

## ***About Capital in the 21<sup>st</sup> Century***

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December 31, 2014

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In my view, *Capital in the 21<sup>st</sup> century* is primarily a book about the history of the distribution of income and wealth. Thanks to the cumulative efforts of several dozen scholars, we have been able to collect a relatively large historical database on the structure of national income and national wealth and the evolution of income and wealth distributions, covering three centuries and over 20 countries. My first objective in this book was to present this body of historical evidence, and then to try to analyze the economic, social and political processes that can account for the many evolutions that we observe in the various countries since the Industrial Revolution. I stress from the beginning that we have too little historical data at our disposal to be able to draw definitive judgments. On the other hand, at least we have substantially more evidence than we used to. Imperfect as it is, I hope this work can contribute to put the study of distribution and of the long run back at the center of economic thinking. In this article, I present three key facts about inequality in the long run emerging from this research (see Figures 1-3; see also Piketty and Saez, 2014) and seek to sharpen and refocus the discussion about those trends. In particular, I clarify the role played by  $r > g$  in my analysis of wealth inequality. I then discuss some of the implications for optimal taxation, and the relation between capital-income ratios and capital shares.<sup>1</sup>

### **What $r > g$ can and cannot explain**

In my view, the magnitude of the gap between  $r$  and  $g$ , where  $r$  is the rate of return on capital and  $g$  the economy's growth rate, is one of the important forces that can account for the historical magnitude and variations in wealth inequality. In particular, it can explain why wealth inequality was so extreme and persistent in pretty much every society up until World War I (see Chapter 10 of my book).

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<sup>1</sup> All data series and models are available in an on-line appendix (see <http://piketty.pse.ens.fr/capital21c>). New updated series are also available on the WTID (World Top Incomes Database) website.

That said, the way in which I perceive the relationship between  $r > g$  and inequality is often not well captured in the discussion that has surrounded my book. For example, I do not view  $r > g$  as the only or even the primary tool for considering changes in income and wealth in the 20<sup>th</sup> century, or for forecasting the path of income and wealth inequality in the 21<sup>st</sup> century. Institutional changes and political shocks - which to a large extent can be viewed as endogenous to the inequality and development process itself - played a major role in the past, and it will probably be the same in the future.

In addition, I certainly do not believe that  $r > g$  is a useful tool for the discussion of rising inequality of labor income: other mechanisms and policies are much more relevant here, e.g. supply and demand of skills and education. For instance, I point out in my book (particularly Chapters 8-9) that the rise of top income shares in the US over the 1980-2010 period is due for the most part to rising inequality of labor earnings, which can itself be explained by a mixture of two groups of factors: rising inequality in access to skills and to higher education over this time period in the United States, an evolution which might have been exacerbated by rising tuition fees and insufficient public investment; and exploding top managerial compensation, itself probably stimulated by changing incentives and norms, and by large cuts in top tax rates (see also Ch. 14; Piketty, Saez and Stantcheva, 2014). In any case, this rise in labor income inequality in recent decades has evidently little to do with  $r > g$ , and it is clearly a very important historical development. Indeed it explains why total income inequality is now substantially higher in the U.S. than in Europe, while the opposite was true until World War 1 (see Fig.1). At that time, high inequality was mostly due to extreme concentration of capital ownership and capital income. Wealth inequality is currently much less extreme than a century ago, in spite of the fact that the total capitalization of private wealth relative to national income has now recovered from the 1914-1945 shocks (see Fig. 2-

3). One central question for the future is to better understand the conditions under which the concentration of property might return to pre-1914 levels.

### **$r > g$ and the amplification of wealth inequality**

I now clarify the role played by  $r > g$  in my analysis of the long-run level of wealth inequality. Specifically, a higher  $r-g$  gap does not have much impact on labor earnings inequality, but it will tend to greatly amplify the steady-state inequality of a wealth distribution that arises out of a given mixture of shocks (including labor income shocks).

