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 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.

Contents

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, because 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. While fine for some purposes, this procedure 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 assess 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, 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. The database is available online, along with a comprehensive Data Appendix that precisely documents the data construction process. 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 contribution is to exploit the database in order to establish a number of new results. We first 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, 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 European wealth-income ratios can be explained by two main factors. The first is a long-run swing in relative asset prices, which, we argue, was itself largely driven by changes in capital policies in the course of the 20th 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-of-depreciation 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 a broad class of general equilibrium models with endogenous saving, the steady-state wealth-income ratio is also a decreasing function of the income growth rate g.

This mechanism sheds light on the rise in the wealth-income ratios of Europe and Japan, two economies where population and productivity growth has slowed markedly: capital is back because low growth is back. It also helps understand why wealth-income ratios are lower in the U.S., where population growth – but not saving – is larger than in Europe. Last, the $\beta = s/g$ steady-state 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 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.

We stress, however, that despite our efforts we still face data limitations when decomposing wealth accumulation in the very long run. Our interpretations are subject to these limitations, and we hope our findings will motivate new research on the historical dynamics of asset prices. Further, in some countries capital gains – particularly on housing – explain a large part of the recent rise of wealth-income ratios. It is only in the very long run or at a very aggregate level (i.e., at a European rather than country level) that relative price effects seem to wash out.

Our findings have implications for the future and for policy-making. First, the low wealth-income ratios of the mid-twentieth century were due to 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, if income growth slows down in the decades ahead, then wealth-income ratios may become high pretty much everywhere. 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.

The return of high wealth-income ratios is 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 taxation (Piketty, 2011, 2014; Piketty and Saez, 2013), which in turn would require a high degree of international cooperation in order to prevent wealth from hiding in offshore

tax havens (Zucman, 2013). If international tax competition prevents these policy changes 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. The implications for financial regulation are important. 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. 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 18th and early 19th century, capital was mostly land, so that there was limited scope for substituting labor to capital. In the 20th and 21st 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 rich countries since the 1970s.

The paper is organized as follows. Section 2 relates our work to the existing literature. In section 3 we define the key ratios and present the accounting framework. We describe the 1970-2010 evolution of wealth-income ratios in Section 4, before decomposing the accumulation of wealth into volume and price effects (Section 5). In section 6, we present decomposition results

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

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 7 in which we discuss the changing nature of wealth in the U.K., France and the U.S. since the 18th century. In section 8, 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 9 concludes.

2 Related literature

2.1 Literature on national wealth

To the best of our knowledge, 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.

The recent emphasis on national wealth, however, largely represents a return to older practice. Until the early twentieth century, economists and statisticians 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. In many ways, it was also easier to estimate national wealth around 1900 than it is today: the structure of property was simpler, with 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 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 measured indirectly by cumulating past investment flows and attempting to adjust for changes in relative prices – what is known as the perpetual inventory method. By contrast, we measure capital directly by using country balance sheets in which we observe the actual market value of most types of assets:

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[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, authors like Karl Marx – who were 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.

real estate, equities (which capture the market value of corporations), bonds, and so on. We are interested in what non-human private capital is worth for households and in what public capital would be worth if privatized. This notion is precisely what the economists of the 18th and 19th century aimed to capture. We believe it is a useful and well defined starting point.[4]

Compared to the capital stock estimates obtained by the perpetual inventory method, country balance sheets have four important advantages. First, they include non-produced assets such as land which cannot be measured by cumulating past investment flows. It is critical to consistently account for non-produced assets if one wants to conduct Solow-type growth accounting exercises and compute the marginal product of capital (Caselli and Feyrer, 2007). Second, balance sheets rely for the most part on observed market prices – obtained from real estate and financial market transactions – while perpetual inventory method capital stocks rely on estimated prices that suffer from a number of pitfalls.[5] Third, our measure of country capital stocks includes most forms of intangible capital, contrary to older estimates. Last and most important, country balance sheets now follow standardized international definitions and are available for many countries and over long periods of time. Market-value balance sheets have their own deficiencies, but as we argue in this paper their advantages vastly exceed their limitations. In our view, they ought to be used more extensively in economic research.

In particular, 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 is 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 some confusion about what the level of the capital-output ratio is supposed to be (see Kaldor, 1961; Samuelson, 1970; Simon, 1990; Jones and Romer, 2010). The data we now have suggest that the ratio is closer to 5-6 in most rich countries today than to the values of 3-4 often used in macro models and textbooks.[6]

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[4]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 confusion in this controversy owes to the lack of balance sheet data and to the difficulty of making comparisons with pre-World War 1 capital stock estimates. It is natural to use relative market prices to aggregate the various capital assets into national capital, just as it is natural to use relative market prices to aggregate the various goods and services into national output.

[5]Appendix Section A.1.2 provides a detailed discussion of the many issued faced by the price estimates used in the perpetual inventory method: the accounting of depreciation, quality improvement, aggregation bias, etc. Equity market prices are themselves not perfect; they can be very volatile in the short run. But in the long run they are arguably the best data we have to capture the market value of corporations' capital stocks.

[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

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 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). We 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 national wealth, more spectacularly in 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]

2.4 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.

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(see Figures A70-A71). This, however, disregards the large stock of housing capital (as well as non-corporate businesses and government capital), which we feel is inappropriate (more on this below).

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

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 distributional trends in the analysis.[8]

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 international guidelines (SNA, 1993, 2008). We take the data exactly as published, except in the rare cases where the balance sheets do not exactly follow the SNA, in which case we correct the data to ensure consistency across countries.[9] For the previous periods, we have gathered 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. Section A of the Data Appendix provides a thorough discussion of the concepts and definitions used by the 1993 and 2008 SNA. All the details on how we have used available historical estimates to construct our own pre-1970 wealth series are provided in the country-specific sections of the Data Appendix; see in particular sections B (devoted to the U.S.), D (Germany), E (France), and F (U.K.). 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.[10] 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).[11] Durable goods owned by households, such as cars and furniture,

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[8]See Davies et al. (2010) for a study of the world distribution of personal wealth.

[9]For example, U.S. Flow of Funds balance sheets include durable goods, contrary to other countries (see below), so to ensure consistency we subtract durables.

[10]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 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. The household sector also includes unincorporated businesses.

[11]In any case, such claims would wash out for the computation of national wealth – which we view as a more meaningful concept than private wealth – since they would count as assets for households and liabilities for the government.

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 and corporate bonds. 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:

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

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]

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[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 durable goods in the U.S.

[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", "foreign wealth" and "foreign capital", and "private wealth" and "private capital"), and to specify whether one uses "market-value" or "book-value" aggregates (unless specified otherwise, we use

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: $Y_t = Y_{dt} + r_t NFA_t$.[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 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 $\alpha_t = r_t K_t/Y_{dt} = r_t \beta_{kt}$, where r_t is the average rate of return on domestic capital. With imperfect capital markets, r_t can substantially vary across assets. With perfect capital markets and no aggregate uncertainty, r_t is the same for all assets and is equal to the marginal product of capital. With a Cobb-Douglas production function $F(K_t, L_t) = K_t^\alpha L_t^{1-\alpha}$, and a closed economy setting, the capital share is entirely set by technology: $\alpha_t = r_t \beta_{kt} = \alpha$. A higher capital-output ratio β_{kt} is exactly compensated by a lower capital return $r_t = \alpha/\beta_{kt}$, 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 $r_t = \alpha/\beta_{kt}$, but the countries with higher-than-average

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"market-value" concepts). 19th 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.

[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 the capital-output ratio β_{kt} turns out to be usually close to the national wealth-income ratio β_{nt} in the 1970-2010 period (see Appendix Figure A67).

wealth-income ratios invest part of their wealth in other countries, so that for them the share of capital in national income $r_t W_t / Y_t = r_t \beta_t$ 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_{kt} rises, the fall of the marginal product of capital r_t is smaller than the rise of β_{kt}, so that the capital share $\alpha_t = r_t \beta_{kt}$ is an increasing function of β_{kt}. Conversely, if $\sigma < 1$, the fall of r_t is bigger than the rise of β_{kt}, so that the capital share is a decreasing function of β_{kt}.[16] Because we include all forms of capital assets into our aggregate capital concept K (including housing), the aggregate elasticity of substitution σ should 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]

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

Wealth accumulation between time t and $t + 1$ can always be decomposed into a volume effect and a relative price effect: $W_{nt+1} = W_{nt} + S_t + KG_t$, where W_{nt} is the market value of national wealth at time t, S_t is the net-of-depreciation national saving flow between time t and $t + 1$ (volume effect), and 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 national wealth-income ratio $\beta_{nt} = W_{nt}/Y_t$ is given by the following equation:

$$\beta_{nt+1} = \frac{1 + g_{wst}}{1 + g_t} \beta_{nt}$$

where: $1 + g_{wst} = 1 + s_t/\beta_{nt}$ = saving-induced wealth growth rate;

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

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[16] A CES production function is given by: $F(K, L) = (aK^{\frac{\sigma-1}{\sigma}} + (1-a)L^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$. 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. We return to this discussion in Section 7.

[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 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 capital assets.

$s_t = S_t/Y_t$ = net-of-depreciation national saving rate (domestic + net foreign saving).

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

$$\beta_{nt} \to \beta_n = s/g$$

Should we use gross-of-depreciation saving rates rather than net rates, the steady-state formula would be $\beta_n = s/(g + \delta)$ 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 s/g formulation, so as to better focus on the saving versus capital gain decomposition. Both formulas are equivalent and require the same data.[18]

The s/g formulation also applies to the capital-output ratio β_k, with the only difference that for β_k the saving rate s to take into consideration is the domestic saving rate (i.e., national saving minus net foreign saving[19]) and g is the growth rate of domestic output (i.e., national income minus net foreign income).

The steady-state formula $\beta = s/g$ is a pure accounting equation. 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: $g_{ws} = s/\beta = 2\% = g$. The formula holds in the steady-state of any micro-founded model, independently of the nature of saving motives. In models where saving is exogenous, the long run wealth-income ratio is obviously a decreasing function of g. Importantly, however, the negative relationship between steady-state β and g also holds true in a very large class of models in which s is endogenous.[20] It holds true, in particular, in different variants of the "bequest-in-the-utility-function" model,[21] in OLG models,[22] in the dynastic, infinite-horizon

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[18]Appendix Table A84 provides cross-country data on 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 one writes down the decomposition of wealth accumulation using gross or net saving, one needs depreciation series.

[19]Net foreign saving equals the current account balance plus net foreign capital transfers (which are usually negligible) minus net errors and omissions in the balance of payments.

[20]For more details, see the working paper version of this article, Piketty and Zucman (2013, section 3).

[21]In such models, the saving rate parameter s follows directly from the strength of the taste for bequest or wealth in the utility function.

[22]The saving rate s is then determined – among other things – by the number of years spent in retirement and the generosity of the public pension system.

model[23] and in most endogenous growth models.[24] In all those models, a growth slowdown – due to a decrease in population growth, productivity growth, or both – leads to higher capital-output and wealth-income ratios in the long run.

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

The steady-state $\beta = s/g$ formula only relies on the assumption that there is no change in the relative price between capital and consumption goods over time. 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 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 be a two-goods model in which the volume of capital is fixed: $V_t = V$ (say, fixed land supply). The market value of capital if given by $K_t = q_t V$, where q_t is the price of the capital good (say, land price per acre) relative to the consumption good. Assume fixed population and labor supply and positive labor productivity growth $g > 0$. 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 capital rises as fast as output and income: there are positive capital gains in the steady-state. By construction, there is no saving at all in this model (since the capital good is in fixed supply), and the rise in the value of capital is entirely due to a relative price effect.[25] This is the opposite extreme of the one-good model, whereby the rise in the value of capital 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 national wealth-income ratio into two multiplicative

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[23]In this model, each dynasty maximizes $\sum_{t \geq 0} U(c_t)/(1+\theta)^t$. The long run rate of return is entirely determined by preference parameters and the growth rate: $r_t \to r = \theta + \gamma g$, where $\gamma \geq 0$ is the curvature of the utility function $U(c) = c^{1-\gamma}/(1-\gamma)$ ($\gamma > 1$ is usually assumed to be more realistic). The steady-state saving rate is equal to $s = \alpha g/r = \alpha g/(\theta + \gamma g)$, where $\alpha = r\beta$ 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. 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 $\beta = s/g$ decreases with g. With a Cobb-Douglas production function (fixed capital share), the wealth-income ratio is given by $\beta = \alpha/r = \alpha/(\theta + \gamma g)$ and takes its maximum value $\overline{\beta} = \alpha/\theta$ for $g = 0$.

[24]In endogenous growth models with imperfect international capital flows, the growth rate might rise with the saving rate, but it will usually rise less than proportionally. It is only in the AK closed-economy model that the growth rate rises proportionally with the saving rate.

[25]See the working paper version of this article, Piketty and Zucman (2013), sections 3.3. and 3.4.

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components (volume and relative price) using the following accounting equation:

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

where: $1 + g_{wst} = 1 + s_t/\beta_{nt}$ = 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 $\beta_{nt}, ..., \beta_{nt+n}$, $s_t, ..., s_{t+n}$, and $g_t, ...g_{t+n}$. In effect, if we observe that the wealth-income ratio rises too fast compared to recorded saving, we record positive real capital gains q_t. Although we tend to prefer the multiplicative decomposition of wealth accumulation (which 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. By construction, our residual capital gains q are the same as those found in the income-wealth reconciliation accounts published by a growing number of statistical agencies, with the only difference that q is net of consumer price inflation.[26]

In the next sections, we present the main descriptive statistics for private wealth, national wealth, and domestic capital, as well as the decomposition results for national wealth (additional decomposition results are in Appendix K). We start with the 1970-2010 period before moving to longer periods of time.

4   The rise of wealth-income ratios 1970-2010

4.1   Private wealth-income ratios

Private wealth-income ratios have gradually increased in rich countries since 1970, from about 200-300% in 1970 to about 400-600% today (Figure 1 above). In top of this general trend,

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[26]In the U.S. for example, the Bureau of Economic Analysis publishes a set of integrated macroeconomic accounts that combine BEA's national income and product accounts (for income) and the Federal Reserve Board's Flow of Funds (for wealth). For the recent decades, all the U.S. series in our database come from the integrated macro accounts, so that by construction the residual capital gains we report are consistent with those presented in these accounts.

there are interesting cross-country variations. Within Europe, the French and U.K. trajectories are comparable: in both countries, private wealth rose from about 300% of national income in 1970 to about 550% 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 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.[27]

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 example of the 1970-2010 rise of wealth-income ratios – fairly close to Italy in terms of magnitude. 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.[28]

The 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

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[27]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 general reason why housing should deliver higher capital gains than financial assets..

[28]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).

was below 400% everywhere in 1970.[29] Whether one should divide private wealth by national or disposable income 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 compare private wealth-income ratios over long periods of time and across countries, it is more justified to look at economic values and therefore to divide private wealth by national income.[30]

4.2 From private to national wealth

We now move from private to national wealth – the sum of private and government wealth - which in our view is a more meaningful and comprehensive concept of 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 privatizations – leading to a reduction in government assets – and to an increase in public debt.

For example, 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. 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 appears to be 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).[31] In Italy, for instance,

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[29]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.

[30]In the end it really depends on how one views government-provided services (and in our database, we provide both ratios). If one assumes that government expenditures are useless, and that the rise of government during the 20th century has limited the ability of private individuals to accumulate 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 is that national income 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% if one includes all in-kind transfers (education, housing, etc.). See Appendix Figure A65.

[31]Should we include claims on future government spending in wealth, private wealth would be higher and government wealth lower, leaving national wealth unchanged.

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   From national wealth to domestic capital

Last, our database provides evidence on the evolution of the structure of national wealth. National wealth is the sum of domestic capital and net foreign wealth. The first basic fact is that net foreign wealth – whether positive or negative – has generally been a relatively small part of national wealth in rich countries throughout the 1970-2010 period (see Figure 6). However, 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 between 40% and 70% of national income in net foreign assets. Although Japan's and Germany's net foreign positions are still substantially smaller than the positions reached by the U.K. and France around 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-income ratio.

In most of the other countries in our database, by contrast, recorded net foreign positions are currently slightly negative – typically between -10% and -30% of national income – and have been declining.[32] So for those countries, the rise in the domestic capital-output ratio β_k has been larger than the rise in the national wealth-income ratio β_n. For example, the capital-output ratio was about 400% in the U.S. in 1970 and reached 460% in 2010.[33]

As we already noted, our measure of the capital-output ratio β_k based on balance sheet data differs from (and is arguably more comparable over time and across countries than) previously available estimates obtained by the perpetual inventory method (PIM). There are two main reasons for this discrepancy: different valuations of housing capital and of corporations' assets.[34]

In balance sheets, real estate is measured at its current market value, using censuses and observed market prices. By contrast, PIM estimates only capture the value of "structures",

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[32]However, the official net foreign asset positions do not include the sizable assets held by 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 be particularly large for Europe (Zucman, 2013).

[33]See Appendix Table A51 and Appendix Figure A67.

[34]Section A.4.5 of the Data Appendix provides a detailed reconciliation on the basis of the US case. A third and less important reason is that balance sheets include inventories and valuables, following international guidelines, while PIM estimates of the capital stock generally do not.

and this value is obtained indirectly by cumulating past real estate investments, adjusting for the evolution of the relative price of construction (in a way that makes it difficult to properly account for changes in quality). This procedure misses a large fraction of the value of the housing stock.[35] It fails to capture the large increase in housing wealth that has happened since 1970 (with notable variations across countries). As Table 2 shows, the rise of housing at market value accounts for virtually all of the increase in β_k in the U.K., France and Canada, for about two-thirds of the increase in the U.S., and about half in Japan.[36]

Second, in our benchmark measure of the capital-output ratio, corporate capital is measured through the market value of equities, while in older estimates corporate capital is at book-value (i.e., based on PIM-estimates of corporations' nonfinancial assets). Tobin's Q ratios between market and book values were much below 1 in the 1970s and are closer to 1 (and at times above 1) in the 1990s-2000s.[37] As a result, measured at market value, domestic capital goods other than housing have significantly contributed to the rise of β_k in a number of countries, most spectacularly Japan and Italy (Table 2).

Which measure of the corporate capital stock, market or book, is more appropriate? Both have their merits. Take the case of Germany. Tobin's Q is low: it has remained around 0.5 since the 1970s, contrary to the U.K. and the U.S. One interpretation is a "stakeholder effect": 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.[38] If that is true, measuring corporate capital stocks at book value might be desirable for some purposes (e.g., for growth accounting), so in our database we also report series

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[35]The gap between the balance sheet and the PIM-based measures of real estate includes the value of land underlying buildings, as well as any measurement error on any side, and all cumulated changes in market-value real estate prices that cannot be attributed to the evolution of construction costs. In the U.S., the gap amounts to about 60% of domestic output in 2010. Whether this should be interpreted as the value of land is unclear, given the imperfections of the price data used in PIM estimates and the fact that the distinction between structures and land is somewhat arbitrary.

[36]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.

[37]See Appendix Figure A92 and Appendix Table A78. For example, in 2010, the value of the U.S. corporate capital stock is approximately the same whether one looks at equity market prices or at the current cost of corporate capital goods as estimated by BEA statisticians. That is, Tobin's Q is around 1.

[38]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.

with corporate capital at book value. There are, however, issues with book-value estimates (one of which being that intangible capital is imperfectly accounted for) that lead us to view market values as probably more informative in the long run.[39] Whether one uses book- or market-values for corporate capital, the capital-output ratio has increased markedly in all rich countries since the 1970s.[40]

5   Decompositions of 1970-2010 wealth accumulation

5.1   Growth rates versus saving rates

How can we account for the rise and cross-country variations of national wealth-income ratio? According to the one-good capital accumulation model, wealth-income ratios are driven by two key forces: the saving rate s and the income growth rate g. So it is useful to have in mind the magnitude of 1970-2010 growth and saving rates. The basic fact is that both rates vary widely across countries and seem largely unrelated (Tables 3-4), which creates room for wide, multi-dimensional variations in wealth-income ratios across countries.

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. In most cases they fall between 1.7% and 1.9% per year, and 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.[41]

In contrast, variations in population growth are large and significant. Since 1970, population growth has exceeded 1% per year in New World countries (U.S., Canada, Australia), and has

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[39]See Appendix Section A.1.2. The fact that intangible capital is not fully accounted tends to bias PIM-corporate capital stocks downwards. Other measurement issues, however, tend to bias them upwards, in particular errors in price deflators and problems in accounting for the assets of firms going out of business (which sometimes incorrectly continue to be counted in the capital stock). Overall, it seems that PIM estimates of corporations' capital stocks have historically tended to be over-estimated. Quite puzzlingly, indeed, in most countries Tobin's Q appears to be structurally below 1, although intangible capital is imperfectly accounted for, which in principle should push it above 1. This is an area in which existing statistics might need to be improved.

[40]In particular, 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), despite the increase in Tobin's Q.

[41]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.

been 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 (Table 3). 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).[42]

Average net-of-depreciation private saving rates also vary widely, 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%. 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, wealth accumulation and transmission,[43] as well as differences in levels of trust and confidence in the future.[44] As a result, there is only a weakly significant negative relationship between private saving and growth rates at the country level, and no relationship at all when one considers national rather than private saving (see Table 4).[45]

Thus, 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. These facts help understand why national wealth-income ratios vary so much across countries, and in particular why high-population growth New World countries tend to have lower ratios than low-growth Europe and Japan.

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[42]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.

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

[44]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.

[45]See also Appendix Figures A122 and A123. Note that in some countries a large fraction of private saving is in effect absorbed by government deficits (more than one third in Italy in 1970-2010). Whether private saving responds to public deficits is an important issue (e.g., it could be that Italian households would have saved less without rising public deficits and the fear of future public finance crisis). However, it is far beyond the scope of the present paper: here we take saving behavior – private, public and national – as given and attempt to analyze the extent to which these volume effects account for the evolution of wealth.

5.2 Volume versus price effects

Table 5 presents our results on the decomposition of 1970-2010 national wealth accumulation into saving and capital gains effects.[46] New savings explain the largest part of wealth accumulation, but 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, 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, and residual capital gains 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.

The capital gains we compute are obtained as a residual, and so may reflect measurement errors in addition to real valuation effects.[47] There are two main possible issues. First, it is possible that national saving flows are under-estimated because they do not include R&D 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 R&D estimates, 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 7).[48] Take the case of France. Predicted national wealth in 2010 – on the basis of 1970 initial national wealth and

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[46]Here we only show the multiplicative decompositions of national wealth. The additive decompositions yield similar conclusions; see Appendix Table A101.

[47]In the Appendix, we check that the pattern of capital gains residuals 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 4) 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, and studies by Eisner (1980), Babeau (1983), Greenwood and Wolff (1992), Wolff (1999), and Gale and Sabelhaus (1999)). 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.

[48]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 7 and 8 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).

cumulated 1970-2010 national saving including R&D – is equal to 491% of national income, while observed wealth is 605%. There is over 100% of national income in "excess wealth".[49]

Second, we might somewhat underestimate the value of public assets in the 1970s 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 1970-2010 increase in national wealth-income ratios β_n, and saving for about 60%, with a lot of heterogeneity across countries.[50] The only exception to the general pattern of positive capital gains is Germany. Given the large 1970-2010 saving flows and low growth rates, we should observe more wealth in 2010 than 400% of national income. There is the equivalent of 50-100% of national income in "missing wealth".

5.3 Domestic versus foreign capital gains

How can we explain the substantial capital gains we find on national wealth, and the losses in the case of Germany? To address this question, it is useful to distinguish capital gains/losses on domestic assets and on net external wealth (Table 6). Our series suggest a number of interpretations, but we stress that data limitations make it impossible to rigorously estimate the exact role played by each of them.

All countries (except Germany) have experienced positive capital gains on domestic wealth. These gains have been particularly large in Europe and mostly (though not entirely) driven by housing. One hypothesis – which, as we shall see, is consistent with the historical data – is that countries like the U.K. and France have benefitted from a long run asset price recovery. Asset prices fell substantially between 1910 and 1950, and have been rising ever since. There might,

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[49]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 cannot completely be ruled out. One would need, however, large and systematic errors to account for the amount of excess wealth we find.

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

however, have been some overshooting in the recovery process, particularly in housing prices. The four 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 part of the capital gains we measure might 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 national wealth-income ratio: given the values taken by s and g over the 1970-2010 period and the steady-state formula $\beta_n = s/g$, the β_n 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 (or do not want to diversify their portfolio internationally as much as they could) then maybe it is not too surprising if this generates upward pressure on housing prices.

Regarding the atypical German capital losses, German statisticians might over-estimate saving flows, under-estimate the current stock of 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.[51] Germans might also have less taste for expensive capital goods (particularly housing) 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 at our disposal, we are not able to put a precise number on each explanation.

It is interesting to note, however, 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 8). Europe as a whole has less residual capital gains than the U.K., France, and Italy, thanks to Germany. Had we regional

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

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 small national or regional economic units, but tend to correct themselves at more aggregate levels. If that is the case, German asset prices might rise in the near future and fall in other European countries.

Turning now to net foreign assets, we find that capital gains and losses on external portfolios have played a large role in the overall dynamics of national wealth (Table 6). The U.S. and German cases are particularly striking. In the U.S., net capital gains on cross-border portfolios represent one third of total capital gains at the national level. Absent net foreign gains, the U.S. wealth-income ratio would not have increased at all since 1970.[52] In Germany virtually all capital losses at the national level can be attributed to foreign assets.

The reason why capital gains on foreign portfolios matter so much is that the gross foreign positions of countries have massively increased since the 1970s – the rise has been spectacular in Europe, a bit less so in the world's largest economies, the U.S. and Japan.[53] A significant share of each country's domestic capital is now owned by other countries. With huge gross positions, even moderate returns differential on cross-border assets and liabilities are enough to generate large and volatile gains and losses on net foreign wealth over time and across countries.

6 Wealth-income ratios in rich countries 1870-2010

It is impossible to properly understand the recent rise of wealth-income ratios in rich countries without putting the 1970-2010 period into a longer historical perspective. As we have seen, on average about 40% of the rise of β_n since the 1970s is due to capital gains, 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? We argue that it is mostly a recovery effect: the 1970-2010 capital gains largely seem to

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[52]Our results on U.S. external wealth capital gains 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.

[53]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., recorded gross foreign assets amount to about 120% of national income, and gross liabilities to about 100% of national. See Appendix figures A39-A42.

compensate the capital losses observed during earlier parts of the 20th century.

The argument relies on the analysis of 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.[54] 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.

Starting with 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 7 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.[55]

Looking at each sub-period, we find a strong U-shaped relative capital price effect in European countries. The U.K., for example, experienced real capital losses at a rate of -1.9% per year between 1910 and 1950, followed by real gains of +0.9% between 1950 and 1980 and +2.4% between 1980 and 2010. 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%

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[54]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.

[55]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.

per year in the U.K., +0.3% in France). In Germany, by contrast, the recovery is yet to 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 we estimate might also reflect measurement issues: 1870-2010 saving flows might be somewhat underestimated in the U.K. and 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.

Table 8 decomposes the huge decline in national 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_n. Low national saving accounts for 46% of the fall in β_n 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_n. 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).[56]

The U.S. case is again fairly different from that of Europe. The fall of β_n 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.

7 The changing nature of national wealth, 1700-2010

7.1 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-income

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

ratio appears to have been roughly stable around 650-700% during the 18th and 19th centuries (Figure 3 above). In France, where a large number of historical national wealth estimates were also established, the picture is similar (Figure 9).

We should make clear that the raw data sources available for the 18th-19th 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 seems robust: all 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 from 1700 to 1914 in both countries, with no obvious long-run trend.

Strikingly, today's wealth-income ratios in the U.K. and France seem relatively close to their 18th century levels, in spite of considerable changes in the nature of wealth. Agricultural land – including land improvement of all sorts – was between 4 and 5 years of national income around 1700; it is now negligible and has been replaced by housing and other domestic capital (offices, machines, patents, etc.). In the long run, the decline of the share of agricultural land in national wealth mirrors that of the share of agriculture in national income, from over two thirds in the 18th century to a few percent today – with a faster and earlier decline in the U.K. The variations in the share of net foreign assets in national wealth are also striking. Net foreign assets were virtually zero in the 18th century. They reached very high levels in the late 19th and early 20th century – almost 2 years of national income in the U.K. in 1910, over 1 year in France. Following the wars and the collapse of the colonial empires, they came back to virtually zero around 1950.

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

That is probably an important part of the explanation. Unfortunately, data limitations again 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.

The main difficulty is that pre-1870 estimates of saving and investment flows are too fragile to be used in wealth accumulation decompositions. With very low growth, any error in the net-of-depreciation saving rate s can make a big 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 18th century U.K. and France actually derived from past investment. In all likelihood, the "pure land value" (i.e., the value of land before any improvement, as it was discovered at prehistoric times) was much less than 4 years of national income. Some 18th century estimates tend to suggest that it was around 1 year of national income.[57] 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 1.5 years of national income.

7.2 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 together historical balance sheets starting around 1770 (Figure 10). We find that the value of agricultural land in the late 18th and early 19th centuries was much less in the U.S. (1 to 2 years of national income) than in Old Europe (3 to 4 years).[58] Part of the explanation could well be lower accumulated investment 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 America that its price per acre was low. The right model to think about this effect involves a production function with an elasticity of substitution between land and labor lower than 1 – 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 3.3. That is, assume that the capital good solely consists of land and that land volume V_t (measured in acres) is in

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[57]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 18th-19th centuries, particularly for the U.K. and France, see Data Appendix.

[58]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 19th century and much of the 20th century).

