ and increase top inequality as we next show.

Recall that (again ε_{it} and z_{it} being iid), we have

$$a_{it+1} = \gamma_{it} a_{it} + z_{it}.$$

Taking expectations on both sides, using the fact that γ_{it} is iid and that in the stationary distribution $\mathbb{E}a_{it+1} = \mathbb{E}a_{it} = 1$, we have

$$\mathbb{E}\gamma = 1 - \bar{z},$$

where $\bar{z} = \mathbb{E}z_{it} \in (0,1)$, as noted above. This equation also implies that $\mathbb{E}\gamma \in (0,1)$.

To determine the relationship between $r-g$ and λ, we consider two special cases.

First suppose that γ (or ε) is log normally distributed. In particular, suppose that $\ln\gamma$ has a normal distribution with mean $\ln(1-\bar{z}) - \sigma^2/2$ and variance $\sigma^2 > 0$ (so that $\mathbb{E}\gamma = 1-\bar{z}$). Then we have

$$\mathbb{E}[\gamma^\lambda] = \mathbb{E}[e^{\lambda \ln \gamma}],$$

which is simply the moment generating function of the normally distributed random variable $\ln\gamma$, which can be written as

$$\mathbb{E}[e^{\lambda \ln \gamma}] = e^{\lambda[\ln(1-\bar{z}) - \sigma^2/2] + \lambda^2\sigma^2/2}.$$

Then the definition of λ, $\mathbb{E}[\gamma^\lambda] = 1$, implies that

$$\lambda[\ln(1-\bar{z}) - \sigma^2/2] + \lambda^2\sigma^2/2 = 0,$$

which has two roots, $\lambda = 0$ (which is inadmissible for the stationary distribution), and the relevant one,

$$\lambda = 1 - \frac{\ln(1-\bar{z})}{\sigma^2/2} > 1.$$

Finally, for small values of $r-g-\beta < 0$, we can write

$$\gamma \approx 1 + r - g - \beta + \varepsilon,$$

and thus from the relationship that $\mathbb{E}\gamma = 1-\bar{z}$, we have that $\bar{z} = -(r-g-\beta) > 0$, so that

$$\lambda \approx 1 - \frac{\ln(1+r-g-\beta)}{\sigma^2/2}.$$

It then readily follows that λ is decreasing in $r-g-\beta$, thus implying that higher $r-g$ and lower marginal propensity to consume out of wealth, β, lead to greater top inequality.[14]

Second, a similar relationship can be derived even when γ is not log normally distributed, but only when $\bar{z}$ is small (and we will see why this may not be very attractive in the context of the stationary distribution of wealth). Let us start by taking a first-order Taylor expansion of $\mathbb{E}[\gamma^{\lambda}]=1$ with respect to λ around $\lambda=1$ (which also corresponds to making $\bar{z}$ lie close to zero). In particular, differentiating within the expectation operator, we have

$$\mathbb{E}[\gamma+\gamma\ln\gamma(\lambda-1)]\approx 1,$$

where this approximation requires λ to be close to 1.[15] Then again exploiting the fact that $\mathbb{E}\gamma=1-\bar{z}$, we have

$$\lambda\approx 1+\frac{\bar{z}}{\mathbb{E}[\gamma\ln\gamma]}>1.$$

(where the fact that $\mathbb{E}[\gamma\ln\gamma]>0$ follows from the fact that $\bar{z}$ is close to zero).[16] This expression clarifies why λ is close to 1 when $\bar{z}$ is close to 0.

Moreover, note that the derivative of $\gamma\ln\gamma$ is $1+\ln\gamma$. For $\bar{z}$ small, $\ln\gamma>-1$ with sufficiently high probability, and thus $\mathbb{E}[\gamma\ln\gamma]$ increases as γ shifts to the right (in the sense of first-order stochastic dominance). Therefore, when λ is close to 1 or equivalently when $\bar{z}$ is close to 0, a higher $r-g-\beta$ increases $\mathbb{E}[\gamma\ln\gamma]$ and reduces the shape parameter λ, raising top inequality. However, it should also be noted that this case is much less relevant for stationary wealth distributions which have Pareto tails much greater than 1.

Benhabib, Bisin and Zhu (2011) extend the result on the Pareto-tail of the wealth distribution to a setup with finitely-lived agents with bequest motives. In this case, the tail of the distribution is in part driven by which individuals have been accumulating for the longest time. They also derive the consumption choices from optimization decisions, consider the equilibrium determination of the interest rate, and confirm the results derived heuristically here. In addition, they show that one type of social mobility—related to the serial correlation of ε, thus making financial returns less correlated for a household over time—tends to make the tail less thick, hence reducing top inequality. These issues are also discussed in Jones (2014).

There are several reasons why these models may not be entirely satisfactory as models of top inequality, however. First, to the extent that very rich individuals have diversified portfolios,

[14] The same conclusion follows without the approximation $\gamma\approx 1+r-g-\beta+\varepsilon$. In this case, we would simply have

$$\lambda=1-\frac{\ln\left(1+\frac{1+r-\beta}{1+g}\right)}{\sigma^2/2},$$

which yields the same comparative statics.

[15] Formally, we have $\mathbb{E}[\gamma+\gamma\ln\gamma(\lambda-1)+o(\lambda)]=1$.

[16] By noting that $\gamma\ln\gamma$ is a convex function and applying Jensen's inequality, $\mathbb{E}[\gamma\ln\gamma]>\mathbb{E}\gamma\cdot\ln\mathbb{E}\gamma=(1-\bar{z})\ln(1-\bar{z})$. For $\bar{z}$ close enough to zero, $(1-\bar{z})\ln(1-\bar{z})=0$, and thus $\mathbb{E}[\gamma\ln\gamma]>0$.

variability in rates of returns as a driver of the tail of the distribution may not be the most dominant factor. Second, the structure of these models implies that labor income plays no role in the tail of the stationary wealth distribution, but this may be at odds with the importance of wages and salaries and "business income" in the top 1 percent or even top 0.1 percent share of the national income (Piketty and Saez, 2003). Third and relatedly, these models do not have a role for entrepreneurship, which is one of the important aspects of the interplay between labor and capital income (see, for example, Jones and Kim, 2014). Fourth, and most importantly in our opinion, these models do not feature social mobility (except the limited type of social mobility related to the correlation of financial returns considered in Benhabib, Bisin and Zhu, 2011), which appears to be an important determinant of top inequality and its persistence. Finally, in more realistic versions such as Benhabib, Bisin and Zhu (2011) and Jones and Kim (2014), a key determinant of the extent of top inequality turns out to be the age or some other characteristic of the household which determines how long the household has been accumulating. But this is also at odds with the salient patterns of the tail of the income and wealth distribution in the United States, whereby successful entrepreneurs or professionals are more likely to be represented at this tale than individuals or households that have been accumulating capital for a long while.

