

Chicago Fed Letter

Piketty's book and macro models of wealth inequality

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Thomas Piketty's book *Capital in the Twenty-First Century* is, in the author's own words, a book about the history of the distribution of income and wealth.¹ Among other interesting and important facts, the book quantifies the evolution of wealth inequality and wealth concentration over time and across a number of countries. Wealth is highly concentrated, and its distribution is skewed with a long right tail;² a small number of very rich individuals hold a large share of total wealth in the economy. The book documents that the share of aggregate wealth in the hands of the richest individuals displays a U shape over time, trending downward for most of the twentieth century and then increasing from the 1980s onward (figure 1). In other words, wealth has become more concentrated over the past 35 years.

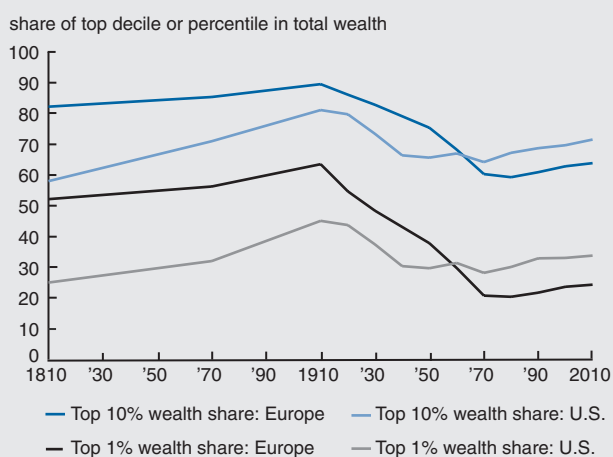
Although Piketty discusses a number of mechanisms affecting wealth inequality—the role of tax progressivity, top income

shares, and heterogeneity in saving rates and inheritances—he singles out a “fundamental force for divergence” in the size of the difference between the post-tax rate of return on capital and the rate of output growth (figure 2). According to this mechanism, a higher post-tax rate of return increases the rate at which past accumulated wealth compounds, thus magnifying wealth inequality. Conversely, a higher rate of output growth reduces

labor earnings. In Piketty's view, the effect of these two forces is big, and changes in the rate of capital taxation and output growth can explain the dramatic evolution of wealth concentration over the past century. Importantly, according to Piketty, it is the *difference* between the net rate of return on wealth and the output growth rate that affects wealth inequality. Furthermore, he does not distinguish between changes in the rate of output growth due to changes in total factor productivity (TFP)³ rather than in the population growth rate.

We recently published a National Bureau of Economic Research working paper on Piketty's book and macroeconomic models of wealth inequality.⁴ In this *Chicago Fed Letter*, we provide a brief summary of the two main contributions of that paper.⁵ First, the paper examines the existing literature on models of wealth inequality through the lens of the facts and ideas in Piketty's book and highlights both what we have learned so far and what we still need to learn in

1. Wealth inequality: Europe and the U.S., 1810–2010

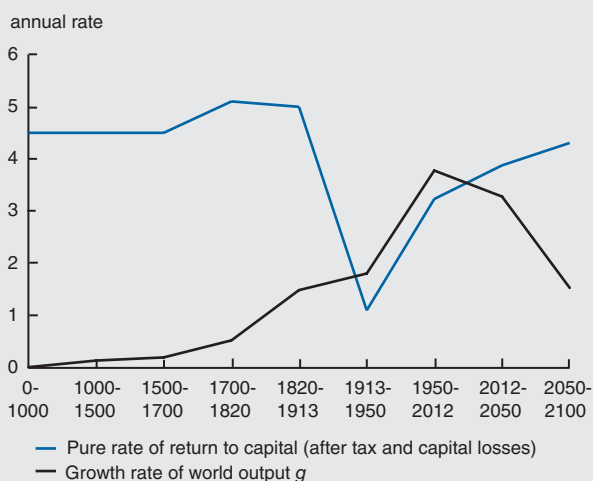


NOTE: Until the mid-twentieth century, wealth inequality was higher in Europe than in the United States.

SOURCE: See piketty.pse.ens.fr/capital21c.

wealth concentration by increasing labor earnings and, therefore, saving by individuals whose main source of income is

2. Post-tax rate of return vs. growth, antiquity until 2100



NOTE: The rate of return to capital (after tax and capital losses) fell below the growth rate during the twentieth century, and may again surpass it in the twenty-first century.

