Capital is Back: Wealth-Income Ratios in Rich Countries 1700-2010

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Abstract

How do aggregate wealth-to-income ratios evolve in the long run and why? We address this question using 1970-2010 national balance sheets recently compiled in the top eight developed economies. For the U.S., U.K., Germany, and France, we are able to extend our analysis as far back as 1700. We find in every country a gradual rise of wealth-income ratios in recent decades, from about 200-300% in 1970 to 400-600% in 2010. In effect, today's ratios appear to be returning to the high values observed in Europe in the eighteenth and nineteenth centuries (600-700%). This can be explained by a long run asset price recovery (itself driven by changes in capital policies since the world wars) and by the slowdown of productivity and population growth, in line with the $\beta = s/g$ Harrod-Domar-Solow formula. That is, for a given net saving rate $s = 10\%$, the long run wealth-income ratio β is about 300% if $g = 3\%$ and 600% if $g = 1.5\%$. Our results have important implications for capital taxation and regulation and shed new light on the changing nature of wealth, the shape of the production function, and the rise of capital shares.

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1 Introduction

This paper addresses what is arguably one the most basic economic questions: how do wealth-income and capital-output ratios evolve in the long run, and why?

Until recently it was difficult to properly address this question, for one simple reason: national accounts were mostly about flows, not stocks. Economists had at their disposal a large body of historical series on flows of output, income and consumption – but limited data on stocks of assets and liabilities. When needed, for example for growth accounting exercises, estimates of capital stocks were typically obtained by cumulating past flows of saving and investment. This is fine for some purposes, but severely limits the set of questions one can ask.

In recent years, the statistical institutes of nearly all developed countries have started publishing retrospective national stock accounts including annual and consistent balance sheets. Following new international guidelines, the balance sheets report on the market value of all the non-financial and financial assets and liabilities held by each sector of the economy (households, government, and corporations) and by the rest of the world. They can be used to measure the stocks of private and national wealth at current market value.

This paper makes use of these new balance sheets in order to establish a number of facts and to analyze whether standard capital accumulation models can account for these facts. We should stress at the outset that we are well aware of the deficiencies of existing balance sheets. In many ways these series are still in their infancy. But they are the best data that we have in order to study wealth accumulation – a question that is so important that we cannot wait for perfect data before we start addressing it, and that has indeed been addressed in the past by many authors using far less data than we presently have. In addition, we feel that the best way for scholars to contribute to future data improvement is to use existing balance sheets in a conceptually coherent manner, so as to better identify their limitations. Our paper, therefore, can also be viewed as an attempt to evaluate the internal consistency of the flow and stock sides of existing national accounts, and to pinpoint the areas in which progress needs to be made.

Our contribution is twofold. First, we put together a new macro-historical data set on wealth and income, available online, whose main characteristics are summarized in Table 1. To our knowledge, it is the first international database to include long-run, homogeneous information on national wealth. For the eight largest developed economies in the world – the U.S., Japan, Germany, France, the U.K., Italy, Canada, and Australia – we have official annual series covering the 1970-2010 period. Through to the world wars, there was a lively tradition of national wealth accounting in many countries. By combining numerous historical estimates in a systematic and consistent manner, we are able to extend our series as far back as 1870 (Germany), 1770 (U.S.), and 1700 (U.K. and France). The resulting database provides extensive information on the structure of wealth, saving, and investment. It can be used to study core macroeconomic questions – such as private capital accumulation, the dynamics of the public debt, and patterns in net foreign asset positions – altogether and over unusually long periods of time.

Our second – and most important – contribution is to exploit the database in order to establish a number of new striking results. Looking first at the recent period, we document that wealth-income ratios have been gradually rising in each of the top eight developed countries over the last four decades, from about 200-300% in 1970 to 400-600% in 2010 (Figure 1). Taking a long-run perspective, we find that today's ratios appear to be returning to the high values observed in Europe in the eighteenth and nineteenth centuries, namely about 600-700%, despite considerable changes in the nature of wealth (Figure 2 and 3). In the U.S., the wealth-income ratio has also followed a U-shaped pattern, but less marked (Figure 4).

In order to understand these dynamics, we provide detailed decompositions of wealth accumulation into volume effects (saving) and relative price effects (real capital gains and losses). The results show that the U-shaped evolution of the European wealth-income ratios can be explained by two main factors. The first is a long-run swing in relative asset prices, itself largely driven by changes in capital policies in the course of the twentieth century. Before World War I, capital markets ran unfettered. A number of anti-capital policies were then put into place, which depressed asset prices through to the 1970s. These policies were gradually lifted from the 1980s on, contributing to an asset price recovery.

The second key explanation for the return of high wealth-income ratios is the slowdown of productivity and population growth. According to the Harrod-Domar-Solow formula, in the long run the wealth-income ratio β is equal to the net saving rate s divided by the income growth rate g. So for a given saving rate s =10%, the long-run β is about 300% if g = 3% and about 600% if g = 1.5%. In short: capital is back because low growth is back.

The $\beta = s/g$ formula is simple, yet as we show in the paper surprisingly powerful. It can account for a significant part of the 1970-2010 rise in the wealth-income ratios of Europe and Japan, two economies where population and productivity growth have slowed markedly. It can also explain why wealth-income ratios are lower in the U.S., where population growth has been historically much larger than in Europe – and still continues to be to some extent – but where saving rates are not higher. Last, the Harrod-Domar-Solow formula seems to account reasonably well for the very long-run dynamics of wealth accumulation. Over a few years and even a few decades, valuation effects and war destructions are of paramount importance. But in the main developed economies, we find that today's wealth levels are reasonably well explained by 1870-2010 saving and income growth rates, in line with the workhorse one-good model of capital accumulation. In the long run, assuming a significant divergence between the price of consumption and capital goods seems unnecessary.

Our findings have a number of implications for the future and for policy-making. First, the low wealth-income ratios of the mid-twentieth century were due to very special circumstances. The world wars and anti-capital policies destroyed a large fraction of the world capital stock and reduced the market value of private wealth, which is unlikely to happen again with free markets. By contrast, the $\beta = s/g$ logic will in all likelihood matter a great deal in the foreseeable future. As long as they keep saving sizable amounts (due to a mixture of bequest, life-cycle and precautionary reasons), countries with low g are bound to have high β. For the time being, this effect is strong in Europe and Japan. To the extent that growth will ultimately slow everywhere, wealth-income ratios may well ultimately rise in the whole world.

The return of high wealth-income ratios is certainly not bad in itself, but it raises new issues about capital taxation and regulation. Because wealth is always very concentrated (due in particular to the cumulative and multiplicative processes governing wealth inequality dynamics), high β implies than the inequality of wealth, and potentially the inequality of inherited wealth, is likely to play a bigger role for the overall structure of inequality in the twenty first century than it did in the postwar period. This evolution might reinforce the need for progressive capital and inheritance taxation (Piketty, 2011; Piketty and Saez, 2013). If international tax competition prevents this policy change from happening, one cannot exclude the development of a new wave of anti-globalization and anti-capital policies.

Further, because s and g are largely determined by different forces, wealth-income ratios can vary a lot between countries. This fact has important implications for financial regulation. With perfect capital markets, large differences in wealth-income ratios potentially imply large net foreign asset positions, which can create political tensions between countries. With imperfect capital markets and home portfolios bias, structurally high wealth-income ratios can contribute to domestic asset price bubbles. According to our computations, the wealth-income ratio reached 700% at the peak of the Japanese bubble of the late 1980s, and 800% in Spain in 2008-2009.[1] Housing and financial bubbles are potentially more devastating when the total stock of wealth amounts to 6-8 years of national income rather than 2-3 years only. The fact that the Japanese and Spanish bubbles are easily identifiable in our dataset also suggests that monitoring wealth-income ratios may help designing appropriate financial and monetary policy. In Japan and Spain, most observers had noticed that asset price indexes were rising fast. But in the absence of well-defined reference points, it is always difficult for policy makers to determine when such evolutions have gone too far and whether they should act. We believe that wealth-income ratios and wealth accumulation decompositions provide useful if imperfect reference points.

Last, our findings shed new light on the long run changes in the nature of wealth, the shape of the production function and the recent rise in capital shares. In the 18^{th} and early 19^{th} century, capital was mostly land (Figure 3), so that there was limited scope for substituting labor to capital. In the 20^{th} and 21^{st} centuries, by contrast, capital takes many forms, to an extent such that the elasticity of substitution between labor and capital might well be larger than 1. With an elasticity even moderately larger than 1, rising capital-output ratios can generate substantial increases in capital shares, similar to those that have occurred in most rich countries since the 1970s. Looking forward, with low growth and high wealth-income ratios, one cannot exclude a further increase in capital shares.

The paper is organized as follows. Section 2 relates our work to the existing literature. In section 3 we present the conceptual framework and accounting equations used in this research. Section 4 is devoted to the decomposition of wealth accumulation in rich countries over the 1970-2010 period. In section 5, we present decomposition results over a longer period (1870-2010) for a subset of countries (U.S., Germany, France, U.K.). We take an even longer perspective in section 6 in which we discuss the changing nature of wealth in the U.K., France and the U.S. since the 18^{th} century. In section 7, we compare the long-run evolution of capital-output ratios and capital shares in order to discuss the changing nature of technology and the pros and cons of the Cobb-Douglas approximation. Section 8 presents some possible directions for

[1] See Appendix figure A8. We do not include Spain in our main sample of countries because the Bank of Spain balance sheets that are currently available only start in 1987, and we want to be able to decompose wealth accumulation over a longer period (at least 1970-2010).

future research. The main sources and concepts are presented in the main text, and we leave the complete methodological details to an extensive online Data Appendix.

2 Related literature

2.1 Literature on national wealth

As far as we know, this paper is the first attempt to gather a large set of national balance sheets in order to analyze the long-run evolution of wealth-income ratios. For a long time, research in this area was impeded by a lack of data. It is only in 1993 that the System of National Accounts, the international standard for national accounting, first included guidelines for wealth. In most rich countries, the publication of time series of national wealth only began in the 1990s and 2000s. In a key country like Germany, the first official balance sheets were released in 2010.

It is worth stressing, however, that the recent emphasis on national wealth largely represents a return to older practice. Until the early twentieth century, economists, statisticians and social arithmeticians were much more interested in computing national wealth than national income and output. The first national balance sheets were established in the late seventeenth and early eighteenth centuries by Petty (1664) and King (1696) in the U.K., Boisguillebert (1695) and Vauban (1707) in France. National wealth estimates then became plentiful in the nineteenth and early twentieth century, with the work of Colqhoun (1815), Giffen (1889) and Bowley (1920) in the U.K., Foville (1893) and Colson (1903) in France, Helfferich (1913) in Germany, King (1915) in the U.S., and dozens of other economists from all industrialized nations. Although these historical balance sheets are far from perfect, their methods are well documented and they are usually internally consistent. One should also keep in mind that it was in many ways easier to estimate national wealth around 1900-1910 than it is today: the structure of property was much simpler, with far less financial intermediation and cross-border positions.

Following the 1914-1945 capital shocks, the long tradition of research on national wealth largely disappeared, partly because of the new emphasis on short run output fluctuations following the Great Depression, and partly because the chaotic asset price movements of the interwar made the computation of the current market value of wealth and the comparison with pre-World War I estimates much more difficult. While there has been some effort to put together historical balance sheets in recent decades, most notably by Goldsmith (1985, 1991), to date no systematic attempt has been made to relate the evolution of wealth-income ratios to the magnitude of saving flows.[2] The reason is probably that it is only recently that official balance sheets have become sufficiently widespread to make the exercise meaningful.

2.2 Literature on capital accumulation and growth

The lack of data on wealth in the aftermath of the 1914-1945 shocks did not prevent economists from studying capital accumulation. In particular, Solow developed the neoclassical growth model in the 1950s. In this model, the long-run capital-output ratio is equal to the ratio between the saving rate and the growth rate of the economy. As is well-known, the $\beta = s/g$ formula was first derived by Harrod (1939) and Domar (1947) using fixed-coefficient production functions, in which case β is entirely given by technology – hence the knife-edge conclusions about growth.[3] The classic derivation of the formula with a flexible production function $Y = F(K, L)$ involving capital-labor substitution, thereby making β endogenous and balanced growth possible, is due to Solow (1956). Authors of the time had limited national accounts at their disposal to estimate the parameters of the formula. In numerical illustrations, they typically took $\beta = 400\%$, $g = 2\%$, and $s = 8\%$. They were not entirely clear about the measurement of capital, however.

Starting in the 1960s, the Solow model was largely applied for empirical studies of growth (see for instance Denison, 1962; Jorgenson and Griliches, 1967; Feinstein, 1978) and it was later on extended to human capital (Mankiw, Romer and Weil, 1992; Barro, 1991). The main difference between our work and the growth accounting literature is how we measure capital. Because of the lack of balance sheet data, in the growth literature capital is typically computed by cumulating past investment flows and attempting to adjust for changes in price – what is known as the perpetual inventory method. By contrast, we measure capital by using national balance sheets in which we observe the actual evolution of the market value of most types of assets: real estate, equities (which capture the market value of corporations), bonds, and so on. We are essentially interested in what non-human private capital is worth for households

[2]In particular, Goldsmith does not relate his wealth estimates to saving and investment flows. He is mostly interested in the rise of financial intermediation, that is the rise of gross financial assets and liabilities (expressed as a fraction of national income), rather than in the evolution of the net wealth-income ratio. Nineteenth century authors like Giffen and Foville were fascinated by the huge accumulation of private capital, but did not have much estimates of income, saving and investment, so they were not able to properly analyze the evolution of the wealth-income ratio. Surprisingly enough, socialist authors like Karl Marx – who were obviously much interested in the rise of capital and the possibility that β reaches very high levels – largely ignored the literature on national wealth.

[3]Harrod emphasized the inherent instability of the growth process, while Domar stressed the possibility that β and s can adjust in case the natural growth rate g differs from s/β.

at each point in time – and in what public capital would be worth if it was privatized. This notion is precisely what the economists of the eighteenth and nineteenth century aimed to capture. We believe it is a useful, meaningful, and well defined starting point.[4] There are two additional advantages to using balance sheets: first, they include data for a large number of assets, including non-produced assets such as land which by definition cannot be measured by cumulating past investment flows. Second, they rely for the most part on observed market prices – such as actual real estate transactions and financial market quotes – contrary to the prices used in the perpetual inventory method, which tend not to be well defined.[5]

Now that national balance sheets are available, we can see that some of the celebrated stylized facts on capital – established when there was actually little data on capital – are not that robust. The constancy of the capital-output ratio, in particular, is simply not a fact for Europe and Japan, and is quite debatable for the U.S. Although this constancy is often seen as one of the key regularities in economics, there has always been a lot of confusion about what the level of the capital-output ratio is supposed to be (see, e.g., Kaldor, 1961; Samuelson, 1970; Simon, 1990; Jones and Romer, 2010). The data we presently have suggest that the ratio is often closer to 5-6 in most rich countries today than to the values of 3-4 typically used in macro models and textbooks.[6]

Our results also suggest that the focus on the possibility of a balanced growth path that has long characterized academic debates on capital accumulation (most notably during the Cambridge controversy of the 1960s-1970s) has been somewhat misplaced. It is fairly obvious that there can be a lot of capital-labor substitution in the long-run, and that many different β can occur in steady-state. But this does not imply that the economy is necessarily in a stable or optimal state in any meaningful way. High steady-state wealth-income ratios can go together

[4]By contrast, in the famous Cambridge controversy, the proponent of the U.K. view argued that the notion of capital used in neoclassical growth models is not well defined. In our view much of the controversy owes to the lack of balance sheet data, and to the difficulty of making comparisons with pre-World War 1 estimates of national capital stocks.

[5]As we discuss in details in Appendix A.1.2, the price estimates used in the perpetual inventory method raise all sorts of difficulties (depreciation, quality improvement, aggregation bias, etc.). Even when these difficulties can be overcome, PIM estimates of the capital stock at current price need not be equal to the current market value of wealth. For instance, the current value of dwellings obtained by the PIM is essentially equal to past investments in dwellings adjusted for the evolution of the relative price of construction. This has no reason to be equal to the current market value of residential real estate – which in practice is often higher.

[6]Many estimates in the literature only look at the capital-output ratio in the corporate sector (i.e., corporate capital divided by corporate product), in which case ratios of 3 or even 2 are indeed in line with the data (see Figures A70-A71). This, however, completely disregards the large stock of housing capital, as well as non-corporate businesses and government capital.

with large instability, asset price bubbles and high degrees of inequality – all plausible scenarios in mature, low-growth economies.

2.3 Literature on external balance sheets

Our work is close in spirit to the recent literature that documents and attempts to understand the dynamics of the external balance sheets of countries (Lane and Milesi-Ferretti, 2007; Gourinchas and Rey, 2007; Zucman, 2013). To some extent, what we are doing in this paper is to extend this line of work to domestic wealth and to longer time periods. We document the changing nature of domestic capital over time, and we investigate the extent to which the observed aggregate dynamics can be accounted for by saving flows and valuation effects. A key difference is that our investigation is broader in scope: as we shall see, domestic capital typically accounts for 90%-110% of the total wealth of rich countries today, while the net foreign asset position accounts for -10% to +10% only. Nevertheless, external wealth will turn out to play an important role in the dynamics of the national wealth of a number of countries, more spectacularly the U.S. The reason is that gross foreign positions are much bigger than net positions, thereby potentially generating large capital gains or losses at the country level.[7] One of the things we attempt to do is to put the study of external wealth into the broader perspective of national wealth.[8]

2.4 Literature on rising capital shares

Our work is also closely related to the growing literature establishing that capital shares have been rising in most countries over the last decades (Ellis and Smith, 2007; Azmat, Manning and Van Reenen, 2011; Karabarbounis and Neiman, 2013). The fact that we find rising wealth-income and capital-output ratios in the leading rich economies reinforces the presumption that capital shares are indeed rising globally. We believe that this confirmation is important in itself, because computing factor shares raises all sorts of issues. In many situations, what accrues to labor and to capital is unclear – both in the non-corporate sector and in the corporate sector, where profits and dividends recorded in the national accounts sometimes include labor income components that are impossible to isolate. Wealth-income and capital-output ratios provide an

[7]See Obstfeld (2013) and Gourinchas and Rey (2013) for recent papers surveying the literature on this issue.

[8]Eisner (1980), Babeau (1983), Greenwood and Wolff (1992), Wolff (1999), and Gale and Sabelhaus (1999) study the dynamics of U.S. aggregate household wealth using official balance sheets and survey data. With a pure household perspective, however, one is bound to attribute an excessively large role to capital gains, because a lot of private saving takes the form corporate retained earnings.

indication of the relative importance of capital in production largely immune to these issues, although they are themselves not perfect. They usefully complement measures of factor shares.

More generally, we attempt to make progress in the measurement of three fundamentally inter-related macroeconomic variables: the capital share, the capital-output ratio, and the marginal product of capital (see also Caselli and Feyrer, 2007). As we discuss in section 7, rising capital-output ratios together with rising capital shares and declining returns to capital imply an elasticity of substitution between labor and capital higher than 1 – consistent with the results obtained by Karabarbounis and Neiman (2013) over the same period of time.

2.5 Literature on income and wealth inequalities

Last, this paper is to a large extent the continuation of the study of the long run evolution of private wealth in France undertaken by one of us (Piketty, 2011). We extend Piketty's analysis to many countries, to longer time periods, and to public and foreign wealth. However, we do not decompose aggregate wealth accumulation into an inherited and dynastic wealth component on the one hand and a lifecycle and self-made wealth component on the other (as Piketty does for France). Instead, we take the structure of saving motives and the overall level of saving as given. In future research, it would be interesting to extend our decompositions in order to study the evolution of the relative importance of inherited versus life-cycle wealth in as many countries as possible.

Ultimately, the goal is also to introduce global distributional trends in the analysis. Any study of wealth inequality requires reliable estimates of aggregate wealth to start with. Plugging distributions into our data set would make it possible to analyze the dynamics of the global distribution of wealth.[9] The resulting series could then be used to improve the top income shares estimates that were recently constructed for a number of countries (see Atkinson, Piketty, Saez 2011). We see the present research as an important step in this direction.

3 Conceptual framework and methodology

3.1 Concepts and definitions

The concepts we use are standard: we strictly follow the U.N. System of National Accounts (SNA). For the 1970-2010 period, we use official national accounts that comply with the latest

[9] See Davies et al. (2010) for a study of the world distribution of wealth using national balance sheet data.

international guidelines (SNA, 1993, 2008). For the previous periods, we have collected a large number of historical balance sheets and income series, which we have homogenized using the same concepts and definitions as those used in the most recent official accounts.[10] Here we provide the main definitions.

Private wealth W_t is the net wealth (assets minus liabilities) of households and non-profit institutions serving households.[11] Following SNA guidelines, assets include all the non-financial assets – land, buildings, machines, etc. – and financial assets – including life insurance and pensions funds – over which ownership rights can be enforced and that provide economic benefits to their owners. Pay-as-you-go social security pension wealth is excluded, just like all other claims on future government expenditures and transfers (like education expenses for one's children and health benefits). Durable goods owned by households, such as cars and furniture, are excluded as well.[12] As a general rule, all assets and liabilities are valued at their prevailing market prices. Corporations are included in private wealth through the market value of equities. Unquoted shares are typically valued on the basis of observed market prices for comparable, publicly traded companies.

We similarly define public (or government) wealth W_{gt} as the net wealth of public administrations and government agencies. In available balance sheets, public non-financial assets like administrative buildings, schools and hospitals are valued by cumulating past investment flows and upgrading them using observed real estate prices.

We define market-value national wealth W_{nt} as the sum of private and public wealth:

$$W_{nt} = W_t + W_{gt}$$

National wealth can also be decomposed into domestic capital and net foreign assets:

$$W_{nt} = K_t + NFA_t$$

[10] Section A of the Data Appendix provides a detailed description of the concepts and definitions used by the 1993 and 2008 SNA. Country-specific information on historical balance sheets are provided in Data Appendix sections B (devoted to the U.S.), D (Germany), E (France), and F (U.K.).

[11] The main reason for including non-profit institutions serving households (NPISH) in private wealth is that the frontier between individuals and private foundations is not always entirely clear. The net wealth of NPISH is usually small, and always less than 10% of total net private wealth: currently it is about 1% in France, 3%-4% in Japan, and 6%-7% in the U.S., see Appendix Table A65. Note also that the household sector includes all unincorporated businesses.

[12] The value of durable goods appears to be relatively stable over time (about 30%-50% of national income, i.e. 5%-10% of net private wealth). See for instance Appendix Table US.6f for the long-run evolution of durable goods in the U.S.

And domestic capital K_t can in turn be decomposed as the sum of agricultural land, housing, and other domestic capital (including the market value of corporations, and the value of other non-financial assets held by the private and public sectors, net of their liabilities).