From $r - g$ to the Implications of Low Growth

A key part of Piketty's argument is that the future will bring even greater inequality because it will be characterized by low economic growth (at least in the developed 'capitalist' economies). This argument relies on two pillars—in addition to the link from $r - g$ to inequality or top inequality as explicated above. The first is that the future will be characterized by low growth. This is not the place to enter into a long debate about the forecasts of future growth rates, but it suffices to note that we do not find forecasts about future growth that do not make any reference to the future of technology, innovation, and the institutions that shape them particularly convincing. Though the demographic trends Piketty emphasizes are well known, their implications for economic growth are much less well understood.

The second important point is that, even if one were to take the link between $r - g$ and inequality on faith, this does not imply that a lower g will translate into a higher $r - g$. As we noted in the text, there are two reasons for this. First, changes in g will impact r from the household side. For example, if consumption decisions are made by optimizing households, then the interest rate is pinned down as $r = \theta g + \rho$, where θ is the inverse of the intertemporal elasticity of substitution. If only some fraction of households optimize and the rest are hand-to-mouth consumers, this equation will still apply because it will be the optimizing consumers who, at the margin, determine the equilibrium interest rate. In cases where $\theta > 1$, $r - g$ would actually decrease with declines in g.

Second, even ignoring the linkage between r and g coming from the household side, changes in g will impact r through their influence on the capital-output ratio (since r is related to the marginal product of capital). This is where Piketty asserts that the elasticity of substitution between capital and labor is very high, ensuring that changes in the capital-labor ratio in the economy do not translate into significant changes in the rate of return to capital and the interest rate. As we noted in the text, however, these strong claims are not backed by the existing evidence. Therefore, we are particularly skeptical of Piketty's conclusion from his theoretical edifice, even with the central role assigned to $r - g$.

These considerations suggest that even if $r - g$ may be a useful statistic in the context of top inequality, it cannot be used either for comparative static type analysis (because it will respond endogenously and depending on technology and institutions to the changes being considered) or even for medium-term forecasting. In addition, the Kaldor-type model presented above highlights another difficulty of reasoning in terms of $r - g$. For this quantity to be constant, we need to specify not only what the saving rate of workers has to be but also how it is changing. In particular, given the saving rate of capitalists and other variables, g is a function of the capitalists's share of national income, ϕ, the saving rate of workers, s_W, and the rate of growth of their labor income. This implies that if $r > g$, then because ϕ is changing, the saving rate and/or the growth rate of labor income of workers must be also implicitly changing.

All of this suggests that r and g must be treated as endogenous variables, and predictions about the future or comparative statics must be conducted in terms of exogenous variables, not in terms of endogenous objects.

Piketty's Second Fundamental Law of Capitalism

The final point we would like to comment on is Piketty's second fundamental law of capitalism, linking the capital-GDP ratio to the saving rate and the growth rate of the economy. Piketty uses this second fundamental law to assert a strong link between the size of the capital stock relative to GDP and the growth rate of the economy, and then on the basis of his forecasts of lower economic growth in the future, reaches the conclusion that the future will bring a pronounced increase in the size of the capital stock relative to GDP in advanced economies. Given a constant interest rate, r, this also implies the continuation of the recent increase in the share of capital in national income. Thus, while the fundamental force of $r - g$ provides an account of a growing top 1 percent share, the second fundamental law of capitalism provides predictions about the future of capital-GDP ratio and the share of national income accruing to capital overall.

In this part of the appendix, we show how something akin to the second fundamental law follows from the Solow growth model, but also that why it is misleading to derive predictions about the evolution of the capital-GDP ratio (or the capital share of national income) from this relationship because it relates these objects to endogenous variables that will all tend to change together in response to shocks or changes in parameters.

Piketty's second fundamental law of capitalism is

$$g = s\frac{Y}{K},$$

where s is the aggregate saving rate. Then, combining this with his first fundamental law (which is just an identity as noted in the text), he obtains that

$$\text{capital share of national income} = \frac{r \times s}{g}.$$

Holding r and s constant, if there is a decline in the growth rate of the economy, g, then capital share of national income will increase. In particular, if the growth rate is halved, then capital's share of national income should double.

Let us start with the steady-state equilibrium of a standard Solow growth model, where there is a constant saving rate, s, and depreciation of capital at the rate δ. Then in this steady-state equilibrium, we have

$$\frac{K}{Y} = \frac{s}{g + \delta}. \tag{A7}$$

To see this, simply note that, assuming a constant saving rate, aggregate saving is

$$sY = I = \dot{K} + \delta K,$$

so that

$$s\frac{Y}{K} = \frac{\dot{K}}{K} + \delta.$$

If we also have $g = \frac{\dot{K}}{K}$, then (A7) follows.

Piketty's version is the special case of this well-known relationship when $\delta = 0$—or when things are specified in "net" units, so that what we have is not national income, but national income net of depreciation, and the saving rate is interpreted as the saving rate above the amount necessary for replenishing depreciated capital. Krusell and Smith (2014) provide a more detailed critique of Piketty's second fundamental law formulated in this way. In particular, as we noted in the text, Piketty's second fundamental law has untenable implications, particularly in the cases where the growth rate of the economy becomes low (and it is these cases on which Piketty bases his conclusions about the implications of low growth on the capital share of national income).

We should also note that the second fundamental law applies when the capital-GDP ratio is constant, and thus $g = \frac{\dot{K}}{K}$ as just noted. Out of steady state (or balance growth path), it is not exactly true. Nevertheless, the relevant conclusion—that there will be an increase in the capital-GDP ratio following a decline in g provided that r and s remain constant—still holds. This follows from the fact that the new steady state following a lower growth rate, say $g' < g$, will involve a higher capital-GDP ratio of

$$\frac{K'}{Y'} = \frac{s}{g' + \delta},$$

and convergence to this new steady state in the baseline Solow model is monotone, so over time the capital-GDP ratio will monotonically increase (though with a small saving rate, the transition can take a long time).

Observe also that because of the depreciation rate, δ, in the denominator, the impact of changes in the growth rate are less than the very large effects Piketty's second fundamental law of capitalism implies (see again Krusell and Smith, 2014).

However, even though we have shown how a version of Piketty's second fundamental law of capitalism follows from the Solow growth model, this does not justify the conclusion that a slowdown in economic growth will automatically increase the capital-GDP ratio or the capital share of national income because, as already noted, almost any change that will reduce the rate of economic growth will also impact the interest rate and the saving rate.