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 (land volume) V and labor 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 country 1 (America) has more land volume relative to labor than country 0 (Old Europe): $V_1/L_1 > V_0/L_0$. Then country 1 will end up with lower land value (relative to income) than country 0 (i.e., $\beta_1 < \beta_0$, with $\beta_1 = K_1/Y_1 = q_1 V_1/Y_1$ and $\beta_0 = K_0/Y_0 = q_0 V_0/Y_0$) 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 the land-abundant country (i.e., $\alpha_1 = F_V V_1/Y_1 < \alpha_0 = F_V V_0/Y_0$) if and only if σ is less than one. Under standard assumptions on preferences and equilibrium rates of return, this in turn implies that land value is lower in the land-abundant country: $\beta_1 < \beta_0$.[59]

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.

Thus, part of the initial difference in β between Europe and America in the 18th-19th 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 attracted labor to the New World, implying large population growth rates and relatively low steady-state $\beta = s/g$ ratios.[60]

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[59]In a dynastic utility model with zero growth, 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 $\beta = s/(1 - s)$, 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 $s = s(r)$ 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 $\beta = s/g$). See the working paper version, Piketty and Zucman (2013).

[60]There is a large historical literature on the factor flows that characterized the 19th 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

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 control a large share of national income by owning the labor force. Should a tiny elite own the entire labor force, the total value of the slave stock could 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%).[61] 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 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 slaves and land values, wealth-income ratios in the U.S. South are relatively close to those of the Old World. Slaves approximately compensate the lower price of land (Figure 11).

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, antebellum America is the land of equal opportunity, the place where past wealth does not matter much. But it is also the place where a new form of class structure – even more extreme than Europe's – flourished, whereby part of the population owned another part.[62]

8   Capital shares and the changing nature of technology

In this section we attempt a brief look at the implications of our new data on capital for understanding the evolution of factor shares and of the shape of the production function. The results should be taken with caution, because measuring factor shares raises many difficulties. But this question is so important that we feel it deserves a few words.

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central than they used to be.

[61]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 $F(K, L) = (aK^{\frac{\sigma-1}{\sigma}} + (1-a)L^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$, we have $\beta_H = \frac{1}{a}\beta^{1/\sigma} - \beta$.

[62]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.

Starting first with the recent decades, Figure 12 shows that capital shares have increased in all rich countries from about 15%-25% in the 1970s to 25%-35% in 2010, with large variations over time and across countries.[63] By our estimates, however, capital-output ratios β_k have risen even more than capital shares α, so that the average return to domestic capital r – which can be computed as α/β_k – has declined somewhat (Figure 13).[64] 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 with imperfect competition and an increase in the bargaining power of capital (e.g., due to globalization and increasing capital mobility). A production function with three factors – capital, high-skill and low-skill labor – where capital is more strongly complementary with skilled than with unskilled labor would also do, if there is a rise in skills or skill-biased technical change. Yet another – and more parsimonious – way to explain the rise in α is a standard two-factor CES production function $F(K, L)$ with an elasticity of substitution $\sigma > 1$.[65] Importantly, with large changes in the capital-output ratio β_k (which in the long-run seem to be mostly due to volume rather relative price effects),[66] one can obtain substantial movements in the capital share with

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[63]Our results are consistent with a growing literature on the global rise of capital shares since the 1970s (Ellis and Smith, 2007; Azmat, Manning and Van Reenen, 2011; Karabarbounis and Neiman, 2014).

[64]Remember that domestic capital K is national wealth W minus the net foreign asset position. The capital-output ratio β_k is the ratio of domestic capital K to domestic output Y_d. The capital share α is equal to the output Y_K generated by domestic capital divided by Y_d. So it is pure accounting that the average return to domestic capital, $r = Y_K/K$, is equal to the capital share Y_K/Y_d divided by the capital-output ratio K/Y_d. Note that the results on Figure 12 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 12 are net of depreciation.

[65]One can of course combine the various possible explanations. Karabarbounis and Neiman (2014) 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 7.2 to 19th 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 (2014) 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 a broad class of one-good general equilibrium models, when g decreases β increases, and when in addition $\sigma > 1$, 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 5). This could be due to a positive price effect for land and R&D assets, which are not included in standard measures of the relative price of capital.

[66]Our market-value domestic capital stock K can be viewed as $K = q_1 V_1 + ... + q_n V_n$, where $V_1, ..., V_n$ are the volumes of the various capital assets (land, housing, structures, machines, patents, ...) and $q_1, ..., q_n$ their

a production function that is only moderately more flexible than the standard Cobb-Douglas. For instance, with $\sigma = 1.5$, the capital share rises from $\alpha = 28\%$ to $\alpha = 36\%$ if β_k jumps from 2.5 to 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 β_k attains 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 $\alpha = 53\%$.[67]

This scenario will not necessarily happen, but it cannot be entirely excluded either. Capital-output ratios and capital shares have no strong reason to be constant. Since domestic saving rates s and output growth rates g vary for all sorts of reasons over time and across countries, it is natural to expect β_k to vary widely. Small departures from standard Cobb-Douglas assumptions then imply that the capital share $\alpha = r\beta_k$ can also vary substantially. It is natural to imagine that σ was much less than 1 in the 18th-19th centuries and became larger than 1 in the 20th-21st centuries. One expects a higher elasticity of substitution in high-tech economies where there are lots of alternative uses and forms for capital.[68]

Taking now 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 18th-19th centuries (around 40%) than it is in the early 21st century (about 30%), despite the recent rise (Figure 14). Will capital shares return to their 18th-19th century levels? The capital-output ratio β_k is still somewhat lower today than in the distant past. So one possibility is that the capital share α will slowly return to about 40% as β_k keeps increasing in the coming decades. However, it could also be that the labor exponent in the production function has declined since the 18th-19th centuries, because of the rise of human capital. Over time, human inputs may have become relatively more important than 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,

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market prices (relatively to the consumption price index). With a single capital good in fixed supply (e.g., pure land), it makes more sense to view the production function as $Y = F(V, L)$ (see section 7.2 above). With many capital goods, the market-value concept of capital stock K is the most natural definition, especially given that the aggregate relative capital price q seems to be close to 1 in the very long-run; otherwise one might want to use $V = K/q$. In any case, for reasons explained above, the best way to use available data is to start from market-value balance sheets and compute the implicit q from wealth decomposition equations.

[67]In a perfectly competitive model with $Y = F(K, L) = (aK^{\frac{\sigma-1}{\sigma}} + (1-a)L^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$, the rate of return is given by $r = F_K = a\beta^{-1/\sigma}$ (with $\beta = K/Y$), and the capital share is given by $\alpha = r\beta = a\beta^{\frac{\sigma-1}{\sigma}}$. 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 $\beta = 8$.

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

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 capital-output ratios β_k. The measurement of α – and therefore of the average rate of return to capital – is complicated by self-employment and tax optimization behaviors 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 intermediation services provided by banks and real estate agents, but not the time spent by capital owners to manage their portfolios. Such costs might well vary over time. They might be larger in fast growing economies rather than in the stagnant, rural economies of the 18th century. So we may over-estimate average rates of return when using national accounts capital income flow series (and the $r = \alpha/\beta_k$ formula), especially in high-growth economies. In this paper, we have tried to show that an alternative way to study 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.

9 Conclusion

The new wealth-income database introduced in this paper reveals some striking facts. Capital is making a comeback: in the top eight developed economies, aggregate wealth has risen from about 200%-300% of national income in 1970 to a range of 400%-600% today. In effect, today's wealth-income ratios appear to be returning to the high values observed in 18th and 19th Europe – namely, 600-700% – in spite of considerable changes in the nature of wealth. The low European ratios of the post-war decades thus appear to be a historical anomaly. With low growth and substantial saving, long run β can naturally be very high – 600-700%, or even more.

A full understanding of the implications of the return of high-wealth income ratios calls for at least three extensions. It would be good to study wealth-income ratios at the world level, to include individual-level wealth inequality in the analysis, and to decompose wealth into an inherited component on the one hand and a self-made component on the other. All of this raises important challenges for future research.

References

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 18e siècle*, Paris: Guillaumin, 1843.

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

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," *Quarterly Journal of Economics*, 2014, forthcoming.

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.

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, *Capital in the 21st Century*, Harvard University Press, 2014

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

Piketty, Thomas and Gabriel Zucman, "Capital is Back: Wealth-Income Ratios in Rich Countries 1970-2010," PSE working paper, 2013.

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 18e 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)
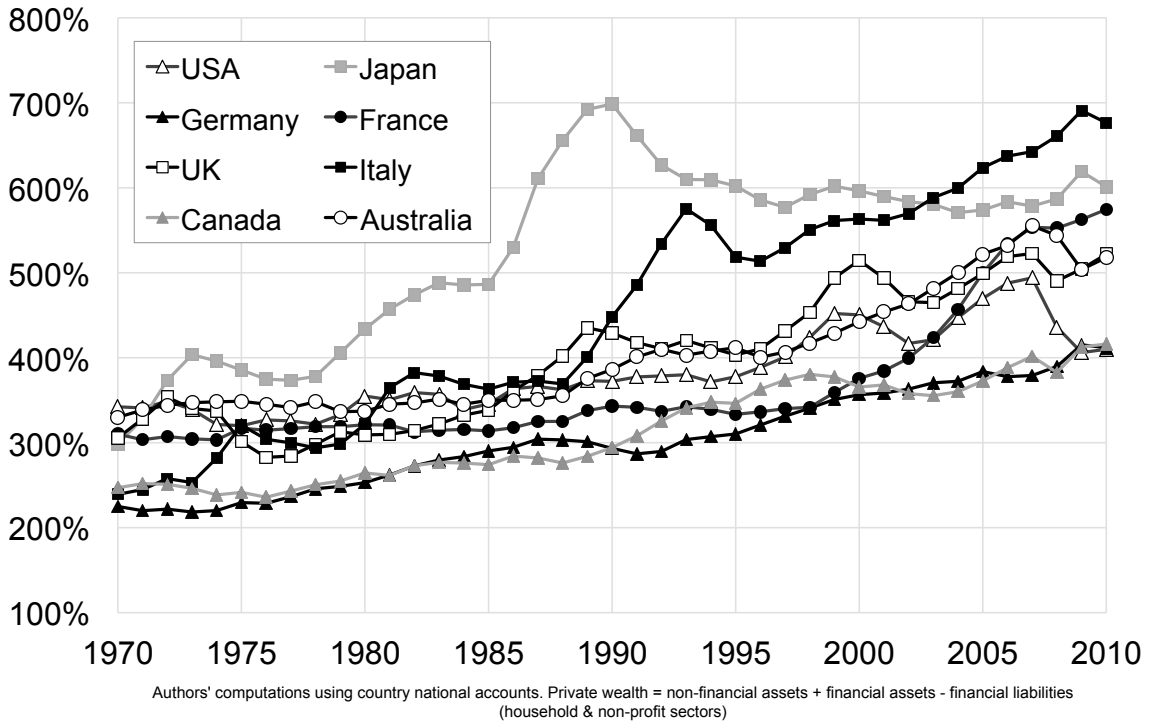
Figure 2: Private wealth / national income ratios in Europe 1870-2010

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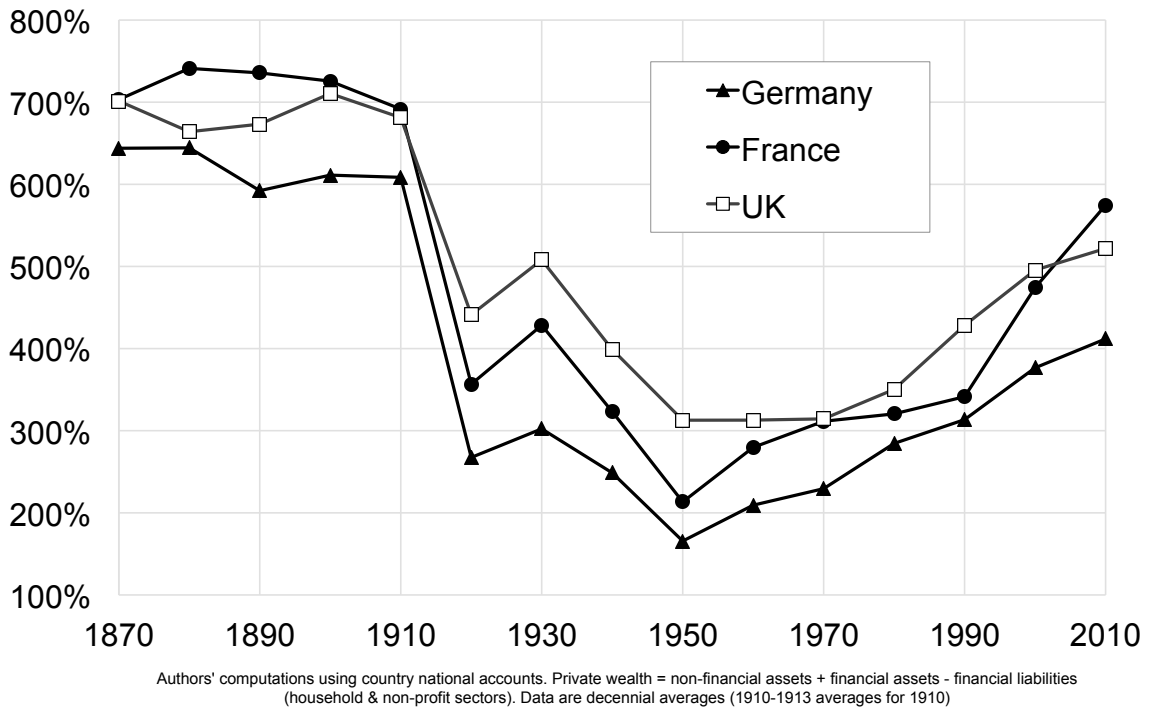
Figure 3: The changing nature of national wealth: UK 1700-2010

National wealth = agricultural land + housing + other domestic capital goods + net foreign assets
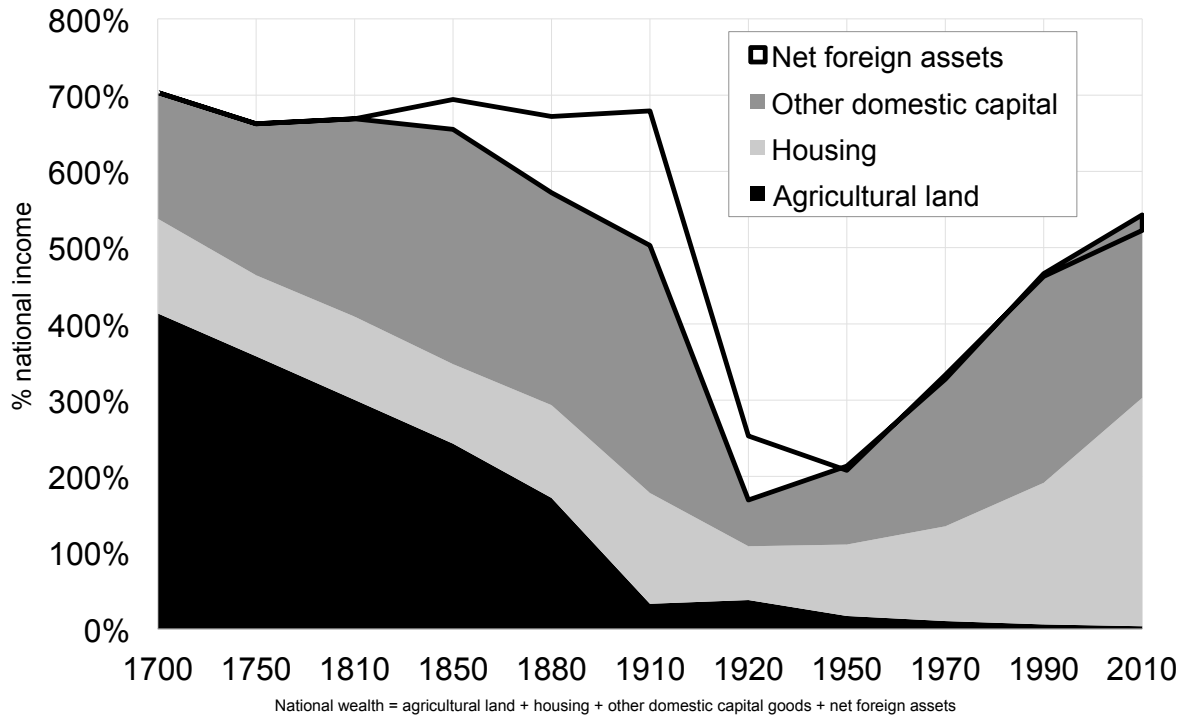
Figure 4: Private wealth / national income ratios 1870-2010: Europe vs. USA

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)
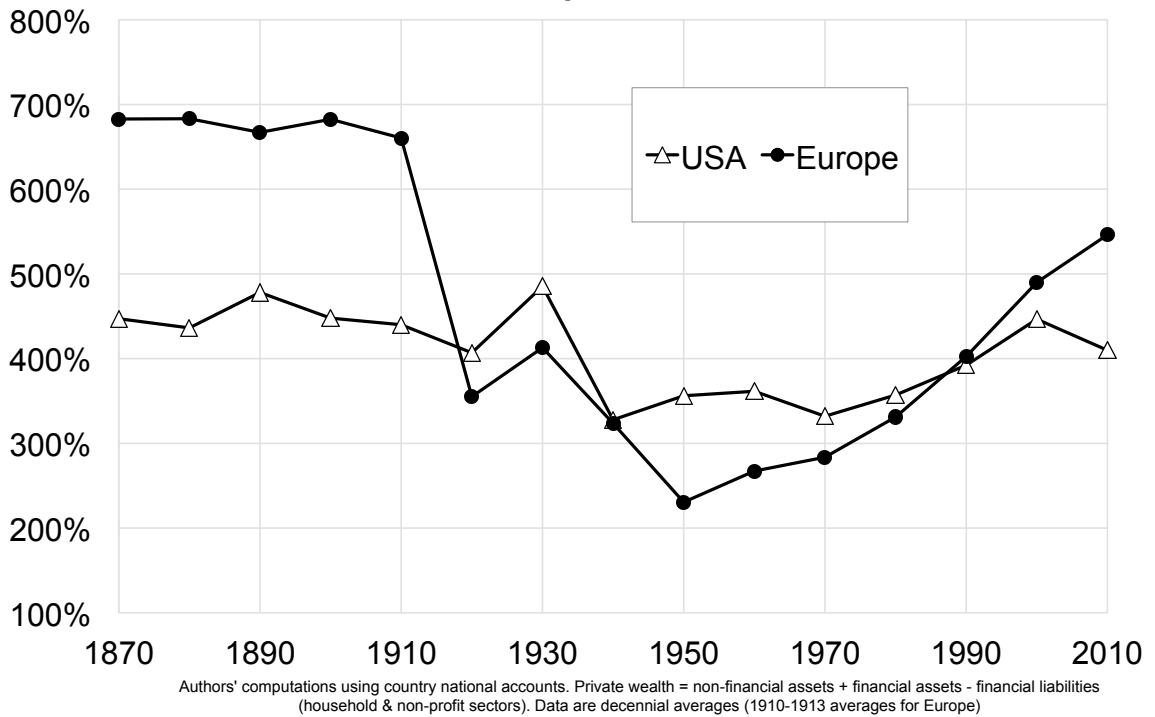
Figure 5: Private vs. governement wealth 1970-2010

Legend: USA, Japan, Germany, France, UK, Italy, Canada, Australia

% of national income

Private wealth

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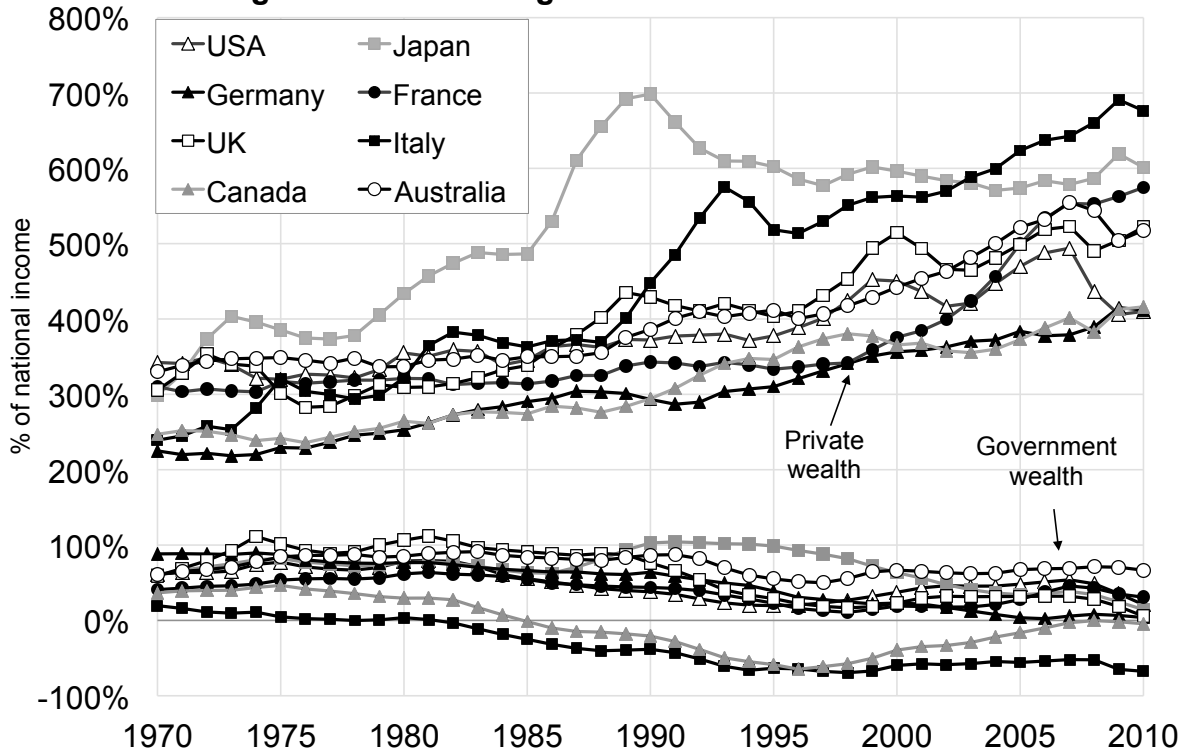
Figure 6: National vs. foreign wealth, 1970-2010

Legend: USA, Japan, Germany, France, UK, Italy, Canada, Australia

% of national income

National wealth
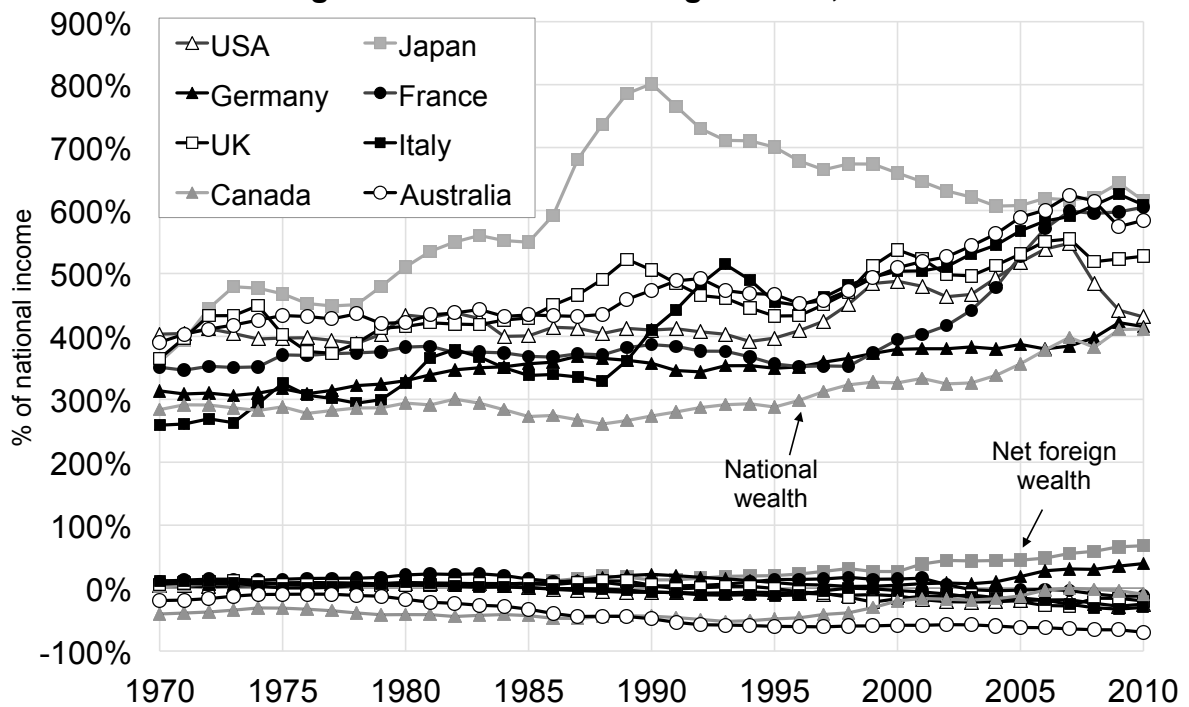
Net foreign wealth

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

40

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

Observed national wealth / income ratio 2010

Predicted national wealth / income ratio 2010 (on the basis of 1970 initial wealth and 1970-2010 cumulated saving flows) (additive decomposition, incl. R&D)
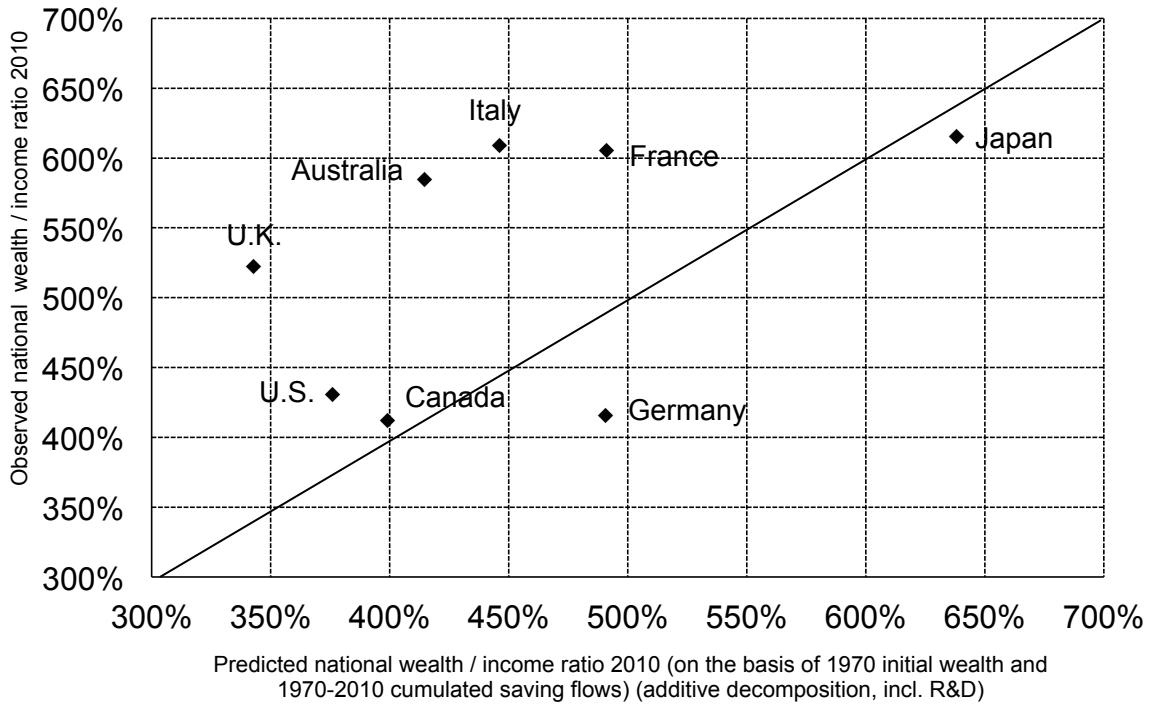
Figure 8: Observed vs. predicted national wealth / national income ratios (2010)

Observed national wealth / income ratio 2010

Predicted national wealth / income ratio 2010 (on the basis of 1970 initial wealth and 1970-2010 cumulated saving flows) (additive decomposition, incl. R&D)

41
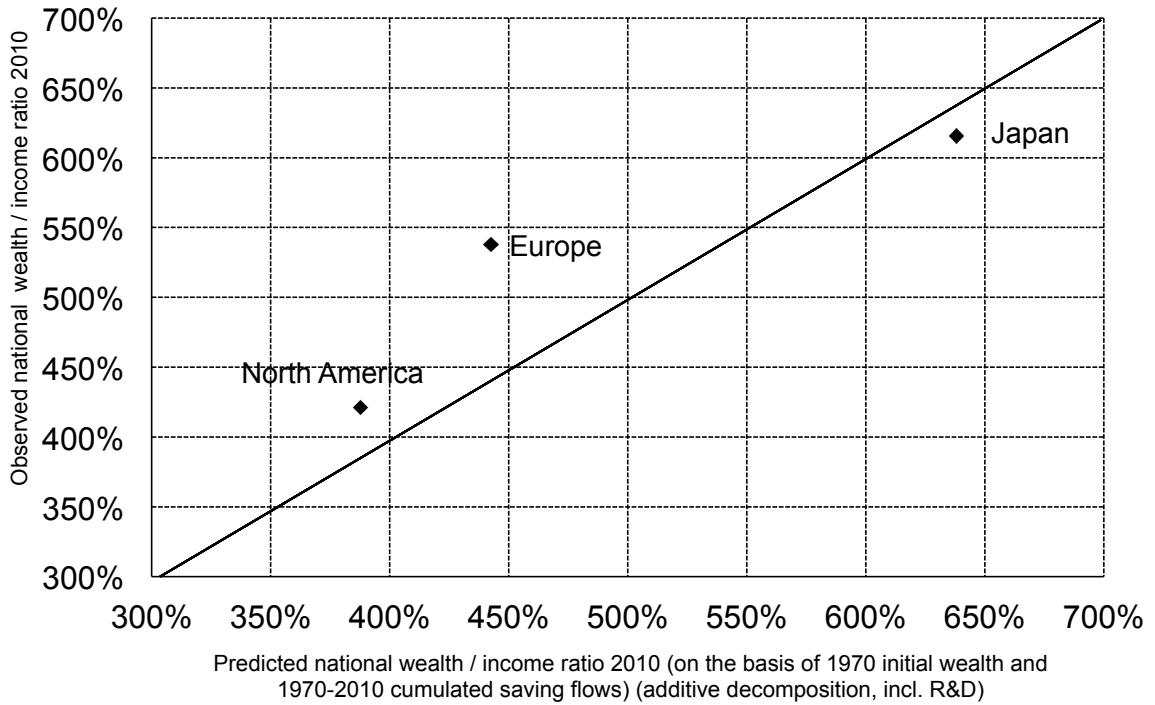
Figure 9: The changing nature of national wealth: France 1700-2010