An alternative measure of the wealth of corporations is the total value of corporate assets net of non-equity liabilities, what we call the corporations' book value. We define residual corporate wealth W_{ct} as the difference between the book-value of corporations and their market value (which is the value of their equities). By definition, W_{ct} is equal to 0 when Tobin's Q – the ratio between market and book values – is equal to 1. In practice there are several reasons why Tobin's Q can be different from 1, so that residual corporate wealth is at times positive, at times negative. We define book-value national wealth W_{bt} as the sum of market-value national wealth and residual corporate wealth: $W_{bt} = W_{nt} + W_{ct} = W_t + W_{gt} + W_{ct}$. Although we prefer our market-value concept of national wealth (or national capital), both definitions have some merit, as we shall see.[13]

Balance sheets are constructed by national statistical institutes and central banks using a large number of census-like sources, in particular reports from financial and non-financial corporations about their balance sheet and off-balance sheet positions, and housing surveys. The perpetual inventory method usually plays a secondary role. The interested reader is referred to the Appendix for a a precise discussion of the methods used by the leading rich countries.

Regarding income, the definitions and notations are standard. Note that we always use net-of-depreciation income and output concepts. National income Y_t is the sum of net domestic output and net foreign income: $Y_t = Y_{dt} + r_t \cdot NFA_t$.[14] Domestic output can be thought as coming from some production function that uses domestic capital and labor as inputs: $Y_{dt} = F(K_t, L_t)$.

We are particularly interested in the evolution of the private wealth-national income ratio $\beta_t = W_t/Y_t$ and of the (market-value) national wealth-national income ratio $\beta_{nt} = W_{nt}/Y_t$. In a closed economy – and more generally in an open economy with a zero net foreign position – the national wealth-national income ratio β_{nt} is the same as the domestic capital-output

[13] W_{bt} corresponds to the concept of "national net worth" in the SNA (see Data Appendix A.4.2). In this paper, we propose to use "national wealth" and "national capital" interchangeably (and similarly for "domestic wealth" and "domestic capital", and "private wealth" and "private capital"), and to specify whether one uses "market-value" or "book-value" aggregates. Note that 19^{th} century authors such as Giffen and Foville also used "national wealth" and "national capital" interchangeably. The difference is that they viewed market values as the only possible value, while we recognize that both definitions have some merit (see below the discussion on Germany).

[14] National income also includes net foreign labor income and net foreign production taxes – both of which are usually negligible.

ratio $\beta_{kt} = K_t/Y_{dt}$.[15] In case public wealth is equal to zero, then both ratios are also equal to the private wealth-national income ratio: $\beta_t = \beta_{nt} = \beta_{kt}$. At the global level, the world wealth-income ratio is always equal to the world capital/output ratio.

We are also interested in the evolution of the capital share $\alpha_t = r_t \cdot \beta_t$. With imperfect capital markets, the average rate of return r_t can substantially vary across assets. In particular, it can be different for domestic and foreign assets. With perfect capital markets, the rate of return r_t is the same for all assets and is equal to the marginal product of capital. With a Cobb-Douglas production function $F(K, L) = K^\alpha L^{1-\alpha}$, and a closed economy setting, the capital share is entirely set by technology: $\alpha_t = r_t \cdot \beta_t = \alpha$. A higher capital-output ratio β_t is exactly compensated by a lower capital return $r_t = \alpha/\beta_t$, so that the product of the two is constant. In an open economy setting, the world capital share is also constant and equal to α, and the world rate of return is also given by $r_t = \alpha/\beta_t$, but the countries with higher-than-average wealth-income ratios invest part of their wealth in other countries, so that for them the share of capital in national income is larger than α. With a CES production function, much depends on whether the capital-labor elasticity of substitution σ is larger or smaller than one. If $\sigma > 1$, then as β_t rises, the fall of the marginal product of capital r_t is smaller than the rise of β_t, so that the capital share $\alpha_t = r_t \cdot \beta_t$ is an increasing function of β_t. Conversely, if $\sigma < 1$, the fall of r_t is bigger than the rise of β_t, so that the capital share is a decreasing function of β_t.[16] Because we include all forms of capital assets into our aggregate capital concept K (including housing), the aggregate elasticity of substitution σ should really be interpreted as resulting from both supply forces (producers shift between technologies with different capital intensities) and demand forces (consumers shift between goods and services with different capital intensities, including housing services vs. other goods and services).[17]

[15] In principle, one can imagine a country with a zero net foreign asset position (so that $W_{nt} = K_t$) but non-zero net foreign income flows (so that $Y_t \neq Y_{dt}$). In this case the national wealth-national income ratio β_{nt} will slightly differ from the domestic capital-output ratio β_{kt}. In practice today, differences between Y_t and Y_{dt} are very small – national income Y_t is usually between 97% and 103% of domestic output Y_{dt} (see Appendix Figure A57). Net foreign asset positions are usually small as well, so that β_{kt} turns out to be usually close to β_{nt} in the 1970-2010 period (see Appendix Figure A67).

[16] A CES production function is given by: $F(K, L) = (a \cdot K^{\frac{\sigma-1}{\sigma}} + (1-a) \cdot L^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$. As $\sigma \to \infty$, the production function becomes linear, i.e. the return to capital is independent of the quantity of capital (this is like a robot economy where capital can produce output on its own). As $\sigma \to 0$, the production function becomes putty-clay, i.e. the return to capital falls to zero if the quantity of capital is slightly above the fixed proportion technology.

[17] Excluding housing from wealth strikes us an inappropriate, first because it typically represents about half of the capital stock, and next because the frontier with other capital assets is not always entirely clear. In particular, the same assets can be reallocated between housing and business uses. Note also that official balance sheets treat housing assets owned by corporations (and sometime those rented by households) as corporate

3.2 The one-good wealth accumulation model: $\beta = s/g$

Generally speaking, wealth accumulation between time t and $t+1$ can always be decomposed into a volume effect and a relative price effect:

$$W_{t+1} = W_t + S_t + KG_t$$

where:

W_t is the market value of aggregate wealth at time t

S_t is the net saving flow between time t and $t+1$ (volume effect)

KG_t is the capital gain or loss between time t and $t+1$ (relative price effect)

In the one-good model of wealth accumulation, and more generally in a model with a constant relative price between capital and consumption goods, there is no relative price effect ($KG_t = 0$). The wealth-income ratio $\beta_t = W_t/Y_t$ is simply given by the following transition equation:

$$\beta_{t+1} = \frac{1+g_{wst}}{1+g_t} \cdot \beta_t$$

where:

$1 + g_{wst} = 1 + s_t/\beta_t$ = saving-induced wealth growth rate

$1 + g_t = Y_{t+1}/Y_t$ = growth rate of national income

$s_t = S_t/Y_t$ = net saving rate.

In the long run, with a fixed saving rate $s_t = s$ and growth rate $g_t = g$, the steady-state wealth-income ratio is given by the well-known Harrod-Domar-Solow formula:

$$\beta_t \to \beta = s/g$$

Should we use gross-of-depreciation saving rates rather than net rates, the steady-state formula would be $\beta = s/(g+\delta)$ with s the gross saving rate, and δ the depreciation rate expressed as a proportion of the wealth stock. We find it more transparent to express everything in terms of net saving rates and use the $\beta = s/g$ formula, so as to better concentrate on the saving versus capital gain decomposition. Both formulations are equivalent and require the same data.[18]

capital assets.

[18]Appendix Table A84 provides cross-country data on private depreciation. Detailed series on gross saving, net saving, and depreciation, by sector of the economy, are in Appendix Tables US.12c, JP.12c, etc. Whether

3.3 The $\beta = s/g$ formula is independent of saving motives

It is worth stressing that the steady-state formula $\beta = s/g$ is a pure accounting equation. By definition, it holds in the steady-state of any micro-founded model, independently of the exact nature of saving motives. If the saving rate is $s = 10\%$, and if the economy grows at rate $g = 2\%$, then in the long run the wealth income ratio has to be equal to $\beta = 500\%$, because it is the only ratio such that wealth rises at the same rate as income: $g_{ws} = s/\beta = 2\% = g$.

In the long run, income growth g is the sum of productivity and population growth. Among other things, it depends on the pace of innovation and on fertility behavior (which is notoriously difficult to predict, as the large variations between rich countries illustrate).[19] The saving rate s also depends on many forces: s measures the strength of the various psychological and economic motives for saving and wealth accumulation (dynastic, lifecycle, precautionary, prestige, taste for bequests, etc.). The motives and tastes for saving vary a lot across individuals and potentially across countries.[20]

One simple way to see this is the "bequest-in-the-utility-function" model. Consider a dynamic economy with a discrete set of generations $0, 1, .., t, ...,$ zero population growth, and exogenous labor productivity growth at rate $g > 0$. Each generation has measure $N_t = N$, lives one period, and is replaced by the next generation. Each individual living in generation t receives bequest $b_t = w_t \geq 0$ from generation $t-1$ at the beginning of period t, inelastically supplies one unit of labor during his lifetime (so that labor supply $L_t = N_t = N$), and earns labor income y_{Lt}. At the end of period, he then splits lifetime resources (the sum of labor income and capitalized bequests received) into consumption c_t and bequests left $b_{t+1} = w_{t+1} \geq 0$, according to the following budget constraint:

$$c_t + b_{t+1} \leq y_t = y_{Lt} + (1 + r_t)b_t$$

The simplest case is when the utility function is defined directly over consumption c_t and the increase in wealth $\Delta b_t = b_{t+1} - b_t$ and takes a simple Cobb-Douglas form: $V(c, \Delta b) =$

one writes down the decomposition of wealth accumulation using gross or net saving, one needs depreciation series.

[19]The speed of productivity growth could also be partly determined by the pace of capital accumulation (like in AK-type endogenous growth models). Here we take as given the many different reasons why productivity growth and population growth vary across countries.

[20]For estimates of the distribution of bequest motives between individuals, see, e.g., Kopczuk and Lupton (2007). On cross-country variations in saving rates due to habit formation (generating a positive $s(g)$ relationship), see Carroll, Overland and Weil (2000). On the importance of prestige and social status motives for wealth accumulation, see Carroll (2000).

$c^{1-s}\Delta b^s$.[21] Utility maximization then leads to a fixed saving rate at the level of each dynasty: $w_{t+1} = w_t + sy_t$. By multiplying per capita values by population $N_t = N$ we have the same linear transition equation at the aggregate level: $W_{t+1} = W_t + sY_t$.

Assume a closed economy and no government wealth. Domestic output is given by a standard constant returns to scale production function $Y_{dt} = F(K_t, H_t)$ where $H_t = (1+g)^t \cdot L_t$ is the supply of efficient labor. The wealth-income ratio $\beta_t = W_t/Y_t$ is the same as the capital-output ratio K_t/Y_{dt}. With perfectly competitive markets, the rate of return is given by the marginal product of capital: $r_t = F_K$. Now assume a small open economy taking the world rate of return as given ($r_t = r$). The domestic capital stock is set by $r = F_K$. National income $Y_t = Y_{dt} + r(W_t - K_t)$ can be larger or smaller than domestic output depending on whether the net foreign asset position $NFA_t = W_t - K_t$ is positive or negative. Whether we consider the closed or open economy case, the long-run wealth-income ratio is given by the same formula: $\beta_t \to \beta = s/g$. It depends on the strength of the bequest motive on the one hand, and on the rate of productivity growth on the other.[22]

With other functional forms for the utility function, e.g. with $V = V(c, b)$, or with heterogenous labor productivities and/or saving tastes across individuals, one simply needs to replace the parameter s by the properly defined average bequest taste parameter. In any case we keep the same general formula $\beta = s/g$.[23]

If we introduce overlapping generations and lifecycle saving into the "bequest-in-the-utility-function" model, then one can show that the saving rate parameter s in the $\beta = s/g$ formula now depends not only on the strength of the bequest taste, but also on the magnitude of the lifecycle saving motive. Typically, following the Modigliani triangle logic, the saving rate $s = s(\lambda)$ is an increasing function of the fraction of one's lifetime that is spent in retirement (λ). The long-run

[21] Intuitively, this corresponds to a form of "moral" preferences where individuals feel that they cannot possibly leave less wealth to their children than what they have received from their parents, and derive utility from the increase in wealth (maybe because this is a signal of their ability or virtue). Of course the strength of this saving motive might well vary across individuals and countries.

[22] In addition, with a Cobb-Douglas production function $F(K, H) = K^\alpha H^{1-\alpha}$, the domestic capital-output ratio is given by: $K_t/Y_{dt} = \alpha/r$. Depending on whether this is smaller or larger than $\beta = s/g$, the long run net foreign asset position is positive or negative. In the closed-economy case, $r_t \to r = \alpha/\beta = \alpha \cdot g/s$.

[23] For instance, with $V(c, b) = c^{1-s}b^s$, we get $w_{t+1} = s(w_t + y_t)$ and $\beta_t \to \beta = s/(g+1-s) = \widetilde{s}/g$ (with $\widetilde{s} = s(1+\beta) - \beta$). In a model with general heterogenous labor incomes y_{Lti} and utility functions $V^{ti}(c, b)$, one simply needs to replace s by the properly defined weighted average s_i (see Piketty and Saez, 2013). Note also that if one interprets each period $0, 1, ..., t, ...$ as a generation lasting H years, then the $\beta = s/g$ formula is better viewed as giving a ratio of wealth over generational income $\widehat{\beta} = s/G$, where $G = (1+g)^H - 1$ is the generational growth rate and g is the corresponding yearly growth rate. For g small, the corresponding wealth-yearly income ratio $H \cdot \widehat{\beta}$ is approximately equal to $\beta = s/g$.

β now depends on demographic parameters, life expectancy, and the generosity of the public social security system.[24]

Last, the $\beta = s/g$ formula also applies in the infinite-horizon, dynastic model, whereby each dynasty maximizes $V = \sum_{t\geq 0} U(c_t)/(1+\theta)^t$. One well-known, unrealistic feature of this model is that the long run rate of return is entirely determined by preference parameters and the growth rate: $r_t \to r = \theta + \gamma g$.[25] In effect, the model assumes an infinite long-run elasticity of capital supply with respect to the net-of-tax rate of return. It mechanically entails extreme consequences for optimal capital tax policy (namely, zero tax). The "bequest-in-the-utility-function" model provides a less extreme and more flexible conceptual framework in order to analyze the wealth accumulation process.[26] But from a purely logical standpoint, it is important to realize that the Harrod-Domar-Solow also holds in the dynastic model. The steady-state saving rate in the dynastic model is equal to $s = \alpha \cdot g/r = \alpha \cdot g/(\theta+\gamma g)$.[27] The saving rate $s = s(g)$ is an increasing function of the growth rate, but rises less fast than g, so that the steady-state wealth-income ratio $\beta = s/g$ is again a decreasing function of the growth rate.[28]

3.4 The two-good model: volume vs. relative price effects

Wherever savings come from, the key assumption behind the one-good model of wealth accumulation and the $\beta = s/g$ formula is that there is no change in the relative price between capital and consumption goods. This is a strong assumption. In practice, relative asset price effects often vastly dominate volume effects in the short run, and sometimes in the medium run as well. One key issue addressed in this paper is whether relative price effects also matter for the analysis of long-run wealth accumulation.

There are many theoretical reasons why they could matter, particularly if the speed of technical progress is not the same for capital and consumption goods. One extreme case would

[24] For a simple model along those lines, see Appendix K.4.

[25] $\gamma \geq 0$ is the curvature of the utility function: $U(c) = \frac{c^{1-\gamma}}{1-\gamma}$ ($\gamma > 1$ is usually assumed to be more realistic).

[26] Depending upon the exact functional form of the utility function $V(c, \Delta b)$ (or $V(c, b)$), one can generate any elasticity of saving behavior $s(r)$ with respect to the net-of-tax rate of return. The elasticity could be positive or negative, large or small, leaving it to empirical studies to settle the issue. Available estimates tend to suggest a low positive long run elasticity (Piketty and Saez, 2013). It is unclear whether increased tax competition and cuts in capital tax rates over the recent decades have affected saving rates and have contributed to the rise of wealth-income ratios.

[27] $\alpha = r \cdot \beta$ is the capital share. Intuitively, a fraction g/r of capital income is saved in the long-run, so that dynastic wealth grows at the same rate g as national income.

[28] With a Cobb-Douglas production function (fixed capital share), the wealth-income ratio is simply given by $\beta = \alpha/r = \alpha/(\theta + \gamma \cdot g)$ and takes its maximum value $\overline{\beta} = \alpha/\theta$ for $g = 0$.

be a two-good model where the capital good is in fixed supply: $V_t = V$ (say, fixed land supply). The market value of wealth if given by $W_t = q_t V$, where q_t is the price of the capital good (say, land price) relative to the consumption good. Assume fixed population and labor supply $L_t = N_t = N_0$, positive labor productivity growth $g > 0$ and the same utility function $U(c, \Delta b) = c^{1-s} \Delta b^s$ as that described above, where $\Delta b_t = b_{t+1} - b_t = w_{t+1} - w_t$ is the difference (in value) between left and received bequests. Then one can easily see that the relative price q_t will rise at the same pace as output and income in the long run, so that the market value of wealth rises as fast as output and income. By construction, there is no saving at all in this model (since the capital good is by assumption in fixed supply), and the rise in the value of wealth is entirely due to a relative price effect.[29] This is the opposite extreme of the one-good model, whereby the rise in the value of wealth is entirely due to a volume effect.

In practice, there are all sorts of intermediate cases between these two polar cases: in the real world, volume effects matter, but so do relative price effects. Our approach is to let the data speak. We decompose the evolution of the wealth-income ratio into two multiplicative components (volume and relative price) using the following accounting equation:

$$\beta_{t+1} = \frac{(1 + g_{wst})(1 + q_t)}{1 + g_t} \beta_t$$

where:

$1 + g_{wst} = 1 + s_t/\beta_t =$ saving-induced wealth growth rate

$1 + q_t =$ capital-gains-induced wealth growth rate

$1 + g_t = Y_{t+1}/Y_t =$ growth rate of national income

$1 + q_t$ is the real rate of capital gain or loss (i.e., the excess of asset price inflation over consumer price inflation) and can be estimated as a residual. We do not try to specify where q_t comes from (one can think of stochastic production functions for capital and consumption goods, with different rates of technical progress in the two sectors), and we infer it from the data at our disposal on $\beta_t, ..., \beta_{t+n}$, $s_t, ..., s_{t+n}$, and $g_t, ...g_{t+n}$. In effect, if we observe that the wealth-income ratios rises too fast as compared to recorded saving, we record positive real capital gains q_t. Although we tend to prefer the multiplicative decomposition of wealth accumulation (which

[29] For instance with a Cobb-Douglas production function $Y = V^\alpha N^{1-\alpha}$, we have: $Y_t = Y_0(1 + \overline{g})^t$ (with $Y_0 = V^\alpha N_0^{1-\alpha}$ and $1+\overline{g} = (1+g)^{1-\alpha}$; if g small, $\overline{g} \approx (1-\alpha)g$); $q_t = q_0(1+\overline{g})^t$ (with $\beta_t = W_t/Y_t = q_t V/Y_t = s/\overline{g}$, i.e. $q_t = (s/\overline{g})(Y_t/V)$); and $Y_{Kt} = rW_t = \alpha Y_t$, i.e. $r = \alpha\overline{g}/s$. In effect, the relative capital price rises as fast as income and output, and the level of the relative capital price is set by the taste for wealth.

is more meaningful over long time periods), we also present additive decomposition results. The disadvantage of additive decompositions (which are otherwise simpler) is that they tend to overweight recent years. The exact equations and detailed decomposition results are provided in Appendix K. In the next two sections, we will present the main decomposition results, starting with the 1970-2010 period, before moving to longer periods of time.

4 Wealth-income ratios in rich countries 1970-2010

4.1 The rise of private wealth-income ratios

The first fact that we want to understand is the gradual rise of private wealth-national income ratios in rich countries over the 1970-2010 period – from about 200-300% in 1970 to about 400-600% (Figure 1 above). We begin with a discussion of the basic descriptive statistics.

Private wealth-national income ratios have risen in every developed economy since 1970, but there are interesting cross-country variations. Within Europe, the French and U.K. trajectories are relatively close: in both countries, private wealth rose from 300-310% of national income in 1970 to 540-560% in 2010. In Italy, the rise was even more spectacular, from less than 250% in 1970 to more than 650% today. In Germany, the rise was proportionally larger than in France and the U.K., but the levels of private wealth appear to be significantly lower than elsewhere: 200% of national income in 1970, little more than 400% in 2010. The relatively low level of German wealth at market value is an interesting puzzle, on which we will return. At this stage, we simply note that we are unable to identify any methodological or conceptual difference in the work of German statisticians (who apply the same SNA guidelines as everybody else) that could explain the gap with other European countries.[30]

Outside Europe, national trajectories also display interesting variations. In Japan, private wealth rose sharply from less than 300% of national income in 1970 to almost 700% in 1990, then fell abruptly in the early 1990s and stabilized around 600%. The 1990 Japanese peak is widely regarded as the archetype of an asset price bubble, and probably rightly so. But if we look at the Japanese trajectory from a longer run, cross-country perspective, it is yet another

[30]See Appendix D on Germany. We made sure that the trend is unaffected by German unification in 1990. The often noted difference in home ownership rates between Germany and other European countries is not per se an explanation for the lower wealth-income ratio. For a given saving rate, one can purchase different types of assets, and there is no obvious reason in general why housing assets should deliver higher capital gains than financial assets. We return to this issue below.

example of the 1970-2010 rise of wealth-income ratios – fairly close to Italy in terms of total magnitude over the 40 years period.

In the U.S., private wealth rose from slightly more than 300% of national income in 1970 to almost 500% in 2007, but then fell abruptly to about 400% in 2010 – so that the total 1970-2010 rise is the smallest in our sample. (The U.S. wealth-income ratio is now rising again, so this might change in the near future). In other countries the wealth-income ratio stabilized or fell relatively little during the 2008-2010 financial crisis.[31] In Canada, private wealth rose from 250% of national income in 1970 to 420% in 2010 – a trajectory that is comparable to Germany, but a with a somewhat larger starting point.

The general rise in private wealth-national income ratios would be even more spectacular should we use disposable personal income – i.e., national income minus taxes plus cash transfers – at the denominator. Disposable income was over 90% of national income until 1910, then declined to about 80% in 1970 and to 75%-80% in 2010, in particular because of the rise of freely provided public services and in-kind transfers such as health and education. As a consequence, the private wealth-disposable income ratio is well above 700% in a number of countries in 2010, while it was below 400% in every country in 1970.[32] Whether one should use national or disposable income as denominator is a matter of perspective. If one aims to compare the monetary amounts of income and wealth that individuals have at their disposal, then looking at the ratio between private wealth and disposable income seems more appropriate. But in order to study the wealth accumulation process and to compare wealth-income ratios over long periods of time, it seems more justified to look at economic values and therefore to focus on the private wealth-national income ratio, as we do in the present paper.[33]

[31] With the interesting exception of Spain, where private wealth fell with a comparable magnitude as in the U.S. since 2007 (i.e., by the equivalent of about 50%-75% of national income, or 10%-15% of initial wealth).