Additional References for the Online Appendix

Aoki, Shuhei and Makoto Nirei (2013) "Pareto Distribution and the Evolution of Top Incomes in the US" University Library of Munich, Paper 47967.

Benhabib, Jess, Alberto Bisin, Shenghao Zhu (2011) "The Distribution of Wealth and Fiscal Policy in Economies with Finitely Lived Agents" *Econometrica*, 79(1), 123-157.

Gabaix, Xavier (1999) "Zipf's Law for Cities: An Explanation" *Quarterly Journal of Economics*, 114(3), 79-767.

Homburg, Stefan (2014) "Critical Remarks on Piketty's 'Capital in the Twenty-first Century'", Discussion Paper No. 530 (Institute of Public Economics, Leibniz University of Hannover, Germany) and ISSN 0949-9962.

Jones, Charles I. (2014) "The Macroeconomics of Piketty" forthcoming *Journal of Economic Perspectives.*

Jones, Charles I. and Jihee Kim (2014) "A Schumpeterian Model of Top Income Inequality" Stanford mimeo.

Kaldor, Nicholas (1955) "Alternative Theories of Distribution" *Review of Economic Studies*, 23(2), 83-100.

Kesten, Harry (1973) "Random Difference Equations and Renewal Theory for Product to Random Matrices" *Acta Mathematica*, 131, 207-248.

Nirei, Makoto (2009) "Pareto Distributions in Economic Growth Models" Hitotsubashi University, mimeo.

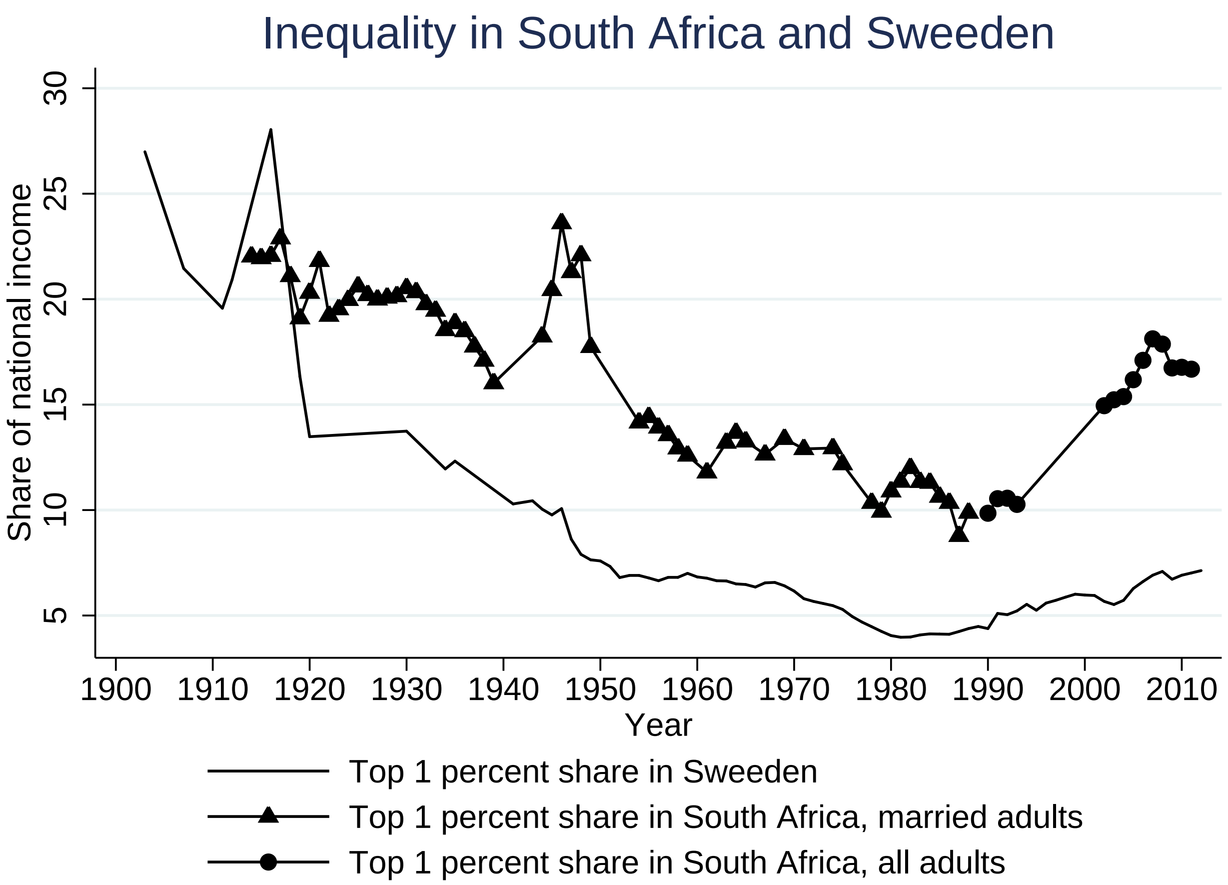

Figure 1: *Top 1 percent share of national income in Sweden and South Africa.* The figure plots the top 1 percent share of national income for South Africa and Sweden. The series for South Africa is from Alvaredo and Atkinson (2010). The series for Sweden is from Roine and Waldenström (2009).