Let me first say very clearly that  $r > g$  is certainly not a problem in itself. Indeed, as rightly argued by Mankiw (2015), the inequality  $r > g$  holds true in the steady-state equilibrium of the most common economic models, including representative-agent models where each individual owns an equal share of the capital stock. For instance, in the standard dynastic model where each individual behaves as an infinitely lived family, the steady-state rate of return is well known to be given by the modified “golden rule”  $r = \theta + \gamma g$  (where  $\theta$  is the rate of time preference and  $\gamma$  is the curvature of the utility function). E.g. if  $\theta=3$  percent,  $\gamma=2$ , and  $g=1$  percent, then  $r=5$  percent. In this framework, the inequality  $r > g$  always holds true, and this does not entail any implication about wealth inequality.

In a representative-agent framework, what  $r > g$  means is that in steady-state each family only needs to reinvest a fraction  $g/r$  of its capital income in order to ensure that its capital stock will grow at the same rate  $g$  as the size of the economy, and the family can then consume a fraction  $1-g/r$ . For example, if  $r=5$  percent and  $g=1$  percent, then each family will reinvest 20 percent of its capital income and can consume 80 percent. This tells us nothing at

all about inequality: this is simply saying that capital ownership allows to reach higher consumption levels - which is really the very least one can ask from capital ownership.<sup>2</sup>

So what is the relationship between  $r-g$  and wealth inequality ? To answer this question, one needs to introduce extra ingredients into the basic model, so that inequality arises in the first place.<sup>3</sup> In the real world, many shocks to the wealth trajectories of families can contribute to making the wealth distribution highly unequal (indeed, in every country and time period for which we have data, wealth distribution *within each age group* is substantially more unequal than income distribution, which is difficult to explain with standard life-cycle models of wealth accumulation). There are demographic shocks: some families have many children and have to split inheritances in many pieces, some have few; some parents die late, some die soon, and so on. There are also shocks to rates of return: some families make good investments, others go bankrupt. There are shocks to labor market outcomes: some earn high wages, others do not. There are differences in taste parameters that affect the level of saving: some families consume more than a fraction  $1-g/r$  of their capital income, and might even consume of the capital value and die with negligible wealth; others might reinvest more than a fraction  $g/r$  and have a strong taste for leaving bequests and perpetuating large fortunes.

A central property of this large class of models is that for a given structure of shocks, the long-run magnitude of wealth inequality will tend to be magnified if the gap  $r - g$  is higher. In other words, wealth inequality will converge towards a finite level. The shocks will ensure that there is always some degree of downward and upward wealth mobility, so that wealth inequality remains bounded in the long run. But this finite inequality level will be a steeply rising function of the gap  $r-g$ . Intuitively, a higher gap between  $r$  and  $g$  works as an

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<sup>2</sup> The inequality  $r < g$  would correspond to a situation which economists often refer to as “dynamic inefficiency”: in effect, one would need to invest more than the return to capital in order to ensure that one’s capital stock keeps rising as fast as the size of the economy. This corresponds to a situation of excessive capital accumulation.

<sup>3</sup> In the dynastic model with no shock, there is no force generating inequality out of equality (or equality out of inequality), so any initial level of wealth inequality (including full equality) can be self-sustaining, as long as the modified Golden rule is satisfied. Note however that the magnitude of the gap  $r-g$  has an impact on the steady-state inequality of consumption and welfare: if  $r-g$  is small then high-wealth dynasties need to reinvest a large fraction of their capital income, so that they do not consume much more than low wealth dynasties.

amplifier mechanism for wealth inequality, for a given variance of other shocks. To put it differently: a higher gap between  $r$  and  $g$  allows to sustain a level of wealth inequality that is higher and more persistent over time (i.e. a higher gap  $r-g$  leads both to higher inequality and lower mobility). Technically, one can show that if shocks take a multiplicative form, then the inequality of wealth will converge toward a distribution that has a Pareto shape for top wealth holders (which is approximately the form that we observe in real world distributions, and which corresponds to relatively fat upper tails and large concentration of wealth at the very top), and that the inverted Pareto coefficient (an indicator of top end inequality) is a steeply rising function of the gap  $r - g$ . This well-known theoretical result was established by a number of authors using various structure of demographic and economic shocks (see in particular Champernowne (1953) and Stiglitz (1969)). The logic behind this result and this “inequality amplification” impact of  $r - g$  is presented in Chapter 10 of my book.<sup>4</sup>