[32] See Appendix Figure A9. Should we include durable goods in our wealth definition, then wealth-income ratios would be even higher – typically by the equivalent about 50% of national income. However the value of durable goods seems to be approximately constant over time as a fraction of national income, so this would not significantly affect the upward trend.

[33] In the end it really depends on how one views government-provided services. If one assumes that government expenditures are useless, and that the rise of government during the 20^{th} century has limited the ability of private individuals to accumulate and transmit private wealth, then one should use disposable income as denominator. But to the extent that government expenditures are mostly useful (in the absence of public spending in health and education, individuals would have to had to pay at least as much to buy similar services on the market), it seems more justified to use national income. One additional advantage of using national income is that it tends to be better measured. Disposable income can display large time-series and cross-country variations for purely definitional reasons. In European countries disposable income typically jumps from 70% to about 80% of national income if one includes in-kind health transfers (such as insurance reimbursements), and to about 90% of national income if one includes all in-kind transfers (education, housing, etc.). See Appendix Figure A65.

4.2 Private wealth vs. national wealth

We now move from private to national wealth – the sum of private and government wealth. In rich countries, net government wealth has always been relatively small compared to private wealth, and it has declined since 1970, as Figure 5 illustrates. This decline is due both to privatization policies – leading to a reduction in government assets – and to the gradual increase in public debt.

In the U.S., as well as in Germany, France, and the U.K., net government wealth was around 50%-100% of national income in the 1970s-1980s, and is now close to zero. In Italy, net government wealth became negative in the early 1980s, and is now below -50%; in Japan, it was historically larger – up to about 100% of national income in 1990 – but fell sharply during the 1990s-2000s and is now close to zero. In Canada, the government turned strongly negative in the late 1980s – with a trough of -60% in 1995, like Italy in 2010 – but is now back to zero. Australia is the only country in our sample with persistently and significantly positive net government wealth.

Although there are data imperfections, the fall in government wealth definitely appears to be quantitatively much smaller than the rise of private wealth. As a result, national wealth has increased a lot, from 250-400% of national income in 1970 to 400-650% in 2010 (Figure 6).[34] In Italy, for instance, net government wealth fell by the equivalent of about one year of national income, but net private wealth rose by over four years of national income, so that national wealth increased by the equivalent of over three years of national income.

4.3 Growth rates vs. saving rates

How can we account for the general rise of wealth-income ratio, as well as for the cross country variations? According to the one-good capital accumulation model and the Harrod-Domar-Solow formula $\beta = s/g$, the two key forces driving wealth-income ratios are the saving rate s and the income growth rate g. So before we present our decomposition results, it is useful to have in mind the magnitude of growth and saving rates in rich countries over the 1970-2010 period. The basic fact is that there are important variations across countries, for both growth

[34]Note that national wealth is unaffected by the treatment of future government spending such as pay-as-you-go pensions. Should we include claims on future spendings spending in wealth, private wealth would be higher and government wealth lower, leaving national wealth unchanged.

and saving rates, and that they seem largely unrelated (Table 2).[35]

Variations in income growth rates are mostly due to variations in population growth. Over 1970-2010, average per capita growth rates have been virtually the same in all rich countries: they are always between 1.6% and 2.0%, and for most countries between 1.7% and 1.9%. Given the data imperfections we face, it is unclear whether differences of 0.1%-0.2% are statistically significant. For instance, the rankings of countries in terms of per capita growth are reversed if one uses consumer price indexes rather than GDP deflators, or if one looks at per-worker rather than per-capita growth.[36]

In contrast, variations in population growth are large and significant. Over 1970-2010, average population growth rates vary from less than 0.2% per year in Germany to over 1.4% in Australia. Population growth is over 1% per year in New World countries (U.S., Canada, Australia), and less than 0.5% in Europe and Japan. As a consequence, total growth rates are about 2.5%-3% in the former group, and closer to 2% in the latter. Differences in population growth are due to differences in both migration and fertility. Within Europe, for example, there is a well known gap between high fertility countries such as France (with population growth equal to 0.5% per year) and low fertility countries like Germany (less than 0.2% per year, with a sharp fall at the end of the period).[37]

Variations in saving rates are also large. Average net-of-depreciation private saving rates vary from 7%-8% in the U.S. and the U.K. to 14%-15% in Japan and Italy, with a large group of countries around 10%-12% (Germany, France, Canada, Australia). In theory, one could imagine that low population growth, aging countries have higher saving rate, because they need to accumulate more wealth for their old days. Maybe it is not a coincidence if the two countries with the highest private saving rate (Japan and Italy) also have low population growth. In practice, however, saving rates seem to vary for all sorts of reasons other than life-cycle motives, probably reflecting differences in tastes for saving and/or wealth accumulation and

[35]Here we focus upon the long run picture, so we mostly comment about the 40-year averages. Complete breakdowns of growth and saving rates by decades are available in the Appendix country tables.

[36]In particular, the U.S. and Japan both fall last in the ranking if we deflate income by the CPI rather than the GDP deflator (see Appendix Table A165). Differences in total factor productivity (TFP) growth also appear to be relatively small across most rich countries. A more complete treatment of TFP growth variations should also include differences in growth rates of work hours, human capital investment (such as higher education spendings), etc. It is far beyond the scope of the present work.

[37]Population growth in Japan over the 1970-2010 period appears to be relatively large (0.5%), but it is actually much higher in 1970-1990 (0.8%) than in 1990-2010 (0.2%). Japan is also the country with the largest fall in per capita growth rates, from 3.6% in 1970-1990 to 0.5% in 1990-2010. See Appendix Table JP.3.

transmission,[38] as well as differences in psychological perceptions of the need for saving (i.e., different levels of trust and confidence in the future).[39] As a result, there is only a weakly significant negative relationship between private saving and growth rates at the country level. And when we consider national rather than private saving (see Table 3), we find no relationship at all between saving and growth.[40]

In brief: as a first approximation, productivity growth is the same everywhere in the rich world, but fertility decisions, migration policy and saving behavior vary widely and are largely unrelated to one another. This potentially creates a lot of room for wide, multi-dimensional variations in wealth-income ratios $\beta = s/g$.

4.4 Basic decomposition: volume vs. price effects

Table 4 presents our results on the decomposition of 1970-2010 national wealth accumulation into saving and capital gains effects.[41] The main finding is that new savings explain the largest part of wealth accumulation, but that there is also a clear pattern of positive capital gains. Take the U.S. case. National wealth was equal to 404% of national income in 1970, and is equal to 431% of national income in 2010. National wealth has grown at an average real rate $g_w = 3.0\%$ per year. On the basis of national saving flows alone, we find that wealth would have grown at rate $g_{ws} = 2.1\%$ per year only. We conclude that the residual capital-gains-induced wealth growth rate $q = (1+g_w)/(1+g_{ws}) - 1$ has been equal to 0.8% per year on average. New savings explain 72% of the accumulation of national wealth in the U.S. between 1970 and 2010, while residual capital gains explain 28%.

Just like in the U.S., new savings also appear to explain around 70-80% of 1970-2010 national wealth accumulation in Japan, France, and Canada, and residual capital gains 20-30%. Capital gains are larger in the U.K., Italy, and Australia.

[38] See, e.g., Hayashi (1986) on Japanese tastes for bequest.

[39] The effect of the rise of life expectancy on saving behavior is unclear. In theory, rising life expectancy may have contributed to pushing saving rates upward, but in practice the level of annuitized wealth seems to be relatively low in a number of rich countries. In France for instance, annuitized wealth represents less than 3% of aggregate private wealth (see Piketty 2011, Appendix A p.37-38), suggesting that this channel does not play an important role in the rise of the wealth-income ratio. In countries with less generous pay-as-you-go pension systems, annuitized wealth can be as large as 10%-20% of aggregate private wealth.

[40] See Appendix Figures A122 and A123. Note that in some countries a large fraction of private savings is absorbed by government deficits (more than one third in Italy over the 1970-2010 period).

[41] Here we only show the multiplicative decompositions of national wealth. The additive decompositions yield similar conclusions; see Appendix Table A101. Additive and multiplicative decompositions of private wealth are presented in Appendix Table A111b.

The capital gains we compute are obtained as a residual, and so may reflect measurement errors in addition to real valuation effects.[42] There are two main possible issues. First, it is entirely possible that national saving flows are substantially under-estimated because they do not include research and development expenditure. To address this concern, we have re-computed our wealth accumulation equations using saving flows that include R&D. Even after we include generous estimates of R&D expenditure, in many countries the 2010 observed levels of national wealth are still significantly larger than those predicted by 1970 wealth levels and 1970-2010 saving flows alone (Figure 7a).[43] Take the case of France: predicted national wealth in 2010 – on the basis of 1970 initial national wealth and cumulated 1970-2010 national saving including R&D – is equal to 491% of national income, while observed national wealth is equal to 605%. We have the equivalent of over 100% of national income in "excess wealth".[44]

Second, we might somewhat underestimate the value of public assets at the beginning of the period in countries like the U.K., France and Italy. Part of the capital gains we measure might simply correspond to the fact that private agents have acquired privatized assets at relatively cheap prices. From the viewpoint of households this is indeed a capital gain, but from a national wealth perspective it is a pure transfer from public to private hands, and it should be neutralized by raising the level of 1970 wealth. Whenever possible, we have attempted to count government assets at equivalent market values throughout the period (including in 1970), but we might still slightly under-estimate 1970 government wealth levels.

In the end, in our preferred specification that includes generous R&D expenditure in saving flows, capital gains account for about 40% on average of the total 1970-2010 increase in β, and

[42]In the Appendix, we have checked that the pattern of capital gains residuals we find is highly correlated with capital gains on listed equities and housing coming from available asset price indexes (see Figures A143 to A157). Note that the capital gains inferred from our wealth decomposition exercises are structurally lower than those coming from equity price indexes, for a good reason. A substantial fraction of national saving takes the form of corporate retained earnings (see Table 3) and these earnings generate structural capital gains in equity markets. Should we exclude retained earnings from saving in the wealth accumulation equation, then we would similarly find much larger residual capital gains (see Appendix Table A105). Such capital gains, however, would be spurious, in the sense that they correspond to the accumulation of earnings retained within corporations to finance new investment (thereby leading to rising stock prices), rather than to a true relative price effect.

[43]R&D has been included in investment in the latest SNA guidelines (2008), but this change has so far only been implemented in Australia. The computations reported in Figures 7a-7b include generous estimates of R&D investment based on the level of R&D expenditure observed in the U.S. satellite account over the 1970-2010 period (see Appendix A.5.2 for a detailed discussion).

[44]Saving flows might be under-estimated for reasons other than R&D. Given the limitations of national accounts (in particular regarding the measurement of depreciation, which is discussed in Appendix Section A.1.2.), this possibility certainly cannot completely be ruled out. One would need, however, large and systematic errors to account for the amount of excess wealth we find.

saving for about 60%, with a lot of heterogeneity across countries.[45]

How can we explain the substantial capital gains we find? As we shall see below, housing and stock market capital gains in the U.K. and France since the 1970s-1980s can be understood as the outcome of a long run asset price recovery. Asset prices fell substantially during the 1910-1950 period, and have been rising regularly ever since 1950. There might, however, have been some overshooting in the recovery process, particularly in housing prices. Four of the countries with the largest capital gains – UK, France, Italy, Australia – have by far the largest level of housing wealth in our sample: over 300% of national income in 2010, a level that was only attained by Japan around 1990. So it is tempting to conclude that part of the capital gains we measure owe to abnormally high real estate prices in 2010.

To a large extent, the housing bubble explanation for the rise of wealth-income ratios is complementary to the real explanation. In countries like France and Italy, savings are sufficiently large relative to growth to generate a significant increase in the wealth-income ratio. Given the values taken by s and g over the 1970-2010 period, and given the steady-state formula $\beta = s/g$, the wealth-income ratios β observed in 1970 were too low and had to increase. If in addition households in these countries have a particularly strong taste for domestic assets like real estate (and/or do not want to diversify their portfolio internationally as much as they could) then maybe it is not too surprising if this generates high upward pressure on housing prices.

There is one interesting exception to the general pattern of positive capital gains: Germany. Given the relatively large saving flows and low growth rates in 1970-2010, we should observe more wealth in 2010 than 400% of national income. According to our estimate that includes R&D expenditure in saving flows, "missing wealth" in Germany is of the order of 50-100% of national income (Figure 7a). German statisticians might over-estimate saving and investment flows, or under-estimate the current stock of private wealth, or both.

Yet another possibility is that Germany has not experienced any asset price recovery so far because the German legal system still today gives important control rights over private assets to stakeholders other than private property owners. Rent controls, for instance, may have prevented the market value of real estate from increasing as much as in other countries. Voting rights granted to employee representatives in corporate boards may similarly reduce the market value of corporations.[46] Germans might also have less taste for expensive capital goods

[45]See Appendix A.5.2 and Appendix Table A99.

[46]Whether this is good or bad for productive efficiency is a complex issue which we do not address in this

(particularly housing goods) than the French, the British and the Italians, maybe because they have less taste for living in a large centralized capital city and prefer a more polycentric country, for historical and cultural reasons. With the data we have at our disposal, we are not able to put a precise number on each explanation.

Last, it is worth noting that when we compute a European average wealth accumulation equation – by taking a weighted average of Germany, France, U.K. and Italy – then capital gains and losses seem to partly wash out (Figure 7b). Europe as a whole has less residual capital gains than the U.K., France, and Italy, thanks to Germany. Had we regional U.S. balance sheets at our disposal, maybe we would find regional asset price variations within the U.S. that would not be too different from those we find in Europe. So one possibility is that substantial relative asset price movements happens permanently within relatively small national or regional economic units, but tend to correct themselves at more aggregate levels. German asset prices might rise in the near future and fall in other European countries.

4.5 Domestic capital vs. foreign wealth

So far we analyzed the accumulation of wealth without paying attention to the composition of wealth portfolios, and in particular irrespective of whether wealth is invested domestically or abroad. National wealth, as we have seen, can be written as the sum of domestic capital and net foreign wealth.[47] The basic fact to have in mind is that net foreign wealth – whether positive or negative – has been a relatively small part of national wealth in rich countries throughout the 1970-2010 period (see Figure 6).

Despite this fact, external wealth has turned out to play an important role in the general evolution of wealth-income ratios. First, Japan and Germany have accumulated sizable positive net foreign positions in the 1990s-2000s, due to their large trade surpluses. In the early 2010s, both countries own the equivalent of between 40% and 70% of national income in net foreign assets. Although Japan's and Germany's net foreign positions are still substantially smaller

paper (at first sight, low equity values do not seem to prevent German firms from producing good products). In this "stakeholder" view of the firm, the market value of corporations can be interpreted as the value for capital owners, while the book value can be interpreted as the value for all stakeholders. Both views have their merits. See Appendix for further discussion.

[47] Remember that a country's net foreign wealth is equal to its gross foreign assets (assets owned by residents in the rest of the world) minus its gross foreign liabilities (domestic assets owned by rest-of-the-world residents). Domestic capital is national wealth minus net foreign wealth, i.e. is equal to the market value of all domestic capital assets located in the home country, whether they are owned by the personal, government, or corporate sector, or by the rest of the world (see below for a decomposition between housing and other capital goods).

than the positions reached by the U.K. and France around 1900-1910, they are starting to be substantial. And the German position is rising fast. As a result, in Japan and Germany, the rise in net foreign assets represents more than a quarter of the total rise of the national wealth-national income ratio (Table 5). In most of the other countries in our database, by contrast, net foreign positions are currently slightly negative – typically between -10% and -30% of national income – and have been declining. For those countries, the rise in the domestic capital-output ratio has been larger than the rise in the national wealth-income ratio. One caveat is that the official net foreign asset positions do not include the sizable assets held by a number of rich country residents in tax havens. In all likelihood, including these assets would turn the rich world's total net foreign asset position from negative to positive. The improvement would probably be particularly large for Europe (Zucman, 2013).

Second, there has been a huge rise in the gross foreign positions of countries since the 1970s. A significant share of each country's domestic capital is now owned by other countries. The rise in cross-border positions is highly significant everywhere – it is spectacular in Europe, a bit less so in the world's largest economies, the U.S. and Japan.[48] One implications is that capital gains and losses on foreign portfolios can be large and volatile over time and across countries. And indeed, we find that foreign portfolios have generated large capital gains in the U.S. (but also the U.K. and Australia) and significant capital losses in some other countries (Japan, Germany, France). Strikingly, in Germany virtually all capital losses at the national level can be attributed to foreign assets (Table 6). In the U.S., net capital gains on cross-border portfolios represent one third of total capital gains at the national level, and the equivalent of the total rise in the U.S. national wealth-national income ratio since 1970.[49]

4.6 Housing vs. other domestic capital goods

Last, we present decomposition results for housing versus other domestic capital assets.

[48]In 2010, gross assets held in France by the rest of the world amount to about 310% of national income, while gross assets held by French residents in the rest of the world amount to about 300% of national (hence a negative position of about -10%, in the official data). For the U.S., gross foreign assets amount to about 120% of national income, and gross liabilities to about 100% of national (hence a negative position equal to about -20%). For detailed series, see Appendix figures A39-A42.

[49]Our results on the net capital gains on U.S. external wealth are consistent with the findings of Gourinchas and Rey (2007). What we add to this line of work is a global macro perspective that includes the accumulation of both domestic and foreign capital. Note that we include all "other volume changes" in saving flows but exclude R&D from saving. We provide detailed accumulation results isolating saving, "other volume changes", and capital gains in the country-specific tables of the Appendix.

The accumulation of housing wealth has played a large role in the total accumulation of domestic capital, but with significant variations between countries. In the U.K., France and Italy, the rise in domestic capital-national income ratios (or domestic capital-output ratios) is almost entirely due to the rise of housing (Table 7). In Japan, housing represents less than half of the total rise of domestic capital – and an even smaller proportion of the total rise of national wealth, given the large accumulation of net foreign assets.[50]

In most countries, other domestic capital goods have also contributed to the rise of national wealth, in particular because their market value has tended to increase. Tobin's Q ratios between market and book value of corporations were much below 1 in the 1970s and are closer to 1 (and at times above 1) in the 1990s-2000s.[51] But there are again interesting cross-country variations. Tobin's Q is very low in Germany: is has remained well below 1 (typically around 0.5), contrary to the U.K. and the U.S. One interpretation is the "stakeholder effect" described above: shareholders of German companies do not have full control of company assets – they share their voting rights with workers' representatives and sometime regional governments – which might push Q below 1.[52] Yet another possibility is that some of the variations in Q reflect data limitations. Quite puzzlingly, indeed, in most countries Q appears to be structurally below 1, although intangible capital is imperfectly accounted for, which in principle should push it above 1. Part of the explanation may be that the book-value of corporations – corporate assets as measured by statisticians using the perpetual inventory method – tends to be over-estimated in national accounts. This is another area in which existing statistics might need to be improved.

5 Wealth-income ratios in rich countries 1870-2010

It is impossible to properly understand the rise of wealth-income ratios in rich countries in the recent decades without putting the 1970-2010 period into a longer historical perspective. As we

[50]One caveat is that the frontier between housing and other capital goods is not always entirely clear. Sometimes the same buildings are reallocated between housing and offices, and housing services can be provided by hotels and real estate companies. Also, the various countries do not always use the same methods and concepts (e.g., in Japan, tenant-occupied housing is partly counted in other domestic capital, and we could not fully correct for this). This is an area where progress still needs to be made. Appendix A.9 pinpoints the key areas in which we believe national accounts could be improved.

[51]See Appendix Figure A92. Note, however, that because of the general increase in corporate capital, book-value national wealth (expressed as a fraction of national income) has increased almost as much as market-value national wealth (see Appendix figure A25).

[52]In Germany, book-value national wealth is substantially above market-value national wealth (about 5 years of national income instead of 4 years). The opposite occurs in the U.K.

have seen, a significant part of the rise of β since the 1970s is due to capital gains: about 40% on average, with large differences between countries. The key question is the following: is this due to a structural, long-run rise in the relative price of assets (caused for instance by uneven technical progress), or is it a recovery effect? Our conclusion is that it is mostly a recovery effect. The capital gains observed during the 1970-2010 period largely seem to compensate the capital losses observed during earlier parts of the 20^{th} century.

We have reached this conclusion by analyzing the evolution of wealth-income ratios over the 1870-2010 period. Due to data limitations, our long term analysis is restricted to four countries: the U.S., the U.K., Germany and France. The key descriptive statistics are the following. For the three European countries, we find a similar U-shaped pattern: today's private wealth-national income ratios appear to be returning to the high values observed in 1870-1910, namely about 600%-700% (Figure 2 above). For the U.S., the U-shaped pattern is much less strong (Figure 4 above). In addition, European public wealth-national income ratios have followed an inverted U-curve over the past century.[53] But the magnitude of the pattern for public wealth is very limited compared to the U-shape evolution of private wealth, so that European national wealth-income ratios are strongly U-shaped too. Last, in 1900-1910, European countries held a very large positive net foreign asset position – around 100% of national income on average. Interestingly, the net foreign position of Europe has again turned (slightly) positive in 2000-2010, when the national wealth-income ratio again exceeded that of the U.S. (Figure 8).

Starting from this set of facts, and using the best historical estimates of saving and growth rates, we have estimated detailed 1870-2010 wealth accumulation equations. As Table 8 shows, the total accumulation of national wealth over this 140-year-long period seems to be well accounted for by saving flows. In order to fully reconcile the stock and flow data, we need a small residual capital gain for the U.S., France and the U.K., and a small residual capital loss for Germany. But in all cases saving flows account for the bulk of wealth accumulation: capital gains seem to wash out in the long run.[54]

Looking at each sub-period, we find in every European country a strong U-shaped relative

[53] Net public wealth was significantly positive (around 100% of national income) during the 1950s-1970s, due to large public assets and low debt. Since then, public wealth has returned to the low level observed on the eve of World War 1.

[54] These results are robust to a wide range of specifications. Appendix Tables A108 to A137 present the complete decomposition results, for each country and sector of the economy, for both the additive and multiplicative models.

capital price effect. In the U.K., for example, we find a negative rate of real capital losses equal to -1.9% per year between 1910 and 1950, followed by real gains of +0.9% per year between 1950 and 1980 and 2.4% between 1980 and 2010 (Table 9). The pattern is similar for France. In these two countries, there seems to have been a slight over-shooting in the recovery process, in the sense that the total cumulated relative asset price effect over the 1910-2010 period appears to be somewhat positive (+0.2% per year in the U.K., +0.3% in France). In Germany, by contrast, the recovery is yet too come (-0.8% between 1910 and 2010).