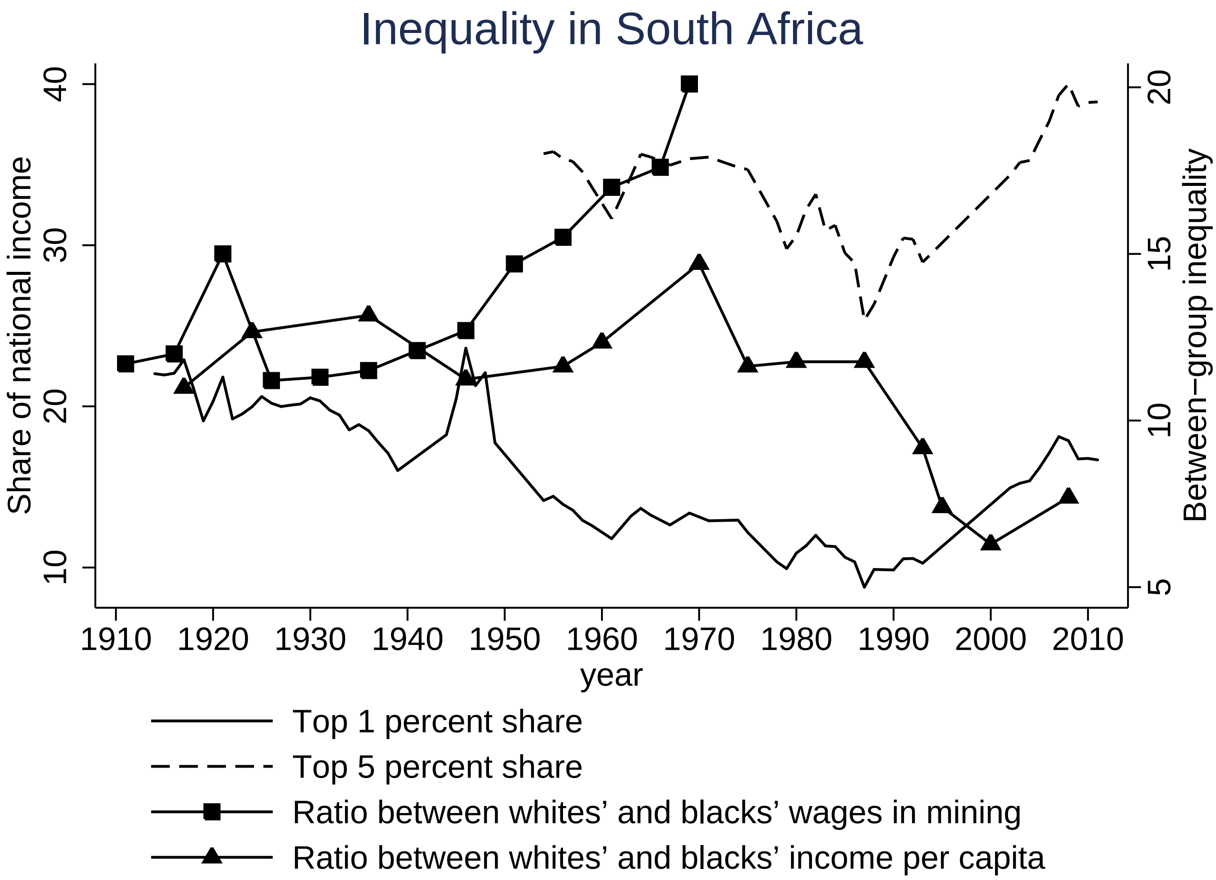

Figure 2: *Top income shares and between-group inequality in South Africa.* The figure plots the top 1 and 5 percent shares of national income for South Africa in the left axis, obtained from Alvaredo and Atkinson (2010). The right axis plots the ratio between whites' and blacks' wages in mining (obtained from Wilson, 1972), and the ratio between whites' and blacks' income per capita (obtained from Leibbrandt et al., 2010).

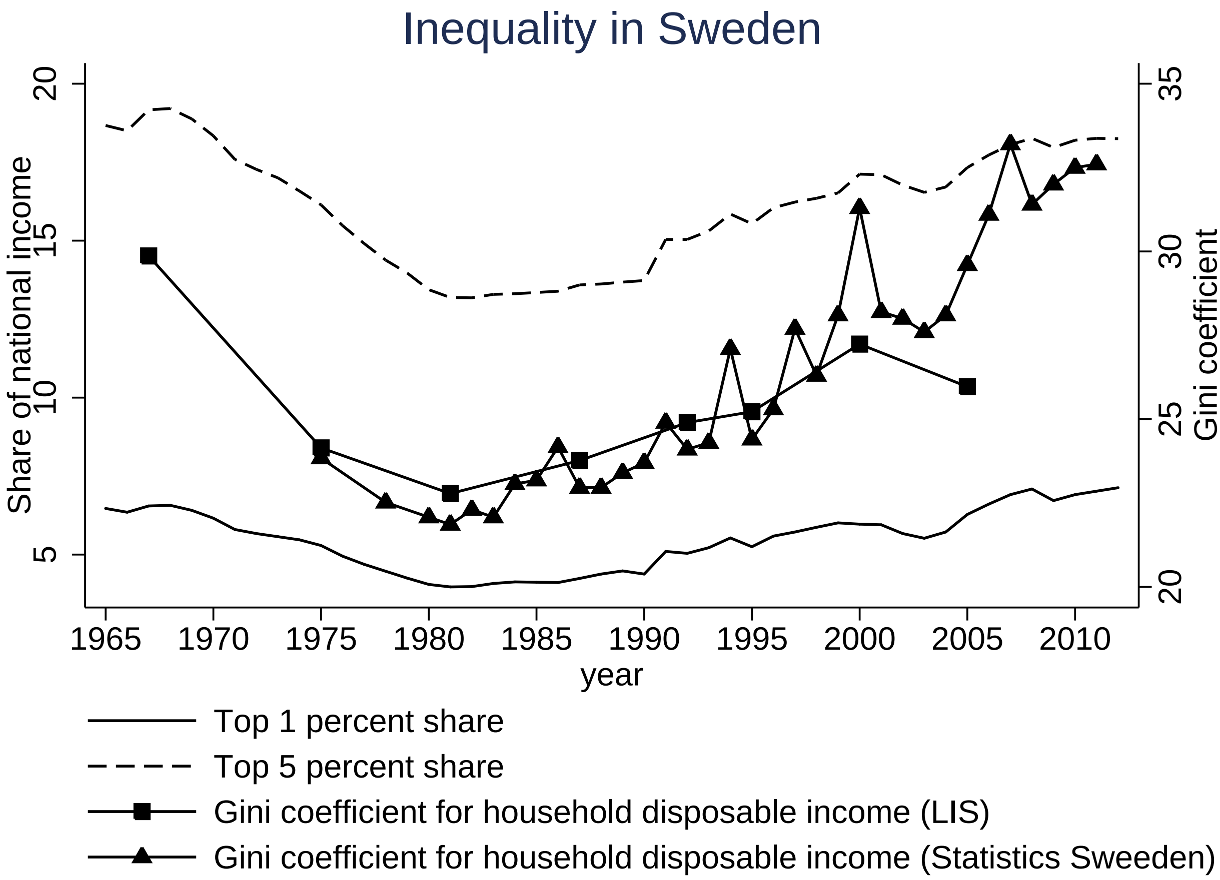

Figure 3: *Top income shares and overall inequality in Sweden.* The figure plots the top 1 and 5 percent shares of national income for Sweden in the left vertical axis, obtained from Roine and Waldenström (2009). The right axis plots the Gini coefficient for household disposable income, from the Luxembourg Income Study (see Milanovic, 2013), and from Statistics Sweden (SCB).

Table 1: Regression coefficients of different proxies of $r - g$. The dependent variable is the top 1 percent share of national income.