% national income

Legend:
- Net foreign assets
- Other domestic capital
- Housing
- Agricultural land

National wealth = agricultural land + housing + other domestic capital goods + net foreign assets
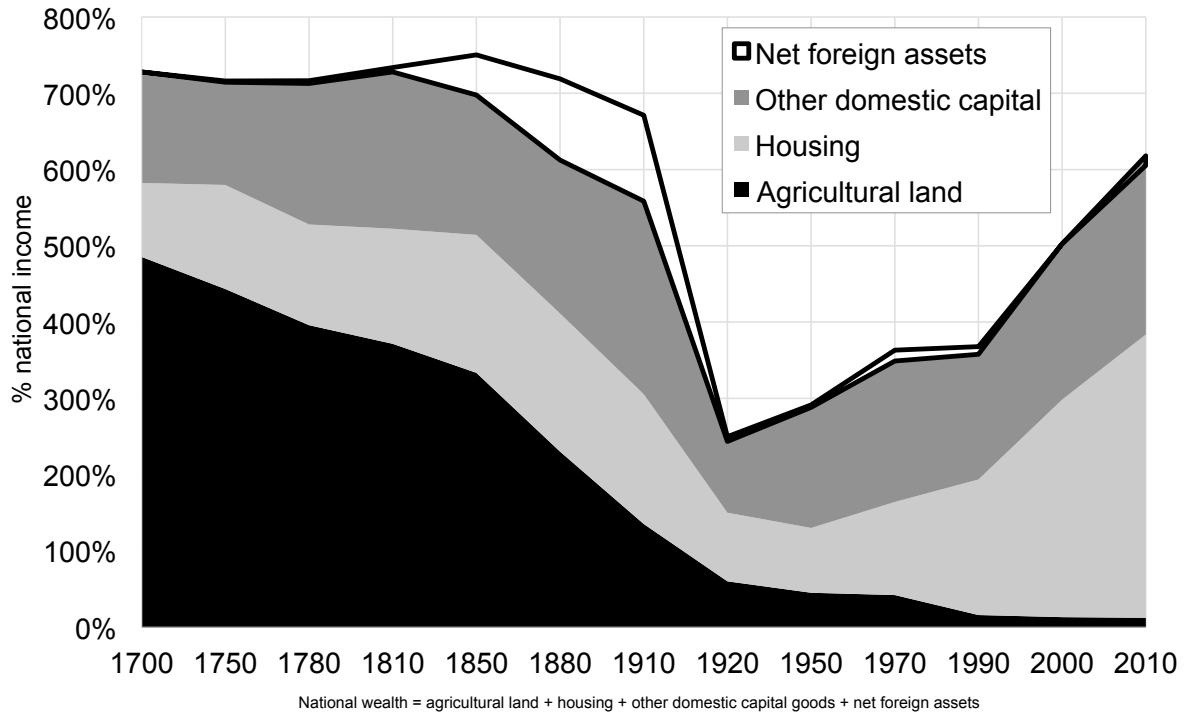
Figure 10: The changing nature of wealth: US 1770-2010

% national income

Legend:
- Net foreign assets
- Other domestic capital
- Housing
- Slaves
- Agricultural land

National wealth = agricultural land + housing + other domestic capital goods + net foreign assets
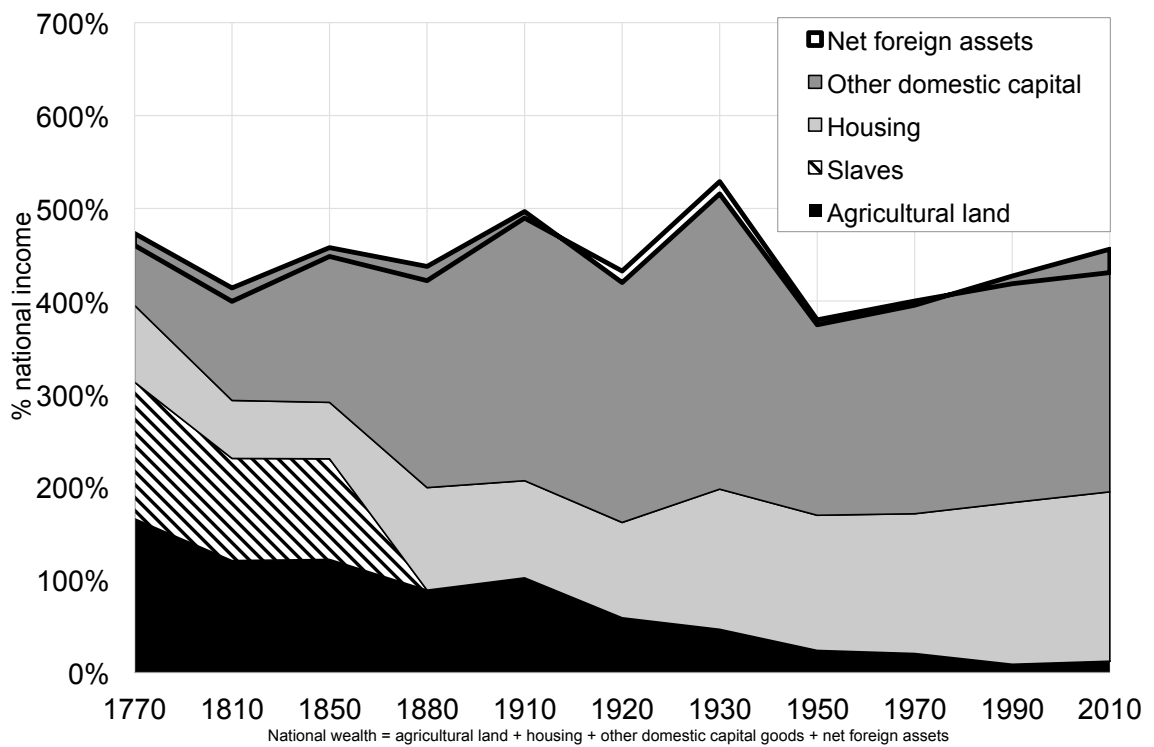
Figure 11: National wealth in 1770-1810: Old vs. New world

Legend:
- Other domestic capital
- Housing
- Slaves
- Agricultural Land

Y-axis: % national income (0% to 800%)

X-axis categories: UK, France, US South, US North
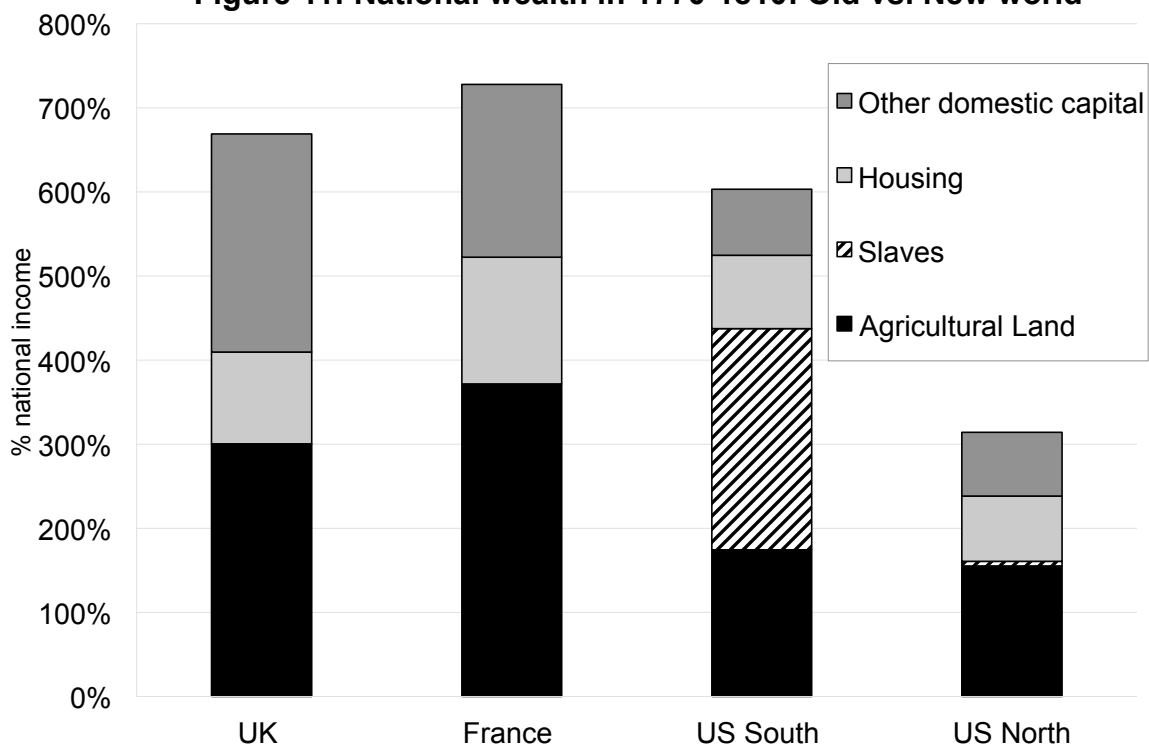
Figure 12: Capital shares in factor-price national income 1975-2010

Legend:
- USA
- Japan
- Germany
- France
- UK
- Canada
- Australia
- Italy

Y-axis: 10% to 40%

X-axis: 1975 to 2010
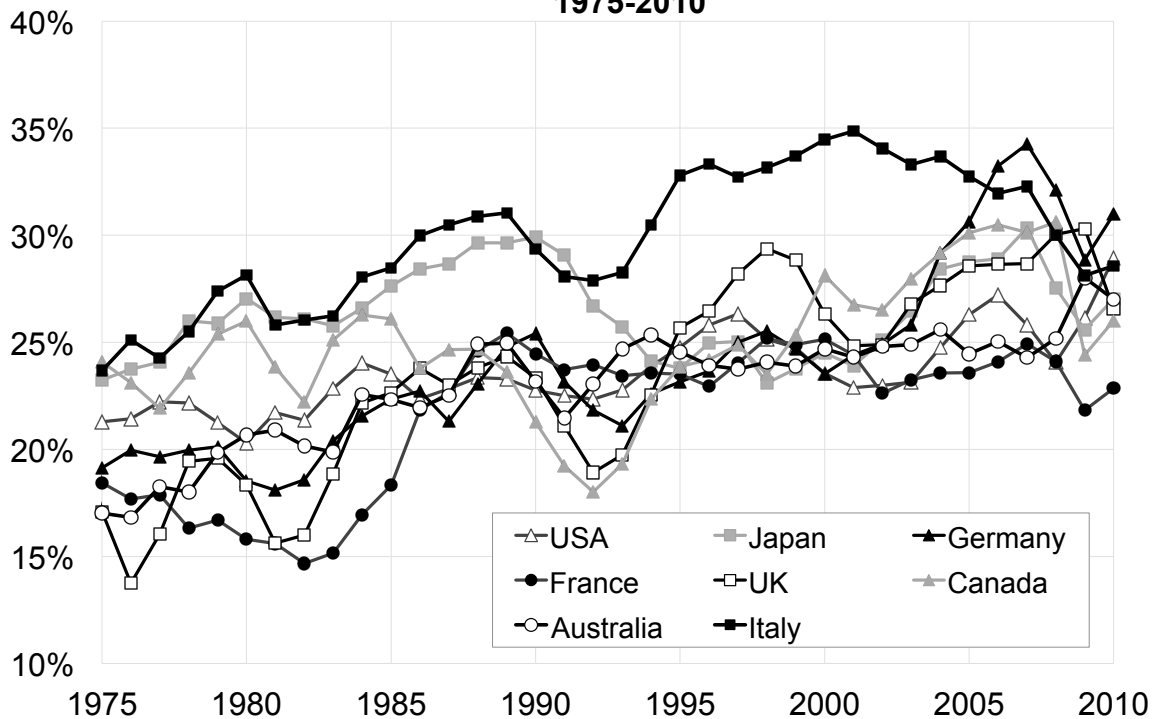
Figure 13: Average return on private wealth 1975-2010

Legend: USA, Japan, Germany, France, UK, Canada, Australia, Italy
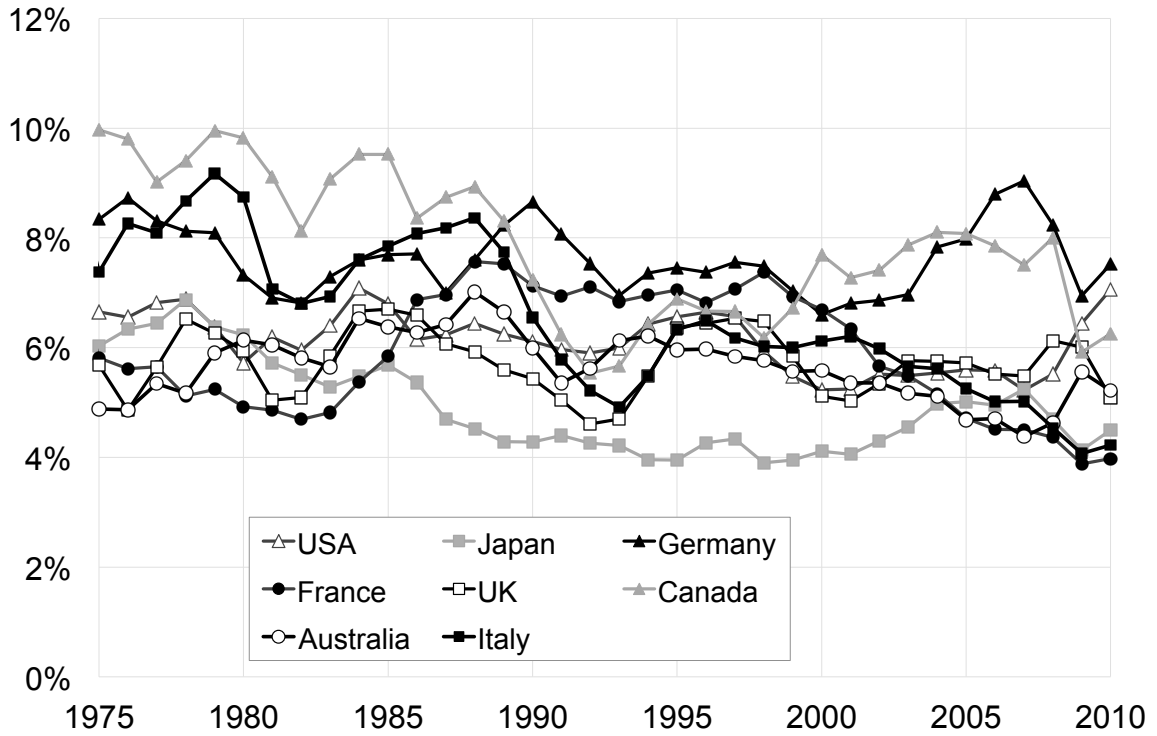
Figure 14: Factor shares in factor-price national income 1820-2010: UK and France

Legend: UK, France

Labor share

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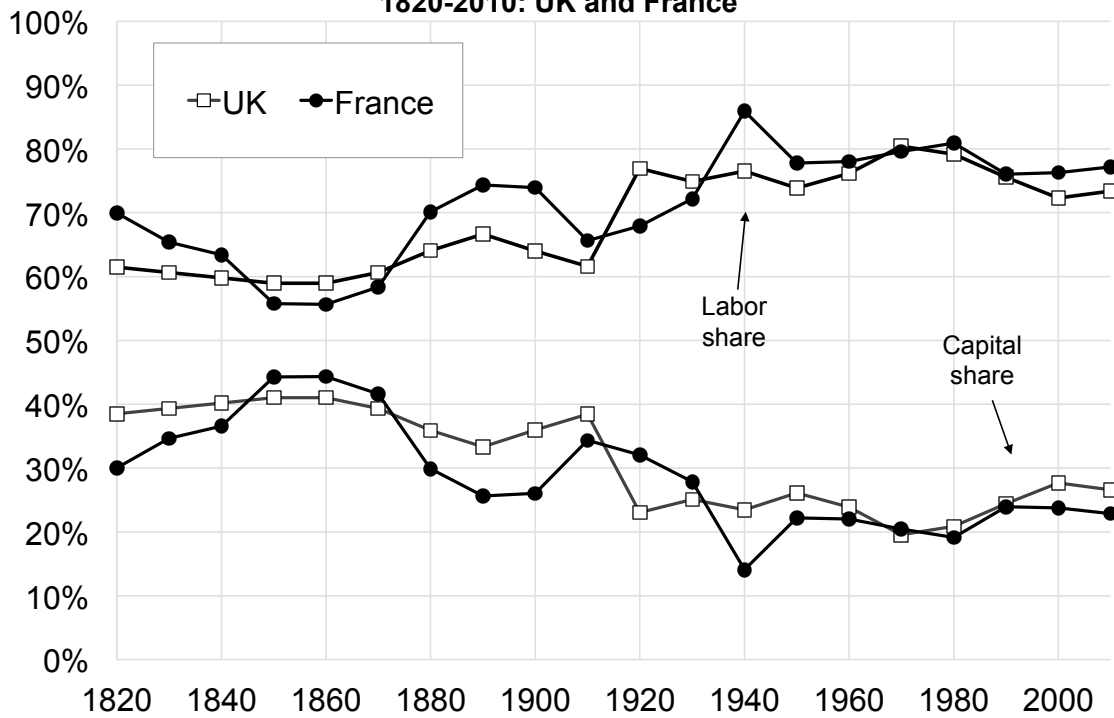
Table 1: A new macro database on income and wealth			
	Total period covered in database	Annual series	Decennial estimates
U.S.	**1770-2010**	1869-2010	1770-2010
Japan	**1960-2010**	1960-2010	
Germany	**1870-2010**	1870-2010	
France	**1700-2010**	1896-2010	1700-2010
U.K.	**1700-2010**	1855-2010	1700-2010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

Table 2: 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%		456%		57%	
	142%	*257%*	*182%*	*274%*	*41%*	*17%*
Japan	356%		548%		192%	
	131%	*225%*	*220%*	*328%*	*89%*	*103%*
Germany	305%		377%		71%	
	129%	*177%*	*241%*	*136%*	*112%*	*-41%*
France	340%		618%		278%	
	104%	*236%*	*371%*	*247%*	*267%*	*11%*
U.K.	359%		548%		189%	
	98%	*261%*	*300%*	*248%*	*202%*	*-13%*
Italy	247%		640%		392%	
	107%	*141%*	*386%*	*254%*	*279%*	*113%*
Canada	325%		422%		97%	
	108%	*217%*	*208%*	*213%*	*101%*	*-4%*
Australia	410%		655%		244%	
	172%	*239%*	*364%*	*291%*	*193%*	*52%*

Table 3: Growth and saving rates 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 4: Structure of national saving 1970-2010

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 5: 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	$g_{ws} = s/\beta$	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%*

Authors' computations using country national accounts. Other volume changes were included in savings-induced wealth growth rate. For full decomposition, see Appendix Country Tables US.4d, JP.4d, etc.

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: 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 8: Accumulation of national wealth in rich countries, 1910-1950						
	National wealth-national income ratios		Decomposition of 1950 national wealth-national income ratio			
			Initial wealth effect	Cumulated new savings	Cumulated war destructions	Capital gains or losses
	β (1910)	β (1950)				
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. On the basis of Germany's 1910 wealth-income ratio and cumulated 1910-1950 saving, the wealth-income ratio should have been 400% + 109% = 509% in 1950. But Germany experienced the equivalent of -120% of national income in war destructions and -165% in capital losses, so that the 1950 wealth-income ratio was only 223%. Maintaining the 1910 wealth-income ratio would have required 637% - 509% = 128% of national income in additional cumulated saving over 1910-1950. 31% of the fall in the wealth-income ratio can thus be attributed to insufficient saving, 29% to war destructions, and 40% to real capital losses.

This Data Appendix has two main purposes: to provide all relevant details on the data sources we use in this research, and to provide additional wealth accumulation decompositions that supplement the main results provided in the paper.

The Appendix is organized as follows. In Section A, we discuss general general methodological principles that apply to all countries. We provide a detailed discussion of what is included in published balance sheets and of how assets and liabilities are measured, following the U.N. System of National Accounts (SNA). Then in Sections B to J we provide country-specific information about sources and methods for each of the 8 countries in our database: the U.S., Japan, Germany, France, the U.K., Italy, Canada, and Australia.[69] The information provided there is detailed enough to enable the reader to reproduce each of our result from readily available published sources. Last, in Section K, we discuss supplementary results on wealth accumulation excluded from the main text for the sake of conciseness.

This Appendix is supported by a series of Excel and PDF files that contain our complete wealth-income dataset. The database is organized as follows. First, there is for each country a separate Excel file USA.xls, Japan.xls, etc., that contains all the raw series on the country's income and wealth, with precise references to the raw sources, and that organizes the raw data according to a 30-tables common template.[70]

From these country-specific files, we have then constructed two Excel files – AppendixTables.xls and AppendixFigures.xls – which contain 171 summary cross-country tables and 157 figures on wealth-income ratios, the structure of household, corporate, government, foreign, and national wealth, the structure of national income, saving flows, wealth accumulation, capital returns, prices, population, and exchange rates, covering the 1870-2010 period for the U.S., U.K., France, and Germany, and the 1970-2010 period for the other countries. The tables and figures presented in the main paper are contained in two separate Excel files – Tables.xls and Figures.xls. Last, all figures from the main text and the Appendix were exported in PDF format

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[69]In Section J we briefly discuss the available data for Spain, which are not as comprehensive as in the other rich countries, and therefore are not included in the core database.

[70]The raw data are gathered in the sheets DataUS, DataJapan, at the end of each file US.xls, Japan.xls, etc.

into a Chartbook. Similarly, all tables were exported into a Databook.

Finally, we also make available online a large number of raw Excel files collected from each country's official data providers and authors, upon which we have relied to construct our wealth and income database.

A   General methodological principles and data sources

A.1   Definition and measurement of assets and liabilities

Measuring capital is notoriously difficult. In this research we systematically follow the most recent international guidelines, as set forth in the 2008 System of National Accounts (SNA).[71] In our online database we often refer to classification codes from the European System of Accounts. ESA is the European Union implementation of the SNA; both are virtually identical.[72]

The SNA defines economic assets as "entities over which ownership rights are enforced by institutional units and from which economic benefits may be derived by their owners." Because ownership rights cannot be enforced on human beings, this definition excludes human capital. Including human capital would raise major conceptual difficulties, and we believe its exclusion is justified. In particular, treating human capital as an asset would call for treating education and health services as investment. But these services are largely viewed as having a consumption value per se, independently of the accumulation of any asset, so that the most basic distinction upon which national accounts are built – consumption vs. investment – would collapse.

All assets are to be measured at the market price prevailing at the date of the accounts.

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[71]The 2008 SNA, jointly adopted by the UN, the OECD, the World Bank, the IMF and the European Commission, supersedes the 1993 SNA, which was the first set of international guidelines including strict rules and concepts for national wealth accounts and balance sheets (and not only for national income). Changes from the 1993 SNA to the 2008 SNA were relatively modest and we mention them in the text below when appropriate. At the time we conducted this research, all the countries in our database followed the 1993 SNA with the exception of Australia which had already adopted the 2008 SNA. Most countries were expected to adopt the 2008 SNA by 2014 (2013 in the U.S.) For a detailed history of national accounts normalization since World War 2, and particularly of the debates and negotiations leading to the 1993 SNA, see Vanoli (2002, particularly pp.381-464).

[72]ESA 95 is the European implementation of the 1993 SNA and ESA 2010 of the 2008 SNA. The ESA 1995 manual is available on-line at http://circa.europa.eu/irc/dsis/nfaccount/info/data/ESA95/en/esa95en.htm.

Official wealth estimates are usually as at December 31st. In our database, from these raw data we construct mid-year estimates by averaging end-of-year values.

There are two broad ways to measure national wealth: (i) by taking a census of wealth, whereby economic units in the nation have to report on the current value of their assets and liabilities; (ii) by cumulating past investment or saving flows, with adjustments made for depreciation and changes in prices – what is known as the perpetual inventory method.[73] In SNA accounts, for household, government, and foreign balance sheets, statisticians essentially rely on census-like methods. For corporate balance sheets, they rely on both methods: non-financial wealth is mostly measured by cumulating past investment flows, while financial wealth is measured by census-like methods. We begin with a brief discussion of census-like vs. perpetual inventory methods.

A.1.1 Censuses of wealth

In official national balance sheets, census-like methods are used to measure all financial assets and liabilities, and they are also used for real estate – the two main components of private wealth, hence of national wealth.

To establish the current market value of the whole stock of financial claims and liabilities of all sectors of the economy, statisticians typically rely on a broad range of sources. First, they rely on the balance sheets of individual financial institutions such as banks, insurance companies, investment funds, and the like. By drawing on the balance sheets of banks, for instance, it is possible to know the amount of deposits held domestically by the various sectors the economy. Using the balance sheets of insurance companies, one knows the amount of life-insurance claims held by households. And so on.

Statisticians also heavily rely on reports about the off-balance sheet positions of banks.

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[73]A third and more seldom used way to value an asset is to take the discounted value of its future economic benefits. This method is used for some natural resources (subsoil assets, and sometimes forests). Yet a fourth method relies on asset values as reported to insurance companies (e.g., fire or theft insurance). This method was used in the past (e.g., in early twentieth century Germany) and is sometimes used today for estimating valuables such as works of art (SNA 2008, 13.43). We discuss below these estimation methods in more details when necessary.

One important off-balance sheet element is the portfolio securities managed by banks on behalf of third-parties. Essentially, all portfolio securities (equities, bonds, mutual fund shares) are entrusted by their owners to custodian banks. By asking banks to report on these portfolios, statisticians can measure the amount of equities held by households, of bonds held by non-financial companies, etc.[74]

Overall, by systematically drawing on the balance sheets and off-balance sheet reports of individual financial institutions, it is fairly easy to obtain accurate market values for the amount of financial claims held by the various sectors of the economy. The main issue is that in the current reporting systems, it is not not possible to measure the portfolio securities entrusted by households to offshore custodian banks (in Switzerland, Singapore, etc.), because there is no automatic exchange of information between banks in tax havens and foreign authorities. Zucman (2013) estimates that these securities amount to about 6% of households' financial wealth globally. So ideally it would be desirable to upgrade by about 6% the net financial claims of households recorded in the balance sheets of rich countries. One problem, however, is that the 6% estimate is a global figure which may conceal significant heterogeneity across countries. The figure may well be significantly higher for a number of European countries, but might be lower for Japan and the U.S. So in this research we have not attempted to upgrade the official balance sheets to account for the tax haven holdings of households. Improving the covering of tax haven wealth at the country level is an important challenge that we leave for future research.

Regarding real estate, the general practice is that its value is based on censuses of built areas (in order to establish the total surface of dwellings) and observed real estate transaction prices. In some countries, statisticians attempt to disentangle the value of real estate in two components: dwellings and land underlying dwellings. Typically, the value of dwellings is obtained by the perpetual inventory method (i.e., by cumulating past residential investment and adjusting for some construction price index), and land values are obtained as a residual (real estate at market

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[74]See Zucman (2013, Section II) for more details on the custodial activities of banks.

values from censuses, minus PIM-estimated dwelling values).

A.1.2   The perpetual inventory method

The assets other than financial claims and real estate – i.e., essentially corporate tangible assets: machines, structures, etc. – are usually measured by the perpetual inventory method. The goal of the perpetual inventory method (PIM) is to approximate the current market value of a number of capital assets when it cannot be directly observed. The general idea is that this value can be approximated by cumulating past investment flows and making suitable price adjustments. Although important effort has been devoted into improving it, the PIM continues to raise a number of important theoretical and practical difficulties (see, e.g., Hulten, 1991). For our study these difficulties are largely irrelevant, because in our benchmark measure of national wealth – market value national wealth – we measure the net wealth of corporation by setting it equal to the market value of their equities. By doing so, we in effect choose not to rely on PIM estimates of corporate capital.[75] It is important, however, to have some ideas of the pitfalls of the PIM.