We emphasize that the imperfections of our data do not allow us to put a precise number on asset over- or undervaluation in 2010. In any multi-sector model with uneven technical change between capital and consumption goods, one should expect capital gains and losses that could vary between countries (for instance depending on comparative advantage). The residual capital gains/losses we estimate might also reflect measurement issues: 1870-2010 saving flows might be somewhat underestimated in the U.K. or France and overestimated in Germany. At a modest level, our point is simply that the one-good capital accumulation model seems to do a relatively good job in the long run, and that the stock and flow sides of historical national accounts are roughly consistent with one another – a result we already find quite remarkable.

Table 10 decomposes the huge decline in wealth-income ratios that occurred in Europe between 1910 and 1950. In the U.K., war destructions play a negligible role – an estimated 4% of the total decline in β. Low national saving during this period accounts for 46% of the fall in β and negative valuation effects (including losses on foreign portfolios) for the remaining 50%. In France and Germany, cumulated physical war destructions account for about one quarter of the fall in β. Low national saving and real capital losses each explain about half of the remaining three quarters. Interestingly, the private wealth-national income ratio has declined less in the U.K. than in France and Germany between 1910 and 1950, but the reverse holds for the national wealth-income ratio (due to the large negative U.K. public wealth around 1950).[55]

The U.S. case is again fairly different from that of Europe. The fall of β during the 1910-1950 period was more modest, and so was the recovery since 1950. Regarding capital gains, we find in every sub-period a small but positive relative price effect. The capital gain effect becomes bigger in the recent decades and largely derives from the U.S. foreign portfolio – it seems too big to be accounted for by underestimated saving and investment flows.

[55] U.K. net public wealth then turned positive during the 1950s-1960s. See Appendix figure A16 and A22.

6 The changing nature of national wealth, 1700-2010

6.1 The changing nature of wealth in Old Europe

What do we know about the evolution of wealth-income ratios prior to 1870? In the U.K. – the country with the most comprehensive historical balance sheets – the national wealth-national income ratios appears to have been approximately stable during the 18^{th} and 19^{th} centuries – around 600-700%, or possibly somewhat higher (Figure 3 above). In France, where a large number of historical national wealth estimates were also established during those two centuries, the picture is similar (Figure 9).

We should make clear that the raw data sources available for the 18^{th}-19^{th} centuries are insufficient to precisely compare the levels of wealth-income ratios between the two countries or between the various sub-periods. But the general pattern definitely seems to be robust. All available estimates, coming from many different authors using independent methodologies, provide the same orders of magnitude. National wealth always seems to be between 6 and 8 years of national income (usually around 7 years) from 1700 to 1914 in two countries, with no obvious trend in the long run.

Strikingly, the wealth-income ratio around 2010 is now relatively close to what it was in the 18^{th} centuries in both the U.K. and France, in spite of considerable changes in the nature of wealth. The general picture is relatively straightforward. The value of agricultural land – including land improvement of all sorts – was between 4 and 5 years of national income in the U.K. and the France in the early 18^{th} centuries, and is now less than 10% national income in both countries. But land has been replaced by other forms of capital – housing and other domestic capital (offices, machines, patents, etc.) – to such an extent that the wealth-income ratio appears to be almost as high today as three hundred years ago. In the long run, the decline of the share of agricultural land in national capital mirrors that of the share of agriculture in national income, from over two thirds in the 18^{th} century to a few percent today – with a faster and earlier historical decline in the U.K. The huge variations in the share of net foreign assets in national wealth are also striking. Net foreign assets were virtually zero in the 18^{th} century. They reached very high levels in the late 19^{th} and early 20^{th} century – almost 2 years of national income in the U.K. around 1910, over 1 year in France. Following the wars and the collapse of the British and French colonial empires, they came back to virtually zero around 1950.

Why is it that wealth-income ratios were so high in the 18^{th}-19^{th} centuries, and why do they seem to be approaching these levels again in the 21^{st} century? A natural explanation lies in the $\beta = s/g$ steady-state formula. With slow growth, even moderate saving rates naturally lead to large wealth-income ratios. Growth was low until the 18^{th}-19^{th} centuries, and is likely to be low again in the 21^{st} century as population growth vanishes, thereby potentially generating high wealth-income ratios again.

This is probably an important part of the explanation. Unfortunately, data limitations make it difficult to evaluate the exact role played by alternative explanations, such as structural capital gains and losses and changes in the value of natural resources (un-accumulated wealth).

The main difficulty is that pre-1870 estimates of saving and investment flows appear to be too fragile to be used in wealth accumulation decompositions. Also, with very low growth – annual growth rates were typically much less than 1% until the 18^{th} century – it is clear than any small error in the net-of-depreciation saving rate s can make a huge difference in terms of predicted steady-state wealth-income ratio $\beta = s/g$. In preindustrial societies where $g \approx 0.5 - 1\%$, whether the net saving rate is $s = 5\%$ or $s = 8\%$ is going to matter a lot. Historical estimates suggest that there was substantial investment going on in traditional societies, including in the rural sector. Annual spendings on land improvement (drainage, irrigation, afforestation etc.) alone could be as large as 3-4% of national income. This suggests that a large fraction of total agricultural land value in 18^{th} century U.K. and France actually derived from past investment. In all likelihood, the "pure land value" (i.e., the value of the pure natural resource brought by land, before any investment or improvement, as it was discovered thousands of years ago, at prehistoric times) was much less than 4 years of national income. Some estimates made in the 18^{th} century tend to suggest that it was around 1 year of national income.[56] Saving and investment series are unfortunately not sufficiently reliable to definitively address the question. The residual "pure land" value could be less than 0.5 year, or up to 2 years of national income.

6.2 The nature of wealth: Old Europe vs. the New World

In order to make some progress on this question, it is useful to compare the value of land in Old Europe (U.K., France, Germany) and in the New World. For the U.S., we have put

[56] See in particular the famous estimates by Thomas Paine (1795), who suggested in front of the French National Assembly to confiscate the "pure land" component of inheritance, which he estimated to be about 1 year of national income. On saving and investment series covering the 18^{th}-19^{th} centuries, particularly for the U.K. and France, see data Appendix.

together historical balance sheets starting around 1770 (Figure 10). The robust finding, which we also obtain with Canada, is that the value of agricultural land in the late 18^{th} and early 19^{th} centuries is much less in the New World – 1 to 2 years of national income – than in Old Europe – 3 to 4 years.[57] Part of the explanation could well be lower accumulated investment and land improvement relative to economic and population growth in the New World (i.e., a lower cumulated s/g ratio). However, available evidence suggests that the relatively low New World wealth-income ratios can also be explained by a "land abundance" effect. Land was so abundant in the New word that its price per acre was low. The right model to think about this effect involves a production function with an elasticity of substitution lower than 1 between land and labor – a necessary condition for the price effect to dominate the volume effect.

To see this, think of a two-good model of the form introduced in section 3.4 above. That is, assume that the capital good solely consists of land and is in fixed supply: $V_t = V$. For the sake of simplicity, assume that no land improvement is possible. The market value of land if given by $K = qV$, where q is the price of land relative to the consumption good. The production function $Y = F(V, L)$ transforms capital input (land) V and labor input L into output Y. Assume that $F(V, L)$ is a CES function with elasticity σ, and that there is zero productivity and population growth.

Consider two countries 0 and 1 with similar technology and preferences. Assume that country 1 (America) has more land relative to labor than country 0 (Old Europe): $V_1/L_1 > V_0/L_0$. Then one can easily see that country 1 will end up with lower land value (relative to income) than country 0 (i.e., $\beta_1 < \beta_0$, with $\beta_1 = K_1/Y_1 = q_1 \cdot V_1/Y_1$ and $\beta_0 = K_0/Y_0 = q_0 \cdot V_0/Y_0$) if and only if the elasticity of substitution σ is less than one. This result directly follows from the fact that the capital share α is smaller in country 1 than in country 0 (i.e., $\alpha_1 = F_V \cdot V_1/Y_1 < \alpha_0 = F_V \cdot V_0/Y_0$) if and only if σ is less than one. The capital share is lower in the land-abundant country. Under standard assumptions on preferences and equilibrium rates of return, this also implies that land value is lower in the land-abundant country: $\beta_1 < \beta_0$.[58]

[57] For the long run evolution of wealth composition in Germany and Canada, see Appendix figures A46 and A47. The German pattern is close to that of the U.K. and France (except that the net foreign asset position of Germany around 1900-1910 is less strongly positive than in the two colonial powers). The Canadian pattern is close to that of the U.S. (except that net foreign asset position is strongly negative throughout the 19^{th} century and much of the 20^{th} century).

[58] With a dynastic utility model, the rate of return is set by the rate of time preference ($r = \theta$), so that $\beta_1 = \alpha_1/r < \beta_0 = \alpha_0/r$. With a bequest-in-the-utility-function model $U(c, b) = c^{1-s}b^s$, then the wealth-income ratio is set by $\beta = s/(1-s)$ (see section 3.4 above), so that the difference in capital share entirely translates into a difference in rates of return: $r_1 = \alpha_1/\beta < r_0 = \alpha_0/\beta$. However to the extent that the interest elasticity of saving

Intuitively, an elasticity of substitution $\sigma < 1$ means that there is not much that one can do with capital when there is too much of it. The marginal product of land falls to very low levels when a few million individuals own an entire continent. The price effect dominates the volume effect. It is exactly what one should expect to happen in a relatively low-tech economy where there is a limited set of things that one can do with capital. At the opposite extreme, in a high-tech economy where there are lots of alternative uses and forms for capital (a robot economy), it is natural to expect higher elasticities of substitution, either closer to 1 (Cobb-Douglas) or even larger than one (as we shall see below).

To summarize: part of the initial difference in β between Europe and America in the 18^{th}-19^{th} centuries seems to be due to a relative price effect (due to land abundance) rather than to a pure saving effect (via the $\beta = s/g$ formula). Both logic actually tend to reinforce each other: the lower land prices and higher wage rates attract labor to the New World, implying very large population growth rates and relatively low steady-state $\beta = s/g$ ratios.[59]

The lower land values prevailing in America during the 1770-1860 period were to some extent compensated by the slavery system. Land was so abundant that it was almost worthless, implying that it was difficult to be really rich by owning land. However, the landed elite could be rich and control a large share of national income by owning the labor force. In the extreme case where a tiny elite owns the entire labor force, the total value of the slave stock can in principle be very large, say as large as 20 years of national income (assuming the labor share is 100% of output and the rate of return is equal to 5%).[60] In the case of antebellum U.S., the situation was less extreme, but the value of the slave stock was still highly significant. By putting together the best available estimates of slave prices and the number of slaves, we have

$s = s(r)$ is positive, this also implies $\beta_1 < \beta_0$. A similar intuition applies to the case with $U(c, b) = c^{1-s}\Delta b^s$ (assuming positive population or productivity growth so as to obtain a well-defined steady-state $\beta = s/g$).

[59]There is a large historical literature on the factor flows that characterized the 19^{th} Atlantic economy. In order to explain why both labor and capital flew to the New World, one needs to introduce a three-factor production function (see, e.g., Taylor and Williamson, 1994, and O'Rourke and Williamson, 2005). One could also argue that transatlantic differences in land value (rural, urban and suburban) still matter today. However they go together with different tastes over housing in city centers versus suburban areas, so that it is difficult to disentangle the various effects. The fact that the bulk of 1870-2010 wealth accumulation is well explained by volume effects – both in Europe and in the U.S. – suggests that today's differences in pure land values are less central than they used to be.

[60]With a one-good model and a Cobb-Douglas production function $F(K, L) = K^\alpha L^{1-\alpha}$, the market value β_H of the human capital stock (i.e., the value of the labor force from the viewpoint of a potential slave owner) is always equal to $(1-\alpha)/\alpha$ times the non-human capital stock. If $\alpha = 1/3$, then $\beta_H = 2\beta$. This is assuming that the slave owner equates returns across all human and non-human assets. With a CES production function $F(K, L) = (a \cdot K^{\frac{\sigma-1}{\sigma}} + (1-a) \cdot L^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$, we have $\beta_H = \frac{1}{a} \cdot \beta^{1/\sigma} - \beta$.

come to the conclusion that the market value of slaves was between 1 and 2 years of national income for the entire U.S., and up to 3 years of income in Southern states. When we add up the value of slaves and the value of land, we obtain wealth-income ratios in the U.S. South which are relatively close to those of the Old World. Slaves approximately compensate the lower land values (Figures 11 and 12).

Needless to say, this peculiar form of wealth has little to do with "national" wealth and is better analyzed in terms of appropriation and power relationship than in terms of saving and accumulation. We view these "augmented" national balance sheets as a way to illustrate the ambiguous relationship of the New world with wealth and inequality. To some extent, America is the land of equal opportunity, the place where wealth accumulated in the past does not matter too much. But at the same time, America is also the place where a new form of wealth and class structure – arguably more extreme and violent than the class structure prevailing in Europe – flourished, whereby part of the population owned another part.[61]

7 Capital-output ratios vs. capital shares

So far we have mostly focused on the evolution of wealth-income and capital-output ratios. We now compare the long-run evolution of capital-output ratios and capital shares in order to briefly discuss the changing nature of technology and the pros and cons of the Cobb-Douglas approximation in the very long run.

The first basic fact is that capital shares did rise in rich countries during the 1970-2010 period, from about 15%-25% in the 1970s to 25%-35% in the 2000s-2010s, with large variations over time and across countries (Figure 13). However they did not rise as much as national wealth-national income and domestic capital-output ratios, so that the average of return to wealth – which can be computed as $r_t = \alpha_t / \beta_t$ – declined somewhat (Figure 14).[62] Of course, this decline is what one would expect in any model: when there is more capital, the rate of return to capital must go down. The interesting question is whether it falls more or less than the quantity of capital. According to our data it has fallen less, implying a rising capital share.

There are several ways to think about this piece of evidence. One can think of a model

[61]During the 1770-1860 period, slaves made as much as 15%-20% of total U.S. population (up to 40% in Southern states). See Appendix Table US.3b.

[62]The results are robust to the various ways of taking into account government capital and interest payment in these computations, which are discussed in Appendix A.7.5. The reader should have in mind that like all our income series, the capital shares displayed in Figure 13 are net of depreciation.

with imperfect competition and an increase in the bargaining power of capital (e.g., due to globalization and increasing capital mobility). One can also think of a production function with three factors – capital, high skill labor and low skill labor – where capital is more strongly complementary with skilled than with unskilled labor. With a rise in skills, and possibly with skill-biased technical change, it can easily generate a rising capital share.

Yet another – and more parsimonious – way to obtain the same result is a standard two-factor, CES production function $F(K, L)$ with an elasticity of substitution $\sigma > 1$.[63] Importantly, the elasticity does not need to be hugely superior to one in order to account for the observed trends. With an elasticity σ around 1.2-1.6, a doubling of capital-output ratio β can lead to a large rise in the capital share α. With large changes in β, one can obtain substantial movements in the capital share with a production function that is only moderately more flexible than the standard Cobb-Douglas function. For instance, with $\sigma = 1.5$, the capital share rises from $\alpha = 28\%$ to $\alpha = 36\%$ if the wealth-income ratio jumps from $\beta = 2.5$ to $\beta = 5$, which is roughly what has happened in rich countries since the 1970s. The capital share would reach $\alpha = 42\%$ in case further capital accumulation takes place and the wealth-income ratio attains $\beta = 8$. In case the production function becomes even more flexible over time (say, $\sigma = 1.8$), the capital share would then be as large as $\alpha = 53\%$.[64]

We do not claim that this scenario will necessarily happen. Our point is simply that it cannot be excluded. Constant capital-output ratios and capital shares are more of a belief than a well-grounded fact. Capital-output ratios have no strong reason to stay constant: s and g vary for all sorts of reasons over time and across countries, so it is natural to expect $\beta = s/g$ to vary

[63] One can of course combine the various possible explanations. Karabarbounis and Neiman (2013) for instance use a two-goods model in which there is a decline in the relative price of investment. As a result, firms shift away from labor toward capital, and with an elasticity of substitution σ larger than 1 the capital share α increases. As the two-goods model we apply in section 6.2. to 19^{th} century U.S. and Europe illustrates, when the relative price of investment is lower (e.g., lower land values) and $\sigma > 1$, the wealth-income ratio has to be higher. Thus, the explanation for the rise in α put forward by Karabarbounis and Neiman (2013) is consistent with our findings of rising β. The difference is that we do not need a two-goods model to account for the rise in α: in any one-good model, when g decreases (while s remains the same so that β increases) and $\sigma > 1$, α has to rise. In the real world, both forces (lower g and declining relative price of some capital goods) probably play a role in the dynamics of α, so that the two explanations should be seen as complementary. One problem, however, with the declining relative price of capital story is that while the price of corporate tangible fixed assets may have declined, taking a broader view of capital we actually find a positive relative price effect over 1970-2010 (see section 4). This could be due to a positive price effect for land, foreign, and R&D assets, which are not included in standard measures of the relative price of capital.

[64] In a perfectly competitive model with $Y = F(K, L) = (a \cdot K^{\frac{\sigma-1}{\sigma}} + (1-a) \cdot L^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$, the rate of return is given by $r = F_K = a \cdot \beta^{-1/\sigma}$ (with $\beta = K/Y$), and the capital share is given by $\alpha = r \cdot \beta = a \cdot \beta^{\frac{\sigma-1}{\sigma}}$. With $a = 0.21$ and $\sigma = 1.5$, α goes from 28% to 36% and 42% as β rises from 2.5 to 5 and 8. With $\sigma = 1.8$, α rises to 53% if $\beta = 8$.

widely. Relatively small departures from standard Cobb-Douglas assumptions then imply that the capital share $\alpha = r \cdot \beta$ can also vary substantially. In our view, it is natural to imagine that σ was possibly much less than 1 in the 18^{th}-19^{th} centuries and became significantly larger than 1 in the 20^{th}-21^{st} centuries. One expects a higher elasticity of substitution in more diversified economies where capital can take many forms.[65]

Taking a very long run perspective on the evolution of factor shares, there seems to be evidence – both in the U.K. and France – that the capital share was somewhat larger in the 18^{th}-19^{th} centuries (say, around 40%) than it is in the early 21^{st} century (about 30%), despite the recent rise. Will capital shares return to their 18^{th}-19^{th} century levels? The capital-output ratio β is still somewhat lower today than what it used to be in the distant past. So one possibility is that the capital share α will slowly return to about 40% as β keeps increasing in the coming decades – consistent with an elasticity of substitution larger than 1. However, it could also be that the labor exponent in the production function has declined structurally since the 18^{th}-19^{th} centuries, because of the rise of human capital. Over time, human inputs may have become relatively more important than non-human capital inputs in the production process. With the data we have at our disposal, we are not able to say. The long-run U.K. and French data, however, suggest that if such a "rise of human capital" happened, it was probably relatively modest.

We stress that our discussion of capital shares and production functions should be viewed as merely exploratory and illustrative. In many ways, it is more difficult to measure capital shares α than wealth-income ratios β. The measurement of α – and therefore of the average rate of return $r = \alpha/\beta$ – is complicated by self-employment and tax optimization behavior of business owners (a growing concern in a number of countries), by the measurement of housing product (which is not fully homogenous internationally), and also by the problem of "informal" financial intermediation. National accounts deduct from the return to capital the costs of formal intermediation services (provided by banks and real estate agents), but do not deduct the time spent by capital owners to manage their portfolios, to spot the right investment opportunities, and so on. Such costs are difficult to measure, and might well vary over time. In particular, they might be larger in fast growing economies rather than in the stagnant, rural economies

[65] The fact that the capital share α was historically low in the mid-20^{th} century (when β was also low) can also be viewed as evidence for $\sigma > 1$. Indeed, α and β move in the same direction if $\sigma > 1$, and in opposite directions if $\sigma < 1$.

of the 18^{th} century. For this reason, we may tend to over-estimate average rates of return to capital when we compute them using national accounts capital income flow series (via the $r = \alpha/\beta$ formula), especially in high-growth economies. In this paper, we have tried to show that an alternative way to address the issue of the relative importance of capital and labor in the economy is to study the evolution of β rather than the evolution of α – which so far has been the focus of most of the attention. Ideally, both evolutions need to be analyzed together.

8 Directions for future research

Our analysis could be extended in various ways. First, it would be interesting to study wealth-income ratios at the world level. Throughout the 1870-2010 period, the top eight developed economies analyzed in this paper represent between one half and three quarters of world output. By making plausible assumptions about the evolution of other countries' wealth-income ratios, we have estimated the evolution of the world wealth-income ratio between 1870 and 2010. Unsurprisingly, we find a spectacular U-shaped pattern (Figure 16).[66] The exact levels are approximate, but the general shape appears to be robust. Prior to World War 1, the world wealth-income ratio was high and rising. Europe made about half of world output around 1900-1910 and had a high wealth-income ratio; β was rising in the U.S. and other parts of the world. The world ratio then fell abruptly during the 1910-1950 period. According to our estimates, it has been recovering since then and is currently approaching its 1910 nadir. Around 75% of the 1990-2010 rise in the world wealth-income ratio (from about 400% to about 450%) is due to Europe and Japan, while China only accounts for about 15%. From a global perspective, therefore, capital accumulation in rich countries is probably a much more important determinant of the decline in the global return to capital than the large Chinese savings.[67]

We also report on Figure 16 one possible evolution of the wealth-income ratio in 2010-2100. This projection is based upon specific and uncertain assumptions about the future. We take the projected population growth rates from the U.N. central scenario (with near zero or negative

[66] See Appendix Table A8 for the detailed computations and assumptions behind Figure 16. Note that the national wealth-national income ratio is less strongly U-shaped than the private wealth-national income ratio, due to the high level of global public assets in the 1950s-1970s.

[67] The increase in the net foreign asset position of China (from 0 to about 30% of national income) has been even smaller than the rise of China's β (from about 200% to 400% of national income). However, to the extent that China's foreign saving is mostly invested in the U.S. and that national capital markets are segmented, the China-U.S. capital flows might account for a substantial fraction of the decline in the U.S. return to capital.

population growth pretty much everywhere after 2050, except in Africa). We assume rapid convergence of emerging countries (at current pace) and stabilization of per capita growth rates at relatively low levels in frontier economies (1.4%). Last, we assume that saving rates will stabilize around 10-12% of national income. If this happens, then the world wealth-income ratio β will keep rising to about 600-700% by 2070-2100, i.e. approximately the same level as Europe in the 18th-19th centuries. Needless to say, this is only one possible scenario. Much will depend on the evolution of fertility behavior, life expectancy, innovation, the shape of the production function ($\sigma > 1$ or < 1), and the various psychological and economic motives for saving.[68] Our bottom line is simply that with low growth there are strong and powerful economic forces pushing toward high wealth-income ratios in the global economy of the 21^{st} century, just like in the low growth societies of the past.