	No cross-country variation in r			*OECD data on interest rates*			$r = MPK - \delta$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Panel A: Estimates using annual panel					
Estimate of $r - g$ at t	-0.006	-0.018*	-0.018*	-0.066**	-0.038**	-0.040*	0.029	-0.004	-0.011
	(0.012)	(0.010)	(0.011)	(0.027)	(0.017)	(0.021)	(0.033)	(0.009)	(0.008)
Estimate of $r - g$ at $t - 1$			0.001			-0.003			0.005
			(0.009)			(0.015)			(0.014)
Estimate of $r - g$ at $t - 2$			0.005			0.010			-0.012
			(0.008)			(0.019)			(0.008)
Estimate of $r - g$ at $t - 3$			-0.002			-0.012			0.014*
			(0.008)			(0.024)			(0.008)
Estimate of $r - g$ at $t - 4$			-0.005			-0.005			0.006
			(0.007)			(0.013)			(0.010)
Joint significance of lags [p-value]			4.55 [0.47]			7.47 [0.19]			12.40 [0.03]
Long-run effect [p-value estimate> 0]		-0.16 [0.13]	-0.18 [0.15]		-0.39 [0.29]	-0.47 [0.34]		-0.04 [0.68]	0.03 [0.89]
Persistence of top 1 percent share [p-value estimate< 1]		0.89 [0.00]	0.89 [0.00]		0.90 [0.31]	0.89 [0.30]		0.90 [0.11]	0.92 [0.18]
Observations	1646	1233	1226	627	520	470	1162	905	860
Countries	27	27	27	19	18	18	28	26	26
				Panel B: Estimates using 10-year and 20-year panels (columns 3,6,9)					
Average $r - g$	0.055	-0.036	-0.252	-0.114	-0.121	-0.110	0.069	0.148	0.238
	(0.110)	(0.118)	(0.269)	(0.138)	(0.132)	(0.320)	(0.118)	(0.100)	(0.164)
Long-run effect [p-value estimate> 0]		-0.05 [0.76]			-0.25 [0.44]			0.29 [0.22]	
Persistence of top 1 percent share [p-value estimate< 1]		0.32 [0.00]			0.52 [0.02]			0.48 [0.00]	
Observations	213	181	106	82	80	43	135	124	61
Countries	27	25	24	18	18	17	27	25	22

Notes-: The table presents estimates of different proxies of $r - g$ on the top 1 percent share of national income. The dependent variable is available from 1871 onwards for the countries covered in the World Top Incomes Database. We use different proxies of $r - g$: Columns 1 to 3 use growth rates from Madisson, and assume no variation in real interest rates across countries. These data are available from 1870 onwards. Columns 4 to 6 use real interest rates computed by subtracting realized inflation from nominal yields on long-term government bonds, and growth rates from the Penn World Tables. These data are only available since 1955 for OECD countries. Columns 7 to 9 use $r = MPK - \delta$, constructed as explained in the text using data from the Penn World Tables, and growth rates from the Penn World Tables. These data are available for 1950 onwards. Panel A uses an unbalanced yearly panel. Columns 2,5 and 8 add five lags of the dependent variable and report the estimated persistence of the top 1 percent share of national income and the estimated long run effect of $r - g$ on the dependent variable. Columns 3,6 and 9 add four lags of $r - g$ on the right-hand side, and also report the long-run effect of a permanent increase of 1% in $r - g$ and a test for the joint significance of these lags (with its corresponding χ^2 statistic and p-value). Panel B uses an unbalanced panel with observations every 10 years or 20 years (columns 3,6,9). Columns 1,2,4,5,7 and 8 present estimates from a regression of the top 1 percent share of national income at the end of each decade in the sample (that is, 1880, 1890, ..., 2010, depending on data availability) on the average $r - g$ during the decade. Columns 2,5, and 8 add one lag of the dependent variable on the right-hand side. Finally, columns 3,6 and 9, present estimates from a regression of the top 1 percent share of national income at the end of each 20-year period in the sample (that is, 1890, 1910, ..., 2010, depending on data availability) on the average $r - g$ during the period. All specifications include a full set of country and year fixed effects. Standard errors allowing for arbitrary heteroscedasticity and serial correlation of residuals at the country level are computed using the pairs-cluster bootstrap procedure proposed by Cameron, Gelbach and Miller (2008) and are reported in parentheses.

Table A1: Regression coefficients of different proxies of $r-g$. The dependent variable is the top 1 percent share of national income. Traditional standard errors assuming homoscedasticity and no serial correlation.

	No cross-country variation in r			*OECD data on interest rates*			$r = MPK - \delta$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
					Panel A: Estimates using annual panel				
Estimate of $r-g$ at t	-0.006	-0.018***	-0.018***	-0.066***	-0.038***	-0.040**	0.029*	-0.004	-0.011
	(0.011)	(0.005)	(0.005)	(0.022)	(0.013)	(0.017)	(0.016)	(0.008)	(0.010)
Estimate of $r-g$ at $t-1$			0.001			-0.003			0.005
			(0.006)			(0.019)			(0.010)
Estimate of $r-g$ at $t-2$			0.005			0.010			-0.012
			(0.006)			(0.019)			(0.010)
Estimate of $r-g$ at $t-3$			-0.002			-0.012			0.014
			(0.006)			(0.019)			(0.010)
Estimate of $r-g$ at $t-4$			-0.005			-0.005			0.006
			(0.006)			(0.017)			(0.009)
Joint significance of lags [p-value]			2.65 [0.02]			1.53 [0.18]			1.01 [0.41]
Long-run effect [p-value estimate> 0]		-0.16 [0.00]	-0.18 [0.05]		-0.39 [0.03]	-0.47 [0.06]		-0.04 [0.67]	0.03 [0.89]
Persistence of top 1 percent share [p-value estimate< 1]		0.89 [0.00]	0.89 [0.00]		0.90 [0.00]	0.89 [0.00]		0.90 [0.00]	0.92 [0.00]
Observations	1646	1233	1226	627	520	470	1162	905	860
Countries	27	27	27	19	18	18	28	26	26
Years per country	61.0	45.7	45.4	33.0	28.9	26.1	41.5	34.8	33.1
				Panel B: Estimates using 10-year and 20-year panels (columns 3,6,9)					
Average $r-g$	0.055	-0.036	-0.252	-0.114	-0.121	-0.110	0.069	0.148*	0.238
	(0.095)	(0.098)	(0.228)	(0.132)	(0.118)	(0.247)	(0.091)	(0.088)	(0.172)
Long-run effect [p-value estimate> 0]		-0.05 [0.72]			-0.25 [0.32]			0.29 [0.11]	
Persistence of top 1 percent share [p-value estimate< 1]		0.32 [0.00]			0.52 [0.00]			0.48 [0.00]	
Observations	213	181	106	82	80	43	135	124	61
Countries	27	25	24	18	18	17	27	25	22
Years per country	7.9	7.2	4.4	4.6	4.4	2.5	5.0	5.0	2.8