In this class of models, relatively small changes in  $r - g$  can generate very large changes in steady-state wealth inequality. For example, simple simulations of the model with binomial taste shocks show that going from  $r-g=2\%$  to  $r-g=3\%$  is sufficient to move the inverted Pareto coefficient from  $b=2.28$  to  $b=3.25$ . Taken literally, this corresponds to a shift from an economy with moderate wealth inequality - say, with a top 1 percent wealth share around 20-30 percent, such as present-day Europe or the United States - to an economy with very high wealth inequality with a top 1 percent wealth share around 50-60 percent, such as pre-World War 1 Europe.<sup>5</sup>

Available micro-level evidence on wealth dynamics confirm that the high gap between  $r$  and  $g$  is one of the central reasons why wealth concentration was so high during the 18<sup>th</sup>-19<sup>th</sup>

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<sup>4</sup> For detailed references to this literature, see the on-line appendix to chapter 10 available at [piketty.pse.ens.fr/capital21c](http://piketty.pse.ens.fr/capital21c). See also Piketty and Zucman (2015, section 5.4).

<sup>5</sup> In the special case with binomial saving taste shocks with probability  $p$ , one can show that the inverted Pareto coefficient is given by  $b = \log(1/p) / \log(1/\omega)$ , with  $\omega = s \cdot e^{(r-g)H}$  (where  $s$  is the average saving taste parameter,  $r$  and  $g$  are the annual rate of return and growth rate, and  $H$  is generation length). See Piketty and Zucman (2015, section 5.4) for calibrations of this formula. Atkinson, Piketty and Saez (2011, figures 12-15) provide evidence on the long-run evolution of Pareto coefficients.

centuries and up until World War 1 (see Chap. 10 and Piketty, Postel-Vinay, Rosenthal (2006, 2014)). During the 20<sup>th</sup> century, it is a very unusual combination events which transformed the relation between  $r - g$  (large capital shocks during 1914-1945 period, including destructions, nationalization, inflation, taxation; high growth during reconstruction period and demographic transition). In the future, several forces might push toward a higher  $r-g$  gap (particularly the slowdown of population growth, and rising global competition to attract capital) and higher wealth inequality. But ultimately which forces prevail is relatively uncertain. In particular, this depends on the institutions and policies that will be adopted.

### **On the optimal progressive taxation of income, wealth and consumption**

I now move to the issue of optimal taxation. The theory of capital taxation that I present in *Capital in the 21<sup>st</sup> century* is largely based upon joint work with Emmanuel Saez (see in particular Piketty and Saez 2013). In this paper, we develop a model where inequality is fundamentally two-dimensional: individuals differ both in their labor earning potential and in their inherited wealth. Because of the underlying structure of demographic, productivity and taste shocks, these two dimensions are never perfectly correlated. As a consequence, the optimal tax policy is also two-dimensional: it involves a progressive tax on labor income and a progressive tax on inherited wealth. Specifically, we show that the long-run optimal tax rates on labor income and inheritance depend on the distributional parameters, the social welfare function, and the elasticities of labor earnings and capital bequests with respect to tax rates. The optimal tax rate on inheritance is always positive, except of course in the extreme case with an infinite elasticity of capital accumulation with respect to the net-of-tax rate of return (as posited implicitly in the benchmark dynastic model with infinite horizon and no

shock). For realistic empirical values, we find that the optimal inheritance tax rate might be as high as 50-60%, or even higher for top bequests, in line with historical experience.