Next, it would be interesting to include individual-level wealth inequality in the analysis. In this paper, we have emphasized the importance of aggregate wealth-income ratios and net foreign wealth positions, i.e. inequality of wealth between countries. However there is evidence – for example from Forbes' global billionaires list – that the evolution of wealth inequality between individuals is also quite spectacular (possibly even more). Over the past 20-30 years, the very top of the world wealth distribution seems to have been rising at a rate that is substantially above that of average wealth – which is itself substantially above the growth rate of per capita income and output, given the rise in global β. One explanation could be that the slowdown of growth can contribute to both a rise of the aggregate wealth-income ratio and to an increase of wealth inequality. Indeed, in any dynamic wealth accumulation model with heterogeneity and random multiplicative shocks, the steady-state variance and inverted Pareto coefficient is an increasing function of the $r - g$ differential between the net-of-tax rate of return and the growth rate of the economy (see, e.g., Atkinson, Piketty and Saez, 2011).

Last, we plan to extend our analysis to investigate the evolution of the share of inherited wealth in aggregate wealth. The return of high wealth-income ratios does not necessarily imply the return of inheritance. In case wealth is distributed in a relatively egalitarian manner and mostly derives from lifecycle saving, then one can have high and rising β with no corresponding

[68] Private saving rates around s =10-12% are in line with what we observe in rich countries – particularly Europe and Japan – in recent decades, so it makes sense to use such values in our benchmark scenario. However if we include government dissaving then national saving rates in rich countries are substantially lower than 10-12% and are on a declining trend, see Appendix Figures A96 to A103. It is also possible that saving rates will eventually react more strongly than expected to a decline in rates of return.

rise in inheritance. To see this, observe that the annual flow of inheritance, expressed as a proportion of national income, which we note b_{yt}, can be decomposed as the product of three terms: $b_{yt} = \mu_t \cdot m_t \cdot \beta_t$ (where β_t is the aggregate-wealth income ratio, m_t is the annual mortality rate, and μ_t is the ratio between average wealth at death and the average wealth of the living). With pure lifecycle wealth, $\mu_t = 0$, so that $b_{yt} = 0$, irrespective of how large β_t might be.

In the case of France, the long-run U-shaped pattern for the inheritance flow b_{yt} actually turns out to be even more spectacular than the U-shaped pattern observed for β_t, due to the fact that μ_t has also followed a marked U-curve. The relative wealth of the elderly was historically low in the postwar period, so that there was not much to inherit in the 1950s-1960s (Piketty, 2011). However this certainly does not imply that the same evolution applies everywhere. As we have seen, there are large variations in the quantity of wealth that different countries accumulate, so it is natural to expect large differences in the importance of inherited wealth.

The historical series available so far regarding the inheritance flow are too scarce to reach firm conclusions on this important issue. Existing estimates suggest that the French U-shaped pattern also applies to Germany (Schinke, 2012), and to a lesser extent to the U.K. (Atkinson, 2012) and the U.S. (see Piketty and Zucman, 2013, for a survey). Cross-country variations could be due to differences in pension systems and the share of private wealth that is annuitized and therefore non transmissible. From a theoretical perspective, however, it is unclear why there should be much crowding out between lifecycle wealth and transmissible wealth in an open economy: any extra pension wealth should be invested abroad. It could be that there are differences in tastes for wealth transmission across countries. Wealthy individuals in the U.K. and in the U.S. may have less taste for bequest than in France and Germany.[69] But there are also important data problems that could partly explain why the rise of the inheritance flow appears to be more limited in some countries than in others. Wealth surveys tend to vastly underestimate inheritance receipts, not to mention inter vivos gifts, which play a large role in the recent French and German evolution (and which can only be properly measured with administrative data). All of this raises important challenges for future research.

[69] One can interpret the lower $\beta = s/g$ in the U.S. in terms of lower bequest taste: with higher population growth and the same bequest taste (per children) as in Europe, the U.S. should save more. However a large part of U.S. population growth historically comes from migration, so this interpretation cannot be fully accurate.

References

Atkinson, Anthony B., "Wealth and Inheritance in Britain from 1896 to the Present," Working paper, 2012.

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

Azmat, Ghazala, Alan Manning, and John Van Reenen, "Privatization and the Decline of Labour's Share: International Evidence from Network Industries," Working paper, 2011.

Babeau, André, "The Macro-economic Wealth-Income Ratio of Households", *Review of Income and Wealth,* 1983, vol.29(4), pp.347-370.

Barro, Robert J., "Economic Growth in a Cross Section of Countries", *Quarterly Journal of Economics,* 1991, vol.106(2), pp.407-443.

Boisguillebert, Pierre, *Le détail de la France,* Paris, 1695, 215p. Reprinted in E. Daire, *Economistes financiers du 18^e siècle*, Paris: Guillaumin, 1843.

Bowley, Arthur L., *The Change in the Distribution of National Income, 1880–1913*, Oxford: Clarendon Press, 1920.

Carroll Christopher D., "Why Do the Rich Save so much?", in *Does Atlas Shrug? The Economic Consequences of Taxing the Rich*, J. Slemrod ed., Harvard University Press, 2000.

Carroll Christopher D., Jody Overland and David N. Weil, "Saving and Growth with Habit Formation," *American Economic Review*, 2000, vol.90(3), pp.341-355.

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

Colquhoun, Patrick, *A Treatise on the Wealth, Power and Resources of the British Empire,* London, 1815, 561p.

Colson, Clément, *Cours d'économie politique,* Paris: Gauthier-Villars, 1903, 1918, 1927 (several editions).

Davies, James B., Susanna Sandström, Anthony Shorrocks and Edward N. Wolff "The Level and Distribution of Global Household Wealth," *Economic Journal,* 2010, vol.121, pp.223-254.

Denison, Edward F., *The Sources of Economic Growth in the United States and the Alternatives Before Us*, New York: Committee for Economic Development, 1962, 308pp.

Domar, Evsey "Expansion and Employment," *American Economic Review,* 1947, vol.37(1), pp.34-55.

Eisner, Robert, "Capital Gains and Income: Real Changes in the Value of Capital in the United States, 1946-77", pp.175-346, in *The Measurement of Capital,* Dan Usher, ed., University of Chicago Press, 1980.

Ellis, Luci and Kathryn Smith, "The Global Upward Trend in the Profit Share," BIS working paper 231, July 2007, 29p.

Feinstein, Charles, "Capital Formation in Great Britain, 1760-1860," in *The Cambridge Economic History of Europe*, vol.7, Part 1, Chapter 2, Cambridge: Cambridge University Press, 1978, pp.28-96.

Foville, Alfred de, "The Wealth of France and of Other Countries," *Journal of the Royal Statistical Society*, vol.56(4), 1893, pp.597-626.

Gale, William G., and John Sabelhaus, "Perspectives on the Household Saving Rate," *Brookings Papers on Economic Activity,* 1999(1), 1999, pp.181-224.

Giffen, Robert, *The Growth of Capital*, London, 1889, 169p.

Goldsmith, Raymond W., *Comparative National Balance Sheets: A Study of Twenty Countries, 1688-1978,* Chicago: The University of Chicago Press, 1985, 353p.

Goldsmith, Raymond W., *Pre-Modern Financial Systems,* Cambridge: Cambridge University Press, 1991, 348p.

Gourinchas, Pierre-Olivier and Hélène Rey, "From World Banker to World Venture Capitalist: The U.S. External Adjustment and the Exorbitant Privilege," in *G7 Current Account Imbalances: Sustainability and Adjustment*, Richard Clariada (ed), Chicago: University of Chicago Press, 2007, pp.11-66.

Gourinchas, Pierre-Olivier and Hélène Rey, "External Adjustment, Global Imbalances, Valuation Effects," forthcoming in Gita Gopinath, Elhanan Helpman and Kenneth Rogoff (eds) *Handbook of International Economics*, vol.4, 2013.

Harrod, Henry, "An Essay in Dynamic Theory," *Economic Journal,* 1939, vol.49(193), pp.14-33.

Hayashi, Fumio, "Why is Japan's Saving Rate so Apparently High?," in Fischer S. (ed.), *NBER Macroeconomics Annual,* 1986, vol.1, pp.147-234.

Helfferich, Karl, *Deutschlands Volkswholhstand, 1888-1913,* Berlin: G. Stilke, 1913, 164p. (second edition, 1915).

Jones, Charles I. and Paul M. Romer, "The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital," *American Economic Journal: Macroeconomics*, 2010 vol.2(1), pp.224-245.

Jorgenson, Dale W. and Zwi Griliches, "The Explanation of Productivity Change," *Review of Economic Studies,* 1967, vol.34(3), pp.349-383.

Kaldor, Nicholas, "Capital Accumulation and Economic Growth," in *The Theory of Capital,* F.A. Lutz and D.C. Hague (eds), New York: Saint Martins Press, 1961.

Karabarbounis, Loukas and Brent Neiman, "The Global Decline of the Labor Share," working paper, 2013, 46p.

King, Gregory, *Natural and Political Observations and Conclusions Upon the State and Condition of England*, 1696, 45p., Published in Chalmers 1804, pp.29-73.

King, Willford Isbell, *The Wealth and Income of the People of the United States*, New York: McMillan Press, 1915, 278p.

Kopczuk, Wojciech and Joseph Lupton, "To Leave or Not To Leave: the Distribution of Bequest Motives," *Review of Economic Studies*, 2007, vol.74(1), pp.207-235.

Lane, Philip and Gian Maria Milesi-Ferretti, "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004," *Journal of International Economics*, 2007, vol.73, pp.223-250.

Mankiw, N. Gregory, David Romer and David N. Weil, "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics,* 1992, vol.107(2), pp.407-437.

Obstfeld, Maurice, "Does the Current Account Still Matter?," *American Economic Review*, 2012, vol.102(3), pp.1-23

O'Rourke, Kevin and Jeffrey Willamson, "From Malthus to Ohlin: Trade, Industrialisation and Distribution Since 1500," *Journal of Economic Growth*, 2005, vol.10, pp.5-34.

Paine, Thomas, "Agrarian Justice", 1795, available at `http://www.constitution.org/tp/agjustice.htm`.

Petty, William, *Verbum Sapienti*, 1664, 26p. Published as an addendum to W. Petty, *The Political Anatomy of Ireland*, London: 1691, 266p. Reprinted in *The Economic Writings of Sir William Petty,* C.H. Hull ed., 2 vol., Cambridge University Press, 1989.

Piketty, Thomas, "On the Long-Run Evolution of Inheritance: France 1820-2050," *Quarterly Journal of Economics*, 2011, vol.126(3), pp.1071-1131.

Piketty, Thomas and Emmanuel Saez, "A Theory of Optimal Inheritance Taxation," *Econometrica,* 2013, forthcoming.

Piketty, Thomas and Gabriel Zucman, "Wealth and Inheritance in the Long Run," 2013, in preparation for the *Handbook of Income Distribution,* vol. 2, Elsevier North-Holland.

Schinke, Christoph, "Inheritance in Germany 1911 to 2009," 2012, PSE working paper.

Samuelson, Paul, *Economics,* 1970, McGraw Hill, 8th edition.

Simon, Julian, "Great and Almost-Great Magnitudes in Economics," *Journal of Economic Perspectives*, 1990, vol.4(1), pp.149-156.

Solow, Robert M., "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics* , 1956, vol.70(1), pp.65-94.

Taylor, Alan, and Jeffrey Willamson, "Capital Flows to the New World as an Intergenerational Transfer", *Journal of Political Economy*, 1994, vol.102(2), pp.348-371

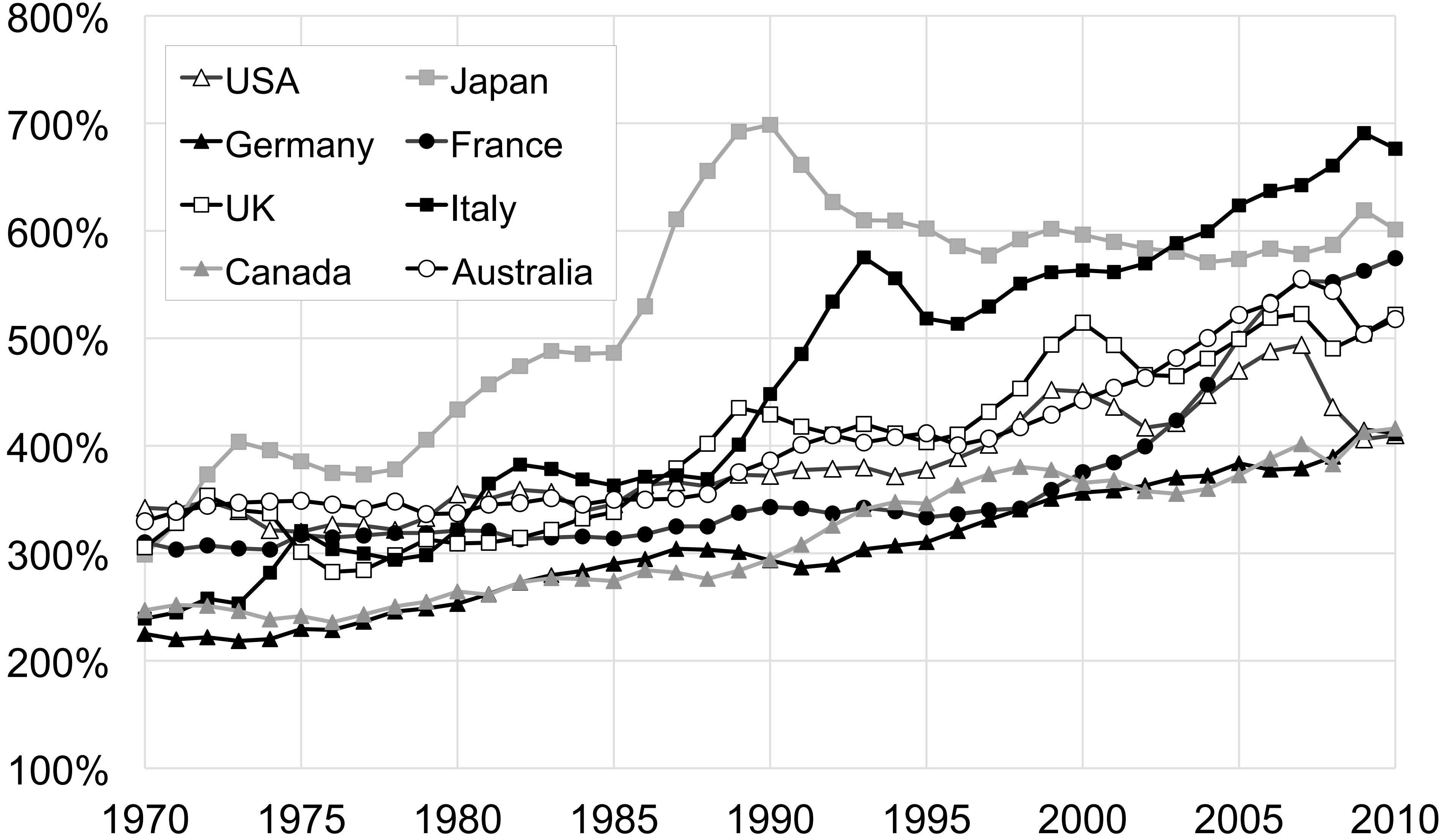
Vauban, Sébastien, *Projet d'une dixme royale,* Paris, 1707, 267p. Reprinted in E. Daire, *Economistes financiers du 18^e siècle*, Paris: Guillaumin, 1843.

Wolff, Edward, "Wealth Accumulation by Age Cohort in the U.S., 1962-1992: The Role of Savings, Capital Gains and Intergenerational Transfers" *The Geneva Papers on Risk and Insurance,* 1999, vol.24(1), pp. 27-49.

Wolff, Edward and Daphne T. Greenwood, "Changes in Wealth in the United States, 1962-1983: Savings, Capital Gains, Inheritance, and Lifetime Transfers," *Journal of Population Economics,* 1992, vol.5(4), pp.261-288.

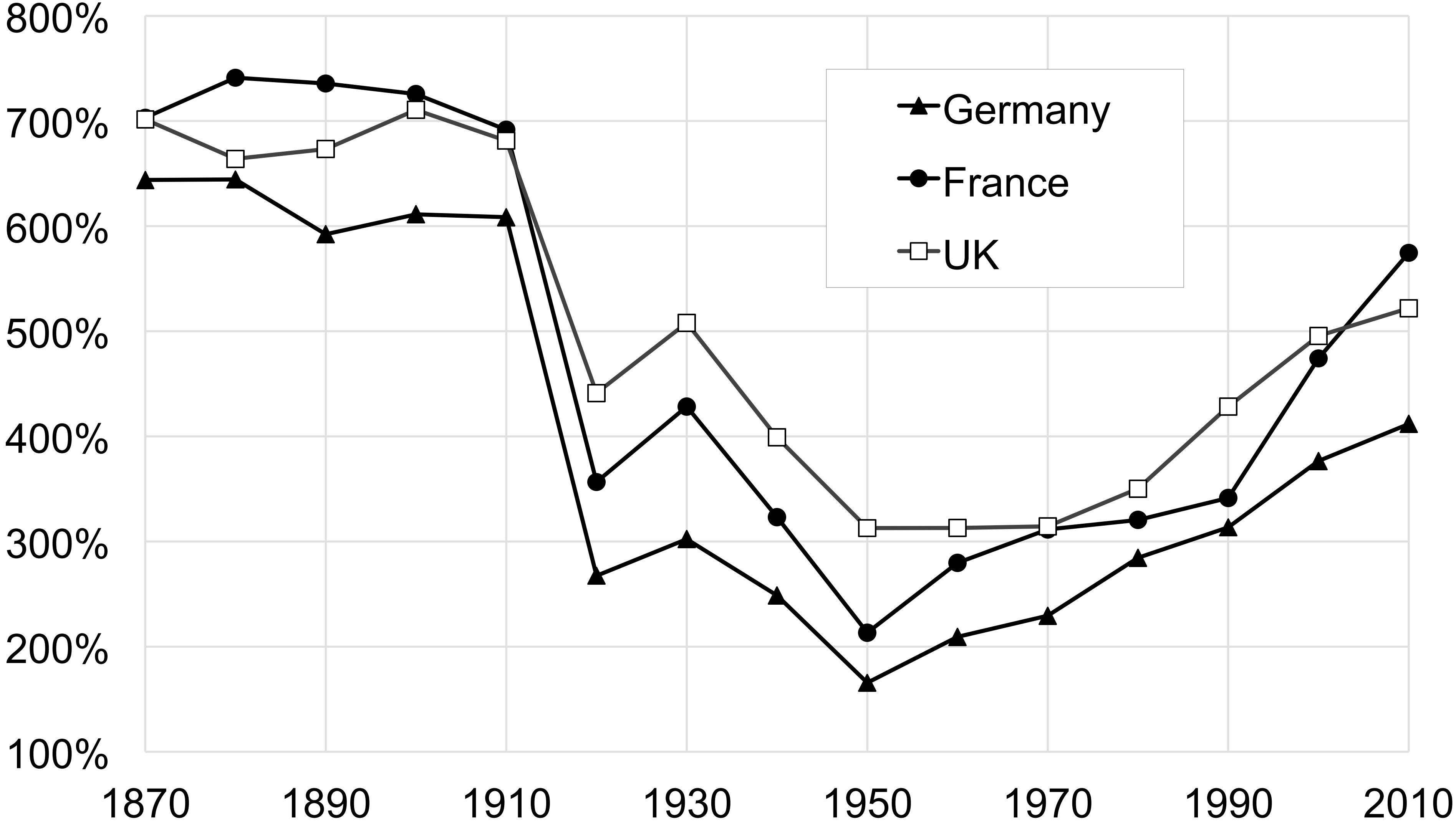
Zucman, Gabriel, "The Missing Wealth of Nations: Are Europe and the U.S. Net Debtors or Net Creditors?", *Quarterly Journal of Economics*, 2013, vol.128(3), pp.1321-1364.