SOURCE: See piketty.pse.ens.fr/capital21c.

order to reach more definitive conclusions about the mechanisms shaping wealth concentration. Second, it explores the quantitative importance of the mechanism proposed by Piketty by evaluating the effects of changes in the rate of return on capital and the rate of output growth on wealth inequality in a quantitative model capable of generating realistic wealth inequality.

In the first part, in which we take stock of the existing models of wealth inequality, we initially discuss the (mostly analytical) literature aiming to account for the observation that the right tail of the wealth distribution is well approximated by a Pareto distribution.⁶ This strand of the literature provides the main theoretical underpinning for the mechanism, emphasized in Piketty's book, according to which wealth concentration increases with the difference between the average net rate of return on wealth r and the trend rate of growth of aggregate output g . Multiplicative idiosyncratic random shocks to the rate of return on wealth are the main mechanism that generates wealth concentration in this class of models. While Piketty sees the rate of output growth as unambiguously reducing wealth concentration, according to some of these models output growth due to TFP increases can either reduce or increase wealth

concentration depending on the environment (e.g., Aoki and Nirei, note 6). For tractability, this literature abstracts from key aspects of reality, such as the determinants of the heterogeneity in rates of return (for instance due to entrepreneurship and portfolio choice), the life cycle, and the observation that bequests are luxury goods (consistent with the evidence that saving rates are strongly increasing in wealth, as documented by

Dynan, Skinner, and Zeldes⁷ and, more recently, Saez and Zucman.⁸ In addition, Gabaix et al.⁹ show that these models imply a transitional dynamics of wealth concentration that is way too slow to account for its empirical evolution over the past 35 years.

Endogenous heterogeneity in saving rates in response to earnings and expenditure shocks (including, possibly, medical and nursing home expenditures during retirement) and, in some cases, endogenous heterogeneity in rates of return are instead at the center of the quantitative models that we discuss next. The comparative advantage of this literature is its emphasis on understanding the forces that shape differences in saving behavior and rates of return and on quantifying the importance of such heterogeneity in accounting for wealth inequality in rich quantitative models. Previous work has convincingly emphasized that entrepreneurial activity (Cagetti and De Nardi¹⁰), a luxury-good bequest motive (De Nardi¹¹), heterogeneity in patience across families (Krusell and Smith; Hendricks¹²), and high earnings risk for top earners (Castaneda et al.¹³) help explain the high degree of wealth concentration (De Nardi, Fella, and Paz Pardo¹⁴ investigate the latter point using tax data on earnings). Among these, entrepreneurial activity and luxury

bequests appear to be the most promising. However, it is not clear to what extent each of these forces interacts with the others and jointly contributes to wealth inequality because, at least so far (with the exception of De Nardi and Yang¹⁵), most of these forces have been studied in isolation. There is also work to do in determining to what extent these quantitative frameworks can match the observed large differences in wealth inequality both across countries and over time. Promising work by Kaymark and Poschke¹⁶ shows that these models, appropriately matched to data, succeed in explaining the evolution of wealth inequality and top wealth shares in the United States over the past 50 years. More specifically, they show that increasing wage dispersion during this period is a major driver of trends in inequality and that changes in taxes and transfers to seniors account for nearly half the observed increase in wealth concentration.

In the second part of our paper, we assess both the strength of the $(r-g)$ force and the extent to which, as conjectured by Piketty, it is the *difference* between the rate of return on capital and output growth that drives wealth concentration. We carry out our analysis within a rich quantitative model that can account for the observed inequality in both wealth and earnings. We show that changes in the rates of return on capital and TFP have only small effects on wealth inequality, while changes in output growth due to population growth have very large effects. The key intuition is that the rate of return and the TFP growth rate affect all households in a similar way. In contrast, a change in the population growth rate affects different categories of individuals through two main channels. First, changes in the population growth rate affect the number of people among whom a bequest is divided and, therefore, the average bequest size. If, for instance, the population growth rate decreases, inherited estates tend to be larger and, since richer people leave larger bequests, a reduction in population growth generates more wealth inequality. Second, a fall in the population growth rate changes the demographic structure and, in

particular, it increases the fraction of older people, who tend to be richer. Thus, the rate of return on capital and output growth are not perfect substitutes in their effects on wealth concentration when output growth is due to population growth. In fact, an increase in the rate of return on capital raises wealth concentration substantially less than a fall in the rate of population and output growth by the same amount.