Notes-: The table presents estimates of different proxies of $r-g$ on the top 1 percent share of national income. The dependent variable is available from 1871 onwards for the countries covered in the World Top Incomes Database. We use different proxies of $r-g$: Columns 1 to 3 use growth rates from Madisson, and assume no variation in real interest rates across countries. These data are available from 1870 onwards. Columns 4 to 6 use real interest rates computed by subtracting realized inflation from nominal yields on long-term government bonds, and growth rates from the Penn World Tables. These data are only available since 1955 for OECD countries. Columns 7 to 9 use $r = MPK - \delta$, constructed as explained in the text using data from the Penn World Tables, and growth rates from the Penn World Tables. These data are available for 1950 onwards. Panel A uses an unbalanced yearly panel. Columns 2,5 and 8 add five lags of the dependent variable and report the estimated persistence of the top 1 percent share of national income and the estimated long run effect of $r-g$ on the dependent variable. Columns 3,6 and 9 add four lags of $r-g$ on the right-hand side, and also report the long-run effect of a permanent increase of 1% in $r-g$ and a test for the joint significance of these lags (with its corresponding χ^2 statistic and p-value). Panel B uses an unbalanced panel with observations every 10 years or 20 years (columns 3,6,9). Columns 1,2,4,5,7 and 8 present estimates from a regression of the top 1 percent share of national income at the end of each decade in the sample (that is, 1880, 1890, ..., 2010, depending on data availability) on the average $r-g$ during the decade. Columns 2,5, and 8 add one lag of the dependent variable on the right-hand side. Finally, columns 3,6 and 9, present estimates from a regression of the top 1 percent share of national income at the end of each 20-year period in the sample (that is, 1890, 1910, ..., 2010, depending on data availability) on the average $r-g$ during the period. All specifications include a full set of country and year fixed effects. Traditional standard errors, imposing homoscedasticity and no residual auto correlation, are reported in parentheses.

Table A2: Regression coefficients of different proxies of $r-g$ controlling for GDP per capita, population growth and country trends.

	No variation in r		*OECD interest rates*		$r = MPK - \delta$	
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Baseline			
Estimate of $r-g$ at t	-0.006	-0.018*	-0.066**	-0.038**	0.029	-0.004
	(0.012)	(0.010)	(0.027)	(0.017)	(0.033)	(0.009)
Long-run effect [p-value estimate> 0]		-0.16 [0.13]		-0.39 [0.29]		-0.04 [0.68]
Persistence of top 1 percent share [p-value estimate< 1]		0.89 [0.00]		0.90 [0.31]		0.90 [0.11]
Observations	1646	1233	627	520	1162	905
Countries	27	27	19	18	28	26
			Panel B: log of GDP per capita			
Estimate of $r-g$ at t	-0.006	-0.018*	-0.035	-0.039**	0.032	-0.006
	(0.011)	(0.010)	(0.028)	(0.017)	(0.031)	(0.009)
log GDP per capita at t	-0.169	0.022	3.270	-0.096	0.145	-0.199
	(0.767)	(0.166)	(2.149)	(0.809)	(1.152)	(0.281)
Long-run effect [p-value estimate> 0]		-0.16 [0.14]		-0.41 [0.36]		-0.06 [0.55]
Persistence of top 1 percent share [p-value estimate< 1]		0.89 [0.00]		0.91 [0.35]		0.90 [0.14]
Observations	1646	1233	620	514	1151	898
Countries	27	27	19	18	28	26
			Panel C: Population growth			
Estimate of $r-g$ at t	0.004	-0.017*	-0.039	-0.034*	0.030	-0.006
	(0.013)	(0.009)	(0.027)	(0.018)	(0.031)	(0.008)
Population growth at t	0.255	0.033	0.544	0.117	0.140	-0.055
	(0.225)	(0.060)	(0.464)	(0.139)	(0.310)	(0.067)
Long-run effect [p-value estimate> 0]		-0.15 [0.11]		-0.37 [0.34]		-0.05 [0.51]
Persistence of top 1 percent share [p-value estimate< 1]		0.89 [0.00]		0.91 [0.30]		0.90 [0.10]
Observations	1646	1233	608	503	1134	885
Countries	27	27	19	18	27	26
			Panel D: Country trends			
Estimate of $r-g$ at t	-0.002	-0.018*	-0.022	-0.024	0.015	-0.006
	(0.010)	(0.011)	(0.015)	(0.017)	(0.016)	(0.009)
Long-run effect [p-value estimate> 0]		-0.10 [0.15]		-0.06 [0.07]		-0.02 [0.52]
Persistence of top 1 percent share [p-value estimate< 1]		0.82 [0.00]		0.62 [0.00]		0.70 [0.00]
Observations	1646	1233	627	520	1162	905
Countries	27	27	19	18	28	26

Notes-: The table presents estimates of different proxies of $r-g$ on the top 1 percent share of national income. The dependent variable is available from 1871 onwards for the countries covered in the World Top Incomes Database. We use different proxies of $r-g$: Columns 1 and 2 use growth rates from Madisson, and assume no variation in real interest rates across countries. These data are available from 1870 onwards. Columns 3 and 4 use real interest rates computed by subtracting realized inflation from nominal yields on long-term government bonds, and growth rates from the Penn World Tables. These data are only available since 1955 for OECD countries. Columns 5 and 6 use $r = MPK - \delta$, constructed as explained in the text using data from the Penn World Tables, and growth rates from the Penn World Tables. These data are available for 1950 onwards. Columns 2,4 and 6 add five lags of the dependent variable and report the estimated persistence of the top 1 percent share of national income and the estimated long run effect of $r-g$ on the dependent variable. Panel A presents the baseline estimates. Panel B adds the log of GDP per capita as a control. Panel C adds population growth as a control. Finally, Panel D adds country-specific trends as controls. All specifications include a full set of country and year fixed effects. Standard errors allowing for arbitrary heteroscedasticity and serial correlation of residuals at the country level are computed using the pairs-cluster bootstrap procedure proposed by Cameron, Gelbach and Miller (2008) and are reported in parentheses.

Table A3: Regression coefficients of different proxies of $r-g$. The dependent variable is the top 5 percent share of national income.