Figure 1: Private wealth / national income ratios 1970-2010



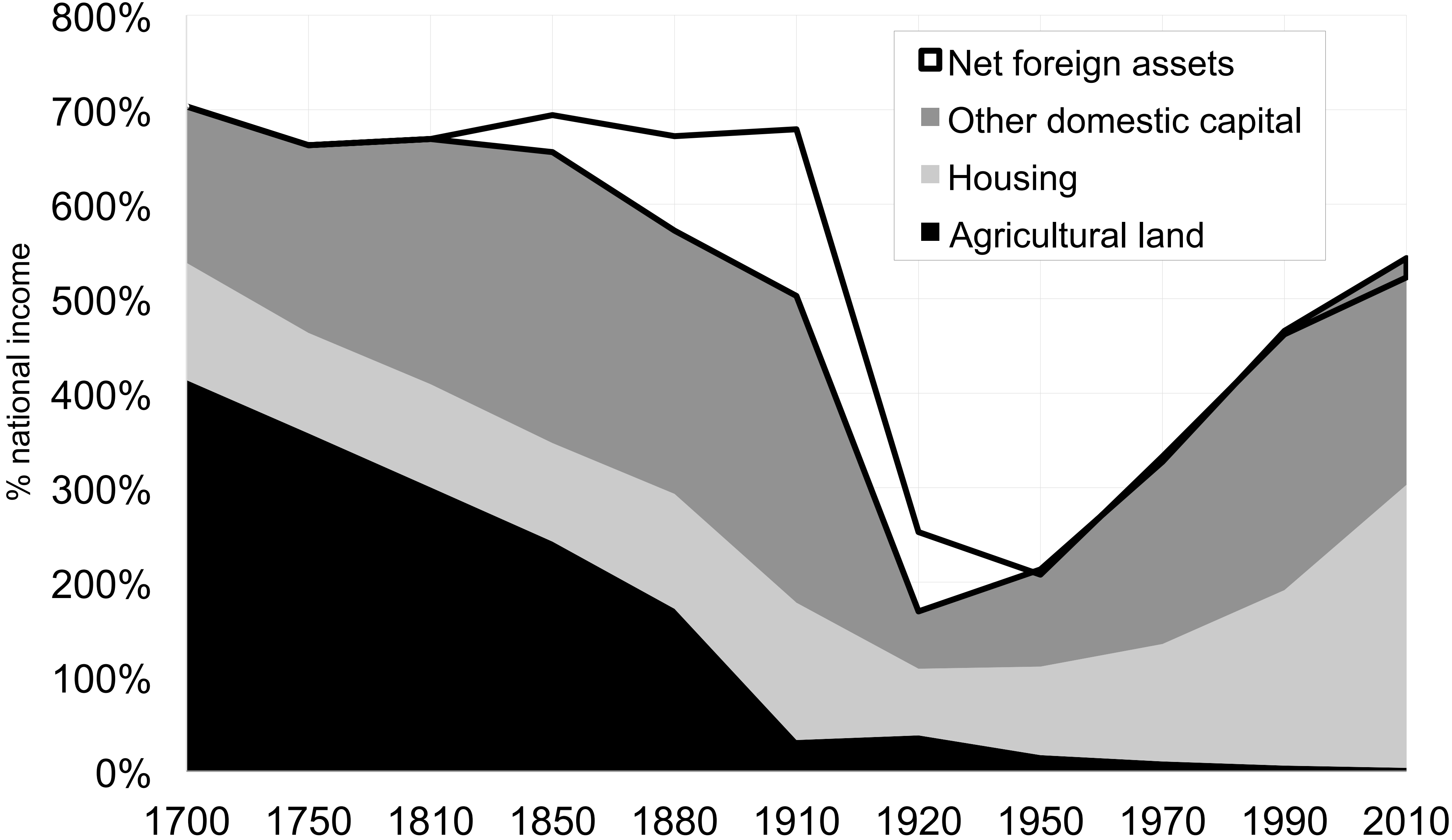
Authors' computations using country national accounts. Private wealth = non-financial assets + financial assets - financial liabilities (household & non-profit sectors)

Figure 2: Private wealth / national income ratios in Europe 1870-2010



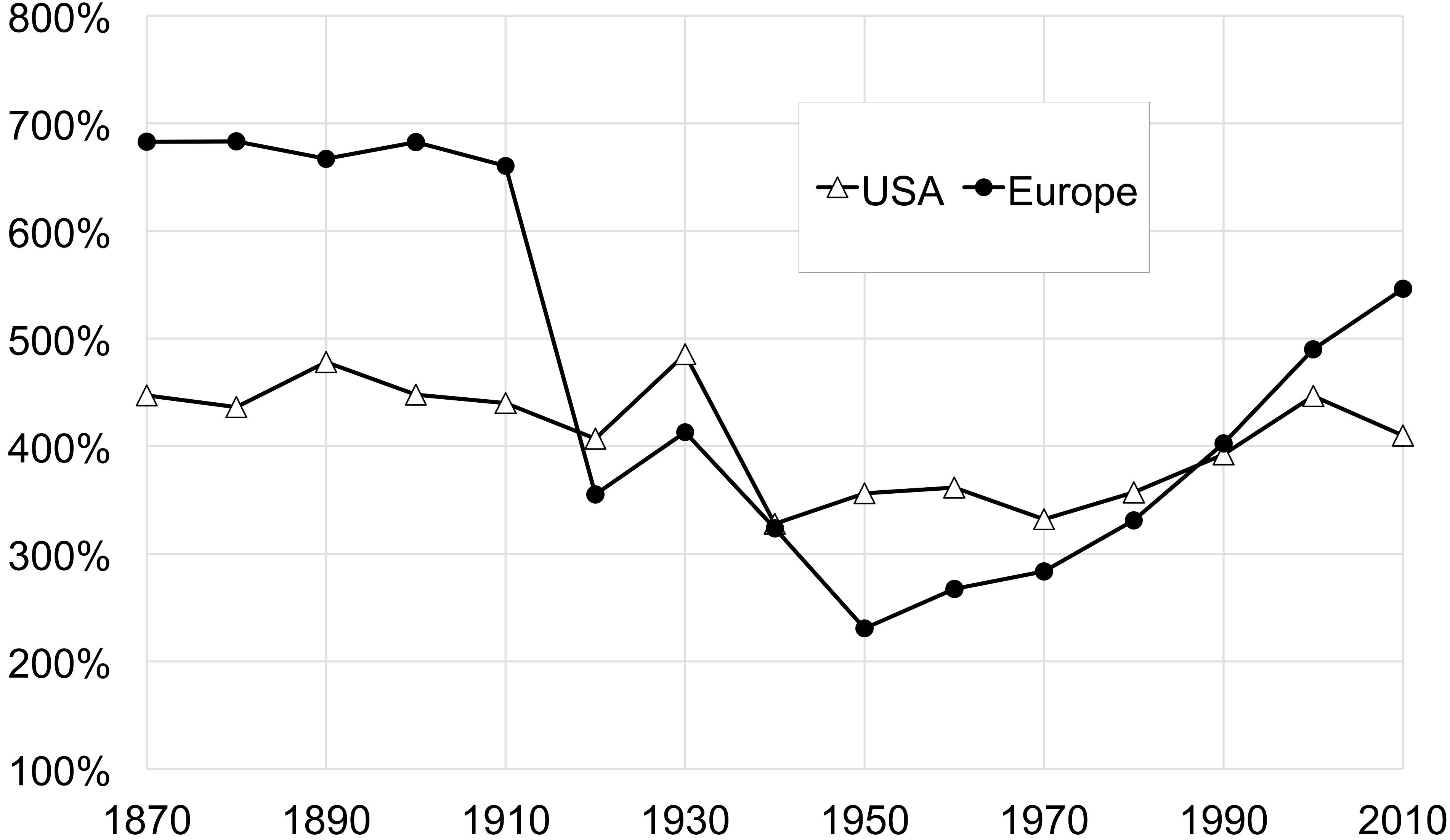
Authors' computations using country national accounts. Private wealth = non-financial assets + financial assets - financial liabilities (household & non-profit sectors). Data are decennial averages (1910-1913 averages for 1910)

Figure 3: The changing nature of national wealth: UK 1700-2010



National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

Figure 4: Private wealth / national income ratios 1870-2010: Europe vs. USA



Authors' computations using country national accounts. Private wealth = non-financial assets + financial assets - financial liabilities (household & non-profit sectors). Data are decennial averages (1910-1913 averages for Europe)

Figure 5: Private vs. governement wealth 1970-2010

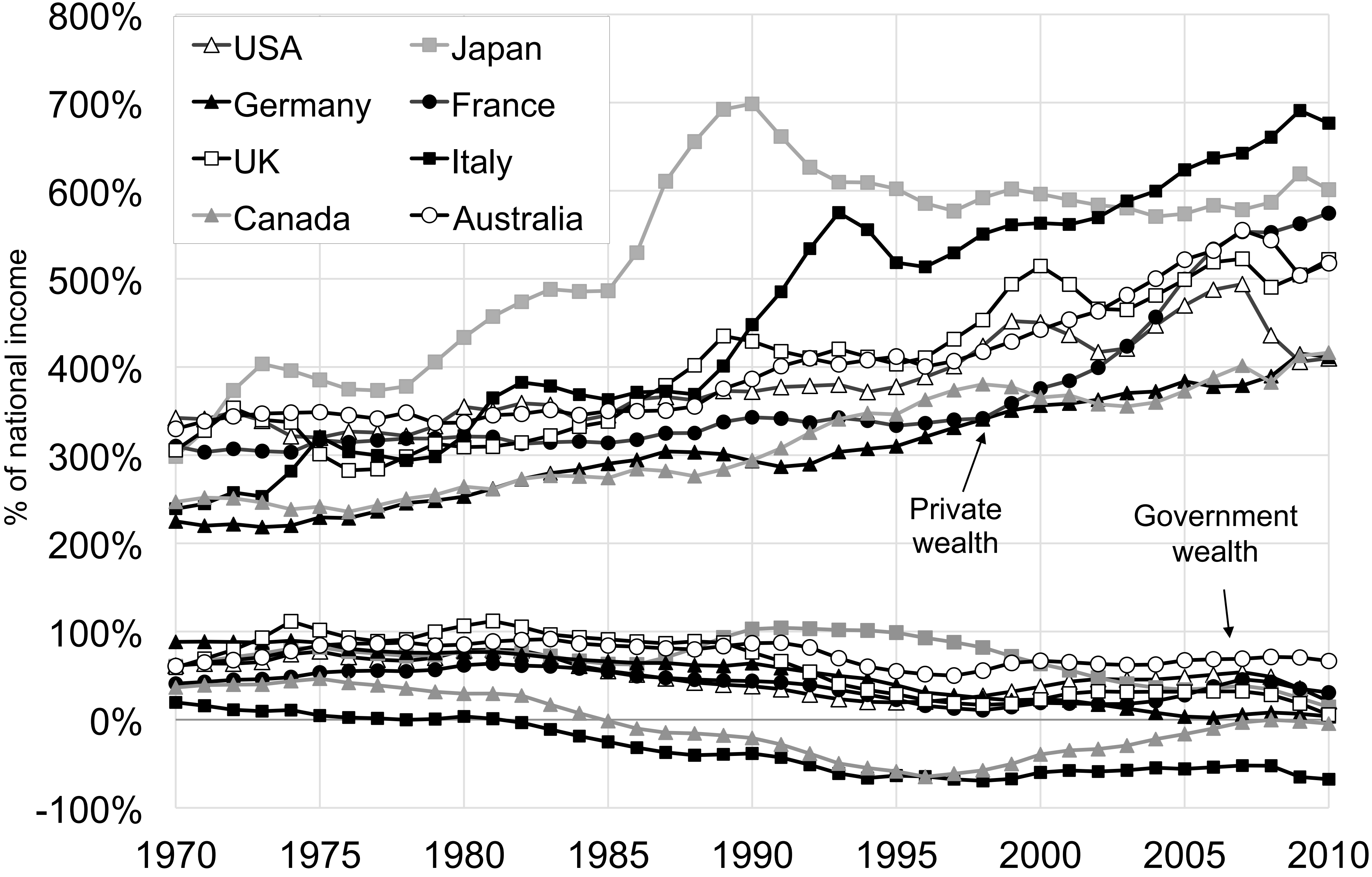
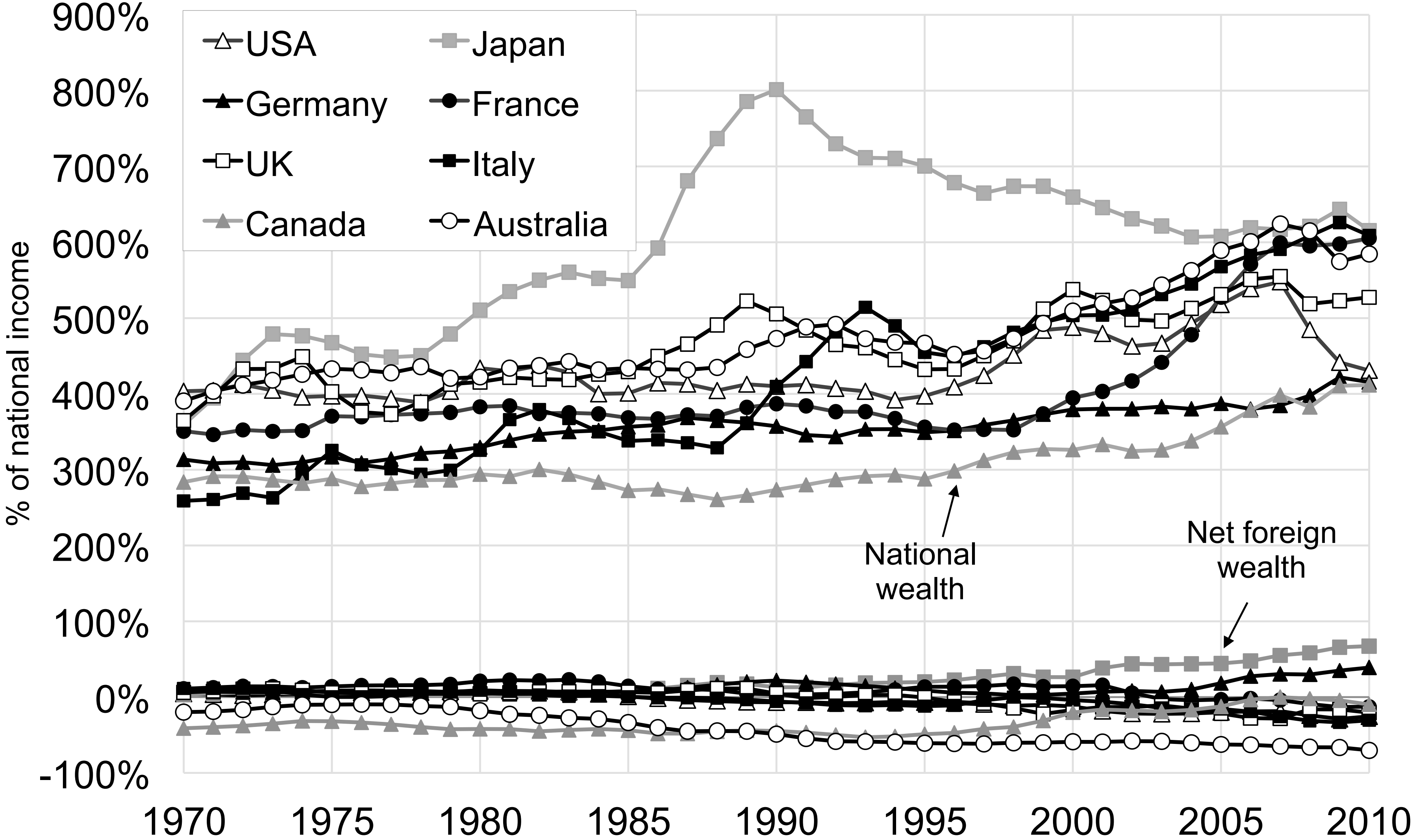


Figure 6: National vs. foreign wealth, 1970-2010



Authors' computations using country national accounts. Net foreign wealth = net foreign assets owned by country residents in rest of the world (all sectors)

Figure 7a: Observed vs. predicted national wealth / national income ratios (2010)

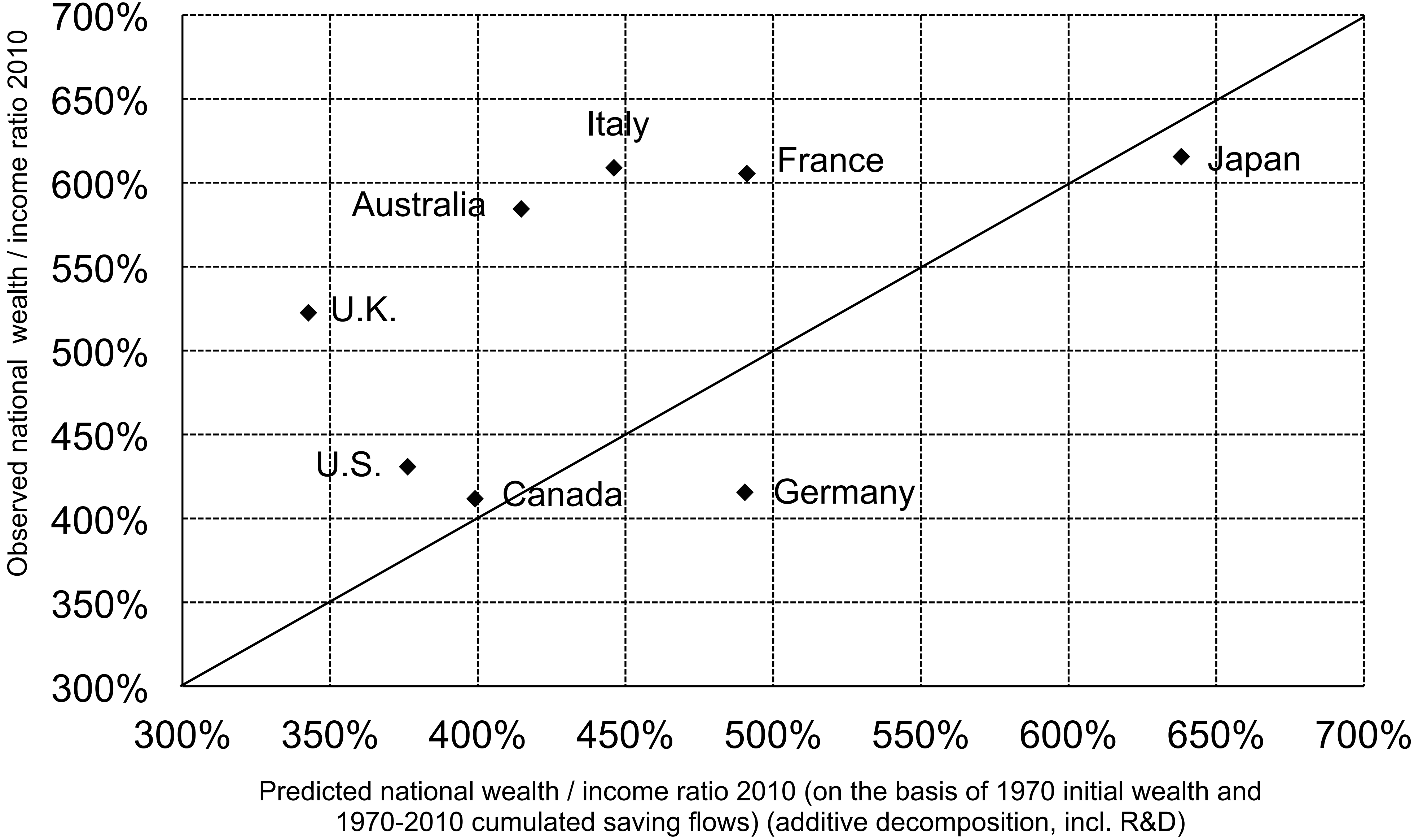


Figure 7b: Observed vs. predicted national wealth / national income ratios (2010)