Next, if we introduce capital market imperfections, then one needs to supplement inheritance taxes with annual taxation of wealth and capital income. Intuitively, in presence of idiosyncratic shocks to future rates of return, it is impossible to know the lifetime capitalized value of an asset at the time of inheritance, and it is optimal to split the tax burden between these different tax instruments. Optimal tax formulas become relatively complicated and difficult to calibrate, however. In my book, I propose a simple rule-of-thumb to think about optimal wealth tax rates. Namely, one should adapt the tax rates to the observed speed at which the different wealth groups are rising over time. For instance, if top wealth holders are rising at 6-7% per year in real terms (as compared to 1-2% per year for average wealth), as suggested by Forbes-type wealth rankings (as well as by recent research by Saez and Zucman (2014)), and if one aims to stabilize the level of wealth concentration, then one might need to apply top wealth tax rates as large as 5% per year, and possibly higher (see Chap. 15; see also Chap. 12, Tables 12.1-12.2). Needless to say, the implications would be very different if top wealth holders were rising at the same speed as average wealth. One of the main conclusions of my research is indeed that there is substantial uncertainty about how far income and wealth inequality might rise in the 21<sup>st</sup> century, and that we need more financial transparency and better information about income and wealth dynamics, so that we can adapt our policies and institutions to a changing environment.

An alternative to progressive taxation of inheritance and wealth is the progressive consumption tax (see e.g. Gates 2014, Auebarh and Hasset, 2015; Mankiw, 2015). This is a highly imperfect substitute, however. First, meritocratic values imply that one might want to tax inherited wealth more than self-made wealth, which is impossible to do with a consumption tax. Next, the very notion of consumption is not very well defined for top wealth

holders: personal consumption in the form of food or clothes is bound to be a tiny fraction for large fortunes, who usually spend most of their resources in order to purchase influence, prestige and power. When the Koch brothers spend money on political campaigns, should this be counted as part of their consumption? A progressive tax on net wealth seems more desirable than a progressive tax on consumption, first because net wealth is easier to define, measure and monitor than consumption, and next because it is better indicator of the ability of wealthy taxpayers to pay taxes and to contribute to the common good (see Chap.15).

Finally, note that in *Capital...*, I devote substantial attention to progressive taxation of income and wealth, but also to the rise of social transfers and the modern welfare state. As rightly argued by Weil (2015), social security and other transfers have played a large role to reduce inequality in the long run (see Chap.13).

### **Capital-income ratios vs capital shares: towards a multi-sector approach**

One of the important findings from my research is that capital-income ratios  $\beta=K/Y$  and capital shares  $\alpha$  tend to move together in the long run, particularly in recent decades, where both have been rising. In the standard one-good model of capital accumulation with perfect competition, the only way to explain why  $\beta$  and  $\alpha$  move together is to assume that the capital-labor elasticity of substitution  $\sigma$  that is somewhat larger than one (which could be interpreted as the rise of robots and other capital-intensive technologies).<sup>6</sup>

Let me make clear however this is not my favored interpretation of the evidence. Maybe robots and high capital-labor substitution will be important in the future. But at this stage, the important capital-intensive sectors are much more traditional sectors like real estate and energy. I believe that the right model to think about rising capital-income ratios and

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<sup>6</sup> With  $Y=F(K,L)=[aK^{(\sigma-1)/\sigma}+(1-a)L^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}$ , the marginal productivity of capital is given by  $r=F_K=a(Y/K)^{1/\sigma}=a\beta^{-1/\sigma}$ , and the capital share is given by  $\alpha=r\beta=a\beta^{(\sigma-1)/\sigma}$ . See Piketty and Zucman (2014, 2015).

capital shares in recent decades is a multi-sector model of capital accumulation, with substantial movements in *relative* prices, and with important variations in bargaining power over time (see *Capital...*, chapters 3-6). Generally speaking, one reason why my book is relatively long is because I try to offer a relatively detailed, multidimensional history of capital and its metamorphosis. Capital ownership takes many different historical forms, and each of them involves different forms of property and social relations, which must be analyzed as such. As rightly argued by Auerbarch and Hasset (2014) and Weil (2014), large upward or downward movements of real estate prices play an important role in the evolution of aggregate capital values during recent decades, as they did during the first half of the 20<sup>th</sup> centuries. This can in turn be accounted for by a complex mixture of institutional and technological forces, including rent control policies and other rules regulating relations between owners and tenants, the transformation of economic geography, and the changing speed of technical progress in the transportation and construction industries relative to other sectors (see *Capital...*, Ch. 3-6; Piketty and Zucman (2014); see also Karababounis and Neiman (2014) about the role played by the declining relative price of equipment). In practice, intersectoral elasticities of substitution combining supply and demand forces can arguably be much higher than within-sector elasticities. This multidimensional nature of capital creates substantial additional uncertainties regarding the future evolution of inequality. In my view, this reinforces the need for increased democratic transparency about income and wealth dynamics.