	No cross-country variation in r			*OECD data on interest rates*			$r = MPK - \delta$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Panel A: Estimates using annual panel					
Estimate of $r-g$ at t	-0.002	0.010	0.007	-0.109**	-0.039	-0.046	0.056	0.006	-0.006
	(0.034)	(0.022)	(0.022)	(0.049)	(0.028)	(0.033)	(0.068)	(0.022)	(0.027)
Estimate of $r-g$ at $t-1$			-0.001			0.008			0.005
			(0.018)			(0.021)			(0.021)
Estimate of $r-g$ at $t-2$			0.035***			0.007			-0.007
			(0.013)			(0.025)			(0.016)
Estimate of $r-g$ at $t-3$			-0.006			0.010			0.020
			(0.013)			(0.034)			(0.012)
Estimate of $r-g$ at $t-4$			-0.008			-0.001			0.011
			(0.013)			(0.019)			(0.015)
Joint significance of lags [p-value]			14.81 [0.01]			3.63 [0.60]			4.63 [0.46]
Long-run effect [p-value estimate> 0]		0.12 [0.67]	0.34 [0.37]		-0.48 [0.30]	-0.25 [0.66]		0.08 [0.80]	0.34 [0.41]
Persistence of top 1 percent share [p-value estimate< 1]		0.92 [0.01]	0.92 [0.01]		0.92 [0.28]	0.91 [0.27]		0.93 [0.12]	0.93 [0.13]
Observations	1307	988	988	590	489	440	985	786	749
Countries	24	21	21	18	17	17	24	20	20
				Panel B: Estimates using 10-year and 20-year panels (columns 3,6,9)					
Average $r-g$	-0.019	-0.147	-0.602	-0.151	-0.075	-0.043	0.102	0.252**	0.323
	(0.207)	(0.207)	(0.514)	(0.224)	(0.217)	(0.500)	(0.199)	(0.128)	(0.256)
Long-run effect [p-value estimate> 0]		-0.24 [0.49]			-0.19 [0.73]			0.50 [0.14]	
Persistence of top 1 percent share [p-value estimate< 1]		0.39 [0.00]			0.60 [0.12]			0.50 [0.00]	
Observations	171	143	86	78	76	41	114	105	55
Countries	22	21	20	17	17	16	22	21	20

Notes-: The table presents estimates of different proxies of $r-g$ on the top 5 percent share of national income. The dependent variable is available from 1871 onwards for the countries covered in the World Top Incomes Database. We use different proxies of $r-g$: Columns 1 to 3 use growth rates from Madisson, and assume no variation in real interest rates across countries. These data are available from 1870 onwards. Columns 4 to 6 use real interest rates computed by subtracting realized inflation from nominal yields on long-term government bonds, and growth rates from the Penn World Tables. These data are only available since 1955 for OECD countries. Columns 7 to 9 use $r = MPK - \delta$, constructed as explained in the text using data from the Penn World Tables, and growth rates from the Penn World Tables. These data are available for 1950 onwards. Panel A uses an unbalanced yearly panel. Columns 2,5 and 8 add five lags of the dependent variable and report the estimated persistence of the top 5 percent share of national income and the estimated long run effect of $r-g$ on the dependent variable. Columns 3,6 and 9 add four lags of $r-g$ on the right-hand side, and also report the long-run effect of a permanent increase of 1% in $r-g$ and a test for the joint significance of these lags (with its corresponding χ^2 statistic and p-value). Panel B uses an unbalanced panel with observations every 10 years or 20 years (columns 3,6,9). Columns 1,2,4,5,7 and 8 present estimates from a regression of the top 5 percent share of national income at the end of each decade in the sample (that is, 1880, 1890, ..., 2010, depending on data availability) on the average $r-g$ during the decade. Columns 2,5, and 8 add one lag of the dependent variable on the right-hand side. Finally, columns 3,6 and 9, present estimates from a regression of the top 5 percent share of national income at the end of each 20-year period in the sample (that is, 1890, 1910, ..., 2010, depending on data availability) on the average $r-g$ during the period. All specifications include a full set of country and year fixed effects. Standard errors allowing for arbitrary heteroscedasticity and serial correlation of residuals at the country level are computed using the pairs-cluster bootstrap procedure proposed by Cameron, Gelbach and Miller (2008) and are reported in parentheses.

Table A4: Regression coefficients of different proxies of $r-g$. The dependent variable is the top 1 percent share of national income. Sample restricted to OECD countries since 1950.

	No cross-country variation in r			*OECD data on interest rates*			$r = MPK - \delta$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Panel A: Estimates using annual panel					
Estimate of $r-g$ at t	-0.127***	-0.057***	-0.057**	-0.066**	-0.038**	-0.040*	0.074	-0.020	-0.020
	(0.046)	(0.022)	(0.023)	(0.027)	(0.017)	(0.021)	(0.080)	(0.015)	(0.020)
Estimate of $r-g$ at $t-1$			-0.001			-0.003			-0.001
			(0.030)			(0.015)			(0.039)
Estimate of $r-g$ at $t-2$			-0.014			0.010			-0.009
			(0.020)			(0.019)			(0.022)
Estimate of $r-g$ at $t-3$			-0.014			-0.012			0.008
			(0.023)			(0.024)			(0.019)
Estimate of $r-g$ at $t-4$			-0.025			-0.005			-0.020
			(0.021)			(0.013)			(0.030)
Joint significance of lags [p-value]			13.47 [0.02]			7.47 [0.19]			3.34 [0.65]
Long-run effect [p-value estimate> 0]		-0.61 [0.31]	-1.02 [0.32]		-0.39 [0.29]	-0.47 [0.34]		-0.24 [0.53]	-0.47 [0.63]
Persistence of top 1 percent share [p-value estimate< 1]		0.91 [0.34]	0.89 [0.33]		0.90 [0.31]	0.89 [0.30]		0.91 [0.39]	0.91 [0.44]
Observations	627	520	470	627	520	470	627	520	470
Countries	19	18	18	19	18	18	19	18	18
				Panel B: Estimates using 10-year and 20-year panels (columns 3,6,9)					
Average $r-g$	-0.671***	-0.631***	-1.146*	-0.114	-0.121	-0.110	0.052	0.017	0.132
	(0.256)	(0.208)	(0.599)	(0.138)	(0.132)	(0.320)	(0.208)	(0.157)	(0.279)
Long-run effect [p-value estimate> 0]		-1.30 [0.11]			-0.25 [0.44]			0.04 [0.92]	
Persistence of top 1 percent share [p-value estimate< 1]		0.51 [0.02]			0.52 [0.02]			0.53 [0.03]	
Observations	82	80	43	82	80	43	82	80	43
Countries	18	18	17	18	18	17	18	18	17