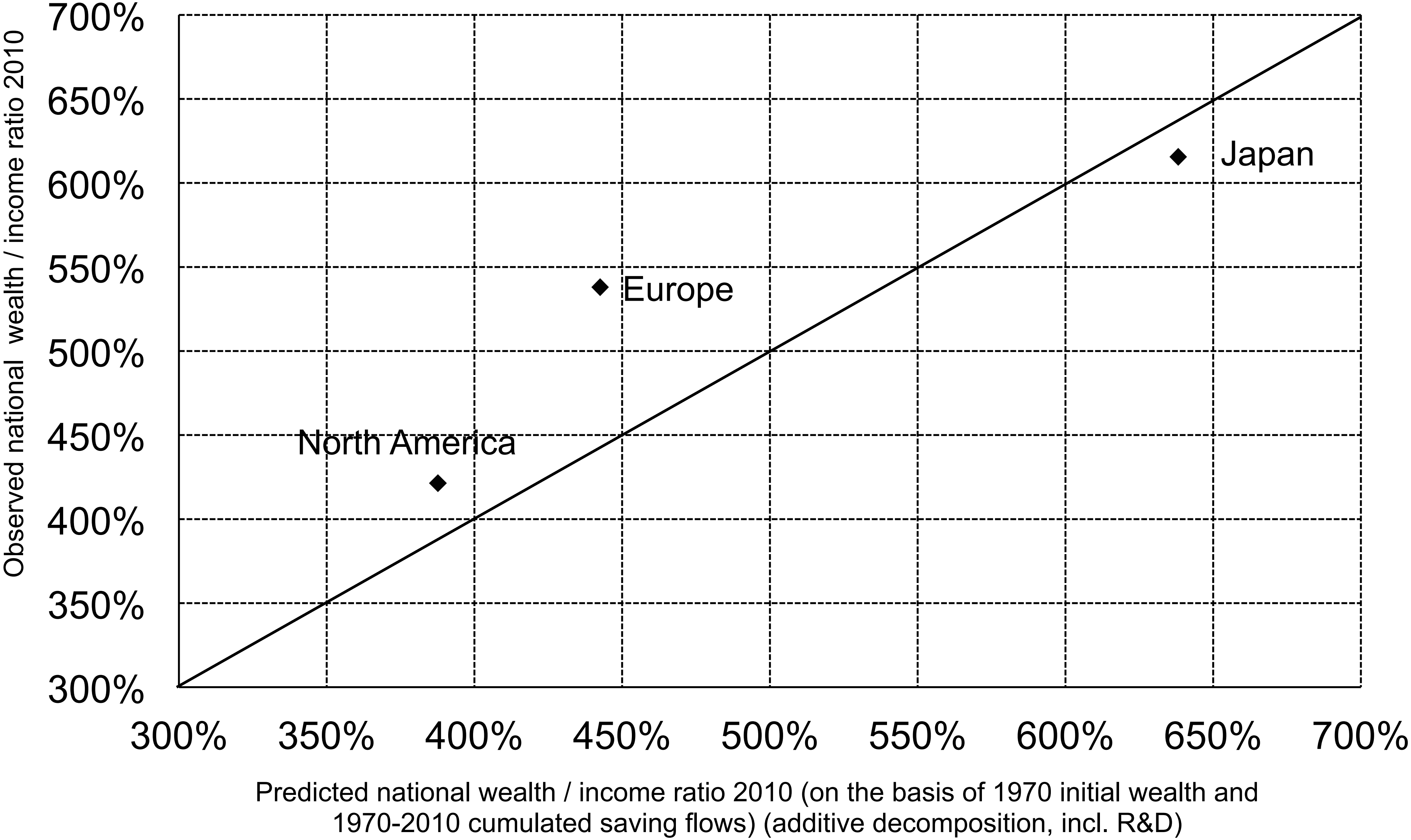


Figure 8: National and foreign wealth 1870-2010: Europe vs. USA

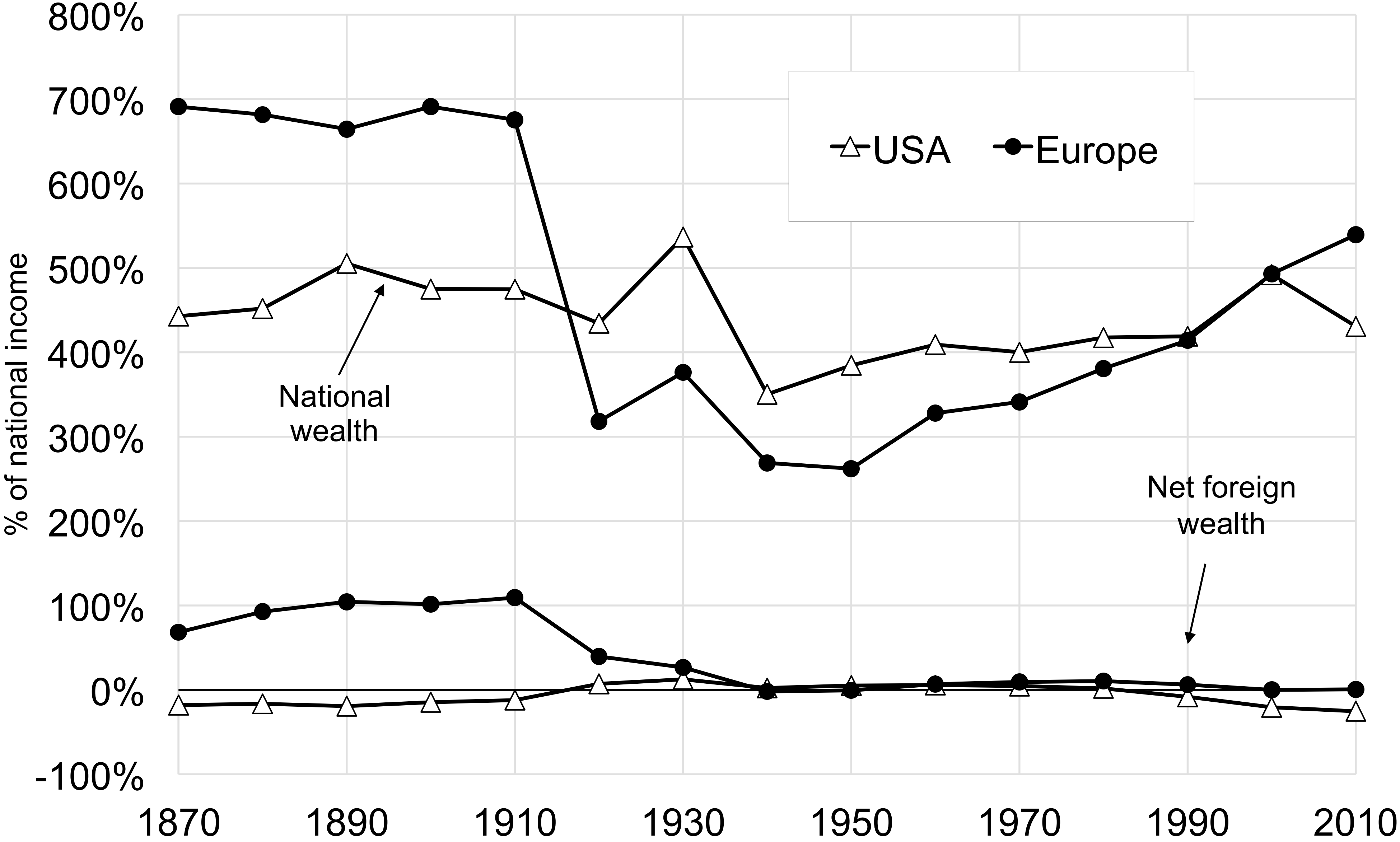
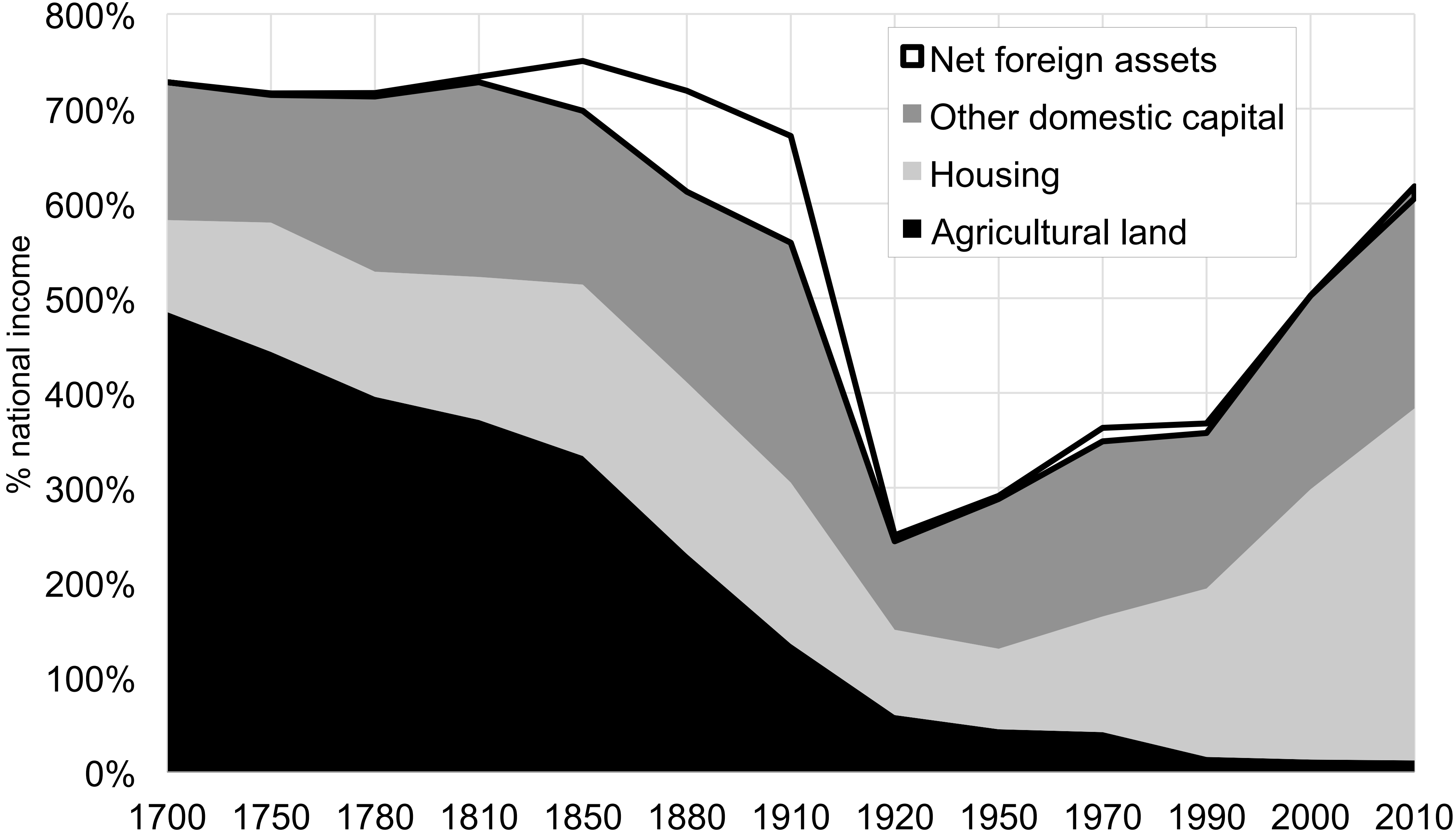
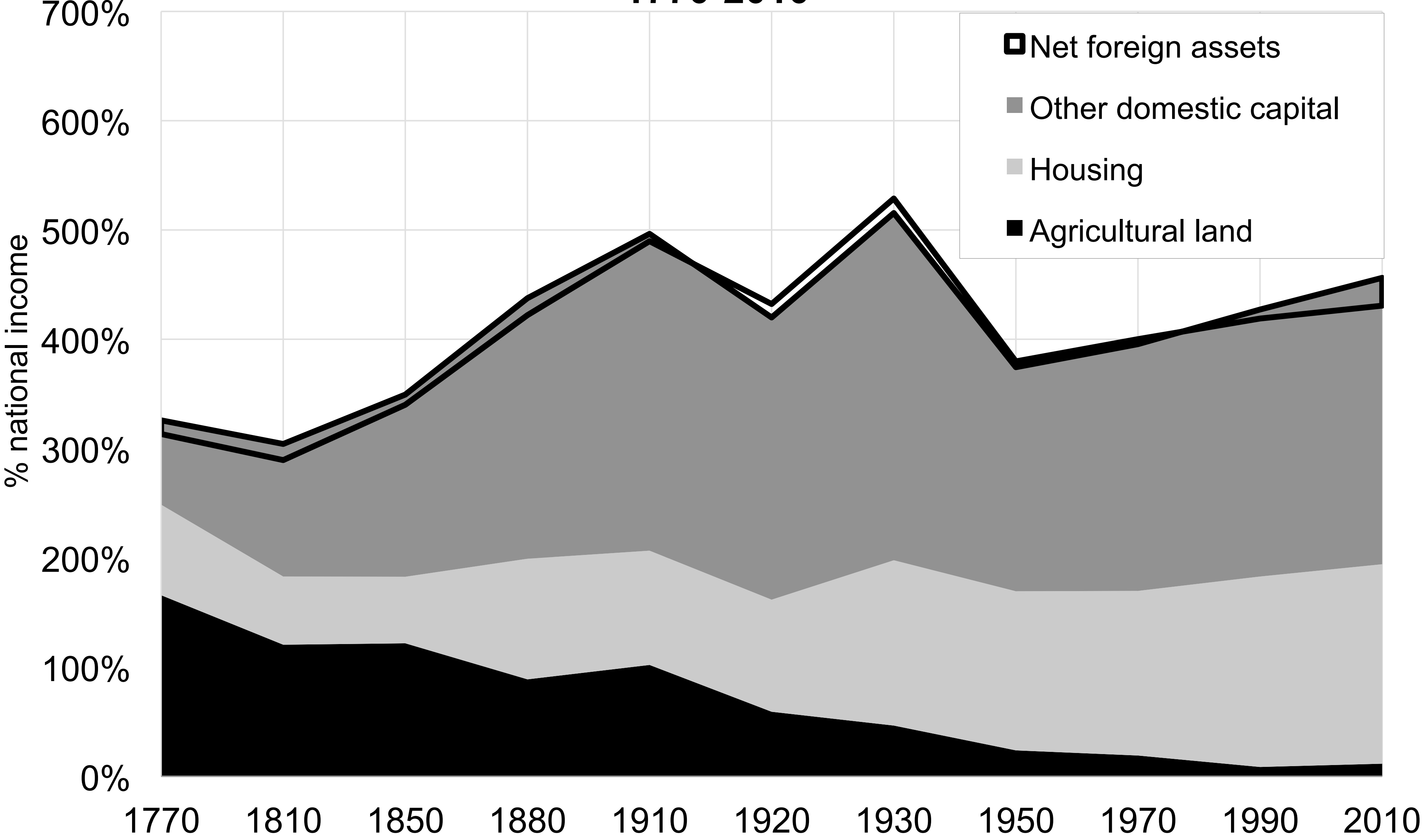


Figure 9: The changing nature of national wealth: France 1700-2010



National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

Figure 10: The changing nature of national wealth: US 1770-2010



National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

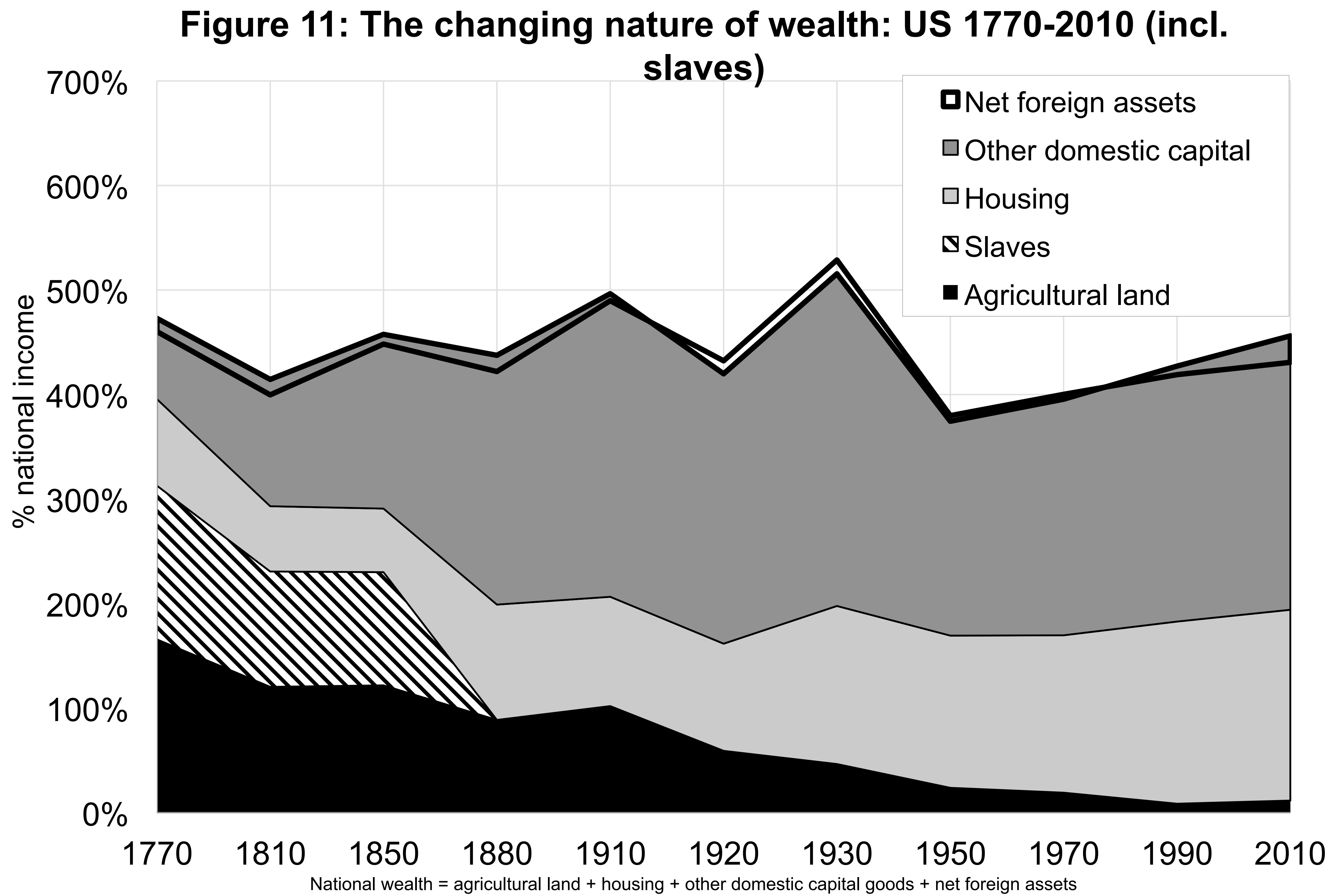
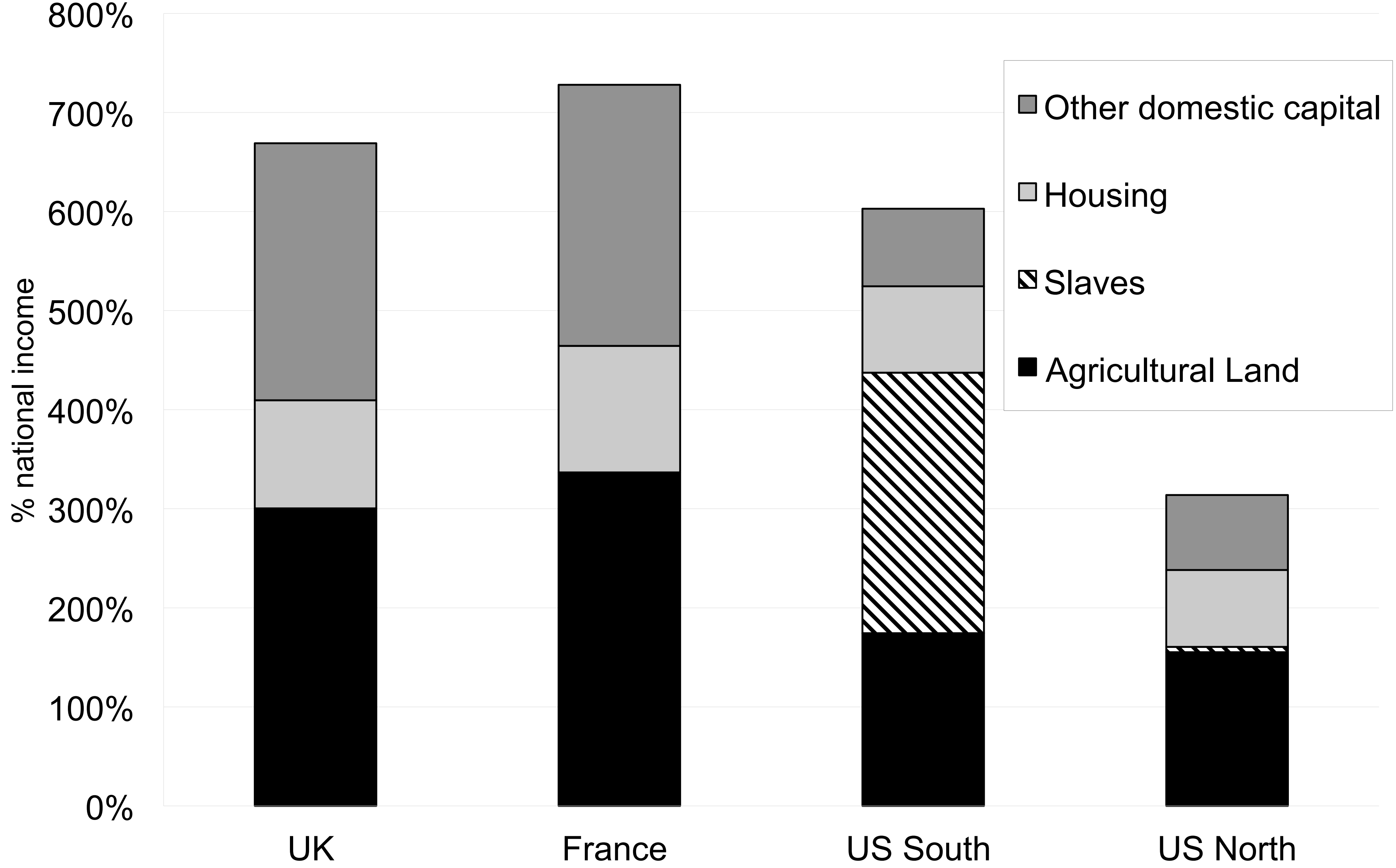


Figure 11: The changing nature of wealth: US 1770-2010 (incl. slaves)
700%
600%
500%
400%
300%
200%
100%
0%
% national income
1770
1810
1850
1880
1910
1920
1930
1950
1970
1990
2010
Net foreign assets
Other domestic capital
Housing
Slaves
Agricultural land
National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

Figure 12: National wealth in 1770-1810: Old vs. New world



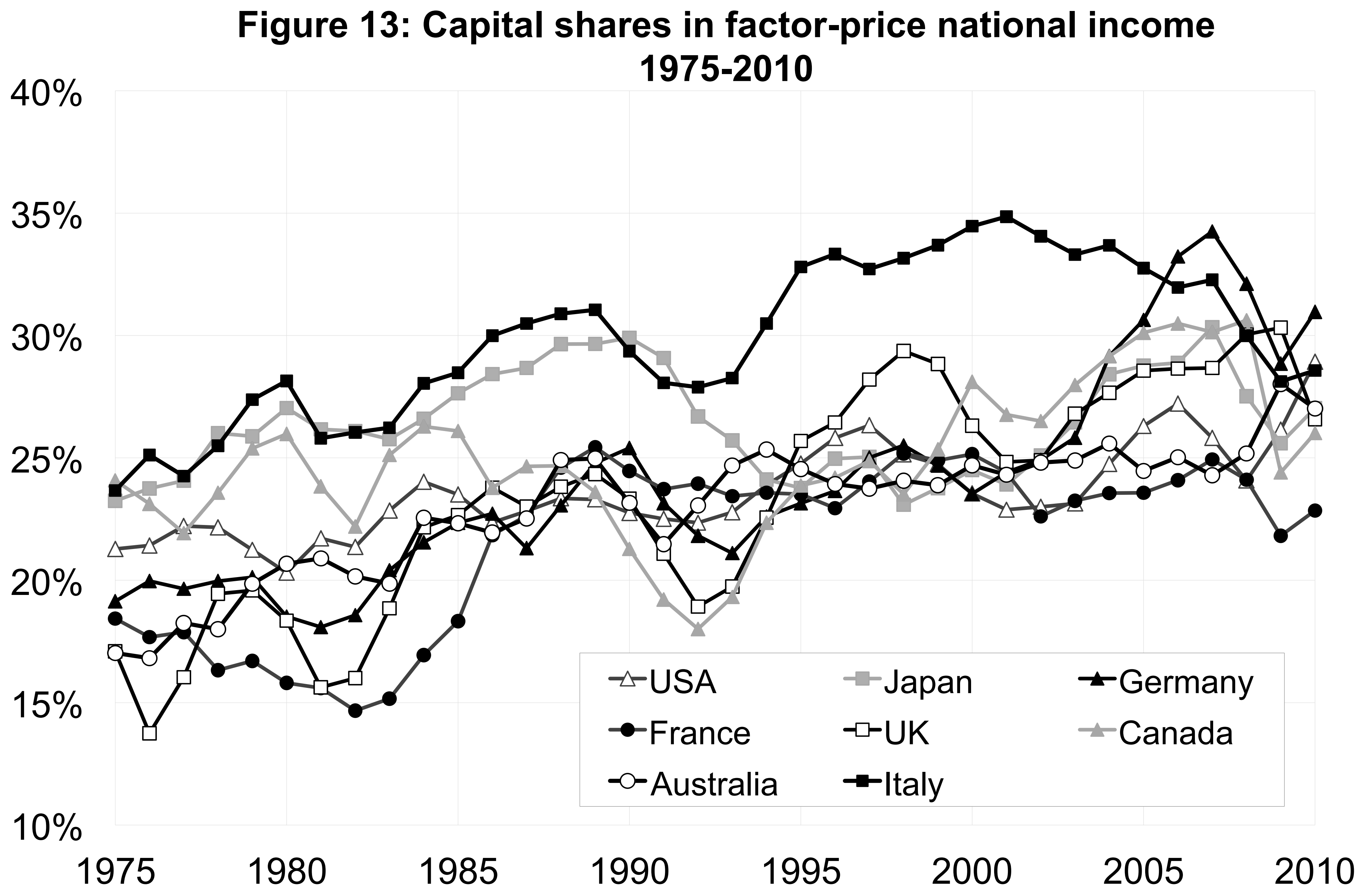


Figure 13: Capital shares in factor-price national income
1975-2010
40%
35%
30%
25%
20%
15%
10%
1975
1980
1985
1990
1995
2000
2005
2010
USA
Japan
Germany
France
UK
Canada
Australia
Italy