## References

Atkinson, Anthony, Thomas Piketty and Emmanuel Saez, « Top Incomes in the Long Run of History », *Journal of Economic Literature*, 2011, vol.49 (1), p.3-71

Auerbach, Alan, and Kevin Hassett, "Capital Taxation in the 21<sup>st</sup> century", 2015, *American Economic Review*, this issue

Champernowne, D.G., « A Model of Income Distribution », *Economic Journal*, 1953, vol.63 (250), p.318-351

Karabarbounis, Loukas and Brent Neiman, « Capital depreciation and Labor shares around the World: Measurement and Implications », NBER Working paper, 2014

Gates, Bill, "Why Inequality Matters", Gates Notes, October 2014

Mankiw, Gregory, "Yes,  $r > g$ . And so what?", 2015, *American Economic Review* (this issue)

Piketty, Thomas, *Capital in the 21<sup>st</sup> Century*, Harvard University Press, 2014. Technical appendix available on-line at <http://piketty.pse.ens.fr/capital21c>.

Piketty, Thomas, Gilles Postel-Vinay and Jean-Laurent Rosenthal, "Wealth Concentration in a Developing Economy: Paris and France, 1807-1994", *American Economic Review*, 2006, vol. 96 (1), p.236-256

Piketty, Thomas, Gilles Postel-Vinay and Jean-Laurent Rosenthal, "Inherited vs. Self-Made Wealth: Theory and Evidence from a Rentier Society (1872-1927)", *Explorations in Economic History*, 2014, vol. 51 (1), p.21-40

Piketty, Thomas and Emmanuel Saez, "A Theory of Optimal Inheritance Taxation", *Econometrica*, 2013, vol.81 (5), p.1851-1886

Piketty, Thomas and Emmanuel Saez, "Inequality in the long run", *Science*, 2014, vol.344 (6186), p.838-844

Piketty, Thomas, Emmanuel Saez, and Stefanie Stantcheva, "Optimal Taxation of Top Labor Incomes : A Tale of Three Elasticities", *American Economic Journal : Economic Policy*, 2014, vol.6 (1), p.230-271

Piketty, Thomas and Gabriel Zucman, « Capital is Back: Wealth-Income Ratios in Rich Countries 1700-2010 », *Quarterly Journal of Economics*, 2014, vol.129 (3), p.1155-1210