Notes-: The table presents estimates of different proxies of $r-g$ on the top 1 percent share of national income. We restrict our sample to OECD countries for which interest rates data is available from 1955 onwards. The countries in our sample include Australia, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, United Kingdom and United States. We use different proxies of $r-g$: Columns 1 to 3 use growth rates from the Penn World Tables, and assume no variation in real interest rates across countries. Columns 4 to 6 use real interest rates computed by subtracting realized inflation from nominal yields on long-term government bonds, and growth rates from the Penn World Tables. Columns 7 to 9 use $r = MPK - \delta$, constructed as explained in the text using data from the Penn World Tables, and growth rates from the Penn World Tables. Panel A uses an unbalanced yearly panel. Columns 2,5 and 8 add five lags of the dependent variable and report the estimated persistence of the top 1 percent share of national income and the estimated long run effect of $r-g$ on the dependent variable. Columns 3,6 and 9 add four lags of $r-g$ on the right-hand side, and also report the long-run effect of a permanent increase of 1% in $r-g$ and a test for the joint significance of these lags (with its corresponding χ^2 statistic and p-value). Panel B uses an unbalanced panel with observations every 10 years or 20 years (columns 3,6,9). Columns 1,2,4,5,7 and 8 present estimates from a regression of the top 1 percent share of national income at the end of each decade in the sample (that is, 1880, 1890, ..., 2010, depending on data availability) on the average $r-g$ during the decade. Columns 2,5, and 8 add one lag of the dependent variable on the right-hand side. Finally, columns 3,6 and 9, present estimates from a regression of the top 1 percent share of national income at the end of each 20-year period in the sample (that is, 1970, 1990, ..., 2010) on the average $r-g$ during the period. All specifications include a full set of country and year fixed effects. Standard errors allowing for arbitrary heteroscedasticity and serial correlation of residuals at the country level are computed using the pairs-cluster bootstrap procedure proposed by Cameron, Gelbach and Miller (2008) and are reported in parentheses.

Table A5: Regression coefficients of different proxies of $r-g$. The dependent variable is the capital share of national income.

	Dep. var: capital share from Penn World Tables						*Dep. var: capital share from Karabarbounis and Neiman (2013)*					
	No cross-country variation in r			*OECD data on interest rates*			*No cross-country variation in r*			*OECD data on interest rates*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						Panel A: Estimates using annual panel						
Estimate of $r-g$ at t	-0.045	-0.009	-0.008	-0.240***	-0.053**	-0.072***	-0.203***	-0.052**	-0.075***	-0.100	-0.007	-0.033
	(0.033)	(0.011)	(0.011)	(0.088)	(0.026)	(0.025)	(0.057)	(0.025)	(0.025)	(0.093)	(0.031)	(0.029)
Estimate of $r-g$ at $t-1$			-0.004			0.046*			0.088***			0.059*
			(0.011)			(0.025)			(0.021)			(0.033)
Estimate of $r-g$ at $t-2$			-0.005			0.063*			0.023			0.062**
			(0.007)			(0.036)			(0.025)			(0.025)
Estimate of $r-g$ at $t-3$			-0.006			-0.002			-0.018			-0.013
			(0.007)			(0.033)			(0.022)			(0.031)
Estimate of $r-g$ at $t-4$			-0.006			0.048*			0.014			0.031
			(0.007)			(0.026)			(0.019)			(0.023)
Joint significance of lags [p-value]			. [0.81]			. [0.00]			. [0.00]			. [0.00]
Long-run effect [p-value estimate> 0]		-0.05 [0.41]	-0.15 [0.19]		-0.28 [0.03]	0.46 [0.13]		-0.20 [0.02]	0.14 [0.51]		-0.03 [0.82]	0.45 [0.06]
Persistence of capital share [p-value estimate< 1]		0.81 [0.00]	0.81 [0.00]		0.81 [0.00]	0.82 [0.00]		0.74 [0.00]	0.77 [0.00]		0.76 [0.00]	0.76 [0.00]
Observations	2687	2619	2611	412	412	397	1735	1239	1239	495	430	406
Countries	123	123	123	19	19	19	99	92	92	19	19	19
						Panel B: Estimates using 10-year and 20-year panels (columns 3,6,9,12)						
Average $r-g$	-0.137	-0.136	-0.258	0.207	0.187	0.560*	-0.026	-0.534	-0.269	0.254	0.086	-0.046
	(0.124)	(0.122)	(0.307)	(0.185)	(0.196)	(0.331)	(0.156)	(0.339)	(0.742)	(0.275)	(0.385)	(0.374)
Long-run effect [p-value estimate> 0]		-0.16 [0.27]			0.18 [0.36]			-0.53 [0.13]			0.06 [0.83]	
Persistence of capital share [p-value estimate< 1]		0.13 [0.00]			-0.06 [0.00]			-0.01 [0.00]			-0.37 [0.00]	
Observations	350	350	208	55	55	34	151	59	40	56	39	26
Countries	123	123	104	19	19	17	57	22	20	18	14	13

Notes-: The table presents estimates of different proxies of $r-g$ on the capital share of national income. The dependent variable is the capital share of national income. In columns 1 to 6, we use data from the Penn World Tables to compute the capital share for 1990 onwards. In columns 7 to 12, we use the capital share data from Karabarbounis and Neiman (2013). We use different proxies of $r-g$: Columns 1 to 3 and 7 to 9 use growth rates from Madisson, and assume no variation in real interest rates across countries. These data are available from 1870 onwards for most of the countries in the sample. Columns 4 to 6 and 10 to 12 use real interest rates computed by subtracting realized inflation from nominal yields on long-term government bonds, and growth rates from the Penn World Tables. These data are only available since 1955 for OECD countries. Panel A uses an unbalanced yearly panel. Columns 2,5,8 and 11 add five lags of the dependent variable and report the estimated persistence of the capital share of national income and the estimated long run effect of $r-g$ on the dependent variable. Columns 3,6,9 and 12 add four lags of $r-g$ on the right-hand side, and also report the long-run effect of a permanent increase of 1% in $r-g$ and a test for the joint significance of these lags (with its corresponding χ^2 statistic and p-value). Panel B uses an unbalanced panel with observations every 10 years or 20 years (columns 3,6,9,12). Columns 1,2,4,5,7,8,10 and 11 present estimates from a regression of the capital share of national income at the end of each decade in the sample (that is, 1980, 1990, ..., 2010, depending on data availability) on the average $r-g$ during the decade. Columns 2,5,8 and 11 add one lag of the dependent variable on the right-hand side. Finally, columns 3,6,9 and 12, present estimates from a regression of the capital share of national income at the end of each 20-year period in the sample (that is, 1990 and 2010) on the average $r-g$ during the period. All specifications include a full set of country and year fixed effects. Standard errors allowing for arbitrary heteroscedasticity and serial correlation of residuals at the country level are computed using the pairs-cluster bootstrap procedure proposed by Cameron, Gelbach and Miller (2008) and are reported in parentheses.