First, capital stocks derived from the PIM obviously rely on the quality of the underlying investment data. Very long run data are needed when depreciation is low, otherwise benchmark historical estimates are required, which are often of dubious quality. More worryingly, the PIM implicitly assumes that the assets of firms going out of business are bought back by domestic corporations. When this is not the case – which frequently happens in practice, either because assets are scraped at the time of bankruptcy or sold to foreign corporations – assets that do not exist anymore continue to be counted in the capital stock until their estimated depreciation reaches 100%. In the U.K., Mayes and Young (1994, p. 95) consider that "the major reason for mis-measurement of the [corporate] capital stock is because capital scrapped by firms going out of business remains in the measured stock." Another implicit assumption of the PIM is

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[75]By contrast, in our alternative measure of national wealth – book-value national wealth – the net wealth of corporation is equal to corporations' non-financial assets plus net financial assets. This measure relies on PIM-estimates of corporate nonfinacial assets.

that statisticians are able to identify the sales of fixed assets by firms going out of business to domestic firms. When they fail to do so, investment flows are counted twice, and the PIM again over-estimates corporate capital stocks. In France, Picart (2004, p. 99) concludes that for these two reasons the PIM may over-estimate the stock of corporate fixed assets by up to 20%. This might explain why in many countries, Tobin's Q is structurally below 1 (see below).

The price component of the PIM also raises formidable difficulties. In private company accounts, assets are valued at the prices at which they were originally acquired – what is known as the "book value" or "historical cost" of assets. This method has the advantage of simplicity (historical prices can be easily verified) but tends to under-estimate the value of the capital stock when there is inflation. By contrast, with the perpetual inventory method assets are to be valued at the prices of a reference period.[76] This requires being able to observe the evolution of the market prices of all corporate fixed assets, which is impossible given the enormous variety of assets of different vintages and the lack of centralized markets for many of them. Thus, in practice, price changes are not observed but estimated – a task which is fraught with difficulties.

One reason why the market price of any fixed asset changes is the fact that as time passes, the asset's future income stream shortens. This economic depreciation is exactly what national accounts attempt to measure with the concept of "consumption of fixed capital." Depreciation is measured on the basis of estimated age-price profiles for various types of assets.[77] There is a

[76]When the reference period is the current period, assets are said to be valued at "replacement cost" or "current cost." But assets can also be valued at the constant prices of a past period, in which case they are simply at "constant costs." One should be careful with these expressions: while flows can be measured at "current prices" (no deflator required) or "constant prices" (deflator required), for stock data, both "current costs" and "constant costs" estimates require the use of price deflators.

[77]Economic depreciation (a price effect) should be distinguished from efficiency decay (a quantity effect), which is equal to the decline in an asset's contribution to production caused by the fact that as time passes, the asset becomes less efficient. Efficiency decay is what productivity studies are usually interested in, and is measured using age-efficiency profiles. Depreciation and efficiency decay are not the same thing: for a light bulb with a duration life of 10 years, the efficiency decay between year 8 and 9 is zero but the economic depreciation is not zero. The two concepts, however, are closely related: under the assumption of competitive markets, depreciation is the present value of rental income loss due to the efficiency decay occurring in each year in the future (Hulten, 1991, p.129). From a quantity perspective, the other component of depreciation beyond efficiency decay is retirement. Not all capital goods of the same cohort retire at the same moment, so statisticians also estimate retirement profiles. To one age-price profile corresponds one and only one age-efficiency/retirement profile. Age-price and age-efficiency/retirement profiles are identical if and only if the two are geometric.

whole literature dealing with what are the most appropriate functional forms for this profile.[78] But the 2008 SNA does not include strict guidelines and leaves the choice of specific functional forms to statisticians (SNA 2008, 20.22), so that some heterogeneity remains across countries.[79] Further, virtually all computations of economic depreciation face important data constraints. Statisticians would ideally like to use age-price profiles that vary over the business cycle as plants open and close, and that change with obsolescence – but the raw data to estimate are scant and do not allow for much sophistication.

The price of fixed assets also changes for many reasons unrelated to depreciation. Ideally, these price changes should be measured at the level of each individual asset vintage category (e.g., computers with 200Mhz micro-processors, 48MB of RAM, etc.). In practice this is of course impossible and statisticians only compute a limited number of prices for pseudo-homogeneous capital goods such as commercial real estate and computers. To estimate these prices, it is essential to properly account for quality improvement and technical change – otherwise computers of say the early 2000s will continue being counted as part of the capital stock above their true market value. While much progress has been done thanks to the greater use of hedonic price indexes following Hall (1971) and Gordon (1989), measures of price changes in industries with very fast rates of quality improvement remains a subject of both theoretical and practical difficulties, and eventually statisticians must often rely on ad-hoc techniques.[80]

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[78]Although there is a two-way correspondence between age-efficiency and age-price profiles, in practice there are arguments for basing estimates on assumptions about efficiency rather than price patterns (see SNA 2008, 20.18-20.20 for an intuitive exposition). For efficiency patterns, the most popular functional forms are: (i) One-hoss: assets retain full efficiency until they completely fall apart (as a light bulb does). In this case the pattern of efficiency decay is completely characterized by one parameter, the useful life of the asset. (ii) Straight-line efficiency, in which efficiency decays in equal increments every year (which is popular because in private accounts assets are often amortized in equal increments). The useful life again fully determines the efficiency decay pattern. (iii) Geometric decay, in which efficiency decays at a constant rate, which implies rapid losses of efficiency in the early years of an asset, and also that assets are never fully retired. See the discussion in Hulten (1991, pp.124-127) and the classic study by Hulten and Wykoff (1981) for tests of the three above patterns of depreciation.

[79]The OECD, however, recommends the use of geometric patterns for depreciation, because the combined age-efficiency and retirement profile of asset cohorts often resemble a geometric pattern. See OECD (2009), *Measuring Capital*, 2nd edition.

[80]For a discussion of the issues raised in addressing technical change with hedonic price index, with specific application to computers, see Triplett (1989).

It is worth stressing again that for our measure of market-value national wealth, the many shortcomings of the PIM are irrelevant, because we measure the value of corporations by their current equity values, and not by the PIM-estimated value of their capital goods.

We now turn to a more detailed discussion of the different components of SNA balance sheets. A balance sheet is established for each sector of the economy: households (including non-profit institutions serving households), corporations (financial and non-financial),[81] government, and the rest of the world. For each sector there are two broad types of assets in SNA balance sheets: non-financial assets and financial assets and liabilities.[82] Below we describe the main techniques used to measure the value of these assets, we provide details on various data limitations and the way we have dealt with them. The discussion closely follows the classification of the System of National Accounts.

A.2   Nonfinancial assets

Nonfinancial assets (labelled AN in the SNA classification) include produced tangible capital, non-produced tangible capital (i.e., natural resources), and intangible capital. We deal with each of them in turn.[83] Coverage of tangible capital is usually excellent in published balance sheets, while coverage of intangible capital varies. In Tables A169 and A170, for each sector of each economy in our database, we precisely indicate what assets are included in the balance sheets that we have used in this research.

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[81]For simplicity in our analysis we group all corporations in a single sector, but the raw sources we provide in the country-specific Excel files disentangle financial from non-financial companies.

[82]For the rest of the world sector, only financial claims and liabilities are recorded. If a Qatari investor owns a hotel in Paris, what is recorded is that a French quasi-corporation owns the hotel, and that the quasi-corporation is wholly owned by a foreign investor – an equity liability for France.

[83]Strictly speaking, there is no distinction between "tangible" and "intangible" capital in the 2008 SNA (the distinction existed in the 1993 but was removed). Rather, there are two types of nonfinancial assets: produced non-financial assets (AN.1), and non-produced non-financial assets (AN.2). Produced non-financial assets (AN.1) includes both tangible and intangible produced assets. Non-produced non-financial assets (AN.2) includes natural resources (AN.21) and intangible non-produced assets (AN.22). However, the distinction between "produced intangible assets" and "non-produced intangible assets" is particularly fuzzy, so we discuss intangible capital in a single section.

A.2.1 Produced tangible capital

Produced tangible capital is what economists are most familiar with. In fact, available estimates of countries' capital stocks usually restrict themselves to this type of wealth. This is the case for the vast majority of all "source of growth" exercises in the spirit of Solow (1957), Kendrick (1961), Denison (1962), and Jorgenson and Griliches (1967).[84] There are three types of produced tangible capital: fixed assets, inventories, and valuables. Estimates do not generally rely on comprehensive wealth censuses.

Tangible fixed assets

Tangible fixed assets are the most important category of produced tangible capital. They include dwellings, other buildings and structures, machinery and equipment, cultivated biological resources, and weapon systems. They are usually estimated by the perpetual inventory method (PIM), i.e. on the basis of past investment flows and estimated changes in the prices of capital goods.

As we have seen, the PIM raises a number of issues. Another traditional issue with the valuation of fixed assets has to do with ownership transfer costs, such as housing stamp duties paid by purchasers of houses, and real estate agents commissions paid by sellers.[85] When a house is purchased for a total price (including commissions) of 105 and sold for a net-of-stamp-duties price of 90, the SNA indicates that the the whole of the ownership transfer costs should be included in gross fixed capital formation and an asset worth 105 recorded in the buyer's balance sheet. Ownership transfer costs, after all, are incurred in order to receive benefits in the future, and so they are investment expenditures. Like other fixed assets, they are then to be gradually depreciated, so that they contribute to a positive net formation of fixed capital

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[84]Some of these studies try to include some intangible capital such as software in their capital stocks estimates, data permitting. But many also exclude residential real estate, a very large fraction of produced tangible capital. This is the case for instance of the KapW variable of the Penn World Table Mark 5 (Summers and Heston, 1991, p.347). The large literature on productivity also usually focuses on the corporate sector, disregarding the often large public assets, i.e. this literature is typically interested in private fixed nonresidential capital (including intangibles when possible).

[85]See Goldsmith (1955) and the review by Paish (1956, p. 337) for early discussions of the issues raised by transfer costs in the measurement of savings.

during the year of purchase and to a negative net formation of capital afterwards.

The 1993 SNA recommended to depreciate ownership transfer costs over the whole life of the associated asset. This procedure raises issues when existing assets can be sold. If houses often change hands, depreciating transfer costs over the whole life of dwellings results in too much ownership transfer costs being recorded in the balance sheets, and eventually in too large stocks of dwellings. Thus in the U.S., "BEA's estimates of residential fixed assets have been overstated (because the transfer costs from multiple owners remain embedded in the capital stock estimates), and consumption of fixed capital has been understated."[86] The 2008 SNA now indicates that ownership transfer costs should be depreciated over the period during which the acquirer expects to hold the associated asset rather than during its whole life, so this issue should be addressed in the years ahead. It does not matter for our estimates of private wealth because the value of household real estate (which is composed of both dwellings and the land underlying) is not based on PIM dwelling values, but obtained through censuses of real estate market transactions. National accountants then use the PIM estimates of dwellings to break down real estate between dwellings and land.[87]

Last, monuments are to be included under "other buildings and structures" in SNA balance sheets. But estimating their value is obviously complicated. Ideally one would want to use comparable sales price. In the absence of such prices, statisticians rely on the perpetual inventory method. The value of an old monument, however, cannot easily be estimated by cumulating investment flows when no such flow was recorded at the time it was built. When already included in the balance sheets, application of the PIM means that monuments get depreciated over time

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[86]BEA, 2013, Preview of the 2013 Comprehensive Revision of the NIPAs.

[87]The issue of ownership transfer costs does not arise for for financial assets because ownership transfer costs for this type of wealth are not treated as investment but as intermediate consumption (in the case of purchases by corporations and government), final consumption (in the case of purchases by households) or exports of services (in the case of purchases by foreigners). Ownership transfer costs for non-produced assets are treated quite oddly in the SNA (SNA 2008, 10.97). By convention, at the flow level, they are to be recorded as fixed capital formation (under "land improvements" for land, and under a separate heading, "ownership transfer costs on non-produced assets" for the other natal resources). At the stock level, they are to be incorporated in the value of the asset to which they relate. There are no costs of ownership transfers shown separately in the balance sheets.

and eventually fully written off, unless specific depreciation patterns are applied. To deal with this issue, the 2008 SNA recommends that from time to time statisticians adjust upwards the value of monuments – an adjustment which should be recorded as a positive "other volume change" (SNA 2008, 12.15). In practice, it seems that in most countries old monuments are not recorded in the balance sheets at all, while relatively recent monuments – for which investment series are observable – seem to be.[88]

Consumer durables and military assets

There is usually little controversy on what is to be counted as tangible fixed asset. Two exceptions are consumer durables and military assets.

First, the SNA excludes consumer durables from balance sheets, and all countries in our sample follow this convention with the notable exception of the U.S.[89] In the SNA, investments in durables are to be treated as current consumption despite the fact that they yield a flow of benefits over time. There is no sound economic reason for excluding durables from the scope of asset,[90] but a practical one: including them would ask for including an additional flow of capital income to the household sector. This would require having data on the rental prices of durables goods, which in practice rarely exist because of the lack of leasing markets.[91] In this

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[88]For instance in France, the buildings of the Louvre museum are not recorded in the balance sheet of the government (only the value of the land underlying the buildings is recorded). However, the museum's pyramid, constructed in 1989, is recorded as an asset, and valued based on what was paid to build it (Baron, 2008, pp.22-23).

[89]Estimates for durables are usually presented as a memo item in published accounts.

[90]Worse, this exclusion causes a certain inconsistency in the accounts: if a vehicle is rented by a household from a lease company, the vehicle is treated as investment by the leasing company in the year it is purchased and then yields a flow of rental payments that adds to GDP. In contrast, cars purchased by household are treated as consumption in the year they are purchased and there is no flow of capital income over the life of the car.

[91]In the U.S., durables are included in produced tangible assets but the BEA does not include the services from durables in GDP. Consumer durables amount to about 35-40% of national income. Jorgenson and Landefeld (2006, p. 45) propose to include the services yielded by durables in GDP, on the basis, for instance, of their rental prices imputed by BLS for its productivity accounts. They find that this would increase U.S. GDP by about 10% (Jorgenson and Landefeld, 2006, Table 1.5 p. 51). The reason why the impact on GDP is so large despite the modest amount of stock of durables is because durables typically depreciate very quickly (the depreciation rate retained by Jorgenson and Landefeld is 20%, see Table 1.22 p. 73), thus the rental price of durables and the gross flow of capital services is high. The net flow (to be included in national income) is of course much smaller, typically the equivalent of $5\% \times 40\% = 2\%$ of national income.

research we stick to SNA guidelines and always exclude durables from assets (and income).

Second, in the 1993 SNA, only those military assets that could be used for civilian purposes, such as buildings, airports, roads, and hospitals, were included in the balance sheets. The 2008 SNA now includes military weapons, which are seen as being used continuously in the production of defense services (deterrence in peacetime). In practice, some countries (e.g., the U.S.) have included military weapons in the government's balance sheet for a long time, while other still do not (e.g., France). We have not tried to correct the raw data to improve comparability in this area: as far as defense spending is concerned, the distinction between consumption and investment is particularly fuzzy. This problem is unlikely to matter much: even in the U.S., which has the highest amount of defense spending relative to national income in our sample, estimated federal government defense fixed assets (including weapons, buildings, etc.) barely amount to 10% of national income in 2010.

Inventories and valuables

Beyond fixed assets, the second type of produced tangible capital in SNA balance sheets is inventories (AN.12) and valuable (AN.13). These assets are small and do not raise practical difficulties.[92] They are typically estimated by combining both census-like method[93] and cumulated flows.

A.2.2 Non-produced tangible capital (natural resources)

One key advantage of SNA balance sheets compared to traditional estimates of the capital stock is that they include estimates for non-produced tangible capital (that is, natural resources) which cannot be obtained by applying the perpetual inventory method, and therefore are lacking in virtually all cross-country databases and have been widely disregarded in growth accounting

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[92]One minor problem is that trees grown for timber (by opposition to trees that yield repeat products (e.g. fruits, etc.) are to be counted as inventories, but it seems that not all countries follow this convention (the distinction between fixed asset and inventory can sometimes be a bit obscure). See discussion below of natural resources. Further, the U.K. does not currently include valuables in its balance sheet but plans to do so with the adoption of the 2010 ESA, and Germany does not measure yet inventories and valuables..

[93]See Baron, (2008, p. 54-55) for the data sources used in the estimation of the stock of forests in France.

exercises.[94] Here we discuss which natural resources are covered and how their value is estimated.

There are three broad types of natural resources in the SNA: land (AN.211), subsoil assets (AN.212), and other natural assets (AN.213, AN.214, and AN.215).[95] In principle, must be recorded in the balance sheets all natural resources "that are subject to effective ownership and are capable of bringing economic benefits to their owners, given the existing technology, knowledge, economic opportunities, available resources, and set of relative prices" (SNA 1993, 13.18). This means that environmental assets over which there are no ownership rights, e.g., seas and air, are not measured. Similarly, wild land and virgin forest over which there is no commercial exploitation are not economic assets for the SNA, and thus will not be included in balance sheets. But land put to an economic use by a well-identified owner will, as well as forests harvested on a large scale for timber. Lastly, natural resources exclude assets whose growth is the result of human cultivation, such as livestock and vineyards, which are produced tangible capital.

How should natural resources be valued? The general rule is that all assets must be valued at market prices based on observed transactions. In many cases however, there are no such prices (e.g., for natural resources which are the property of the government and never sold). In these cases, statisticians should aim at computing a present value of future returns (SNA 1993, 13.28).[96] Each of the three broad types of natural resources raises specific difficulties and recording practices remain somewhat heterogeneous across countries.

Land

There are three types of land: (i) land underlying residential buildings, (ii) land underlying

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[94]One notable exception is Caselli and Feyrer (2007) who attempt to account for natural resources in their computation of the marginal product of capital, based on the natural resources data gathered by the World Bank for its "Wealth of Nations" database, available at http://data.worldbank.org/data-catalog/wealth-of-nations.

[95]Together, they formed the category of "tangible non-produced assets" in the 1993 SNA, which has been relabeled "natural resources" in the 2008 SNA (AN.21).

[96]This method raises many issues, in particular the choice of the discount factor. The SNA 1993 indicates that "the rate of discount and the capitalization factors should be derived from information based on transactions in the particular type of assets under consideration – forest lands, mines and quarries – rather than using a general rate of interest, such as one derived from the yield on government bonds." (SNA 1993, 13.34).

non-residential buildings,[97] and (iii) other land.[98] For all types, recorded values should exclude the value of all buildings, cultivated crops, etc.[99] In practice, it is often difficult to separate the values of buildings and of the land underlying. In this case, the SNA indicates that land values should be obtained by subtracting the replacement cost value of the buildings (obtained by the perpetual inventory method) from the value on the market of the combined land and buildings (SNA 1993, 13.57). One consequence is that, by construction, increases in real estate prices, to the extent that they do not reflect increases in construction costs, are attributed to land rather buildings in the balance sheets.

The balance sheets of the countries in our database all cover land. Coverage is very good: all types of lands are usually included for all sectors. The exceptions are as follows: in the U.S., U.K., and Germany, "other land" is not measured,[100] and in the U.S., land underlying buildings is not measured for the government and financial corporations sectors. In the country-specific sections, we precisely describe how we correct for these inconsistencies. In effect, our series include all forms of land (as defined by SNA) for all countries, including "other land". Over the 1970-2010 period, the corrections are quantitatively inessential, because agricultural land has become a relatively minor asset. When one makes comparisons over longer time periods, however, it is critical to ensure that all forms of land are included.

As we stress in the main text of the paper, it should also be emphasized that land values include the cumulated value of all land improvement made in the past, and that it is fairly complicated to isolate the "pure" non-produced component out of the total. To a large extent,

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[97]In ESA accounts, both are included under AN.2111, "land underlying buildings and structures."

[98]This includes land under cultivation (AN.2112); recreational land and associated surface waters (AN.2113); and other land and associated surface water (AN.2119).

[99]In particular, major improvements to land are to be treated as gross fixed capital formation, and the resulting asset separated from the land itself. To this end, the 2008 SNA introduces a new "land improvement" asset under "buildings and structures." When it is impossible to separate the value of the land before improvement and the value of the improvements, the 2008 SNA states that the land should be allocated to the category that represents the greater part of the value (while the 1993 SNA used to include improvements with land itself). In a similar vein, ESA 1995 guidelines recommend that for forests, trees should be distinguished from the underlying land and recorded as part of national inventories (AN.12), see e.g., Baron (2008, p. 54) for the case of France. This convention is retained in the 2008 SNA (13.51).

[100]With the exception of agricultural land (AN.2112) which is measured in the U.K. and U.S.

this also applies to other natural resources.

Subsoil assets

Subsoil assets, labeled mineral and energy reserves in the 2008 SNA, include coal, oil, natural gas, and minerals that are economically exploitable given current technology and prices. One difficult question is which sector they should be attributed to. In some countries, subsoil assets legally belong to the owner of the ground, but in others they always belong to the government, which in turn grants extraction rights. The 2008 SNA generally makes a clear distinction between legal and economic ownership but indicates that in this specific case legal ownership should always be followed (SNA 2008, 13.50) and thus subsoil assets legally owned by the government should be recorded as assets for the government, even when they are extracted and eventually exhausted by private sector companies. When the government grants extraction rights to the private sector, a flow of "rents on subsoil assets" should then be written.[101]

The choice to attribute subsoil assets to the government when it is the legal owner is not innocuous: it potentially raises a double-counting issue. Government-owned subsoil assets exploited by private corporations are arguably capitalized in the corporations' equity prices. So they risk being counted twice in national wealth: both as government wealth (directly) and as private wealth (indirectly through equities).

In practice, in our sample of countries, the U.S., U.K., Germany and Italy do not estimate yet the value of subsoil assets. Australia, Japan, France, and Canada do. Australia and France attribute all subsoil assets to the government, while Japan attributes them to non-financial corporations. Canada does not attribute subsoil assets to any particular sector and reports them in separate memo accounts. To ensure consistency, we chose to always report subsoil assets as a "memo item" excluded from our market-value national wealth, just like in Canada.[102] This way

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[101]Note that subsoil assets, just like land and any immovable assets, can never directly belong to the rest of the world: in the SNA all domestic non-financial assets belong to resident units. Foreign holdings of non-financial assets are recorded as foreign holdings of equities in artificial domestic corporations, called notional residents units, which are the owners of the non-financial assets. See SNA 2008, 4.49.

[102]There is no double counting issue when national wealth is measured at book-value, i.e. when corporations' net assets are measured by the perpetual inventory method rather than through equity prices. So when sufficiently

we avoid any risk form of double counting and we are consistent across our sample countries.[103] When information on the value of subsoil assets is not available from national balance sheets (U.S., U.K., Germany, Italy), we report for comparison purposes estimates provided by the World Bank in its Wealth of Nations database for the years 1995, 2000, and 2005. Subsoil assets appear to be less than 10% of national income in the U.S., Japan, Germany, France, and U.K, but as high as 35% in Australia and 60% in Canada.

Other natural resources

These include "non cultivated biological resources" (AN.213), "water resources," (AN.213), and what the 2008 SNA labels "other natural resources" (AN.215), which includes radio spectra and other assets. Since market prices are typically not available for these kind of natural resources, they are to be valued by the present value of their future expected returns.

There is substantial heterogeneity in how these assets are presently recorded, but this is of no consequences for our purposes given their very limited importance in national wealth. Forests appear to be the only potentially important asset of this kind in our sample of countries, and so we provide estimated values (coming either from official balance sheets or from the World Bank Wealth of Nations) as memo items in the country-specific files.[104] The value of timber forests appear to be negligible in Germany, France, U.K., Italy, and Australia, and more significantly positive in the U.S. (6% of national income), Japan (15%) and Canada (25%). Australia has started reporting estimates of radio spectra but these appear to be negligible[105] and we do not attempt to upgrade other countries' balance sheets.

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detailed series are available (i.e., in the case of Australia and Canada), we include subsoil assets in book-value national wealth.

[103]In practice we did not make any correction to the Japanese and French data because subsoil assets are essentially 0. So we simply corrected the Australian data – i.e., removed subsoil assets from the government balance sheet to a memo column, see discussion below of Australian data.

[104]According to SNA guidelines, virgin forests should be recorded as "non-cultivated biological resources," (SNA 2008, 10.182 p.214) while for timber forests, trees should be recorded as inventories (work-in-progress) and the land underlying as land. However the conceptual difference between virgin and timber forests is somewhat obscure, so we report estimates for the overall value of forests.

[105]In 2011 radio spectrum were estimated to be worth A$8.8bn, i.e. less than 1% of national income.

A.2.3   Intangible capital

Contrary to a widely held view, national balance sheets do include estimates for intangible capital. Coverage is arguably imperfect, but it is expanding. In particular, a key development in the 2008 SNA was to include R&D as an asset, so that the balance sheets now cover – at least in principle – what is most commonly considered to be part of corporations' intangible capital.[106] There remains, however, some heterogeneity in recording practices.

R&D

The first and most important category of intangible capital is R&D. Up to the 1993 SNA, R&D expenditure used to be treated as intermediate consumption. With the 2008 SNA they are now counted as investment. At the time we conducted this research, all countries except Australia still applied the 1993 SNA. However, a number of countries, most prominently the U.S., had already started compiling satellite R&D accounts (see Lee and Schmidt, 2010 for results covering the 1959-2007 period) and were planning to include R&D in their main accounts. The OECD also publishes data on R&D expenditure in member countries.

There are two potentially relevant measures or R&D, depending on the question one is interested in: stocks of R&D including and excluding spillover effects, i.e. the benefits of R&D that spill over from the original investor to other actors.[107] From the viewpoint of SNA balance sheets, what matters is what R&D is worth for its owner, and so we focus on R&D stocks excluding spillovers.

According to BEA, U.S. gross investment in R&D is about 3% of GDP and this ratio has been roughly stable since the 1960s. This is a bit higher than the OECD average of about 2.5%.

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[106]See for instance Corrado, Hulten, and Sichel (2005, pp.24-25) for a classification and estimation of intangible capital in the U.S. Two borderline cases are firm-specific human capital (e.g., cost of developing workforce) and organizational structure, for which there is no consensus in scope. The SNA has always refused – rightly in our view – to include human capital in its balance sheets. As long as third-party markets do not exist for management innovation and intangible assets of the like, it seems justified to exclude them from the balance sheets.

[107]In the U.S., BEA presents data on R&D excluding spillovers and the BLS including spillovers (but BLS estimates are restricted to R&D of private firms, in contrast to BEA which includes estimates for government, universities, and other non-profit institutions).

Depreciation in the U.S. is estimated to be about 2% of national income so that net investment in R&D is barely 1%.[108] Net stocks of R&D are estimated to be worth about 15% of national income.[109]

Measuring R&D raises formidable difficulties, and R&D accounts are still in their infancy. Like other produced assets, R&D stocks are obtained by applying the perpetual inventory method, i.e. by cumulating constant dollar measures of research and development expenditures and by allowing for depreciation and other price changes. Many of the difficulties raised by the PIM discussed above are compounded when applied to R&D. Accounting for depreciation (Mead, 2007) and price changes (Copeland et al., 2007) is fraught with difficulties. R&D depreciation rates found in the literature range from 12% to 29% and it is certainly possible that currently published BEA estimates over-estimate depreciation. It is also likely that all R&D expenditure are not well identified yet, so that gross R&D flows may be understated. So in our view, one should probably see a 1% yearly net flow of R&D as a lower bound.

Given the many difficulties in estimating R&D and the lack of reliable data sources for most countries, we have not tried to systematically add R&D expenditure to saving flows in our database. However, when we decompose wealth accumulation between saving and capital gains effects, we provide a number of robustness checks by adding rough estimates for R&D to saving flows, on the basis of the U.S. data.[110] In the U.S., a 1% net flow of R&D cumulated over the 1970-2010 amounts to a R&D stock of about 20% of national income in 2010. We also explore scenarios in which the actual net flow of R&D is 2% of national income (which translates into a cumulated 1970-2010 flow of about 50% of national income in 2010), which would be closer

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[108]BEA also provides estimates of the "capital services" provided by the stocks of R&D to the government and non-profit sector. In 2007, these services, net of depreciation, were estimated to be worth about $50bn, i.e. less than 0.5% of national income. This means that if the net return on government (and non-profit) capital was to be included in national income (which is currently not the case) accounting for R&D would raise national income by an additional 0.5% (but saving would not be affected).

[109]In Australia, net stocks of R&D are estimated to be worth about 7-8% of national income.

[110]We have not attempted to use individual country data (say from the OECD science, technology, and industry dataset) because estimates of net-of-depreciation R&D flows are not available in most countries yet. Most countries in our sample appear to be relatively close to the U.S. gross level of R&D expenditure (about 2-3% of GDP), with the notable exceptions of Italy and Spain which seem to be closer to 1.5%.

to the truth if currently available U.S. data overstate depreciation or understate gross R&D expenditures.

Intellectual property products other than R&D

In addition to R&D, the 2008 SNA includes four other types of intellectual property products:[111] (i) expenditure on "mineral exploration and evaluation," (ii) "computer software and database," (iii) "entertainment, literary or artistic originals," and (iv) "other IP products."

All countries in our database have data for computer software.[112] However, no country except Australia covers yet mineral exploration, artistically originals and other IP products yet. In Australia, these assets appear to be almost negligible (about 5% of national income). Looking forward, the implementation of the 2008 SNA will probably mean significant improvements in this area, although the limitations of the PIM are often compounded when applied to intangibles.

Non-produced intangible capital

The last category of intangible capital consists of a number of "non-produced" intangible assets: on the one hand, contracts, leases, and licences;[113] on the other, goodwill and marketing assets (brand names, trademarks, logos and domain names, etc.). Note that the distinction between "produced" and "non-produced" intangible capital is particularly fuzzy. Marketing assets, for instance, are logically produced assets, but the SNA classified them as non produced (due to the difficulty in measuring their value).

The 2008 SNA includes specific guidelines as to which types of contracts, leases and licences should be counted as assets: only those that enable a party to benefit from an asset or service at advantageous conditions, i.e. "at a price that would differ from the price that would pre-

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[111]Intellectual property products" (AN.117) are defined as products that are "the result of research, development, investigation or innovation leading to knowledge that the developers can market or use to their own benefit in production because use of the knowledge is restricted by means of legal or other protection" (SNA 2008, 10.98).