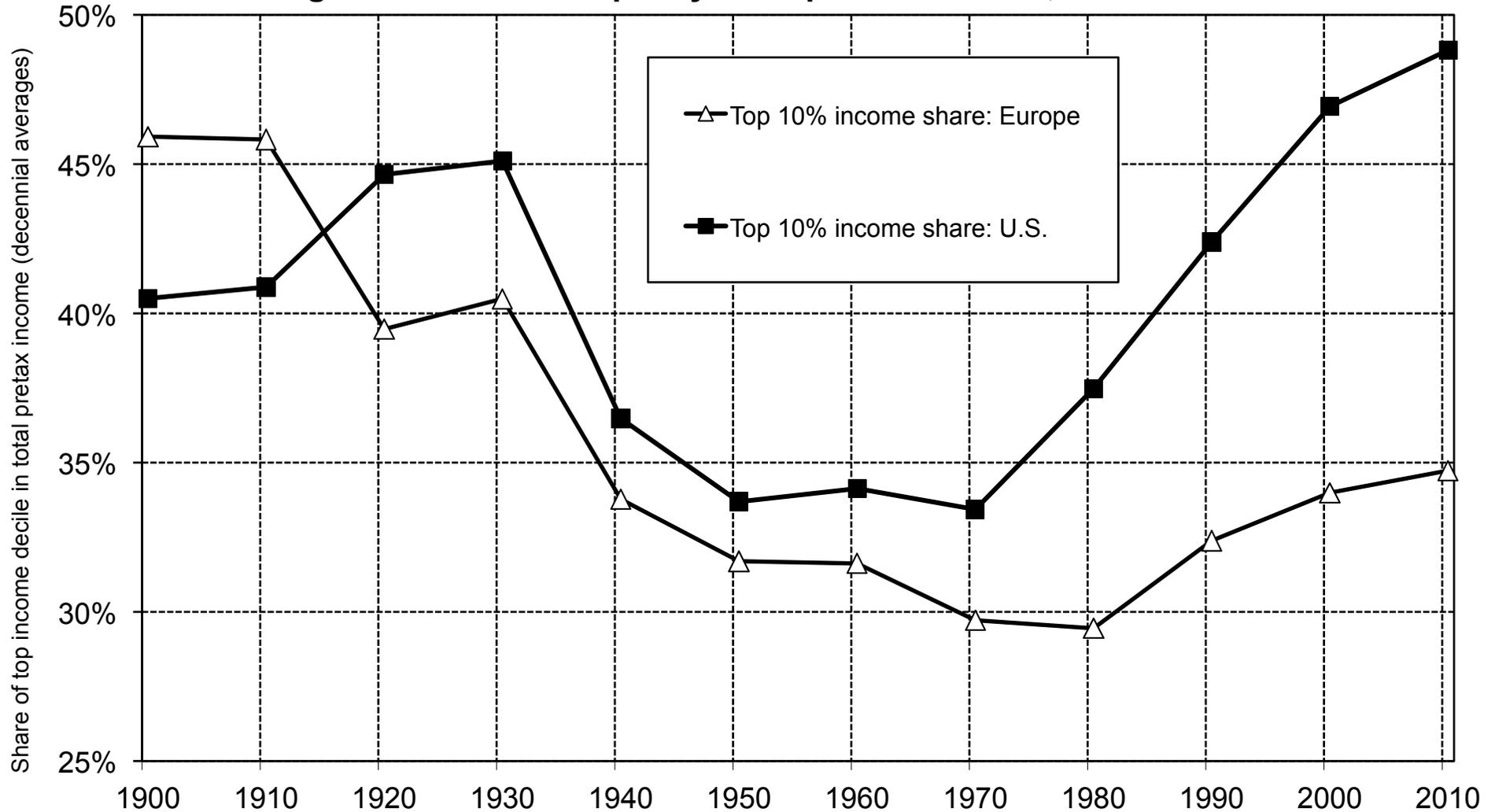
Piketty, Thomas and Gabriel Zucman, « Wealth and Inheritance in the Long Run », in *Handbook of Income Distribution*, A. Atkinson, F. Bourguignon, eds., vol; 2, Elsevier, 2015

Saez, Emmanuel, and Gabriel Zucman, "Wealth Inequality in the United States since 1913", NBER Working Paper, 2014

Stiglitz, Joseph, « Distribution of Income and Wealth Among Individuals », *Econometrica*, 1969, vol.37 (3), p.382-397

Weil, David, "Capital and Wealth in the 21<sup>st</sup> century", *American Economic Review*, 2015, this issue