Conclusion

In addition to providing many important facts and ideas, Piketty's book has revitalized interest in inequality, and especially wealth inequality, and in understanding the determinants of savings across all levels of the wealth and earnings distributions. In our NBER working paper, which will be published as a chapter in the book *The Global Ramifications*

of Thomas Piketty's *Capital in the 21st Century* (Heather Boushey, Bradford DeLong, and Marshall Steinbaum, eds., Harvard University Press, forthcoming), we discuss promising avenues for models and data work that are needed to better explain how wealth inequality arises, to what extent government policies can affect it, and what the implied costs and benefits of these policies are for society.

¹ Thomas Piketty, 2014, *Capital in the Twenty-First Century*, English edition, translated by Arthur Goldhammer, Harvard University Press: Cambridge, MA.

² See Anthony B. Atkinson, 1983, *The Economics of Inequality*, Clarendon Press, Oxford; Edward N. Wolff, 1992, "Changing inequality of wealth," *American Economic Review*, Vol. 82, No. 2, pp. 552–558; Edward N. Wolff, 1998, "Recent trends in the size distribution of household wealth," *Journal of Economic Perspectives*, Vol. 12, No. 3, pp. 131–150; and Santiago Budria Rodriguez, Javier Díaz-Giménez, Vincenzo Quadrone, and José-Victor Ríos-Rull, 2002, "Updated facts on the U.S. distributions of earnings, income, and wealth," *Quarterly Review*, Federal Reserve Bank of Minneapolis, Vol. 26, No. 3, pp. 2–35.

³ Total factor productivity is a variable that accounts for the growth in total output not caused by traditionally measured inputs of labor and capital.

⁴ Mariacristina De Nardi, Giulio Fella, and Fang Yang, 2015, "Piketty's book and macro models of wealth inequality," National Bureau of Economic Research, working paper, No. 21730.

⁵ This summary recently appeared as a column on VoxEU.org, the policy portal of the London-based Centre for Economic Policy Research, at <http://www.voxeu.org/article/piketlys-book-and-macro-models>.

⁶ See Jess Benhabib, Alberto Bisin, and Shenghao Zhu, 2011, "The distribution of wealth and fiscal policy in economies with

finitely lived agents," *Econometrica*, Vol. 79, pp. 123–157; and Shuhei Aoki and Makoto Nirei, 2016, "Pareto distribution of income in neoclassical growth models," *Review of Economic Dynamics*, forthcoming, April.

⁷ Karen E. Dynan, Jonathan Skinner, and Stephen P. Zeldes, 2004, "Do the rich save more?," *Journal of Political Economy*, Vol. 112, No. 2, pp. 397–444.

⁸ Emmanuel Saez and Gabriel Zucman, 2015, "Wealth inequality in the United States since 1913: Evidence from capitalized income tax data," London School of Economics, mimeo.

⁹ Xavier Gabaix, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll, 2015, "The dynamics of inequality," National Bureau of Economic Research, working paper, No. 21363.

¹⁰ Marco Cagetti and Mariacristina De Nardi, 2006, "Entrepreneurship, frictions and wealth," *Journal of Political Economy*, Vol. 114, No. 5, pp. 835–870.

¹¹ Mariacristina De Nardi, 2004, "Wealth inequality and intergenerational links," *Review of Economic Studies*, Vol. 71, No. 3, pp. 743–768.

¹² Per Krusell and Anthony Smith, Jr., 1998, "Income and wealth heterogeneity in the macroeconomy," *Journal of Political Economy*, Vol. 106, No. 5, pp. 867–896; and Lutz Hendricks, 2007, "How important is preference heterogeneity for wealth inequality?," *Journal of Economic Dynamics & Control*, Vol. 31, pp. 3042–3068.

¹³ Ana Castaneda, Javier Díaz-Giménez, and José-Victor Ríos-Rull, 2003, "Accounting for U.S. earnings and wealth inequality," *Journal of Political Economy*, Vol. 111, No. 4, pp. 818–857.

¹⁴ Mariacristina De Nardi, Giulio Fella, and Gonzalo Paz Pardo, 2015, "The implications of richer earnings dynamics for consumption, wealth, and welfare," University College London, mimeo.

¹⁵ Mariacristina De Nardi and Fang Yang, 2015, "Wealth inequality, family background, and estate taxation," National Bureau of Economic Research, working paper, No. 21047, and forthcoming in the *Journal of Monetary Economics*, 2016.

¹⁶ Baris Kaymak, and Markus Poschke, 2015, "The evolution of wealth inequality over half a century: The role of taxes, transfers and technology," McGill University, mimeo, and forthcoming in the *Journal of Monetary Economics*, 2016.

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