[112]For instance, in the U.S. software is included in the balance sheet since the benchmark revision of the national accounts that took place in 1999. It should be noted however that the SNA does not impute a flow of services from stocks of software – which would raise the same estimation issues as for consumer durables.

[113]These include marketable operating leases, permits to use natural resources, permits to undertake specific activities, and entitlements to future goods.

vail in the absence of the contract, lease, or licence" (SNA 2008, 10.186). Examples include tenants who have fixed rentals but are practically able to sublet their building for a higher price ("marketable operating lease"),[114] licences to use radio spectra granted to mobile phone operators ("permits to use natural resources"),[115] taxi licences when they can be sold ("permit to undertake specific activities"), and publishers' exclusive rights to publish new works by a famous author ("entitlements to future goods and services").

Goodwill and marketing assets are not recorded for all corporations, but only when their value can be identified through market transactions, i.e. when they are purchased. That is, if a corporation is bought at a price that exceeds the value of its net assets, then in principle statisticians are supposed to record the difference as goodwill and marketing assets. At the time we conducted this research, only Italy did provide estimates of goodwill, and no country except Australia had data for contracts, leases and licences.

A.3 Financial assets and liabilities

In addition to tangible produced assets, natural resources, and intangible capital, financial assets and liabilities are the fourth broad category of wealth included in SNA balance sheets. They play a central role in this research, as gross financial wealth is typically about 50% of gross

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[114]When such leases are not marketable, they are to be excluded from assets. In the U.K., the ONS used to record a pretty large amount of "non-marketable tenancy rights", but these rights, since they are non-marketable, do not meet the SNA definition of an asset and so have been excluded from wealth in the official UK accounts since 2012 (we have also systematically excluded them from the series we report in our database, see U.K. section below).

[115]Note that in the case of mobile phones, the SNA makes a clear distinction between the spectrum, which constitutes a natural resource (a tangible, non-produced asset), and the license to use the spectrum, which constitutes a separate asset (intangible and non-produced). In general, however, what should exactly be included in "permits to use natural resources" is unclear. Take the case of government-owned fishing waters. The SNA recognizes that there are two options (SNA 2008, 17.333 sqq). The government can grant a fishing quota to the private sector for exploiting the assets during an extended period of time. In this case, a "permit to use natural resources" asset should be recorded. The government can also extend permissions to fish from one year to the next. In this case, no "permit" should be recorded in the balance sheet: the fishing waters are considered to be leased, and the government earns a flow of "rents on natural resources". Of course the frontier between the two situations is particularly fuzzy. As regards mineral resources, the SNA recommends to always record a flow of rents rather than a permit asset (SNA 2008, 17.340 sqq.). Permits to use natural resources were essentially created to account for mobile phone licences and in practice only cover this type of asset.

private wealth.[116] Financial assets and liabilities are typically compiled by central banks and then integrated in the overall balance sheet by the domestic statistical institute. In the U.S. for example, financial balance sheets are produced by the Federal Reserve Board, and then used by the Bureau of Economic Analysis for inclusion in the Integrated Macroeconomic Accounts. The financial positions of the various sectors of the economy are obtained by direct census-like methods, not by cumulating financial investment flows. Inputs include the balance sheets of individual financial institutions (banks, insurance companies, investment funds, etc.) as well as surveys of the off-balance sheets positions of banks (e.g., in order to establish the portfolio holdings of the household and corporate sectors).

Regarding pensions, pay-as-you-go, social security pension wealth is not recorded as assets – and rightfully so in our view. Including unfunded, social security pension wealth in the balance sheets would raise all sorts of difficulties. In particular, it would logically call for the inclusion of the net present value of all other public spendings and taxes. While doing so is certainly useful for some analytical purposes, such computations are inherently fragile, and for the purpose of this comparative research we prefer to retain a more standard notion of wealth.[117] Claims on private pension funds, however, are included in the balance sheets.[118] Note that while the value of private pension funds and life insurance reserves is counted as financial asset in the household sector balance sheet, the value of public pension funds reserves (if any) is counted as financial asset in the governement sector balance sheet.

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[116]In our database one can actually distinguish two groups of countries. In the U.S., U.K., and Canada, gross financial wealth / gross private wealth ratios fluctuate around 60% over the 1970-2010 period, while in Germany, France, Italy, and Australia , they fluctuate around 40%. Japan has transitioned from the latter group (34% in 1970) to the former (58% in 2010).

[117]Note that the 2008 SNA encourages to provide information on implicit liabilities of pay-as-you go social security pension systems in a satellite account.

[118]This is true whatever the nature of the funds – defined benefit or defined contribution. An asset (and a liability for the pension provider) must be recorded regardless of whether the employer has recorded any pension liability in its own balance sheet.

A.3.1 Valuation issues

While market values of financial assets can usually be readily observed, this it not always the case, and obtaining market-value approximations can sometimes prove difficult. There are three main issues. The first relates to shares in unlisted companies. The 1993 SNA recommended that unlisted shares should be estimated on the basis of the prices of listed companies with similar earnings and dividend history and prospects, with, if needed, a downward adjustment to account for inferior liquidity. The 2008 SNA provides somewhat less restrictive guidance; valuation can be based on recent transaction price, net asset value, price to earnings ratios, book values reported by enterprises with macrolevel adjustments, and so on (SNA 2008, 13.71). Practices, however, still differ across countries.

A second valuation issue arises for corporations such as public enterprises, the central bank, and partnerships, that do not issue shares. In this case, what is recorded in SNA balance sheets is an "other equity" line equal to the corporation's net assets (SNA 2008, 13.74).

Lastly, debt securities should always be valued at their current market prices (SNA 2008, 13.59). That is, a bond with a face value of 100 that trades for 70 should be recorded in the debtor's balance sheet as a liabilities of 70.[119] The market price is the one that matters because debtors usually have the possibility to buy-back their own bonds if they so wish. But while most countries in our sample follow market value accounting, the U.S. currently does not: bonds are recorded at par value.[120]

Measuring bonds at market value has the important advantage of making it impossible for governments to manipulate the recorded amounts of public debt. Under face value accounting rules, by contrast, a government can artificially drive down its indebtedness by systematically issuing bonds above par (e.g., bonds with face values of 100 that promise very high coupon payments, such that the market price of the bonds when initially sold is above 100). One also

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[119]Relatedly, although loans should be recorded in the balance sheets at nominal values, non-performing loans should be reported as a memo item at market values (SNA 2008, 13.67).

[120]Note also that in the European Union, public debt under the Maastricht treaty is also recorded at face value (but at market value in SNA balance sheets).

needs public debt series expressed at market prices to compute real returns on government debt (see Hall and Sargent, 2011, for such an exercise on U.S. data).[121]

In normal circumstances there is usually little difference between market and face values. In the U.S., the market/par ratio has always between 90% and 110% over the 1942-2010 period,[122] and so we found it unnecessary to correct the official BEA series.[123] However, in periods of crisis, market and par values can substantially differ. This was the case for a number of European countries in the 1920s-1930s and in the U.K. during Napoleonic wars. Market values can also be much below face values in countries with very poor records on debt commitment. Unfortunately, precisely estimating the total market value of government debt can be quite complicated when numerous types of government debts co-exist. The notion of market value is also problematic when a large chunk of the debt is not tradable, as was the case in 18th century France where a lot of the debt consisted in inalienable life annuities (Weir, 1989; Velde and Weir, 1992). Estimating market values, by contrast, is a fairly manageable task when the public debt takes the form of a single perpetual bond, as was basically the case in the U.K. during the second half of the 18th century and the entire 19th century.[124] In this case, a straightforward comparison of the nominal coupon interest rate (e.g., 3% in the U.K. between 1757 and 1888) with the actual yield (given by market quotes) is enough, provided the total quantity of bonds in circulation is known. We discuss the sources we use for the historical estimates of public debt in the individual

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[121]Interest payment series, in particular are insufficient, because the government can always artificially drive down to 0 its flow of interest payments by issuing and perpetually rolling over zero-coupon bonds. Consider the following example: the government issues a $100 par value zero-coupon 10 year bonds, i.e. promises to pay $100 in 10 years and 0 interest in the meantime. Assuming a constant 4% interest rate r, the price of the bond on the market when issued is $100 \times (1+r)^{-10}$, i.e. 67.5. One year after, the market price of the bond is $100 \times (1+r)^{-9}$, i.e. 70.2. The government re-purchases the bond at a price of 70.2, bondholders make a capital gain of 2.7 and no interest is formally paid. The government then issues a new 10-years 0 coupon bond, etc.

[122]To compute this ratio we use Cox and Hirschhorn (1983) who provide market values for government bonds for 1942-1980, and the subsequent update of this work conducted at the Dallas Fed (which was published on the Dallas Fed website until 2012 but did not appear to be available online anymore in April 2013). See Hall and Sargent (2011, p. 199) for references on the other attempts at measuring the market value of U.S. federal debt.

[123]One practical difficulty with using market values is the lack of estimates for State and local government debt.

[124]In 1752, all U.K. government bonds were consolidated in a single perpetual bond, the consol. The original interest was 3.5%, later reduced to 3% (in 1757), 2.75% (in 1888, Goeschen's conversion) and 2.5% (in 1903).

country appendices devoted to the U.S., U.K., France, and Germany.

A.3.2 Central bank balance sheets

Although their output is primarily non-market, in national accounts central banks are not included in general government but in the financial corporation sector. They are treated as public financial companies controlled by government. They make profits, because they pay less on their liabilities than on their assets (seignorage income), which they fully remit to governments in the form of dividends. The control exercised by the government on the central bank is reflected in an "other equity" asset in the government's balance sheet.[125] How this "other equity" should be valued is largely a matter of convention, since the central bank is not a typical for-profit company whose shares can be traded. The SNA indicates that the central bank's equity should be set equal to its net assets, i.e. the difference between its total holdings (foreign exchange reserves, domestic bonds, etc.) and its non-equity liabilities (banknotes, deposits held by commercial banks, etc.).

If bonds are recorded at book value, the central bank's net assets are typically very small and largely invariant to the scale of its operations: if a central bank wants to increase its assets by $X, it also has to create $X in new liabilities,[126] leaving its net assets (hence government gross and net wealth) constant. This is true whatever the nature of the central bank's assets, i.e. even if it mostly holds foreign claims.[127] Net assets will temporarily vary in the unlikely event where

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[125]The U.S. is an exception: the shares of the Federal Reserve Banks are not held by the government but by the 3,000 or so private banks which are members of the Federal Reserve System (all national banks have to be member while state banks are free to join). Holding shares of a Federal Reserve Bank is a condition for being part of the System. However, these shares do not carry with them any control right or claim on profits: shareholders are given a 6% dividend and all profits are paid to the Treasury. See Board of Governor of the Federal System, "The Federal System: Purposes and Functions", 9th edition, June 2005, p.12, available online at http://www.federalreserve.gov/pf/pdf/pf_complete.pdf.

[126]The central bank has two different types of liabilities: (i) monetary liabilities, such as banknotes, that do not pay interest but provide some services (e.g., means of payments); (ii) non-monetary liabilities, such as fixed term deposits, that pay some return attractive enough for banks to hold them. When the central bank finances its asset purchases by increasing its non-monetary liabilities (which is typically what has occurred since 2008-200), the expansion of the balance sheet is sometimes said to be "sterilized". But since the central bank commits to exchanging deposits for banknotes upon request, increasing the monetary or non-monetary liabilities eventually has the same inflation implications. See Reis (2013) for an analysis of central banks' balance sheets.

[127]In China for example, the PBOC had about 20 trillion yuans in foreign assets (about US$3,200bn) at end

the central bank realizes losses on its holdings. In principle, one can imagine losses high enough such that the central bank's net assets become temporarily negative, i.e. the central bank is technically insolvent. This does not raise any particular issue, however: since the central bank makes profits from seigniorage, it can always build up its equity capital by stoping dividend payments to the Treasury for some time, until its net assets recover.[128]

If assets are recorded at market value, as the SNA indicates they should, then the central bank's net assets vary from year-to-year along with the market valuation of its bond holdings. In practice, most countries appear uneasy with the idea of recording sizable fluctuations and potentially negative value for the central bank's equity. Consequently they chose to keep recorded central bank equities fixed at their book value, i.e. at the amount of capital paid up by the shareholders.[129] So for instance the Fed's equity capital in U.S. balance sheets is equal to the capital paid up by the Federal Reserve System member banks, which totaled about \$25bn in 2010.[130] The same goes in Japan, where the BoJ is valued at a mere 100 million yens (about

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2011, but about the same in liabilities (reserve deposits, bonds, and other). The PBOC, like any central bank, can directly purchase foreign assets if it so wishes, but it has to give foreigners newly created yuans or deposits in exchange. In practice the PBOC purchases dollar assets from the banks of Chinese exporting firms (which have plenty), and gives them deposits in exchange (so that the PBOC liabilities belong to residents, not foreigners). In effect, there is a transfer of foreign claims from the corporate sector to the central bank in order to enable the PBOC to implement its exchange rate policy. The central bank attempts to "sterilize" the inflationary consequences of the increase in Chinese bank assets by offering them bonds and fixed term deposits in exchange of their dollars, rather than currency and liquid deposits. Other countries where the central bank monopolizes a large fraction of the country's foreign assets in order to control the exchange rate – prompting fears of "currency wars" – include Switzerland and Japan. In Switzerland, the foreign claims of the SNB increased from 15% of GDP in 2008 to more than 50% in 2011, as the SNB committed to maintaining a floor on the Swiss franc/euro exchange rate. At the same time, Swiss corporations' net foreign assets decreased and their claims on the SNB increased, so that the overall net foreign assets of Switzerland and net worth of the SNB remained roughly unchanged. In Japan, official reserve assets are not held by the central bank but by the Ministry of Finance, which is part of general government, but the mechanisms are the same (the Bank of Japan acts as agent for the government and is not independent in this respect).

[128]It can also ask the government to recapitalize it, which will happen automatically if the dividend rule is such that the dividend payment is always equal to net central bank profit, be it positive or negative. See Hall and Reis (2013) for an analysis of central banks' dividend rule payments.

[129]Note that this can be done while maintaining market valuation of assets by adding in the liability side of the balance sheet a line equal to the unrealized capital gains/losses on the central bank's portfolio (so that losses show as negative liabilities). This is what the ECB does: its equity capital is basically fixed (it only increases when new central banks join the Eurosystem or the EU), and unrealized trading losses/gains appear as "revaluation accounts" in the ECB balance sheet.

[130]In the balance sheet, the Fed's assets are also at book value. Equity only increases when new capital is

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1 million US dollars) and in the U.K., where the BoE capital has been worth £14.6 million for centuries. In France, by contrast, the equity of the Bank of France seems to reflect the difference between the market value of its assets and its liabilities, consistent with SNA guidelines.[131] More harmonization would be desirable in this area. An alternative way to measure the central bank's equity would be to take the present discounted value of seignorage income. Practically this would not make a lot of difference with currently recorded values, but it would probably be somewhat more consistent.[132]

A.4 Private and national wealth and capital

A.4.1 Definition of private and government wealth

There are four domestic sectors in the SNA: households, non-profit institutions serving households (NPISH), corporations, and the general government. In the balance sheets, each sector has a net wealth equal to its non financial assets plus financial assets minus liabilities.[133]

In this research, we define private wealth as the net wealth of the households and NPISH sectors. In addition to individuals, the households sector includes most unincorporated enterprises.[134] The NPISH sector includes all non-profit institutions that are neither controlled by

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paid up by member banks. Earnings accumulated by the Fed but not yet paid to Treasury are recorded in the liability side of the Fed's balance sheet as "interest on Federal Reserve notes due to the U.S. Treasury." If the Fed makes operating losses (e.g., in case it realizes losses on its portfolio), the equity capital of the Fed does not decrease, but the Fed records negative "interest on Federal Reserve notes due to the U.S. Treasury" and dividends payments are stopped until the losses are offset. See Carpenter et al. (2013, p. 11).

[131]Bank of France equity was worth about $100bn euros in 2010 (5% of national income). From 1994 to 2007 it was worth 30-40bn, then 65bn in 2009 and 91bn in 2010. This increase explains the increase in the "other equity" assets of the general government, from about 100bn before the crisis to 160bn in 2011.

[132]Before the crisis, Fed dividend payments to the U.S. Treasury amounted to $20-30bn per year. They increased to about 80bn during the crisis, but are projected to diminish in the years ahead, and come back to about 30bn around 2020 (Carpenter et al., 2013). Capitalized at 5%, this would put the Fed's equity at about $600bn, i.e. about 5% of national income – which is comparable to the currently recorded "market" value of the Bank of France.

[133]By convention, in SNA balance sheets equities are included in liabilities; so unless we specifically mention otherwise, the term "liabilities" must be understood including equities. The corporate sector is always broken down between nonfinancial and financial corporations, but for simplicity we report results that aggregate both types of companies. Detailed separate series are available in the Excel files.

[134]Specifically, it includes all unincorporated enterprises owned by households except those that have sufficiently detailed accounts and behave in the same way as corporations, which are in the corporate sector ("quasi-corporations"). In practice, the frontier between quasi-corporation and other unincorporated enterprises is hard

government nor market producers. It therefore excludes institutions like private hospitals and schools that charge fees high enough to cover the majority of their production costs – those are market producers and thus part of the corporate sector.[135] The frontier between households and NPISH is often blurred, and we see this fact as one key argument for including NPISH in private rather than government wealth. For instance, when charitable givings are tax deductible and foundations are laxly regulated there are incentives for wealthy individuals to create shell foundations to shelter assets and avoid taxes (see Landais and Fack, 2011). In this case including NPISH with households is clearly the right thing to do.[136] From a more practical point of view, it is also the right thing to do for the purpose of our comparative research because in some countries NPISH are not isolated as a separate sector but indistinguishably included with households. Overall, NPISH net wealth is usually small, and always less than 10% of private wealth: about 7% in the U.S., 4% in Japan, 1% in France.

Next, we define government wealth as the net wealth of the general government sector, which includes central, state, and local governments, as well as social security administrations. Government units that are engaged in market production and keep a complete set of separate

to draw, and a number of "quasi-corporations" are probably not recorded as such. Differences in the recording of quasi-corporations is problematic since it can affect the comparison of the structure of production across countries, the computation of labor and capital shares, and the analysis of the structure of household wealth. Take for instance an unincorporated enterprise that has 100 in nonfinancial assets, and 0 in financial assets and liabilities. If it is recorded as a quasi-corporation, the household sector will have 100 in equity assets, otherwise it will have 100 in nonfinancial assets. For our purposes in this research, however, such problems are largely irrelevant.

[135]In the SNA, the key criterion to determine whether a unit belongs to the corporate sector is whether the unit is a market producer or not. A market producer is an entity that offers the majority of its production at "economically significant prices," which usually means that sales cover more than half the costs.

[136]Note that while foundations are to be included in the non-profit sector, family trusts, which are also a common vehicle for avoiding taxes, are to be treated as quasi-corporations (SNA, 2008, 24.75). That is, trusts are in principle financial companies, and households are supposed to own equities equal to the net worth of the trusts they own. Given that a great number of trusts are set up in offshore tax havens, this means that U.S. and U.K. statisticians should record a sizable amount of foreign "other equity" on the asset side of the household sector balance sheet (even though the trusts may mostly own domestic assets). What happens in practice is a bit unclear. Even if statisticians correctly identify the assets of the trust (e.g., because the trust uses a domestic bank for the custody of its portfolio), they might still fail to record an asset for household sector (e.g., if they fail to recognize that the trust is owned by a wealthy family) and too little household wealth would tend to be recorded. And of course if the assets of the trust itself are not captured (e.g., because they are deposited with an offshore custodian) then the nation's financial assets are under-estimated (Zucman, 2013).

accounts are not in general government but in the corporate sector – which of course includes all government-controlled companies. The SNA isolates public from private corporations, but not all countries provide this breakdown.

From these definitions of private and national wealth, we consider two measures of national wealth.

A.4.2   Corporate wealth and the two measures of national wealth

The first measure, what we call "market value national wealth", simply sums private and government wealth. The capital stock of corporations is included in national wealth through the equity holdings of households and the government.

The second measure, what we call "book-value national wealth", sums all the nonfinancial assets (produced tangible capital, non-produced tangible capital, and intangible capital) of all domestic sectors and adds the net foreign asset position. This total is what is sometimes referred to as "national wealth" in the SNA (2008, 13.4) or as the "net worth of the total economy" (ESA 1995, 8.99). By definition, book-value national wealth is also equal to market-value national plus the net wealth of the corporate sector. So the two measures coincide when the net wealth of the corporate sector is zero, or, equivalently, when Tobin's Q is equal to 1.[137]

In 2010, net corporate wealth is close to 0 in the the anglo-saxon countries included in our dataset (U.S., U.K., Canada, and Australia) so using market or book-value national wealth does not make much difference. U.S. national wealth, for example, is 431% of national income if we use the concept of market value national wealth, and 445% if we use the concept of book-value – that is, net corporate wealth is only 14% of national income, and Tobin's Q is equal to 0.98. Most of the time, however, net corporate wealth significantly differs from zero. In Japan, Germany, and France, it is about +150% of national income today. In the anglo-saxon countries it was also significantly positive before the 1990s. In the 1970s, for instance, net corporate wealth

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[137]Tobin's Q is traditionally defined as: (market value of equities + non-equity liabilities) / (total assets). Another ratio sometimes used and that we report in our country files is Tobin's "equity" Q: (market value of equities) / (total assets - non equity liabilities).

was about 54% of national income in the U.S., and as high as 128% of national income in the U.K. – just like in Japan and Germany. As a result, when one uses book-value rather than market-value national wealth, then the national wealth-income ratio is (i) consistently higher in Japan, Germany, and France over the 1970-2010 period; (ii) initially higher in anglo-saxon countries but increases less over time.

What is the most appropriate measure of national wealth? We certainly do not pretend to have a definitive answer to this difficult question, and that is why whenever possible we provide all our results on 1970-2010 wealth accumulation using the two definitions.

From a historical perspective, however, we tend to have a preference for market-value national wealth, because it is a concept closer to the one used by the economists of the 18th, 19th, and early 20th centuries. Historical estimates of national wealth were indeed largely based upon censuses of wealth at market value rather than perpetual inventory method-based estimates of tangible assets. Market-value national wealth is also closer to the concept of wealth that one finds in tax returns, since taxpayers are typically supposed to declare the market value of their holdings in the estate and other wealth taxes. So if one is interested in comparing wealth in national accounts with wealth in tax returns (e.g., to estimate the flow of inherited wealth, as in Piketty, 2011) then using market-value national wealth seems preferable.

From a relative reliability perspective, if the equity values recorded in the balance sheets are a better measure of the value of corporations' nonfinancial assets than statistician's direct estimates based on the perpetual inventory method, then using the concept of market-value national wealth is also more justified. In practice, both nonfinancial assets and equity value data have pitfalls, but after a careful examination of the strength and weaknesses of available balance sheets, we have come to the conclusion that nonfinancial assets data are probably somewhat more fragile. The main reason is that corporate tangible assets seem to be systematically over-estimated in national balance sheets.

Quite puzzlingly, indeed, in national accounts Tobin's Q appear to be less than 1 most of the time. On average over the 1970-2010 period, it has been less than 1 everywhere. In

Japan, Germany and France, Tobin's Q has been less than 1 every single year over the last 40 years, and although in the anglo-saxon countries it has at times exceeded 1 (during equity stock market booms), it appears to have a tendency to revert below unity. This is puzzling for two reasons: first, macro theory would suggest that Tobin's Q should revert to unity, or even above 1, since intangible capital is imperfectly captured in the balance sheets; second, micro studies consistently find Tobin's Q higher than 1. Although numerous factors are at play, it is likely that these two puzzles owe in part to some over-estimation of corporate tangible assets in national accounts.

A.4.3 Why is Tobin's Q generally less than 1?

The main reason why corporate tangible assets may be over-estimated in the balance sheets is that the data are based on the perpetual inventory method which, as acknowledged by statisticians, suffers from a number of deficiencies. As discussed above in more details, there are three potentially serious issues. First, it is often difficult to properly discard the assets of firms going out of business, and for that reason too much capital may tend to be recorded. Second, it is notoriously difficult to track the price evolution of a number of capital goods. When statisticians fail to properly account for quality improvement, inflation is over-stated and capital stocks at current prices are also over-stated (old computers are included in the capital stock at too high a price). The bias can be large, as Gordon (1990) argued. Lastly, accounting for depreciation is fraught with difficulties, and depreciation might be under-estimated in national accounts (Wright, 2004).

The corporate tangible overpricing story is consistent with the fact that micro studies consistently find Tobin's Q higher than 1. Fernandes et al. (2013, Table 2), for example, find Tobin's Q around 2 in the U.S. and 1.75 in other countries (with the lowest ratio in Italy, 1.44).[138]

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[138]Data cover 90% of the market capitalization of publicly traded firms in 14 countries and are for 2006 (a higher when stock markets were relatively high). They use the standard definition of Tobin's average Q: (market value of equities + non-equity liabilities) / (total assets). Corporate assets include cash, financial investments, loans, investment in unconsolidated subsidiaries, customer liabilities, real estate, property, plant and equipment, other assets; they seem to exclude intangible capital.

Micro estimates of the corporate capital stock do not face the problem of accounting for the assets of firms going out of business. It is likely, however, that contrary to national balance sheets, corporate accounts somewhat under-estimate tangible assets, so that the true Tobin's Q probably lies somewhere between macro and micro estimates. First, tax rules typically allow for more generous depreciation allowances, and corporations have an incentive to further over-state depreciation in order to pay less in corporate income tax. That is why in general depreciation computed in the national accounts differs from depreciation reported by corporations for tax purposes.[139] Second, assets are usually recorded at book-value in private accounts – i.e., at the price at which they were bought, rather than at current market prices. So while national accounts may have a tendency to over-state investment goods inflation, private accounts have a tendency to under-state it. Third, many micro estimates do not account for intangible capital at all, while national balance sheets increasing try to do so, at least partly.

The main competing explanation as to why Tobin's Q seems to be less than 1 most of the time in macro data is that the equity values recorded in the balance sheets may be in some sense too low.

First, many equities are not listed. Putting a price on unquoted shares is a highly complicated and uncertain business, and statisticians often have to rely on ad-hoc techniques. So it is entirely possible that the value of the shares in closely held firms are under-stated in some countries and time periods. The SNA states that the equities held by governments in public corporations must be set equal to the corporations' net assets – that is, Tobin's Q is in principle equal to 1 for public companies in national accounts (SNA 2008, 13.74). However, some countries such as the U.K. have not been following this principle and used to put too low values on government's stakes in public companies. This might explain why some countries have recorded very low Tobin's Q in the 1970s and 1980s.

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[139]In the U.S., the NIPA Table 7.13 provides a reconciliation between depreciation reported to the IRS and recorded in the national accounts. On average over the 1970-2010 period, depreciation in tax returns has slightly exceeded depreciation in national accounts (by about 1% on average). Interestingly, however, since the mid-2000s depreciation is much higher in the national accounts than in corporate tax returns, in contrast to the 1980s, 1990s and early 2000s.

A more fundamental reason as to why equity values may tend to be less than the net assets of corporations is the control rights valuation story discussed by Piketty (2010, Appendix A, pp. 34-35). Equity market prices reflect marginal transactions. But investors who wish to take control of a corporation typically have to pay a large premium to obtain majority ownership. This mechanism might explain why Tobin's Q tends to be structurally below 1. It can also provide an explanation for some of the cross-country variation that we observe in our dataset: the higher Tobin's Q in anglo-saxon countries might be related to the fact that shareholders have more control on corporations than in Germany, France, and Japan. This would be consistent with the results of Gompers, Ishii and Metrick (2003), who find that firms with stronger shareholders rights have higher Tobin's Q. Relatedly, the control rights valuation story may explain part of the rising trend in Tobin's Q in rich countries.

As we explain in the paper, the "control right" or "stakeholder" view of the firm can in principle explain why the market value of corporations is particularly low in Germany (where worker representatives have voting rights in corporate boards without any equity stake in the company). According to this "stakeholder" view of the firm, the market value of corporations can be interpreted as the value for the owner, while the book value can be interpreted as the value for all stakeholders. In this sense, both definitions have some merit and should be viewed as complementary: they measure the value of corporate wealth from the viewpoint of different agents. However we should again stress that there are many other – less fundamental – reasons why market and book values differ in practice, and why book values might be abnormally high. It would be highly valuable in future research to make progress on these issues and to attempt to isolate the pure "control right" and "stakeholder" of Tobin's Q. This is far beyond the scope of the present paper.

A.4.4 Foreign wealth and domestic capital

From national wealth (at market-value or book value), we construct domestic capital by subtracting the net foreign asset position.

Foreign assets and liabilities are recorded in two different places in the macro accounts of countries: in SNA balance sheets (liabilities and assets of the rest of the world sector) and in the international investment position (IIP). The IIP, like the balance of payments, relies on accounting concepts that have traditionally slightly differed from those used in the SNA, but there is an ongoing effort to harmonize both sets of statistics. The 2008 SNA and the 6th edition of the IMF Balance of Payments Manual have in particular fully harmonized both the coverage and accounting rules. Classification still differs, as the IIP uses functional categories (portfolio investments, direct investments, etc.) while the SNA uses instrument categories (equities, bonds, deposits, etc.). And in practice there are still at times some inconsistencies between the data reported in the IIP and in SNA balance sheets. In the country-specific Sections below we explain how we have dealt with these discrepancies.