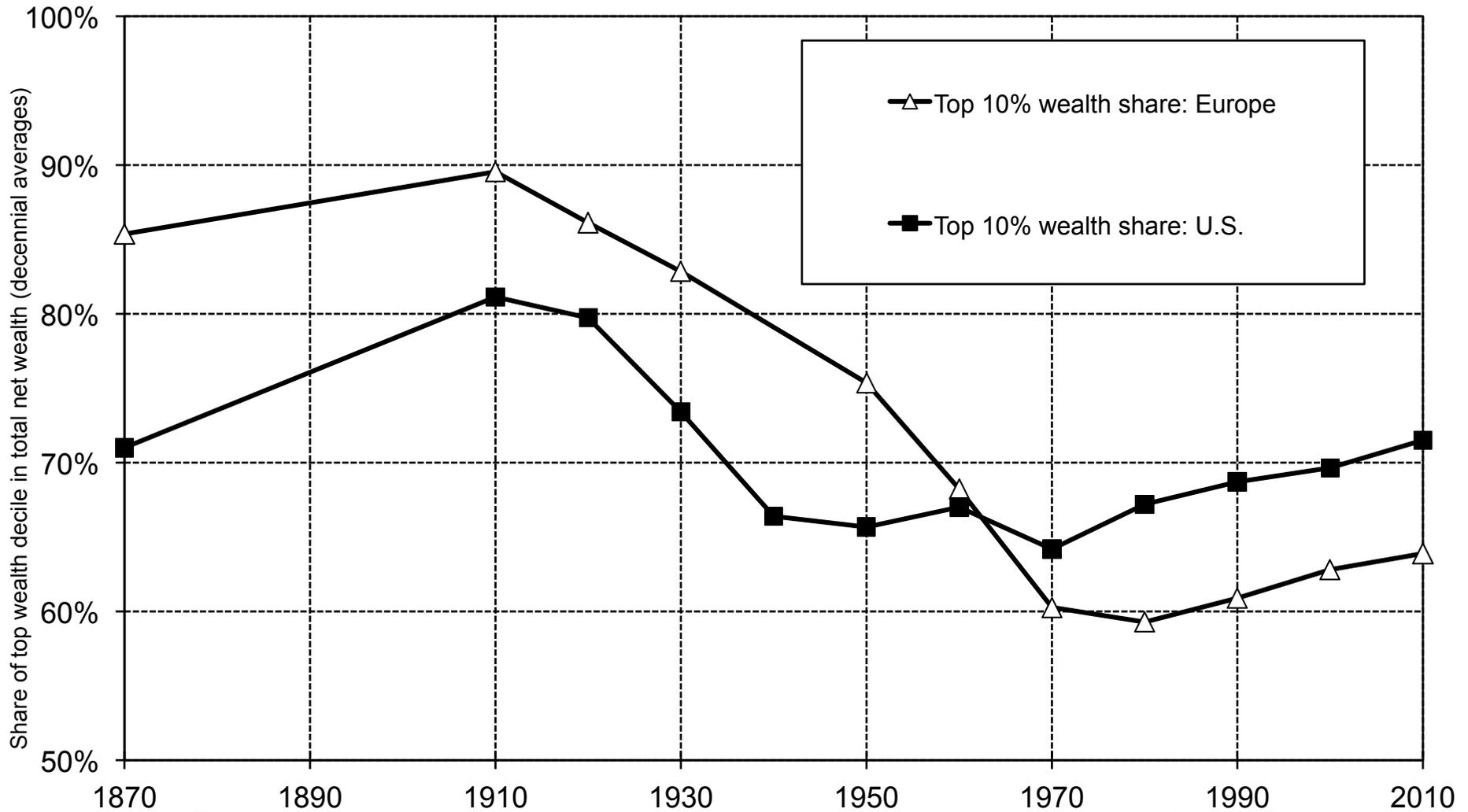
**Figure 1. Income inequality: Europe and the U.S., 1900-2010**



The share of total income accruing to top decile income holders was higher in Europe than in the U.S. around 1900-1910; it is a lot higher in the U.S. than in Europe around 2000-2010.