Figure 14: Average return on private wealth 1975-2010

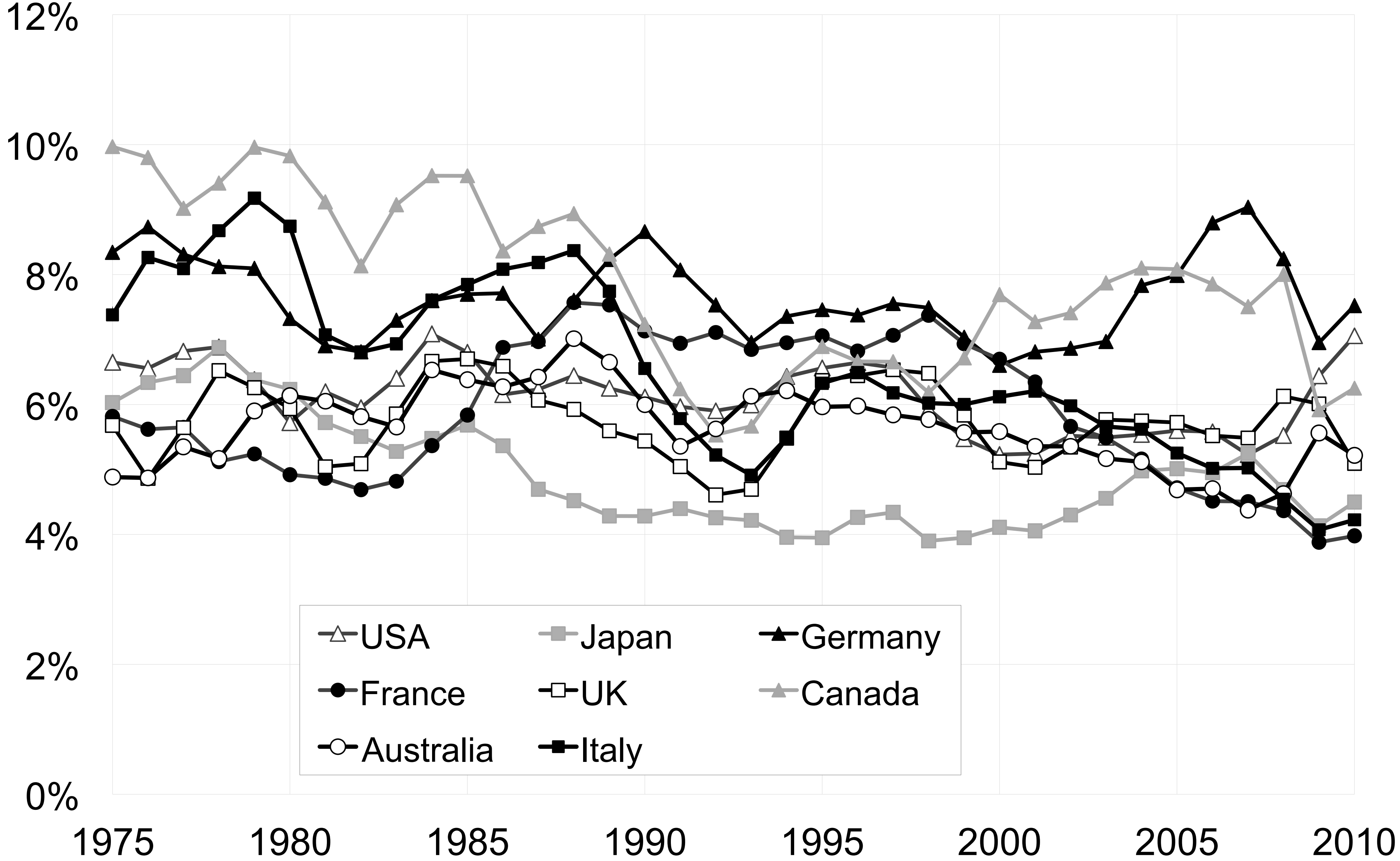


Figure 15: Factor shares in factor-price national income 1820-2010: UK and France

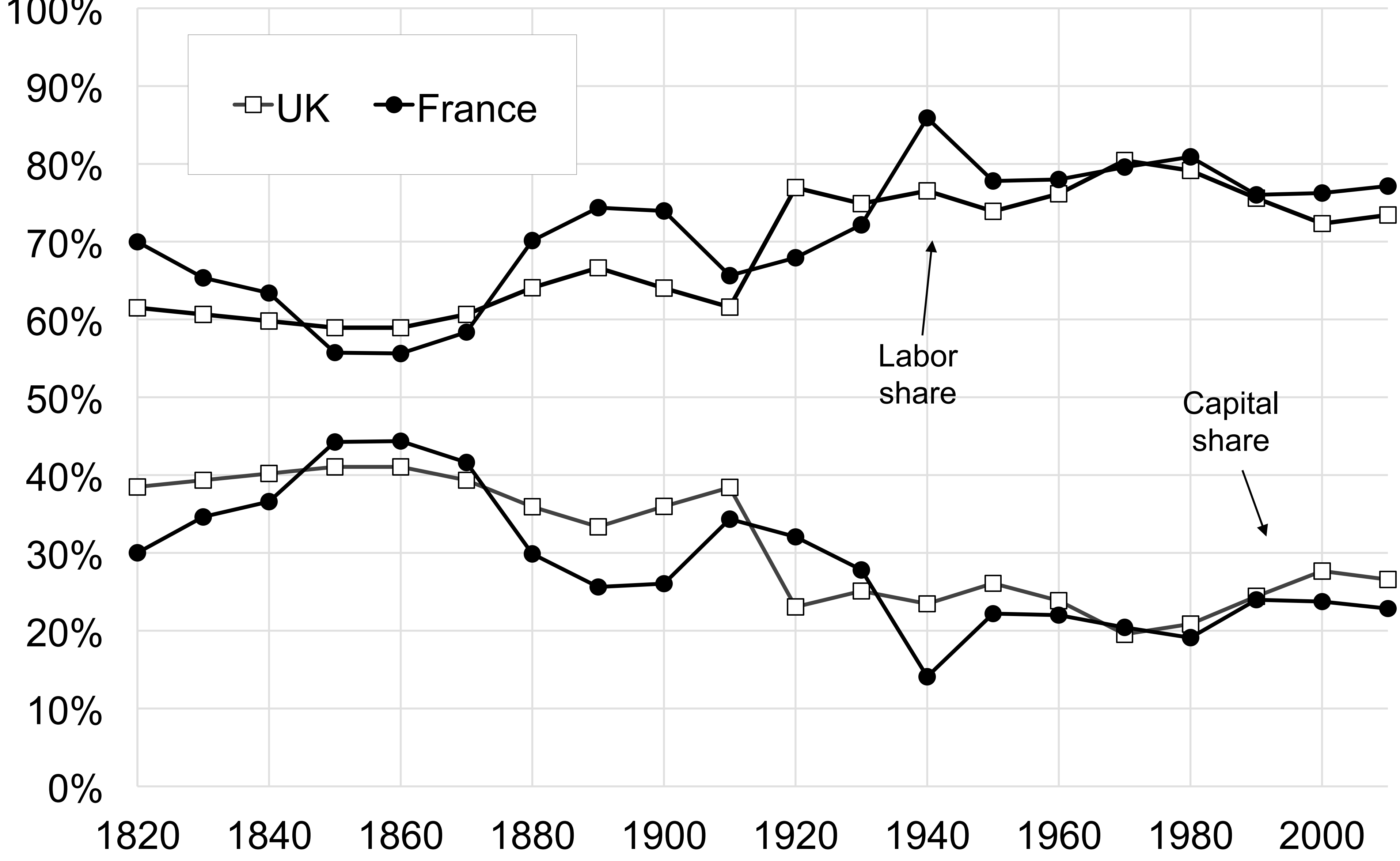
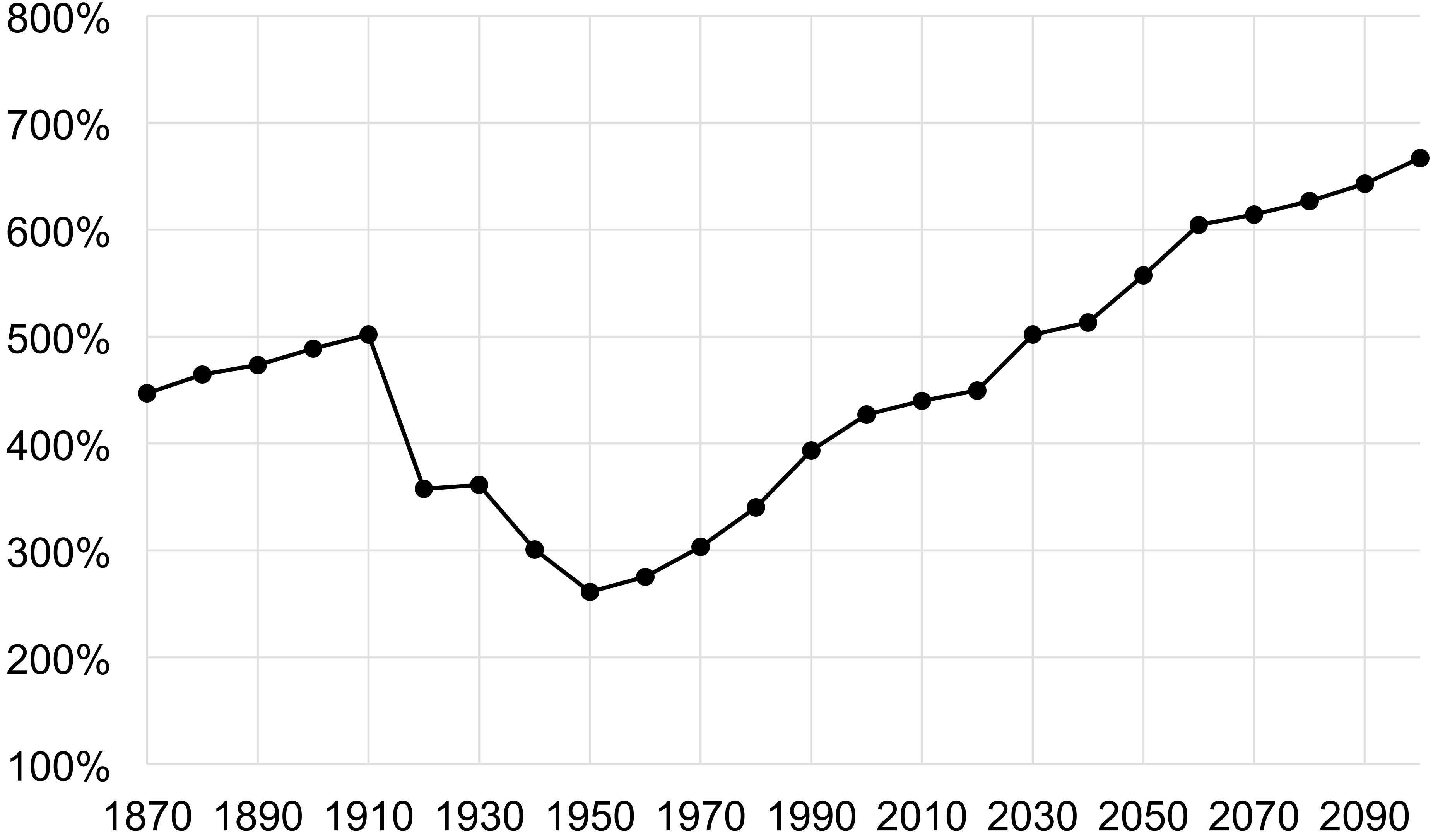


Figure 16: World private wealth / national income ratio 1870-2100



Authors' computations and simulations using country national accounts and UN growth projections. Private wealth = non-financial assets + financial assets - financial liabilities (household & non-profit sectors)

Table 1: A new macro database on income and wealth			
	Total period covered in database	Annual series	Decennial estimates
U.S.	**1770-2010**	1869-2010	1770-2010
Japan	**1960-2010**	1960-2010	
Germany	**1870-2010**	1870-2010	
France	**1700-2010**	1896-2010	1700-2010
U.K.	**1700-2010**	1855-2010	1700-2010
Italy	**1965-2010**	1965-2010	
Canada	**1970-2010**	1970-2010	
Australia	**1970-2010**	1970-2010	

Income and wealth database constructed by the authors using country national accounts (official series and balance sheets and non-official historical estimates). See country appendices for sources, methods and detailed series.

Table 2: Growth rate vs private saving rate in rich countries, 1970-2010				
	Real growth rate of national income	Population growth rate	Real growth rate of per capita national income	**Net private saving rate** (personal + corporate) (% national income)
U.S.	**2.8%**	1.0%	1.8%	**7.7%**
Japan	**2.5%**	0.5%	2.0%	**14.6%**
Germany	**2.0%**	0.2%	1.8%	**12.2%**
France	**2.2%**	0.6%	1.6%	**11.1%**
U.K.	**2.2%**	0.3%	1.9%	**7.3%**
Italy	**1.9%**	0.3%	1.6%	**15.0%**
Canada	**2.8%**	1.1%	1.7%	**12.1%**
Australia	**3.2%**	1.4%	1.7%	**9.9%**

Authors' computations using country national accounts. Growth rates are geometric averages and for income use chain-weighted GDP deflators. For alternative deflators, see Appendix Table A3 and Country Tables US.3, JP.3, etc. 1970-2010 average saving rates are obtained by weighting yearly saving rates by real national income.

Table 3: Saving rates 1970-2010: national vs. private

Average saving rates 1970-2010 (% national income)	Net national saving (private + government)	Net private savings (personal + corporate)	*incl. personal savings*	*incl. corporate savings (retained earnings)*	Net government saving
U.S.	5.2%	7.7%	4.6% ***60%***	3.1% ***40%***	-2.4%
Japan	14.6%	14.6%	6.8% ***47%***	7.8% ***53%***	0.0%
Germany	10.2%	12.2%	9.4% ***76%***	2.9% ***24%***	-2.1%
France	9.2%	11.1%	9.0% ***81%***	2.1% ***19%***	-1.9%
U.K.	5.3%	7.3%	2.8% ***38%***	4.6% ***62%***	-2.0%
Italy	8.5%	15.0%	14.6% ***97%***	0.4% ***3%***	-6.5%
Canada	10.1%	12.1%	7.2% ***60%***	4.9% ***40%***	-2.0%
Australia	8.9%	9.9%	5.9% ***60%***	3.9% ***40%***	-0.9%

Authors' computations using country national accounts. 1970-2010 averages are obtained by weighthing yearly saving rates by real national income.

Table 4: Accumulation of national wealth in rich countries, 1970-2010					
	National wealth-national income ratios		Decomposition of 1970-2010 wealth growth rate		
			Real growth rate of national wealth	Savings-induced wealth growth rate	Capital-gains-induced wealth growth rate
	β (1970)	β (2010)	g_w	$g_{ws} = s/β$	q
U.S.	404%	431%	3.0%	2.1% ***72%***	0.8% ***28%***
Japan	359%	616%	3.9%	3.1% ***78%***	0.8% ***22%***
Germany	313%	416%	2.7%	3.1% ***114%***	-0.4% ***-14%***
France	351%	605%	3.6%	2.7% ***75%***	0.9% ***25%***
U.K.	314%	523%	3.5%	1.5% ***42%***	2.0% ***58%***
Italy	259%	609%	4.1%	2.6% ***63%***	1.5% ***37%***
Canada	284%	412%	3.8%	3.4% ***89%***	0.4% ***11%***
Australia	391%	584%	4.2%	2.5% ***61%***	1.6% ***39%***

Table 5: Accumulation of national wealth in rich countries, 1970-2010: domestic capital vs foreign wealth

	1970 national wealth / national income ratio			2010 national wealth / national income ratio			1970-2010 rise in national wealth / national income ratio		
		incl. Domestic capital	*incl. Foreign wealth*		*incl. Domestic capital*	*incl. Foreign wealth*		*incl. Domestic capital*	*incl. Foreign wealth*
U.S.	404%	*399%*	*4%*	431%	*456%*	*-25%*	27%	*57%*	*-30%*
Japan	359%	*356%*	*3%*	616%	*548%*	*67%*	256%	*192%*	*64%*
Germany	313%	*305%*	*8%*	416%	*377%*	*39%*	102%	*71%*	*31%*
France	351%	*340%*	*11%*	605%	*618%*	*-13%*	254%	*278%*	*-24%*
U.K.	365%	*359%*	*6%*	527%	*548%*	*-20%*	163%	*189%*	*-26%*
Italy	259%	*247%*	*12%*	609%	*640%*	*-31%*	350%	*392%*	*-42%*
Canada	284%	*325%*	*-41%*	412%	*422%*	*-10%*	128%	*97%*	*31%*
Australia	391%	*410%*	*-20%*	584%	*655%*	*-70%*	194%	*244%*	*-50%*

Table 6: National wealth accumulation in rich countries: domestic vs. foreign capital gains

	1970-2010 capital gains on national wealth (% of 2010 national income)	Decomposition of 1970-2010 capital gains	
		Domestic wealth	Foreign wealth
U.S.	105%	72%	33%
Japan	27%	45%	-18%
Germany	-25%	-3%	-22%
France	164%	179%	-15%
U.K.	235%	217%	18%
Italy	213%	240%	-27%
Canada	63%	55%	7%
Australia	220%	178%	41%

Authors' computations using country national accounts. Other volume changes were put in saving flows and thus excluded from capital gains.

Table 7: Domestic capital accumulation in rich countries, 1970-2010: housing vs other domestic capital

	1970 domestic capital / national income ratio			2010 domestic capital / national income ratio			1970-2010 rise in domestic capital / national income ratio		
		incl. Housing	*incl. Other domestic capital*		*incl. Housing*	*incl. Other domestic capital*		*incl. Housing*	*incl. Other domestic capital*
U.S.	399%	*142%*	*257%*	456%	*182%*	*274%*	57%	*41%*	*17%*
Japan	356%	*131%*	*225%*	548%	*220%*	*328%*	192%	*89%*	*103%*
Germany	305%	*129%*	*177%*	377%	*241%*	*136%*	71%	*112%*	*-41%*
France	340%	*104%*	*236%*	618%	*371%*	*247%*	278%	*267%*	*11%*
U.K.	359%	*98%*	*261%*	548%	*300%*	*248%*	189%	*202%*	*-13%*
Italy	247%	*107%*	*141%*	640%	*386%*	*254%*	392%	*279%*	*113%*
Canada	325%	*108%*	*217%*	422%	*208%*	*213%*	97%	*101%*	*-4%*
Australia	410%	*172%*	*239%*	655%	*364%*	*291%*	244%	*193%*	*52%*

Table 8: Accumulation of national wealth in rich countries, 1870-2010

	Market-value national wealth-national income ratios		Real growth rate of national income	Decomposition of 1870-2010 wealth growth rate		
				Real growth rate of wealth	Savings-induced wealth growth rate	Capital-gains-induced wealth growth rate
	β (1870)	β (2010)	g	g_w	$g_{ws} = s/\beta$	q
U.S.	413%	431%	3.4%	3.4%	2.6% ***76%***	0.8% ***24%***
Germany	745%	416%	2.3%	2.0%	2.6% ***128%***	-0.6% ***-28%***
France	689%	605%	2.1%	2.0%	1.8% ***91%***	0.2% ***9%***
U.K.	656%	523%	1.9%	1.8%	1.6% ***89%***	0.2% ***11%***

The real growth rate of national wealth has been 3.4% per year in the U.S. between 1870 and 2010. This can be decomposed into a 2.6% savings-induced growth rate and a 0.8% residual term (capital gains and/or measurement errors).

Authors' computations using country national accounts. War destructions & other volume changes were included in savings-induced wealth growth rate. For full decomposition, see Appendix Country Tables US.4c, DE.4c, etc.

Table 9: Accumulation of national wealth: US, UK, Germany, France, 1870-2010					
	Market-value national wealth-national income ratios		Real growth rate of national wealth	Savings-induced wealth growth rate (incl. war destructions)	Capital-gains-induced wealth growth rate
	β_t	β_{t+n}	g_w	$g_{ws} = s/\beta$	q
	Panel A: United States				
1870-2010	413%	431%	3.4%	2.6% *76%*	0.8% *24%*
1870-1910	413%	469%	4.3%	2.9% *68%*	1.4% *32%*
1910-2010	469%	431%	3.1%	2.5% *80%*	0.6% *20%*
1910-1950	469%	380%	2.7%	2.2% *82%*	0.5% *18%*
1950-1980	380%	434%	4.0%	3.7% **94%**	0.2% **6%**
1980-2010	434%	431%	2.7%	1.6% *58%*	1.1% *42%*
	Panel B: United Kingdom				
1870-2010	656%	527%	1.8%	1.5% *83%*	0.3% *17%*
1870-1910	656%	694%	2.1%	1.7% *79%*	0.4% *21%*
1910-2010	719%	527%	1.6%	1.4% *86%*	0.2% *14%*
1910-1950	719%	241%	-1.3%	0.6% *-43%*	-1.9% *143%*
1950-1980	241%	416%	4.0%	3.0% **76%**	0.9% **24%**
1980-2010	416%	527%	3.4%	1.0% *28%*	2.4% *72%*
	Panel C: Germany				
1870-2010	745%	416%	2.0%	2.6% *128%*	-0.6% *-28%*
1870-1910	745%	637%	2.1%	2.3% *107%*	-0.1% *-7%*
1910-2010	637%	416%	2.0%	2.8% *137%*	-0.8% *-37%*

1910-1950	637%	223%	-1.4%	0.0% ***-3%***	-1.5% ***103%***
1950-1980	223%	330%	6.3%	6.8% **108%**	-0.5% **-8%**
1980-2010	330%	416%	2.5%	2.5% ***101%***	0.0% ***-1%***
	Panel D: France				
1870-2010	689%	605%	2.0%	1.8% ***91%***	0.2% ***9%***
1870-1910	689%	747%	1.3%	1.4% ***103%***	0.0% ***-3%***
1910-2010	747%	605%	2.2%	2.0% ***89%***	0.3% ***11%***
1910-1950	747%	261%	-1.2%	-0.1% ***8%***	-1.1% ***92%***
1950-1980	261%	383%	5.9%	4.7% **80%**	1.2% **20%**
1980-2010	383%	605%	3.4%	2.2% ***65%***	1.2% ***35%***

The real growth rate of national wealth has been 3.1% per year in the U.S. between 1910 and 2010. This can be decomposed into a 2.5% savings-induced growth rate and a 0.6% residual term (capital gains and/or measurement errors).

Authors' computations using country national accounts. War destructions & other volume changes were included in savings-induced wealth growth rate. For full decomposition, see Appendix Country Tables US.4c, DE.4c, etc.

Table 10: Accumulation of national wealth in rich countries, 1910-1950

	National wealth-national income ratios		Decomposition of 1950 national wealth-national income ratio			
	β (1910)	β (1950)	Initial wealth effect	Cumulated new savings	Cumulated war destructions	Capital gains or losses
U.S.	469%	380%	132%	193%	0%	55%
Germany	637%	223%	400%	109% ***31%***	-120% ***29%***	-165% ***40%***
France	747%	261%	421%	144% ***38%***	-132% ***27%***	-172% ***35%***
U.K.	719%	208%	409%	75% ***46%***	-19% ***4%***	-256% ***50%***

Germany's national wealth-income ratio fell from 637% to 223% between 1910 and 1950. 31% of the fall can be attributed to insufficient saving, 29% to war destructions, and 40% to real capital losses.