A.4.5 Comparisons with previous estimates of domestic capital stocks

Our measure of domestic capital based on balance sheet data, K (national wealth W_n minus net foreign assets NFA), differs from previously available estimates obtained by the perpetual inventory method (PIM). Here we explain the sources of the discrepancy, we provide a detailed reconciliation for the U.S. case, and we argue that our measure has a number of advantages.

Generally speaking, there are three main reasons why our measure of domestic capital K computed from balance sheets differs from the traditionally used series on net domestic stocks of fixed assets.

First, real estate is valued differently. In country balance sheets, real estate is measured at its current market value, using censuses and observed market prices. By contrast, fixed assets only include the value of "structures", and this value is obtained indirectly by cumulating past investment flows and attempting to adjust for the change in the relative price of construction. The resulting estimate is typically lower than the one recorded in balance sheets.

Second, there are differences in the valuation of corporate capital stocks. In PIM estimates, corporate capital is measured "at book value", by cumulating past corporate investment flows

and attempting to adjust for the change in the relative price of equipment and structures. By contrast, in our benchmark measure of wealth ("market-value national wealth") we look at corporations' market values (as reflected in equity market prices). Because market-to-book Tobin's Q ratios are generally below 1 (see section A.4.2 and A.4.3 above), our measure of market-value corporate capital is usually smaller than that obtained by the PIM (although there are exceptions, e.g., in the U.S. Tobin's Q has tended to be above 1 since the mid-1990s).

Third, inventories and valuables are included in the balance sheets, following international guidelines, but they are not fixed assets.

So for instance, in the U.S. the Bureau of Economic Analysis reports that at end-2012 the current stock of net domestic fixed assets (based on the PIM) amounts to 355% of net domestic output Y_d, excluding consumer durables.[140] This figure includes the total estimated net current cost of domestic structures (residential and non-residential), equipment, and intellectual property products. Corporate fixed assets amount to an estimated 112% of net domestic output, government fixed assets to 91% and private non-corporate sectors (households, non-profits and non-corporate businesses) account for the remaining 152%.

A domestic capital to output ratio of 355% is less than the capital-output ratio β_k of 484% one can compute from Flow of Funds balance sheets (and from the BEA's integrated macroeconomic accounts, that rely on the Flow of Funds balance sheets for wealth; see our discussion of U.S. data in Appendix B below). There is a gap of the equivalent of 129% of domestic output. The gap can be decomposed as follows:

- Domestic real estate is worth 76% of output more in the Flow of Funds balance sheets than in fixed assets series. The gap includes the value of land underlying structures (which is included in the balance sheets but not in fixed assets). It also includes all cumulated price changes in the market value of real estate that cannot be attributed to changes in construction costs and the price of land.

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[140]See BEA fixed assets accounts, http://www.bea.gov/iTable/index_FA.cfm, Table 1.1, line 2, data last revised on September 30, 2013.

- In the balance sheets, corporate capital is worth 36% of output more than corporate fixed assets and inventories.[141]

- Inventories are worth 17% of domestic output (valuables are not measured yet in the U.S. balance sheets).

As we argue in the paper and in this Data Appendix (see in particular section A.1 above), measures of domestic capital obtained through balance sheets have a number of advantages over perpetual-inventory method fixed assets series. Balance sheets include non-produced assets such as land, which cannot be captured by cumulated past investment flows. Equity market prices capture capture the value of intangible capital, contrary to traditional PIM estimates.[142] As we have seen in Section A.1.2, PIM-fixed assets series also have a tendency to over-estimate corporate capital stock, because assets of firms going out of business continue to be counted in the capital stock until their estimated depreciation reaches 100%, and the price estimates used to compute the current-cost value of fixed assets raise numerous issues (aggregation bias, quality improvement, etc.) that can lead to large errors in the long run.

A.5 Definition and measurement of saving flows

A.5.1 What we include in saving

In addition to wealth and capital stock data, the main ingredient needed to estimate the capital accumulation equations is of course saving data.

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[141]Note, however, that this depends on how one computes corporate capital in the balance sheets. Corporations net worth (that is, corporate fixed assets and inventories plus corporate financial assets, minus corporate liabilities and corporate equities at market value) is actually negative: by that metric, Tobin's Q is less than 1 in 2012. But there is an inconsistency in the Flow of Funds balance sheets (and BEA's integrated macro accounts): the sum of all net financial claims of all domestic sectors is positive, despite the fact that the U.S. has a negative net foreign asset position. There are two much financial assets recorded (or too little liabilities) in the Flow of Funds. It is likely that this discrepancy comes from errors in the accounting of liabilities in the corporate sector. If one attributes 100% of the error to the corporate sector, then Tobin's Q is actually positive in 2012 – corporate equities are worth more than the value of corporate non-financial assets plus net financial claims. Note that the U.S. is the only country in our sample for which there is a discrepancy between total domestic net financial claims and the net foreign asset position.

[142]However, progress is being made in this area, as R and D expenditure are starting being treated as investment (rather than consumption). BEA fixed assets statistics now include intellectual property products. However, this is only part of corporations? intangible capital (see our discussion in Section A.2.3).

Our saving series directly come from counties' national accounts, and we follow the SNA guidelines in determining what is to be included in saving and what is not. The guidelines are consistent at the flow and stock levels. So in particular, consumer durables are not treated as investment since they are not assets; contributions to social security pay-as-you go pension schemes are not counted as saving, but contributions to private pension funds are. We always measure saving net-of-depreciation, since wealth is also net-of-depreciation in the balance sheets.

We add net capital transfers to reported saving flows. The main capital transfers are capital taxes (D91 in ESA95 classification) and investment grants (D92). In both cases, including net capital transfers in saving is justified, because these transfers add (or subtract) to the amount of resources that can be used to accumulate wealth. Capital taxes are mostly estate and gift taxes received by the government and paid by households. Failure to subtract them from private saving would lead us to over-estimate the personal saving flow (hence record slightly too low residual capital gains), and under-estimate the government saving flow. Investment grants are mostly paid out by the government and received by corporations. Again, they help corporations accumulate capital, so including them in corporate saving is justified. A third category of capital transfers, "other capital transfers" (D99), includes cases in which the ownership of an asset is transferred from one sector to the other, and debt cancelled by mutual agreement between the creditor and the debtor. We also include them in our concept of saving for simplicity – an alternative would have been to include them in "other volume changes" (see discussion below), but practically this does not make any noticeable difference.[143]

Since we are interested in estimating the relative importance of capital gains and saving flows, we do not include any identified capital gain in our measure of saving. For some questions, it might make sense to include some form of capital gains in saving flows. Auerbach (1985), for example, argues that capital gains should conceptually be included if an asset has become

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[143]The SNA makes a subtle distinction between debt debt cancellation by mutual agreement (which is to be recorded as a capital transfer) and debt write-off (which is to be included in other volume changes). Debt cancellations seems to mostly concern international debts (e.g., cancellation of poor countries external debt), but the distinction made in the SNA is quite obscure to us.

more productive, because in this case the capital gain reflects a gain in future production, but should not be included if the price change results for instance from a shift in tastes (e.g., change in the rate of time preference or risk aversion that affects the price of land). Practically, however, identifying the source of capital gains is fraught with difficulties, and in this research we do not attempt to make such distinction. Note, however, that in principle we would like to include in saving flows all those capital gains those are caused by the imperfect measurement of saving and investment (e.g., un-measured investment in intangibles). We cannot do this in our baseline decompositions that rely on published saving and investment series, but when we decompose wealth accumulation we provide a number of supplementary results in which we add rough estimates for the amount of unmeasured saving and investment, in order to check the robustness of our findings.

Lastly, we measure saving in nominal terms. That is, if the flow of national saving is 10 and national income 100, the national saving rate of 10%, whatever the inflation rate. For some purposes (e.g., if one is interested in understanding the determinants of personal saving rates), it is better to measure saving in real terms (see Gale and Sabelhaus 1999 pp. 187-188 and the reference therein). The decrease in personal saving from the 1970s to the 1990s, in particular, may partly owe to the drop in inflation. For our wealth decomposition analysis, however, nominal saving is the correct concept, since our key objective is precisely to estimate the role of capital gains and losses in wealth accumulation.

A.5.2 How we account for R&D

As explained in Section A.2.3., in the 2008 SNA R&D is to be included in saving flows. However, only Australia so far applies the 2008 SNA. In our baseline decompositions results, therefore, we use saving flows that exclude R&D. But we also provide a number of supplementary results that include rough estimates of R&D expenditure in saving.

In particular, in Tables A99 and A104, we decompose the increase of national and private wealth-national income ratios under a number of scenarios on the amount of R&D expenditure.

In the U.S., the BEA reports that cumulated 1970-2010 net R&D expenditure have amounted to about 20% of national income. Given the limitations in the measurement of R&D discussed above, we see this as an extreme lower bound. Under this lower bound scenario, the share of the increase in the national wealth-income ratio in rich countries that can be attributed to saving is about 40-50% on average, and the share of capital gains about 50%-60%.[144] If we now make generous allowance for R&D – cumulated expenditure worth about 50% of 2010 national income on average in rich countries – then the fraction of the increase of the national wealth-income ratio explained by saving is a bit higher than 60% on average, with significant heterogeneity across countries.

We should stress that these computations are merely illustrative. We have not attempted to take into account differences in R&D spending across countries, nor potential trends over the 1970-2010 period. Our point is simply that with reasonable allowance made for R&D, saving explain a large fraction of the 1970-2010 increase of the national wealth-income ratio – at least 40%, and more probably around 60% on average. The average order of magnitude is robust to any plausible assumption (in light of available evidence) one can make on R&D. Conversely, whatever the exact amount of R&D spending in rich countries, we find that capital gains (not caused by R&D) explain on average a non-trivial fraction of the rise in wealth-income ratios over the 1970-2010 (at most 60%, and more likely around 40%). Looking forward, the systematic inclusion of R&D expenditures in saving will make it possible to better isolate the exact role they play in the accumulation of wealth in rich countries.

A.5.3 Other volume changes

The accounting framework presented in the paper isolates two sources of changes in wealth only: saving and capital gains. National accounts isolate a third source: "other volume changes". Other volume changes capture the effects of war destructions, disaster losses, and the discovery of new assets (e.g., subsoil resources) – and more generally of all changes in wealth that cannot

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[144]This can be seen in Table A99 by changing the R&D assumption to 20% for instance for the additive decomposition.

readily be accounted neither by investment nor by identifiable valuation effects.

Other volume changes also include the effects of reclassifications across sectors or instruments, as well as the statistical discrepancy that exists between the two available measures of financial saving in the national accounts: that originating from real accounts (i.e., basically income minus consumption minus fixed capital formation) and the one that originates from financial accounts (the increase in financial claims as reported by financial companies).[145] All of this sounds innocuous enough, but other volume changes can play a substantial role in the wealth accumulation of some countries, especially for some sectors of the economy where measurement issues are important, such as the foreign sector.[146] They can be quite large: in the U.S., for instance, on average total other volume changes have been +0.4% per year over 1946-2010.[147] So we have paid close attention to them in our analysis.

In the SNA, other volume changes are presented in the accounts that attempt to reconcile the flow side of national accounts (saving) with the stock side (wealth). Those accounts have two parts: "other volume changes" and "revaluation" (i.e., capital gains and losses). Not all countries publish such reconciliation accounts, but for the countries that do, we provide in the country-specific files detailed decompositions of wealth accumulation that isolate saving, capital gains/losses, and other volume changes. By construction, by doing so the capital gains that we compute as a residual are exactly equal to the capital gains/losses series published in the official "revaluation" accounts. When we summarize our results (e.g., in the main text of the working paper), unless otherwise noted we include other volume changes with saving flows – so that in effect those flows measure all identifiable volume changes, either coming from saving or from other sources.

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[145]This statistical discrepancy is the analogue of the "net error and omissions" line in balance of payments, i.e. the difference between the current and capital account balances (foreign saving from the real side) and the financial account balance (foreign saving from the financial side).

[146]Other volume changes, for instance, are at the heart of the debate on the exact magnitude of the "exorbitant privilege" that the U.S. enjoys by being able to earn higher total returns on its assets than on its liabilities. See Gourinchas and Rey (2007) and Curcuru, Dvorak and Warnock (2008).

[147]The bulk of those come from the statistical discrepancy between the two measures of saving (+0.3%), the rest (discovery of new assets, etc.) accounts for +0.1% per year on average over 1946-2010.

A.6 Price deflators

Wealth-income ratios do not rely in any way on price indexes: the wealth-income ratio β_t is simply the ratio of nominal wealth in year t by nominal income in year t. But to compute real growth rates and to decompose wealth accumulation between a volume component and a real capital gains component, one needs price indexes.[148] What is the best price index to use is a complicated question for which we do not claim to have a definitive answer. Ultimately for the purpose of this comparative research we chose to retain the GDP deflator, because it is the one price index for which cross-country harmonization and statistical progress have been more important.

Remember that there are three key issues in the comparison of prices over time: How to account for new goods, such as the iPhone (the "new goods bias")? How to deal with quality improvements (the "quality bias")? And how to account for the fact that consumer choices change when prices change (the "substitution bias")? The consumer price indexes and GDP deflators of most countries have both done a great deal of progress in addressing the new goods bias and the quality bias. Regarding the substitution bias, however, progress has been faster for the GDP deflator. The standard way to address the substation bias is to use chain-weighting techniques. Under the impetus of the OECD, chain-weighting has been generalized for the GDP deflator, but it is still not used everywhere for the CPI.

As we document in our database, the GDP deflator and CPI usually evolve similarly in the medium and long-run, but in the short run the discrepancy can be sizable. It is useful to keep in mind that there are four broad reasons as to why the evolution of the GDP deflator and the CPI can differ:

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[148]To compute decennial averages of wealth-income ratios, price deflators can matter a little bit. There are three different methods to compute decennial averages of wealth-income ratios $\beta = W/Y$. First we can take the average of the annual $\beta = W/Y$; second we can divide decennial averages of W and Y expressed in 2010 values; third we can divide decennial averages of W and Y expressed in current values. The three definitions yield almost identical estimates when there is limited inflation, but there can be non-trivial gaps during war and high inflation decades. To avoid the issue, in this research decennial averages of wealth-income ratios are always computed, unless otherwise noted, by taking the average of the annual ratios.

(i) *Terms of trade effects*: when the price of imports grows more than the price of domestically-produced goods (e.g., during oil shocks), the CPI increases more than the GDP deflator.

(ii) *Investment goods effect*: when the price of capital goods grows less than the price of consumption goods (which is typically the case for computers once quality improvements are well accounted for), then both the CPI and the personal consumption expenditure (PCE) deflator increase more than the GDP deflator. This investment goods effect explains a significant fraction of the divergence between GDP and consumption deflators in Japan and Germany over the last 15 years. In Germany for instance, from 2000 to 2010, GDP price inflation has averaged 1% per year, but the CPI has grown 1.6% whereas the investment deflator has actually decreased (-0.3% per year).

(iii) *Public consumption effects.* When the price of the goods and services consumed by the government increase less than the price of private goods, the CPI grows more than the GDP deflator. In the U.S. and in 1950s-1960s France, the opposite has apparently happened: the price of public goods seems to have grown a bit more than the price of private goods. (Of course, indexes for public consumption expenditure face the formidable problem of how to properly account for quality improvements in education, defense, police, and so on[149]).

(iv) *Methodological differences in the construction of price indexes* In principle, the CPI and PCE deflators should closely follow each other. But there are at times significant discrepancies. These discrepancies have been the key driver of the divergence between the CPI and the GDP deflator in the U.S. The main difference between the CPI and the PCE deflator is that they usually rely on different index formulas. In the U.S, the CPI-U is a Laspeyres index, i.e. an index in which quantities weights are fixed at the base year level. Laspeyres indexes in effect assume that consumers do not react to relative price changes, therefore tend to overstate inflation – the "substitution bias."[150] By contrast, the U.S. GDP deflator relies on more appropriate chain-

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[149]One standard solution to the quality bias is the use hedonic price techniques, but this is usually of little help for public expenditure.

[150]In Paasche indexes, quantities are fixed at their end-of-sample level. Paasche indexes in effect assume full reactions to relative price changes, therefore tend to understate inflation. To avoid substitution bias, one needs to use "superlative indexes", such as the The Fisher Ideal index – a geometric average of Paasche and Laspeyres

weighted Fisher indices. In the latter half of the 1990s, the Boskin commission concluded that the CPI tended to overstate inflation (see Boskin et al., 1998). As a response, BEA introduced the C-CPI-U, a chained-weighted Törnqvist index (C stands for chained). Over the 2000-2010 period, the C-CPI-U and the PCE have closely followed each other (the C-CPI-U is not available for earlier periods). Minor methodological differences still remain, however. The PCE is somewhat broader in scope (it includes, for instance, spending on behalf of consumers by employers and government health agencies); it uses a different set of weights (coming from the NIPA rather than from Consumer Expenditure Survey), and it sometimes relies on price series other than those used in the CPI.

A.7   Factor shares and returns

In the country-specific files we provide detailed decomposition of corporate product and national income into labor and capital components. The analysis of factor shares in the corporate sector is standard and does not raise any particular difficulty. At the national level, however, there are a number of issues. The main difficulty is how to deal with self-employment. Other issues include whether one should attribute some capital income to the government sector, and difficulties in the measurement of housing capital income. We deal with each of these issues in turn.

A.7.1   Capital shares in the non-corporate business sector

There are three main ways to estimate factor shares in the non-corporate business sector: (i) assign the self-employed 100% of the average wage of salaried workers; (ii) apply some capital returns to the capital stocks of self-employed individuals; (iii) assume the same factor income decomposition in the non-corporate and corporate business sectors.

Most estimates of the shares of labor and capital in national income try to impute a wage to the self-employed (see Glyn, 2009). This is for instance the method that Ameco retains to compute its own adjusted wage series.[151] One problem, however, is that there is no particular reason

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indexes – or the Törnqvist index.

[151]Series ALCD0 (adjusted wage share in market price GDP) and ALCD2 (adjusted wage share in factor-cost GDP).

why we should attribute 100% of the average wage of salaried workers to the self-employed. The self-employed have historically been concentrated in sectors where average incomes have been much lower than the national average, such as agriculture; today, on the contrary, many of them are in relatively high-paying sectors, such as health. One way to deal with this issue is to use data on income and employment at the sectoral level to assign the self-employed imputed sectoral wages, correcting for part-time work when possible.[152]

The method that consists in applying rates of return to the capital stock of the self-employed is rarely used, as until recently comprehensive balance sheets for the non-corporate sector were not available.

In practice, estimates that apply average wages to the hours worked by self-employed persons (or capital returns to their capital stocks) often result in negative returns to either capital or labor. As Jorgenson and Landefeld (2006, p. 33) discuss, the reasons for this problem are not entirely clear. Explanations include the possibility that mixed income may be under-estimated in national accounts, and issues in the measurement of the numbers of hours worked by self-employed (or the capital stocks they use). Mixed income can be under-estimated for a number of reasons: the self-employed may underreport income to tax and statistical authorities; some of the earnings of small business owners that should logically be recorded as mixed income are also sometimes treated as corporate dividends in the national accounts. The latter problem occurs when small businesses are included in the corporate sector but the partners are counted as self-employed in labor force surveys (e.g., because they choose to be paid in the form of dividends only). This problem is particularly acute in countries that have a vast network of small and medium enterprises, such as Germany. In this case, too much corporate dividends tend to be recorded, and too little mixed income compared to the the number of self-employed identified in surveys.[153]

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[152]This is the what is usually done in productivity studies (see for instance EU KLEMS). This is also the method used by Jorgenson and Landefeld (p. 34) to form their estimate of total capital income in the U.S. economy (Table 1.6, p. 54-55) which also includes imputed values of the services of consumer durables as well as the net rent on government tangible assets.

[153]Only non-corporate businesses can be the source of mixed income. But the distinction between corporate

In view of the many issues raised by the methods that impute wages or returns to the self-employed, in our database, whenever possible, we have opted for the third method: we assume that the capital share is the same in the non-corporate as in the corporate business sectors.[154] One drawback is that this method cannot always be applied: we need to know the net-product of the non-corporate business sector, and in some cases national accounts are not detailed enough. But one advantage of the method, when the data exist, is that we can check the plausibility of the results by computing the average wage of self-employed individuals which is consistent with identical factor shares in the corporate and non-corporate business sectors.

In the country-specific appendices, we precisely explain how we estimated factor shares in the non-corporate sector given available data, and the robustness checks that we were able to conduct. We also describe on a case-by-case basis the way we have obtained historical estimates of factor shares for the 19th century, at times when all standard methods raise formidable difficulties because of the high share of agriculture in output.[155]

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and non-corporate activity is far from being always clear. In the 2008 SNA (4.155-4.156), the main criterion is whether the liability of the partners is limited (corporation) or unlimited (un-incorporated enterprise). However, some un-incorporated enterprises are to be treated as "quasi-corporations" in the SNA if they have complete sets of accounts, many partners, and behave like corporations.

[154]Specifically, we compute factor income in the non-corporate sector by multiplying the net product of the non-corporate business sector by the factor shares that prevail in the corporate sector. A number of estimates of factor shares deal with self-employment by applying the corporate sector's factor shares to mixed income (rather than to the overall net product of the non-corporate business sector). This way of doing things necessarily results in higher labor shares in the non-corporate sector than in the corporate sector, since total labor income in the non-corporate sector is then equal to wages paid to non-corporate salaried workers plus the imputed labor component of mixed income. The problem is that there is no clear reason why the labor share should necessarily always be higher in the non-corporate sector, so overall it seems to us that our method is somewhat more consistent.

[155]There are three main issues. First, there is no particular reason why the distribution of factor shares should be the same in agriculture as in the corporate sector, so the method we generally use for 1970-2010 makes relatively little sense before. Second, attributing an average agricultural wage to peasant farmers often faces important data constraint. Lastly, there is the very tricky issue of how to deal with unpaid family workers, historically quite important in many countries, in some cases through to the mid-twentieth century. Attributing those workers the average wage often results in labor share exceeding 100% in the whole economy (see Glyn, 2009, p. 109).

A.7.2 Housing capital income

An important part of the economy's capital income – though one which unfortunately tends to be disregarded in standard measures of factor shares – is housing capital income. However, it is not always straightforward to properly isolate this income in published national accounts.

In principle, things are quite simple: housing capital income is equal to the net product of the housing sector, which by convention is measured in the SNA as the net operating surplus of the household sector.

There are two main issues here. First, home-owners who have contracted mortgages consume financial intermediation services. These services, called "financial intermediation services indirectly measured" (FISIM), are conventionally defined as the margin between mortgage interest rates and a reference rate (such as the rate at which banks can refinance themselves with the central bank). In the national accounts, FISIM consumed by home-owners are treated as intermediate consumption, so that they are excluded from the value added of the household sector, hence from the net product of the housing sector. Because there is substantial cross-country heterogeneity in the way FISIM are measured,[156] comparisons of housing products across countries are rendered somewhat difficult. One solution would be to add FISIM on mortgages to net housing product; however in many countries FISIM on mortgages are not isolated.

The second issue that affects the comparability of housing capital income is the following. By definition, the net operating surplus of the household sector only captures the income generated by households' housing activities. But households do not own 100% of the housing stock, and there is some variation in the share of houses owned by corporations. In Germany and France, households own about 85% of the dwelling stock and non-financial corporations almost all the rest, while in the U.K. the household share is 95%. In the country-specific appendices, we precisely describe how we have estimated housing capital stocks and income given available data, and what scopes the estimates cover.

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[156]In particular, statistical agencies often use ad hoc methods to smooth variations in FISIM that occur when central banks set extremely low refinancing rates (as has been the case since 2008).

A.7.3 Should the government earn capital income?

By convention, in the SNA the net return to government capital is implicitly assumed to be zero. The SNA estimates the value of government (and other non-market producers) output by costs. The only cost measured for the use of capital inputs in the production of government services is depreciation. In principle a financing opportunity cost – i.e., a rate of return on government non-financial assets – should also be included. This rate of return cannot be directly observed, but one natural candidate would be the interest rate that the government pays on its debt. Doing so, however, would raise the issue that GDP would rise when interest rates for government debt increase. And it is also unclear what exact interest rate should be picked – short term, long term, etc. This seems to be the main reasons why the SNA prefers to retain in practice the assumption of zero net return on government assets, although capital income imputations are routinely made for owner-occupied dwellings (a task, however, made easier by the fact that market rents are readily available).[157] In this research we have not attempted to correct the official data and so there is no capital income in the government sector.

A.7.4 Alternative measure of the capital share: the concept of capital services

In our database, we measure capital income, consistent with standard practice, as the sum of net operating surplus (net corporate profits and housing capital income), the fraction of mixed income that can be attributed to capital, and net foreign capital income. However, there is no strong reason why this should always be equal to the contribution made by capital to production. One can for instance imagine that corporate profits are generated by imperfect competitions, so that the net operating surplus of the corporate sector is not strictly speaking a return to capital.

Independently from the SNA, however, there is a rich tradition of productivity analysis that

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[157]Jorgenson and Landefeld (2006) propose to include the net return to government capital in GDP. They find that the gross return is about 3.5% of GDP ("services of durables, structures, land, and inventories held by government": $340bn in 2002, see Table 1.5 p.51). This gross return includes depreciation which is already counted in GDP ($178bn) so that the net return is about $162bn, i.e. a bit less than 2% of national income.

attempts to isolate the contribution to production of capital, labor, and multi-factor productivity at the industry level.[158] A number of statistical agencies are currently devoting substantial effort into integrating these productivity accounts to the standard national accounts and making the two consistent.[159] This is recognized in the 2008 SNA, which proposes that "for those offices interested, a table supplementary to the standard accounts could be prepared to display the implicit services provided by non-financial assets." (SNA 2008, 20.1).

There are two ways to measure the contribution of capital to production, what is known as "capital services": (i) using observed rental prices (to be then multiplied by the quantities of capital used), (ii) imputing those prices. Since in practice rental markets do not exist for a number of capital goods (or relevant rental prices are not collected), in productivity studies, rental prices are routinely imputed on the basis of the famous Hall and Jorgenson (1967) user cost formula. That is, the rental price p_k of a capital good k, also known as the user cost (i.e., the unit cost for the use of k for one period), is computed on the basis of k's estimated price, P^k, a reference rate of return equal to the opportunity cost of money, r, a depreciation rate, δ (estimated from age-efficiency profiles etc.) and asset price inflation, $\hat{P}^k$:

$$p_k = P^k[r - \hat{P}^k + (1 + \hat{P}^k)\delta]$$

Neglecting the small $\delta\hat{P}^k$ term, this formula can be simplified as $p_k = P^k(r - \hat{P}^k + \delta)$ and has a straightforward interpretation: the rental price is equal to the real opportunity cost of an investment of value P^k plus the loss in asset value as the asset ages (economic depreciation).[160] In practice, as discussed for instance in Hsieh (2002, pp. 507-508), the literature uses a variety of methods to compute the real interest rate $r - \hat{P}^k$.

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[158]Productivity data are produced by the BLS in the U.S. (http://www.bls.gov/bls/productivity.htm) and the EU-KLEMS consortium in the European Union.

[159]See in the U.S. Jorgenson and Landefeled (2006) and Jorgenson (2009). There are several inconsistencies between the SNA and productivity accounts. E.g., the former value industry and sectoral output at market price while the latter use basic prices, i.e., deduct taxes on products (net of subsidies), such as value-added taxes, excise duties, import taxes, etc. (code D21 for taxes and D31 for subsidies in ESA95 classification).

[160]This formula excludes the treatment of taxes. See for instance Jorgenson and Landefeld (2006, pp. 76 sqq) for an introduction to the user-cost formula, the effect of introducing taxes, the methods use to compute the real interest rate, etc.

When there is a discrepancy between operating surplus and the value of capital services, it can be that not all operating surplus is a payment made to capital (e.g., monopoly rents) or that some assets used in production have not been well identified (e.g., intangible capital) or that their value or depreciation has not been well estimated. Conversely one can compute the discount factor that equates the value of capital services with operating surplus.

As we explain in the main text of the paper, our overall conclusion is that capital shares α are in many ways more difficult to measure than wealth-income and capital-output ratios β. So far the economics literature has mostly focus upon the study of α. We argue in this research that the study of β should rank highly in future research agendas. Ideally one would obviously like to make progress on both fronts.

A.7.5 Computing the average return on wealth

Using national account data, one can compute the economy-wide average rate of return on wealth r by dividing the capital share α by the wealth-income ratio β: $r = \alpha/\beta$. In practice, there are slightly different ways to proceed.

The simplest way is to set α equal to the share of capital in factor-price national income, i.e. $\alpha = Y_K/(Y - T_p)$, where Y_K is the sum of all capital income earned by domestic residents as identifiable in national accounts (housing capital income, corporate capital income, imputed capital income in the non-corporate business sector, and net foreign investment income), and $Y - T_p$ is factor-price national income (i.e., national income net of production taxes T_p), and to set β equal to the private wealth-national income ratio W/Y. This formulation assumes that product taxes T_p are split between labor and capital in equal proportions and is straightforward to implement. It is the one we use for the computation of the average rate of returns series presented in Table A145 and displayed in Figure 14 of the main paper. This formulation has also the advantage that the capital share and the labor share (defined as the sum of all labor income as identifiable in national accounts: wage and salaries, imputed labor income in the non-corporate business sector, and net foreign labor income) sum to 1.