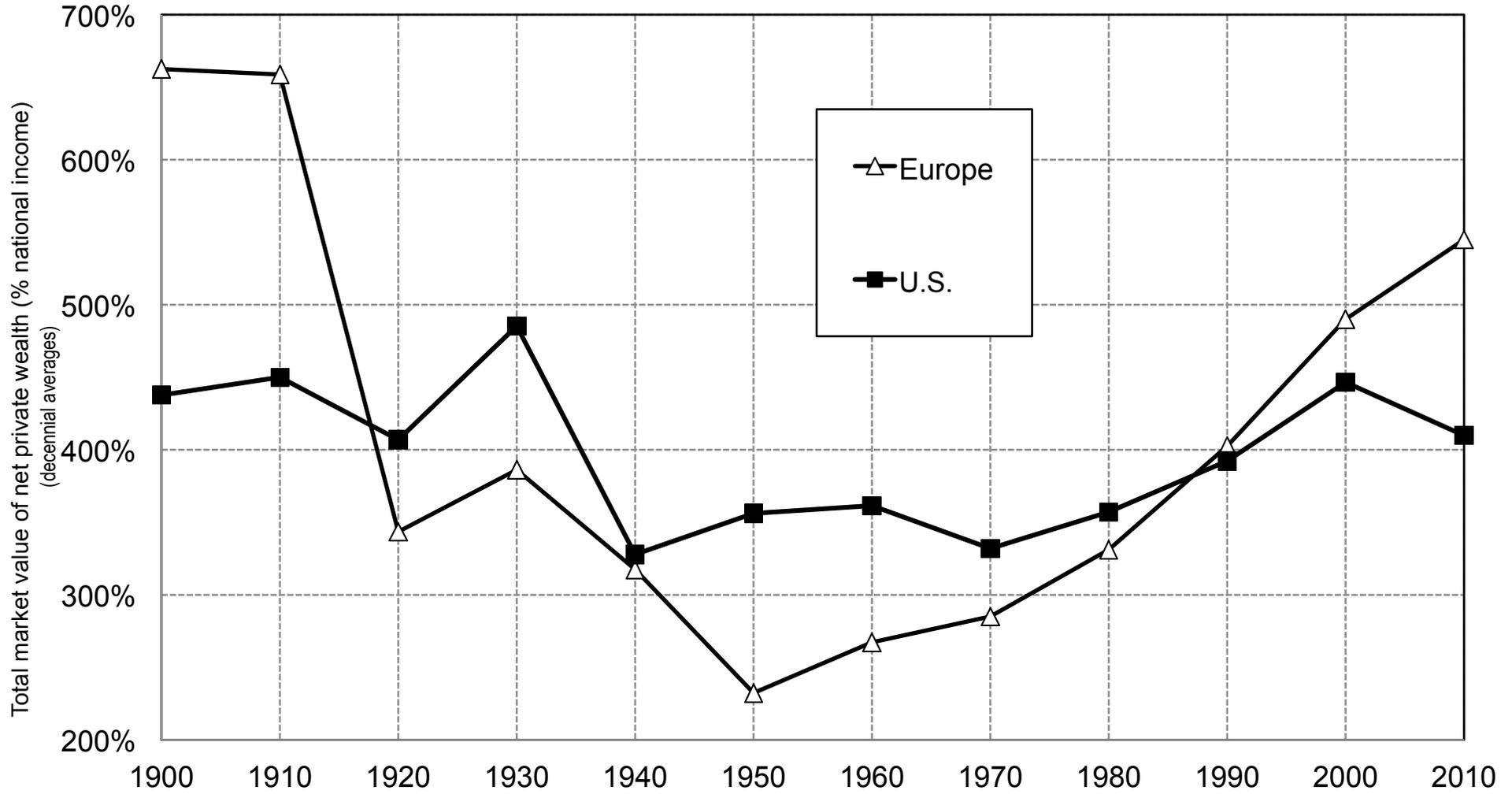
Sources and series: see [piketty.pse.ens.fr/capital21c](http://piketty.pse.ens.fr/capital21c) (fig.9,8)

**Figure 2. Wealth inequality: Europe and the U.S., 1870-2010**



The share of total net wealth belonging to top decile wealth holders has become higher in the US than in Europe over the course of the 20<sup>th</sup> century. But it is still smaller than what it was in Europe before World War 1.  
Sources and series: see [piketty.pse.ens.fr/capital21c](http://piketty.pse.ens.fr/capital21c) (fig.10.6)

**Figure 3. Wealth-income ratios: Europe and the U.S., 1900-2010**



Total net private wealth was worth about 6-7 years of national income in Europe prior to World War 1, down to 2-3 years in 1950-1960, back up to 5-6 years in 2000-2010. In the US, the U-shaped pattern was much less marked.

Sources and series: see [pikett.pse.ens.fr/capital21c](http://pikett.pse.ens.fr/capital21c) (fig.5.1)