A problem, however, is that this procedure is slightly inconsistent in the sense that β includes government debt while α excludes government interest payments. So in effect the average rate of return is under-estimated. The consistent formula includes government interest payments (net of government interest receipts) in the capital share. In Table US.11, JP.11, etc., of the country-specific files, we report detailed computations of the standard capital share α and the augmented capital share α^* including net government interest payments (the results are summarized in Appendix Table A48 and A48b). One problem is that the sum of α^* and the labor share now exceeds one. The corrected rate of return $r^* = \alpha^*/\beta$ turns out to be qualitatively similar to the return $r = \alpha/\beta$.[161]

Another consistent way to proceed would be to exclude net government interest payments from the numerator, but to include the return earned by government on its assets, and to divide this economy-wide flow of capital income by the national-wealth income ratio $\beta_n = (W + W_g)/Y$. This is probably the most consistent way to proceed – it would deliver the average return on national wealth, as opposed to the average return on private wealth only in the above computations. But as we have seen, government capital income is not measured yet in national accounts, so this procedure cannot be implemented easily.

A.8 International data on countries' income and wealth

For the 1970-2010 period, the usual international data sources are highly incomplete, so we had to return to the raw primary national sources, namely the accounts compiled by national statistical institutes. For instance, OECD wealth accounts exist for a limited number of years; for most countries, complete balance sheets with full details on non-financial and financial assets and liabilities for the various sector (households, government, corporations, rest of the world) are available only for the 1995-2010 period at best. OECD income accounts also only cover the most recent years. UN official series – available on `data.un.org` – cover only flow accounts, not

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[161]The absolute level of the corrected returns r^* is slightly higher, but the trend is roughly similar. In most countries net government interest payments display no clear trend in the 1970-2010 period, because the rise in public debt has largely been compensated by a decrease in nominal interest rate paid by governments.

balance sheets.[162]

As regards historical sources, we choose in most cases to return to the raw available material as well, for both income and wealth. Historical data sets on national accounts such as Maddison (2001, 2007, 2010) include series on GDP and population only, not on wealth or capital. They typically do not include factor shares series either. We did check, however, that all per capita real growth rates and all population growth rates in our database coincide with Maddison in the very long run. The per-capita real income growth rates that we obtain for the U.S., U.K., and France over the periods 1700-1810, 1810-1910, and 1910-2010 are within 0.1% of Maddison's (see Table A157). In the country-specific sections below, we explain the source of the discrepancy when our choices among the available raw sources have differed from Maddison's.

In addition to country-specific historical sources and studies, we also used a number of cross-country historical studies of income and wealth. Key references here include Mulhall (1896, 1899), Gini (1914), Studenski (1958), and Goldsmith (1985, 1991).

A.9   Overview of the main areas in which progress needs to be made

Our research includes a Chartbook constructed from our wealth-income database. In the Chartbook we present the main evolutions in wealth-income ratios, the structure of national wealth, national income, and so on. Generally speaking, the displayed cross-country and time variations are meaningful. However, we would like to point out a number of cases in which we see important data issues. This is the occasion to precisely pinpoint the areas in which, in our view, national accounts need to make progress.

Looking first at income, the measurement of housing products raises a number of difficulties, as discussed in Section A.7.2 above. In Figure A57, we provide tentative estimates of the evolution of the share of housing product in domestic product across countries. While the rising trend for each country is definitely robust, the absolute level of housing products – and thus cross-country comparisons – should be taken with a grain of salt. One issue is that data for

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[162]The main income and population tables are also available at http://unstats.un.org/unsd/snaama/dnlList.asp.

Japan and Canada only refer to owner-occupied houses, while data for other countries include both owner- and tenant-occupied housing. There are also inconsistencies in the treatment of property taxes across countries. As a general rule, these taxes are excluded from housing products: we measure the share of the net value added of the housing sector (net of depreciation and of production taxes) in the net value added of the domestic economy (net of depreciation and of all production taxes, i.e. factor cost net domestic product). However, in some countries like Canada, property taxes cannot be subtracted from housing product. Given the increasing importance of housing in both income and wealth, we believe that progress is badly needed in this area.

More broadly, decompositions of the domestic product by production sector raise some difficulties. Generally speaking, net domestic product Y_p can be written as the sum of the net product of the housing sector Y_h, net product of non-corporate business sector (including non-profit institutions) Y_{se}, net product of the corporate sector Y_c, net product of the government sector Y_g, and production taxes T_p:

$$Y_p = Y_h + Y_{se} + Y_c + Y_g + T_p$$

It is the decomposition we use for each country in our database in Tables US.9, JP.9, etc. We plot the share of each sector in domestic product in Figures A59, A61, A62, A63, and A64. We stress, however, that cross-country comparisons should be taken with care, because the frontiers of each sector are not always perfectly comparable across countries. What is recorded as non-corporate and corporate activity, in particular, tends to be increasingly affected by tax considerations – which may explain the rising share of non-corporate activity in the U.S. since the mid-1980s (Figure A61). This issue also affects the measurement of distributed corporate profits (i.e., dividends) displayed in Figure A98.

We also caution the reader against trying to infer too much from our estimates of factor shares. As explained in the working paper, and as detailed in Section A.7 above, computations of factor shares at the national level raise all sorts of difficulties. These issues are compounded

when we get back through time, because the share of the non-corporate sector – for which measurement issues are the most important – increases. In Figure A66 we present estimates of the capital share over the 1910-2010 period for the three main European countries, Germany, France, and the U.K. We have attempted to provide reasonable estimates of the capital share during the World Wars, but as discussed in the country-specific sections below, the raw available material is limited. The cross-country variations (in particular during World War II) should be taken with a lot of care. In our view, additional historical research is needed in this area. In this research, we have argued that an alternative way to gauge the relative importance of labor and capital in the economy is to look at the evolution of wealth-income and capital-output ratios. We hope that we have shown this to be fruitful approach, although ideally both approach must be combined.

Moving now to wealth, one particularly tricky issue, in which much progress remains to be done, is the measurement of public assets. While we have taken great care to provide plausible estimates on the basis of published balance sheets, making reasonable adjustments when needed (as detailed in the country-specific sections), we are well aware that it is an area in which there are important statistical issues. In particular, it is difficult to provide accurate estimates of the claims held by governments in public corporations in the aftermath of World War II. In principle, as we have seen, these corporations must be recorded under the assumption that Tobin's Q is equal to 1 (i.e., government claims must be set equal to the value of public companies' assets net of non-equity liabilities). However, the extent to which this principle was followed in available historical balance sheets is unclear, and therefore our estimates of government public assets in the 1950s-1970s are surrounded with uncertainties. The cross-country variations presented in Figure A82 should be taken with care. One way to make progress in this area would be to compute fresh estimates of the equivalent market-value of public companies in the 1950, 1960s and 1970s, by getting back to the individual accounts and balance sheets of those companies and applying standard observable financial ratios, such as price/earnings, or price/revenues. Further, we stress that the decomposition of public assets between "financial" and "nonfinancial" assets

is very fragile, and in some sense meaningless (Figure A84 to A87). In principle, the rule is that if a unit sells the majority of its output at "economically significant prices", then it is a corporation in the sense of the SNA, and if it owned by the government, this translates into a financial asset for the government. In contrast, if a government-controlled unit sells a minority of its output at economically significant prices, then it is directly included in the government sector, which translates into nonfinancial assets for the government. The frontier between both cases is often thin in practice.

Moving now to historical estimates of the level and nature of wealth, we stress that the raw data for the 18th and 19th centuries do not allow us to very precisely estimate the wealth-income ratio. They only enable us to provide a reasonable order of magnitude for the level of the ratio (600%-800% in Europe) and its dynamics (namely, we find no long run trend before World War I in Europe: in both France and the U.K., the wealth-income ratio appears to stay relatively close to 700%). Similarly, the decompositions of domestic capital between agricultural land, housing, other domestic capital are approximate, and should not be used for fine comparisons across time and countries. The main robust finding is the long run decline of agricultural land. Precise quantifications of the shares of the different assets always face a number of data constraints.[163] The limitation of the raw material should be kept in mind when comparing the share of agriculture (Figure A34) and other domestic capital (Figure A36) in national wealth.

Similarly, in the recent period, estimates of the amount of natural resources reported in Figure A45 are approximate. Most countries do not yet systematically attempt to estimate the value of natural resources, and statistical methods remain heterogeneous.

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[163]Some houses – and more generally hotels, etc. – can be owned by the corporate and government sector (and thus will be counted as other domestic capital). Further, it is sometimes hard to exclude the value of farm buildings or cattle from agricultural land. The country-specific sections provide all relevant details on how we have attempted to provide separate estimates for each given available sources.

B United States

B.1 Official national accounts series

Official U.S. accounts are organized in two parts: most of the flow data are in the National Income and Product Accounts (NIPA), published by the Bureau of Economic Analysis, while stocks of assets and flows of financial assets are in the Flow of Funds Accounts (FFA), published by the Federal Reserve Board. These statistics do not directly follow the SNA guidelines.[164] The Bureau of Economic Analysis, however, attempts to integrate the NIPA and FFA in a framework founded on the SNA, the Integrated Macroeconomic Accounts (IMA). In this research, in order to ensure comparability, we always use when available data from BEA's integrated macro accounts.[165] The integrated accounts start in 1960, the flows of funds in 1945, and the NIPA in 1929. We have reconstructed homogeneous 1929-2010 income series by linking the integrated accounts with the NIPA, and homogenous 1945-2010 wealth series by linking the integrated accounts with the Flow of Funds balance sheets. There is usually a perfect continuity in 1960.[166]

B.1.1 National income, 1929-2010

For the 1929-2010 period we use the official IMA and NIPA data with no modification whatsoever. We simply re-arrange them in a slightly different accounting framework in order to facilitate comparisons with other countries.

Specifically, the IMA isolates a non-financial non-corporate business sector that does not exist in the SNA. This sector includes (i) non-financial partnerships, that the SNA classifies as non-financial corporations; (ii) sole proprietorships, that the SNA includes in the household sector; and (iii) the activities associated with tenant-occupied housing, which are also included in

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[164]The OECD compiles U.S. national accounts data in the SNA framework, but the series start in 1998.

[165]The IMA series are available from two sources: (i) BEA (http://www.bea.gov/national/nipaweb/Ni_FedBeaSna/Index.asp) and (ii) FRB (http://www.federalreserve.gov/datadownload/Choose.aspx?rel=Z1). The series are mnemonic and identical, but at the time we conducted this research, FRB data were slightly more up-to-date, so we downloaded the raw data from the FRB's website. See our file "IMA_1946_Today.xls".

[166]When this is not the case, our Excel file "USA.xls" precisely describes the very minor adjustments we make.

SNA's household sector.[167] In order to analyze the sectoral composition of domestic production and to compare it with other countries, we exclude tenant-occupied activities from the non-corporate sector and include them in the housing sector.[168] We find that the share of the non-corporate sector (excluding housing) in domestic production follows a U-shape pattern over the 1960-2010 period, from 24% in 1960 down to 17% in 1983 and then gradually increasing again to 22% in 2010, the highest level in the rich world. This evolution stands in sharp contrast to other rich countries, where the relative importance of non-corporate activities has continuously declined. Potential explanations for the U.S. reversal include tax incentives favorable to non-corporate activities, e.g. following the 1986 Tax Reform Act, and the importance of a number of financial activities (such as hedge funds) that are traditionally unincorporated.[169]

For the factor share analysis reported in Table US.11, we assume that the same factor income decomposition holds in the non-corporate business sector as in the corporate sector.[170] Consistent with a number of studies, we find rising capital shares (net-of-depreciation, exclud-

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[167]Owner-occupied housing is in the household sector in both SNA and IMA. See the *Survey of Current Business* paper by Bond et al. (2007) for a discussion of the differences between the SNA and the IMA.

[168]Since the integrated macro accounts include tenant-occupied housing activities in a non-corporate sector distinct from the household sector, we cannot compute the housing sector net product as the operating surplus of the household sector. However, the NIPA provide separate data on the housing sector (Table 7.4.5. Housing Sector Output, Gross Value Added, and Net Value Added). Our factor-price net housing product series is NIPA Table 7.4.5 line 13 (net housing value added) - line 15 (taxes on production and imports in the housing sector) + line 16 (subsidies). This housing product is consistent with how we measure housing activity in other countries, except for one minor point: the NIPA data on housing encompass the housing activity of the government and corporations, whereas for most other countries, our housing series only include the housing activity of households. Households usually account for more than 80% of a country's housing activity.

[169]We compute the net product of the non-corporate business sector as the net product of the households + NPISH + non-corporate non-financial business sectors minus the net product of the housing sector. Non-financial partnerships are included in the non-corporate sector in the U.S., while in other countries which follow the SNA they are in the corporate sector. This might explain part of the relatively high U.S. share of non-corporate activities. Note however that financial partnerships are included in the financial corporate sector, so they cannot account for the rising share of non-corporate activities.

[170]Our capital share differs from the one that can be computed from Jorgenson and Landefeld (2006, Table 1.8 p. 56) for four reasons: (i) Jorgenson and Landefeld include imputed rents on durables in income (net of depreciation, they amount to about 2% of national income); as well as (ii) net rents on government tangible capital (an additional 2%, net of depreciation). (iii) They attribute property taxes and some other product taxes to capital, while we (somewhat simplistically) assume an equal split of all product taxes between labor and capital. (iv) They impute wages to the self-employed in order to estimate the capital share in the non-corporate sectors sector, while we assume the same factor income breakdown in the non-corporate and corporate sectors.

ing government interest), from about 20% in the early 1970s to 25-30% in 2005-2010. This increase has been accompanied by a rise in distributed profits, while retained earnings (net-of-depreciation) appear rather constant, oscillating around 3% of national income. Over a century, the share of distributed profits in national income follows a spectacular U-shape pattern, from 8% in 1929, down to 2% in the mid-1950s, and back to 6% today.

B.1.2   National wealth, 1945-2010

Private wealth, 1945-2010

Our net household wealth is the one provided by the integrated macro accounts, with two minor modifications as to ensure consistency with other countries. First, we exclude consumer durables from assets. There are good arguments to treat durables as assets, as U.S. statisticians do, but for the purpose of this comparative research, we stick to the international guidelines.[171] Second, at the time we conducted this research, IMA balance sheets excluded the value of farm land; we add it back.[172]

The data we report on the composition of private wealth differ from the official data in one additional way. In the official U.S. balance sheets, residential real estate owned by the household sector only include owner-occupied dwellings; landlords formally own equities on non-corportate businesses, which is inconsistent with what other countries do. To improve comparability, we add tenant-occupied dwellings to households' real estate and decrease households' equities in non-corporate businesses in proportion.[173] We do not further consolidate the household and

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[171]Note that the BEA classifies consumer durables as assets but currently excludes them from saving and investment flows. Purchases of durables are recorded as "other volume changes" in the flow-stock reconciliation accounts. For the sake of consistency, we subtract the investment in consumer durables from all "other volume changes" series, and so in effect we treat durables as private consumption expenditures, as other countries do.

[172]After we finished our U.S. computations, BEA started including farm land in its balance sheets. Part of it is included in the non-corporate sector, the other part in the non-corporate business sector. In the SNA non-corporate farms would be included in the household sector, but corporate farms would be in the corporate sector. So by including all farm land in the household sector, we slightly over-estimate household wealth. On the other hand, "other land" (recreational – code AN.2113 in SNA – and other – AN.2119) is not measured in U.S. balance sheets and including it would raise U.S. household wealth. These issues are negligible for our purposes since farm land is only 10% of national income today and household "other land" is typically very small as well (7% of national income in France, for example).

[173]Specifically, we transfer all of the non-corporate business sector's residential real estate assets to the house-

non-corporate business sectors.[174] Just like for other countries, our private wealth series include non-profit institutions serving households. BEA's integrated accounts do not isolate non-profit institutions from households, but we report FRB data on non-profit net wealth in Table US.6c.[175] In 2000 the net wealth of non-profit organizations was about 30% of national income, or 7% of the combined households plus NPISH net wealth.

Note that while most of the countries in our database provide separate statistics for the values of constructions and of the land underlying these constructions, this is not the case in the U.S. Instead, BEA reports statistics on the market value of "real estates," which include the market value of both land and structures.[176]

Government wealth, 1945-2010

We only make one correction to the government balance sheets reported in the macroeconomic accounts: we add estimates for the government's land holdings. At the time we conducted this research, the BEA balance sheets only included public structures and equipments. Government real estate was estimated on the basis of the current-cost of the structures and underlying land values were set to zero. We upgrade the balance sheets by drawing on a number of official and non-official estimates.[177]

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hold sector; we do the same for mortgage liabilities; and we decrease the value of the equity claims held by households on the non-corporate sector in proportion. See detailed computations and explanations in "USA.xls." This has no impact on the net wealth of households but simply modifies its composition. Note that the non-corporate business sector also has non-residential real estate, that we do not transfer to the household sector.

[174]To provide meaningful comparisons of the structure of private wealth across countries, one should deal with the fact that in the U.S., sole proprietorships are excluded from the household sector and included in the non-corporate sector. As a result, households own equities on non-corporate businesses, including on sole proprietorships. Relative to other countries, this tends to inflate the share of equities in households' portfolios. In effect the real assets of partnerships are recorded as equity assets of households in the U.S., but as real assets in most other counties. This explains why non-housing real assets of households are low in Table U.S.6c as compared to other countries. This accounting difference, however, is irrelevant for the purpose of the present study.

[175]Table B.100 of the FFA gives the tangible assets of NPISH over the 1945-2009 period, namely non-profit organizations' real estate at market value plus equipment and software at current cost. The supplementary Table L.100 of the FFA y also provide information on the financial assets and liabilities of NPISH, but the series only cover the end-1987 to end-2000 period. Accordingly we only report the net wealth of NPISH over the 1988-2000 period.

[176]There is a further distinction between residential real estates (that is, houses) and non-residential real estates (e.g., offices).

[177]Specifically, for the 1953-1969 period we use the Historical Statistics of the United States series F364 p. 252

We also report as a memo item excluded from wealth estimates for the government's sub-soil assets, which are currently lacking in the BEA accounts. In 1994 BEA did compile an integrated economic and environmental satellite account for the year 1987, including estimates of oil, gas, coal, metals and other minerals, forests, etc.[178] But shortly after its publication, Congress asked the Commerce Department to suspend work in this area. An expert panel was charged to examine whether the NIPA should be permanently broadened to include activities involving natural resources and the environment. The panel concluded positively (Nordhaus and Kokkelenberg, 1999) but so far the recommendations have not been followed and the last official environmental accounts are for 1987.

At end 1987, natural resources other than land were estimated by BEA to be worth between 23% and 40% of national income, with timber worth $336bn (8%), non-timber forests $315bn (8%) and subsoil assets in the $300bn-950bn range (i.e., 7%-24% of national income). There is obviously a great deal of uncertainty surrounding these figures, but for information we report in Table US.6a the central estimate of 15% of national income for subsoil assets. Subsequent estimates provided by the World Bank in its Wealth of Nations database give a similar order of magnitude, if a bit lower. In 2005 the World Bank puts subsoil assets at about 9% of national income, and forest at 3%.[179] The OMB also provides estimates of the federal government's

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(these data are based on a study by Milgram, 1973). For the 1970-1985 period we use the estimates of Boskin et al. (1985, Table 7 p.933) and Boskin, Robinson and Huber (1989, p. 327). From 1986 on, we rely on the federal land values provided in the Office of Management and Budget's Analytical Perspectives for fiscal year 2012 (Table 31-2 p. 479) and we assume that the value of state and local land is a constant multiple of federal land. The OMB attempts to measure federal land at market value based on the price dynamics of private land. Hence estimated federal land holdings were particularly high in 2006-2007 (close to $1tr) and decreased to about $400bn in 2010 (see detailed series in DataUS2).

[178]See BEA (1994), "Integrated Economic and Environmental Satellite Accounts," *Survey of Current Business,* April, pp.33-49.

[179]The World Bank estimates that the overall U.S. total natural capital stock is worth $4.1tr, i.e. 36% of national income. This figure can be decomposed as follows: subsoil assets ($1.0tr) + timber and non-timber forests ($0.4tr) + protected areas ($1.1tr) + crop and pasture land, i.e. agricultural land ($1.6tr, a figure a bit higher than the 1.25tr of farm land at market value reported in the Flow of Funds for end 2005.). None of these assets are currently included in BEA balance sheets, except for agricultural land. Subsoil assets, timber and non-timber forests should in principle be included in assets (while protected areas should not since they are not economic assets in the sense of the SNA) so we report the value of subsoil assets on one hand, and timber + non-timber forests on the other as memo items in Table US.6a.

proved reserves of oil and natural gas which appear to be an even more modest 3% of national income in 2010.[180]

Corporate wealth, 1945-2010

We report official data on corporations' assets and liabilities with no modification whatsoever. The main issue is that the assets of financial companies are under-estimated because they exclude land.[181] This problem is probably not very important, however, as the non-financial assets of financial companies appear relatively small (13% of national income excluding land in 2010), and so we have not attempted to address it. We find that the ratio between the equity liabilities of corporations and their assets net of non-equity liabilities (that is, Tobin's Q) appears to be usually below unity, the exception being the 1995-2007 period. This result suggests that BEA's corporate capital stocks may have tended to be historically over-estimated (as argued by Wright, 2004). Alternatively, one can imagine that non-listed equities are somewhat under-estimated.[182]

Foreign wealth, 1945-2010

We use the rest of the world balance sheet reported in the integrated macro accounts, which come straight from the Flow of Funds (table L.106). Some of the data differ from the more widely used international investment position compiled by the BEA. A few words on the main discrepancies is in order.

The main difference is that in the Flow of Funds accounts, interbank claims and liabilities are netted out and derivatives are excluded, so that gross positions are substantially lower.

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[180]OMB Analytical Perspectives for fiscal year 2012, Table 32-2, "mineral rights".

[181]They only include the current-cost value of structures (including dwellings) and equipment and software. This deficiency appears to be the reason why the FRB does not currently publish any balance sheet for the financial sector (those are only reported in the integrated accounts).

[182]In the U.S. balance sheets there is no distinction between the value of listed and unlisted equities. The Federal Reserve Board estimates the value of unlisted corporations from estate tax returns with estate multiplier techniques. Computing the proper multiplier for the specific population of private-equity holders is not straightforward, and it is not impossible that the multiplier used by the IRS has tended to be somewhat too low. As Moskowitz and Vissing report (2002, p. 745-746 and Table 3 p. 752), until the 1990s the total value of private equities exceed that of listed equities, so this might be a rather important issue.

At end 2011, in the IIP gross foreign assets were $21.1tr, gross liabilities $25.1tr, and the net position -$4.0tr. In the Flow of Funds, gross assets were $14.2tr, gross liabilities $18.8tr and the net position -$4.6tr. Both sets of statistics have foreign direct investments at current cost.[183] Of the 6.5-7 trillion gap in gross positions, about 4.5 trillion comes from derivatives, and the rest largely from the consolidation of inter-bank claims. Why the net position differs, however, is unclear, as net derivative positions are roughly zero.[184]

Interestingly enough, while gross positions are lower in the integrated accounts than in BEA's international investment position, gross income flows are higher than in BEA's balance of payments. In 2011 for instance, gross foreign income inflows amounted to $716.5bn in the integrated accounts (the same figure as in the NIPA) but to only $676.3bn in the balance of payments. NIPA Table 4.3B provides a reconciliation and shows that the bulk of the discrepancy comes from differences in territorial coverage.[185] Lower positions but higher income flows in the integrated accounts translate into substantially higher yields than those that can be inferred from BEA's international accounts. Specifically, we find that the arithmetic average yield on U.S. foreign assets has been 7.6% over the 1990-2010 period; the yield on liabilities 5.1% and the differential a sizable +2.5%. Using comparable figures from BEA's international accounts, respective figures are 5.5%, 4.1% and +1.4%.[186]

We certainly do not pretend that any set of series is more consistent than the other. We

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[183]BEA has three valuation methods for foreign direct investments: historical costs, current costs (whereby produced capital is estimated at its current cost by the perpetual inventory method, and current land values are estimated using general price indexes), and market value (i.e., based on indexes of stock-market prices).

[184]Note that there is a slight difference in the scope of foreign vs. domestic entities between the two sets of accounts. In the FRB/integrated macro accounts, international banking facilities (IBFs) are treated as non-resident while in BEA's international accounts they are resident. IBFs are separate accounts or branches of U.S. banks, operating on the U.S. territory, that mostly have foreign customers and are free of certain regulations. However, although the inclusion of IBFs can affect the gross positions, there is no particular reason why it should affect the U.S. net foreign asset position.

[185]In BEA's international accounts, Puerto Rico and other small U.S. territories are treated as part of the United States, while in the NIPA / FRB / integrated accounts, they are part of the rest of the world.

[186]Identical yield estimates based on BEA's data are provided by Curcuru, Thomas and Warnock (2013, Table 4, right-hand panel). Note that all those yields rely on FDI positions at current costs (FDI positions are identical in the integrated accounts and BEA international accounts). Note also that we compute yields as year's t flow divided by beginning of year t position, and that the income flow figures quoted above contain a labor income component that we of course subtract to compute yields.

simply point that Federal Reserve series deliver a substantially higher yield differential than the large literature on returns differentials has found so far using BEA data (see Curcuru, Thomas, Warnock 2013 for a comparison of the different waves of results). Whether this reflects deficiencies in the (supposedly internally consistent) integrated or international macro-accounts (such as inconsistencies in netting rules at the flow and stock levels), or more substantial economic differences would need careful examination. We also leave to future research a proper comparison of the overall return differential between the two sets of accounts (yield plus capital gains, by asset class).

B.2   Historical national accounts

Historical estimates of U.S. income and wealth are plentiful, and usually of reasonably high quality for the post-Civil war period.

B.2.1   National income, 1870-1929

We use the 1869-1929 national income series of Balke and Gordon (1989), which improve upon previous estimates, in particular by Kendrick (1961) and Kuznets (1941, 1946, 1961). Balke and Gordon (1989) do not provide any decomposition of national income into consumption and saving, so we had to compute our own saving flow. We take national saving as the sum of net domestic private and public capital formation reported by Kuznets (1961) and of net foreign investments.[187] We compute government saving as the sum of net public capital formation and net government lending/borrowing, which we obtain as the first difference of the net financial position of the government.[188]

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[187]Specifically, we compute the ratio of domestic investment to national income from Kuznets' data, as printed in the Historical statistics of the U.S vol. 1 p.231 series F71-F97, and we apply this ratio to Balke and Gordon's (1989) national income. We then add the net outflow of U.S. capital abroad, computed from the balance of payments statistics reported in the Historical Statistics vol. 2 pp. 866-868 series U1-U25. Note that Kuznets' investment data are quinquennial averages whereas in the balance of payments we have yearly estimates, so in effect our national saving series is a mix of quinquennial averages and yearly data points. This slight inconsistency, however, is irrelevant for our purposes. See Table US.12b and US.12c for all details.

[188]In Table US.4e we provide a further decomposition of government deficits into net interest payments and primary deficits. Before 1929, the net interest payment series we use is actually equal to the gross interest paid by the Federal government (from the Historical Statistics series Y461). See Table US.5c for detailed computations.

B.2.2   National wealth, 1870-1945

Private wealth, 1870-1945

For the 1916-1945 period, we use the mid-year household wealth estimate carefully computed by Kopczuk and Saez (2004) on the basis of the balance sheets of Goldsmith (1952) and Wolff (1989). We make two corrections to the Kopczuk-Saez data: we exclude consumer durables,[189] and we multiply household net wealth ex-durables by 1.07 in order to ensure consistency with the official post 1945 data.[190] Our wealth series very closely tracks Wolff's (1989) W3 concept which is total household wealth minus durables.[191]

For the 1870-1916 period, we first try to obtain reliable national wealth data points for 1870, 1880, 1900, and 1912 – reported in Table US.6f – based on the balance sheets constructed by Goldsmith (1952, 1962, 1985).[192] Specifically, for the years 1900 and 1912, we use Goldsmith's (1952, 1962) data as printed in the Historical Statistics of the U.S, 1976, vol.1, p.255, series F422-445. The data are based on the perpetual inventory method with allowance made for land. They are of relatively good quality so we do not make any correction except for the exclusion of consumer durables. All relevant methodological details can be found in Goldsmith's original publications. For 1880, we report data adapted from Goldsmith (1985, p. 297). Pre-1900 U.S. balance sheets are based on the regular wealth censuses that were conducted at the time. However, they suffer from a number of deficiencies which led us to upgrade Goldsmith's 1880 data point by 20%.[193] Lastly for the year 1870 we use the balance sheet reported by Hoenack

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[189]The BEA provides consumer durable series starting in December 31st, 1925. Before 1925, we use the estimate of Goldsmith (1962, p. 118) for January 1901, 1913, 1923, and linear interpolation to fill in the gaps. In 1900 and before, we assume that durables are a constant fraction of national income (33%, the 1901 value).

[190]There are two reasons why the estimate of Kopczuk and Saez is slitghly below the official data in mid-1946. First we have upgraded the official data to account for farm land. Second, Kopczuk and Saez exclude non-transmissible wealth and there was a small but positive amount of pension fund wealth at the time.

[191]As Kopczuk and Saez (2004) focus upon transmissible wealth, they use Wolff's W2 wealth concept, i.e. W3 minus annuitized pension wealth. For detailed comparisons between the various series, see Excel file "USA.xls."

[192]The balance sheets appear in a number of publications by Goldsmith, with sometimes minor differences, but the bulk of the original work dates back to Goldsmith (1952) – see in particular Goldsmith 1952 p. 306 for the original figures on the reproducible tangible wealth of the U.S.

[193]See the detailed discussion below of the raw sources and adjustments made for the 1770-1870 period.

(1964, p. 197) with minor adjustments as to ensure continuity with Goldsmith's data.[194] We find that national wealth increases from about 413% of national income in 1870 to 490% of national income in 1912.

From these national wealth figures, we subtract the estimated net wealth of the government in order to obtain the net wealth of the private sector in 1870, 1880, 1900, and 1912. To obtain yearly household wealth series, we fill in the gaps using available private saving flows (from Kuznets 1961, see above) and assuming constant rates of real capital gains in 1870-1880, 1880-1900, 1900-1912, and 1912-1916. Given available private saving and wealth data, in Table US.5a we find that we need to assume a positive yearly rate of capital gains on private wealth $q = +1.8\%$ in 1870-1880, $q = +1.0\%$ in 1880-1900, $q = +0.7\%$ in 1900-1912 and $q = +1.0\%$ in 1912-1916. Overall we need a small residual capital gain $q = +1.1\%$ in order to account for the evolution of private wealth in 1870-1910.

There are obviously some margins of errors involved here, as both saving and wealth series have some uncertainties. However, it is reassuring to observe that the bulk of the 1870-1910 accumulation of private U.S. capital seems to be well accounted for by saving flows: as we report in Tables US.4a and US.4b, savings explain more than 70% of wealth accumulation. This result is consistent with available equity price indexes. Shiller (2005) computes a real yearly geometric average rate of capital gains on U.S. equities equal to 2.6% in 1870-1910, lending support to our finding that there were relatively small but nonetheless positive capital gains in this period. The time pattern of the residual real capital gain q we find before World War I is also consistent with Shiller's series, as capital gains on equities are particularly strong in the 1870s (+3.7% per year) and smaller afterwards.[195]

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[194]Specifically, we adjust Hoenack's "total national tangible wealth" upward (by 15%) in order to account for under-valuation in census statistics. We also make an allowance for gold and silver (about $0.45bn in 1870) which are not included in Hoenack's tangible wealth statistics. Lastly, we subtract consumer durables (that we estimate to be worth about 20% of national income) and add the net foreign asset position, about $-1.4bn or -18% of national income (this figure comes from Lewis, 1938; see our discussion below of foreign assets data).

[195]That is, the real equity capital gains is +2.9% in 1880-1900 and +2.2% in 1900-1912. However between 1912 and 1916 real equity prices drop -2.6% per year, which is inconsistent with our estimate of positive residual capital gain $q = 1.0\%$ during this time period. One possible explanation is that we may under-estimate the flow of private saving, which is quite hard to estimate during World War I.

Government wealth, 1870-1945

While there are numerous series on government debt, they usually do not properly account for the liabilities of the States and municipalities. So we returned to the raw sources in order to construct annual 1870-1945 government liabilities data. Overall we find that government liabilities first decrease through to World War I, from 40% of national income in the 1870s to about 20% on the eve of the war. The U.S. then comes out of Wold War I with about 50% of public debt, and of World War II with about 130%. Federal government liabilities data are from Treasury Direct (http://www.treasurydirect.gov). State and local government debts are from the Historical Statistics of the U.S., 1976, vol.2 pp.1127 series Y680 and Wallis (2000, Table 2 p. 66).[196] State debts are negligible in the post 1870 period (less than 10% of total public debt) but municipal debts do matter: in the early twentieth century they were as large as the federal debt – and almost as large during the Great Depression.[197] Table US.5c provides a decomposition of total public liabilities by government level.

Measuring the government's assets is somewhat more complicated. In this research we try to make some progress by providing estimates across countries and over time as homogeneous as possible. Our definition of public assets includes all the government's produced fixed assets – equipment and structures, including military assets – financial assets (currency and deposits, loans, securities, etc.) and land. We exclude other non produced assets such as energy and mineral resources, timber, spectrum rights, and the like.

Historical fixed assets estimates, based on the perpetual inventory method, are plentiful. From 1925-on we use the official BEA series. For the 1870-1925 period we rely on Goldsmith (1952, p. 306).[198] Government fixed assets are small and grow slowly until World War I (from

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[196]These figures are consistent with the census data reported by (Copeland, 1961, p. 7).

[197]In 1933 for instance, Federal debt is 46% of national income, State debt 6% and municipal debt 33%, so that overall public debt is 85% – a level more significant than what Federal data alone would suggest. Before the Civil War, most of the public debt was State debt. Many States defaulted in the 1870s and 1880s. See Reinahrt and Rogoff's chart book, Figure 66a.

[198]Goldsmith's data are reproduced in the Historical Statistics of the U.S. vol.2 p.255 series F428 and F429. One problem here is that Goldsmith disregards military and naval equipments, but this is a minor shortcoming before World War 1, so we do not attempt correct for it and simply paste Goldsmith's series to the BEA fixed assets statistics.

about 10% in the 1870s to about 25% in 1913), in line with quite modest public investment rates (about 0.7% in 1870-1910). They grow faster in the interwar, reaching 60-70% of national income on the eve of World War II. Government land adds about 20% of national income throughout the period.[199] Regarding government's financial assets, the evidence is somewhat scarce, as official flow of funds statistics start in 1945, and we rely on Copeland (1961, Table 1 p.7).[200] Financial claims appear to be small until the Great Depression (less than 10% of national income) and then rise to about 20-30% in the 1930s and 1940s, the same level as today.

Net foreign assets, 1870-1945

There are numerous historical estimates of U.S. foreign assets and liabilities, as U.S. authorities have long been interested in measuring foreign investments. Treasury conducted its first benchmark survey of foreign holdings of U.S. securities in 1853.[201] The Department of Commerce published the first official balance of payment in 1922. Until 1937, only flow data were released on a regular basis, but Commerce did estimate cross-border positions at irregular intervals. Though not always published at the time, some of these estimates were subsequently released in a number of Commerce reports and refined by scholars. In June 1941, Treasury conducted a comprehensive census of foreign investments in the U.S., whose results were published in 1945. Available figure suffer from different shortcomings (e.g., the use of par rather than market values, the lack of data on short-term investments, etc.) but all show the same pattern. Through to World War I, the U.S. was a small net debtor, with net foreign liabilities in the vicinity of 10%-20% of national income. Then it turned into a small net creditor in the aftermath of World War I, with a net position of 0%-20% until 1986. For the whole 1870-1945 period, our foreign assets and liabilities data are based on Lewis (1938) and Department of

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[199]Data for land are from Goldsmith (1952), as printed in the Historical Statistics of the U.S., vol. 1, p. 255, series F444.

[200]We compute government financial assets as the difference between Copeland's gross and net debts; see Copeland (1961, p.182) for details on what the difference exactly recoups. Copeland provides data for 1890, 1913, 1929, 1939, and 1950. We fill in the gaps by linear interpolation. We also assume that public financial assets are a constant fraction of national income in 1870-1890.

[201]See Griever, Lee and Warnock (2001, p.636) for a history of the U.S. system for measuring cross-border securities holdings.

Commerce publications, as reported in the Historical Statistics of the U.S. vol. 2 p. 869.[202]

B.3   National income and wealth, 1770-1870

As is well known, macroeconomic data for the pre-Civil War period have many deficiencies, and therefore we have not attempted to construct yearly estimates of national income and wealth before 1870. Rather, we provide in Table US.6f estimates for 1770, 1810, 1850, and 1860.

B.3.1   Population and national income, 1770-1870

We have relied on the reference sources with minor adjustments. For 1810 and 1850, we take national income to be equal to 90% of the current dollars GNP estimates given by Goldsmith (1985). We use the population series provided by the Historical statistics of the U.S. and construct a composite price index from the same source. We assume that real income growth per capita is fixed over 1770-1810 (0.7% per year), 1810-1850 (1.5%) and 1850-1870 (1.6%). The resulting profile for national income is very close to the one obtained by Maddison.[203]

B.3.2   Private and national wealth series, 1770-1870

1770

We start from the per capita average wealth estimates computed by Alice Hanson Jones for year 1774 on the basis of a large sample of probate records (wealth at death). We make no modification whatsoever, except for the two following points: (i) we convert Jones' estimates from current pounds to current dollars (using the conversion 1 pound sterling = 4.44 US dollar) so as to make the estimates comparable to post-independence estimates; (ii) we convert Jones "per free capita" estimates into "per capita" estimates using the appropriate fraction of free vs.

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[202]These series are consistent with the figures reported by Mira Wilkins (1989, 2004), in her two monumental books on the history of foreign investments in the U.S. We use Wilkins (1989, p. 147) for the 1880s. In Table US.6f we also report net foreign asset positions from Goldsmith (1952, 1962) as printed in the Historical Statistics of the U.S. vol. 2 p. 255 series F445. These estimates are broadly consistent with the Lewis/Commerce figures – if anything Goldsmith seems to report slightly too high NFAs in the late nineteenth/early twentieth century and in 1922.

[203]Although they were computed independently, our estimates of national income also come reasonably close to those of Lindert and Williamson (2011, Tables 3-5 for 1774 and 1800). The growth pattern is also broadly consistent with the index of industrial production constructed by Davis (2004) for the 1790-1915 period.

unfree population (slaves made up about 20% of the total population of the Thirteen American Colonies in 1774, most of them in the South – where the fraction was close to 40% –, and very few in the North).[204] So for instance Jones reports an average per free capita wealth for the Thirteen Colonies equal to 47.5 pounds in 1774 (excluding slaves and durables),[205] which we convert into an average per capita wealth equal to 169 dollars.[206] We report on Table US.6f the detailed results separately for each broad asset category, and separately for the South and the North so as to illustrate the very large disparities due to the slavery system. According to our computations, for the Thirteen Colonies taken as a whole, the total market value of slaves represents the equivalent of 147% of national income, but most of it comes from the South (268% of national income) and very little from the North (5% of national income).[207] If we exclude slaves and durables (which we do in our baseline definition of private wealth), then private wealth appears to be very close in the South and in the North (about 310%-320% of national income). Although there is obviously a lot of uncertainty about these 1774 estimates, the broad conclusions appear to be robust.[208]

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[204]We report detailed population figures – taken from the Historical Statistics of the U.S., 1976 edition, vol.2, p.1168, series Z1-19 – in Table US.3b. "Negro" population made up 21.4% of the total population of the American colonies in 1770 and 20.7% in 1780 (we take 20% for simplicity, and also to take into account the tiny fraction of free "negroes", as shown by post-1790 data). In the "South" – all colonies from Delaware to Tennessee, including Maryland, Virginia, North and South Carolina, Georgia, Kentucky – the proportion was 39.5% in 1770 and 37.7% in 1780 (we take 37% for simplicity), while in the "North" – all other colonies, from New England to the Middle Colonies, including New York, New Jersey and Pennsylvania – the proportion was 4.3% in 1770 and 3.7% in 1780 (we take 3% for simplicity). At that time the total population of the American Colonies was divided almost equally between the "South" (48.7% in 1770, 50.0% in 1780) and the "North" (we take 50% for simplicity).

[205]47.5 = 74.1 - 21.3 (slaves) - 5.3 (consumer durables and perishables). We exclude both slaves and durables from our baseline definition of private wealth but keep them as memo items in Table US.6f. We use Jones' per free capita estimates published in Historical statistics of the US, 1976, vol. 2, p.1175, series Z169-191. Land values include residential real estate, which on the basis of available estimates we estimate to be worth one third of the total. For a complete description of her methods and results, see Jones (1977).

[206]4.44 x 0.8 x 47.5 = 168.7. Detailed formulas and results are available on the Excel file.

[207]We upgrade our 1770 per capita national income by 5% so as to take into account real and nominal growth between 1770 and 1774. We assume that per capita income is equal to 110% of the overall average in the South and 90% in the North. According to Lindert and Williamson (2011, Table 6), the South/average income ratio might have been as large as 120%-125% in 1774 but only 107% in 1780. We take 110% as an average value (this has limited implication for our purposes here).

[208]Jones put a lot of care at converting her wealth-at-death estimates into wealth-of-the-living estimates via mortality multiplier techniques. In particular she tried hard to correct for the upward bias due to the fact wealthy decedents use probate records more often than poor decedents. This is very difficult though, and Lindert and

Finally, we take the ratios from Jones' 1774 estimates for the Thirteen Colonies and apply them to 1770 national income in order to obtain our 1770 estimates (see excel file).

1810, 1850, 1860 and 1880

For these years we use a corrected version of the national balance sheets presented by Goldsmith (1952).[209] These balance sheets are mostly based upon US wealth censuses for 1850-1880 (and upon Blodget (1806) for the 1805-1810 estimate) and suffer from a number of deficiencies. U.S. wealth censuses were conduced approximately every 10 years over the 1850-1922 period. In principle they provide estimates of market value of all real and personal wealth (including slaves in 1850 and 1860). However the raw values reported in census documents are generally closer to assessed tax values, and as such are often substantially lower than market values and need to be upgraded. In practice it is difficult to know with precision the required size of the upgrade, and there are good reasons to believe that most published estimates tend to be too low (particularly for the early censuses of 1850-1880).[210] This also explains why they were eventually abandoned and later replaced by national balance sheets (see Hoenack, 1964).[211] On the basis of the discussion by the various authors, we choose to upgrade all raw published tangible wealth estimates given by early censuses by 20%, which seems relatively conservative.[212]

Willamson (2011) – while recognizing the very high quality of Jones' work, on which they rely a lot – have recently argued that Jones' average per capita wealth might be somewhat overestimated, possibly by as much as 30%. They make this downward correction and find corrected, implicit wealth-income ratios – including slaves – around 247%-260% for 1774 and 378%-409% for 1800 (depending on whether they set the rate of return to 6% or 8%, they find capital shares around 16%-20% in 1774 and 25%-30% in 1880; see Lindert and Williamson, 2011 Table 5). Given the very high value of the slaves stock (which Lindert and Williamson, 2011 p.16 note xix believe to be correct), this would however put the non-slave wealth-income ratio at an unusually low level in 1774 (well below 200%). So we choose not to correct downwards Jones' estimates and take them as they were published. In any case, our estimate for 1770/1774 is very close to what Lindert-Williamson adopt for 1800, and most importantly all estimates find non-slave wealth-income ratios at relatively low levels by historical standards (around 200%-350%), and very high values for slaves (around 150% of national income, and as much as twice this amount for the South). Given our very long term perspective in this paper, this is well enough for our purposes.

[209] Goldsmith did not present estimates for 1860, and the numbers reported here use census estimates presented by Hoenack (1964 p.197) and in Historical statistics of the US, 1976, vol.1, p.457 series K10-13.

[210] Balance sheets computed by Goldsmith for 1900-1939 are based upon a lot more data (and postwar estimates on even more data, and finally became the official US balance sheets).

[211] See also the discussions of US wealth censuses by King (1915) and Giffen (1889).

[212] See detailed formulas and computations in the Excel file.

The other major problem with Goldsmith's estimates for this early period has to do with slaves. There are good reasons to believe that Goldsmith (1952, pp.317-318) vastly underestimates the market value of slaves. He uses assessed tax values for slaves, which have always been severely downward biased, both in 1850-1860 wealth censuses and in 1790-1810 tax data. The market values of slaves that are implicit in Goldsmith's estimates (see Goldsmith 1952, pp.317-318) seem implausibly low, both as compared to the probate estimates due to Jones (1977), and to modern research on the slave economy by Vogel and Engermann (1976, 2006) and subsequent authors (see, e.g., Kotlikoff, 1979 and Wahl, 2008). So we compute the total market value of slaves for 1810, 1850 and 1860 by multiplying the numbers of slaves (from population censuses) by average prices given by modern research (namely, 500$ for 1810, 800$ for 1850 and 1,000$ for 1860). The resulting estimates are consistent with those derived by Jones for the year 1774 and with the current consensus on the total slave value at the eve of the Civil war (namely, about 4 billions current dollars in 1860; see Wahl, 2008).[213]

Finally, government debt figures come from the Historical statistics of the US, 1976, vol.2, pp.1117-1118, series Y493. These figures are for the federal government only, and we have made rough allowances for for State and local debt as follows.[214] Regarding government assets, we assume that they amount to 10% of national income in 1770 and 1810, and 20% in 1850 and 1860.

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[213]Slave prices vary with age, and average prices (including children slaves) have risen from 300-400 in 1800 to 1,000$ in 1860, and from 500-700 to 1,500$-2,000$ for prime age slaves. See, e.g., Fogel and Engerman (1976, 2006), Kotlikoff (1979), Wahl (2008). Annual earnings of free farm laborers rose from about 80-100$ in 1800 to about 170-200 in 1860 (see Historical statistics of the US, vol.1 p.163 series D705-717.) That is, slave prices were about 5-10 years of low skill labor income, probably closer to 7-8. To put it differently, the rate of return was closer to 15% than to 10% (in any case, certainly not 5%). This is consistent with the fact that Kotlikoff finds very high implicit interest rates in slaves sales contract with delayed payments (about 15%-20%). Lindert and Williamson (2011) prefer 8%. According to Historical statistics vol.2 p.1174 series Z166, slave prices were about £40-50 per slave in the 1770s, i.e. about 200$.

[214]Wilkins (1989, p. 32) reports that State debts amounted to $25 million at end 1789, and we use this figure for 1810 (Federal debt appears to have been constant over this period of time, from 54mn in end 1789 – of which 21.6% held by foreigners – to 53mn in 1810). In 1841, Wallis (2000, Table 2 p. 66) reports that State and local debts amounted respectively to 193mn and 25mn, and we use these figures for 1850 and 1860. In 1770 we assume that the overall public debt is 10% of national income.

C Japan

C.1 Official national accounts series

Our national account series for Japan come from the Economic and Social Research Institute of Japan's Cabinet Office, which disseminates both flow and stock series complying with SNA guidelines.[215] We start with the most up-to-date series available in July 2012, which are those included in the 2012 Annual Report on National Accounts (national accounts for 2010). The report provides complete flow and stock data based on 1993 SNA concepts and uses 2005 as benchmark year. Japanese statisticians do not fully revise previous statistics to make them consistent with the most recent ones, so we had to get back to previous editions of the Annual Report to compute our own homogenous 1955-2010 income and 1970-2010 wealth series. We provide below the main steps of this reconstruction; the interested reader will find all the details in our file "Japan.xls."

C.1.1 National income, 1955-2011

The Japanese Cabinet office provides series on both calendar and fiscal year basis; we systematically use calendar-year data. The 2012 Annual Report on National Accounts covers the 2001-2010 period for all series and the 1994-2010 period for the expenditure approach of GDP (private final consumption expenditure, government final consumption expenditure, gross capital formation, and net exports).[216] We report these raw series in the sheet "DataJapan" of "Japan.xls." We extend them to 1980 by drawing on the 2011 Annual Report (national accounts for 2009), which also complies with SNA93 but uses 2000 as benchmark year.[217] For the 1955-1980 sub-period, we use data from the Annual Report of 2000 (national accounts for 1998), which was the last vintage of accounts based on SNA68 (benchmark year 1990). We simply splice the old series onto the most recent ones with appropriate adjustment to ensure

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[215]http://www.esri.cao.go.jp/en/sna/menu.html.
[216]See file "Income_2001_Today.xls".
[217]See file "Income_1980_2009.xls".

continuity.[218]

We include non-profit institutions serving households in the household sector. (As Table JP.6d shows, NPISH account for about 4% of Japan's private wealth). In the housing sector, we only include owner-occupied housing activities, because the data at our disposal do not allow us to add tenant-occupied activities.[219] There are no data on wages paid in the corporate and non-corporate business sectors separately, so we cannot isolate these two sectors in our analysis of the structure of national income.[220] The share of the overall business sector has declined from about 90% of factor-price national income in 1970 to about 80% in 2010, as the housing and foreign sector shares increased.

The three strands of data we use (SNA93 2005 benchmark, SNA93 2000 benchmark, and SNA68 1990 benchmark) are not fully consistent. In particular, there are conceptual differences between SNA68 and SNA93 (e.g., related to the scope of public vs. private entities, the treatment of financial intermediation services, etc.) that introduce a margin of error in our reconstruction of Japan's national accounts. But these errors are mostly irrelevant for the purposes of the present paper. What matter most to us are the saving data, the reconstruction of which deserves a few words.

Though Japanese saving data have often been criticized, and rightly so, we benefit from a great deal of progress made in recent years. The key issue with Japan's saving statistics was that depreciation tended to be under-estimated because it used to be partly based on historical prices (i.e., not adjusted for inflation) rather than current prices (see Hayashi, 1986, p. 150; Dekle, 1991, p. 5). This problem has been addressed: starting with the 2012 Annual National Accounts,

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[218]Prior to 1955, there exist official income data starting in 1930, see Japan Statistics Bureau, Historical Statistics of Japan (bilingual), 1989, volume 3, Section 13-5, for official flow data covering the 1930-1976 period. As there are no similar data for wealth, we have not used these series in the present research.

[219]National accounts state that households' operating surplus covers imputed services of owner-occupied dwellings. Arai (2005, Table 12 p. 19) provides statistics suggesting that imputed rents account for about 80% of all gross rents. Though we have been unable to find any explicit mention of this in official documents, it seems that tenant-occupied housing is included in mixed income.

[220]But there are statistics on compensation of employees, operating surplus, depreciation, etc., by kind of economic activity, see our files "GDPByActivity". These are the data we use for our series on compensation of employees in the government and NPISH sectors (no data before 1970).

the evaluation of the consumption of fixed capital is wholly changed to current prices. In our database, depreciation is actually higher in Japan than in other countries, with depreciation / GDP ratios gradually rising from 15% in 1970s to 20% in the 2000s.[221] Our private sector saving series show a gradual decrease in the private saving rate from about 26% of national income in 1970 to 10% in 2010. Though some inconsistencies remain between the different waves of national accounts (see for instance Horioka, 2008, Figure 1 p. 40), relative to this broad trend, the margin of error is fairly modest.[222]

We also pay special attention to deflators. As Table JP3 shows, there has been a large divergence in the evolution of the GDP deflator, the personal consumption expenditure deflator, and the CPI. Koga (2003) discusses the sources of the discrepancies between the GDP deflator and the CPI. The two key factors are: (i) the relative decline in the price of investment goods (in particular due to quality improvements); and (ii) the differences in index formulas used: the CPI is a fixed-based Laspeyres index (quantities weights are fixed at the base year level), whereas the GDP and the PCE deflators are chain-weighted indexes.[223]

C.1.2   National wealth, 1960-2011

We follow the same procedure for our national wealth series as for national income. We start with the most recent vintage of data, the SNA93 (2005-benchmark) statistics which cover the period 2001-2010, and carefully reconstruct homogenous 1970-2010 series by drawing on SNA93 (2000) and SNA68 (1990) data. Japan has a long tradition of wealth accounting, with complete

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[221]This higher level of depreciation is consistent with Japan's high wealth-income ratio. Expressed as a fraction of book-value domestic wealth, depreciation fluctuates between 2% and 4%, with a U-shaped pattern over the 1970-2010 period. Japanese accounts also use to disregard a considerable fraction of the government's consumption of fixed capital (Hayashi, 1986, p. 151) but this problem has been addressed with the adoption of SNA93.

[222]Note that to minimize errors, we reconstruct pre-2001 corporate retained earnings as the residual of national, government, and personal saving, rather than from data on corporate profits and distributed earnings, which are potentially affected by changes in what statisticians include in the corporate sector.

[223]In 2003, Japanese statisticians still used fixed-based Paasche indexes (quantities weights fixed at the current year level) for the GDP and PCE deflators, but afterwards moved to chain-weighted deflators as other OECD countries. A set of retrospective chain-weighed GDP deflator series was released, starting in 1980. These are the deflators we use.

sectoral balance sheets available from 1970 onward, and national wealth data as far back as 1955 (but with no sectoral breakdown for the 1955-1970 sub-period).

Private wealth

Just like for saving flows, there are old issues with Japan's balance sheets, but a fair number of them have been addressed recently. Dekle (1991, p. 4) mentions one key problem: the under-valuation of households' equities. Non-publicly traded stocks used to be valued at par, hence substantially under-estimated. But this has changed following the adoption of SNA93: unquoted shares are now valued on the basis of the market-to-book ratios, dividend yields, and price-to-earnings ratios observed for comparable quoted corporations, with a 70% illiquidity discount. This method is consistent with those used in most other OECD countries.[224]

Japan is one of the few countries in our sample that provide separate balance sheets for households and non-profit institutions serving households (NPISH). We include NPISH in private wealth. These institutions have a small positive net wealth, which has remained roughly stable as a fraction of national income since 1970 (16% in 1970 vs. 21% in 2010). Including or excluding NPISH has no significant effect on the analysis of private wealth accumulation.

Government and national wealth

We use the same sources for our government and national wealth series as for private wealth. For book-value national wealth, we are able to extend the analysis to 1955 using SNA68 (base-year 1980) national balance sheets. These balance sheets give the value of the various non-financial assets of the domestic economy (as well as the net foreign asset position), but without isolating the different institutional sectors. In contrast to many other countries, detailed estimates of land values available as far back as 1955 (see our files "Land.xls"), in additional to the more common data on fixed assets such as dwellings, equipment, etc. (see our file "FixedAssets.xls").

The balance sheet of the government sector stands out among our sample of countries. While

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[224]See in particular Japan's answer to the OECD's "Questionnaire on the Valuation of Equity in Financial Accounts", available online at http://www.oecd.org/dataoecd/16/23/34661062.pdf.

government financial assets usually do not exceed 50% of national income, in Japan they reach 125% in 2010. Non-financial assets are also particularly high (150% of national income, vs. 50-100% in other countries). And on the other side of the balance sheet, gross liabilities amount to more than 250% of national income, again much more than elsewhere (about 100% in most other countries). Why are Japan's public debts and assets so high?

Starting with financial assets and liabilities, four factors matter a great deal. First, gross government asset and liability figures are inflated because foreign exchange reserves are on the government balance sheet rather than on the central bank's. In 2010, the government's foreign assets were about 30% of national income. Typically, when the Ministry of Finance wants to increase its foreign exchange holdings by X, it issues X in new debt that will be held by the Bank of Japan, and uses the newly created yens to purchase X in foreign assets.[225] In other countries such as Switzerland and China, the central bank is the holder of the reserve portfolio and official purchases of foreign assets only affect the gross positions of the central bank, not that of the government.

Second, in Japan a large part of government intervention in the economy takes the form of borrowing and lending ("fiscal loans") rather than taxation and spending. In particular, the government runs a large program of lending to small and medium corporations, public companies, and local government, known as the fiscal investment and loan program (FILP).[226] The loans are granted by the Fiscal loan fund, a public financial company (not part of the government sector) but the fund contributes to increasing the government's financial assets and liabilities, because the government borrows to finance it.[227] Third, a sizable fraction of

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[225]So the liabilities of the government (to the BoJ) increase by X (newly government bond issued), the government's assets increase by X (foreign assets), the BoJ's assets increase by X (government bonds), and the BoJ's liabilities increase by X (money created to finance the asset purchase). In practice the foreign assets are purchased from domestic banks, so the BoJ's liabilities are mostly held by domestic residents (foreign banks hold about 10% of the current account balances at the BoJ, see "BoJ current account balances by sector", https://www.boj.or.jp/en/statistics/boj/other/cabs/index.htm).

[226]Similar programs in other countries are much smaller and include Oseo and Caisse des Depots et Consignations in France, the Small Business Administration in the U.S., Kreditanstalt für Wiederaufbau (KfW) in Germany, etc.

[227]The two major funding source of the Fiscal loan fund are FILP bonds issued by the fund (not part of the public debt) and government deposits. As of the end of March 2010, the central government held 20 trillion

government bonds are held by social security funds and other government entities.[228] Fourth, the government owns a fairly large amount of shares in public corporations (114 trillion yens in 2010, i.e. about 30% of national income). Foreign exchange reserves, fiscal-loans-related claims, intra-governmental holdings of public bonds, and equities in public companies each amount to about 30% of national income in 2010, and together account for virtually all of the government's financial asset. Intra-governmental and central bank holdings of public debt also account for about one-fourth of the overall public debt (i.e. 60% of national income out of 250% in 2010).

Another fourth of the total public debt is held by public financial companies, such as Japan Post. As a result, the public debt held by the private sector is only half the total public debt.[229] Of course public financial companies in turn have large liabilities towards the private sector (i.e., household deposit at the Post), so consolidating them with the government sector would not significantly improve the net position of the government. But the large holdings of government debt by public companies arguably make it easier for the government to borrow; they also explain the many controversies surrounding the project of privatizing Japan Post.

As regards the high level of non-financial assets, they are in line with the large public investment rates recorded over 1970-2010 (3.4% of national income on average), which are two to three times higher than in other rich countries. In the end, the net position of the Japanese government is close to 0, which is comparable to most of the other countries in our database.

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yen in deposits with the Fiscal Loan Fund and social security funds (which are part of general government) an additional 24 trillion. In 2010, fiscal loans amounted to 162 trillion yens (42% of national income, see FILP annual report 2012, p. 37.

[228]Social security funds held 75tr in central government securities as at the end of March 2010 and the central government held close to 25tr in Treasury discount bills, so that overall intra-governmental holdings of public debt securities amounted to about 100 trillion yen, i.e. more than 25% of national income.

[229]Specifically, in round figures, the government had 1,000tr yens in liabilities (about 250% of national income) as of the end of March 2010, of which 200tr were held by the central bank and the government itself (see above discussion). This leaves 800tr of debt "held by the public" (about 200% of national income). Of these, public financial companies held 100tr in loans and about 200tr in bonds.

C.2 Historical national accounts

Official national income data start in 1930.[230] The first non-official estimates of income appear to data back to 1900 (see Studenski, 1958, p. 497 for references). However, prior to the beginning of the official balance sheets in 1955, we have not been able to find reliable estimates of national wealth.

D Germany

D.1 Official national income and wealth series, 1991-2011

National income

Post-1991 series come from the official national accounts compiled by Destatis (the official statistical institute). Regarding national income and its components, we use the 2012 edition of Destatis Annual Sectoral Accounts.[231] This publication contains the full sequence of sectoral accounts in line with the ESA 1995 standard.[232] We use it with no modification whatsoever.

To analyze the distribution of factor income, we assume that the distribution of labor and capital income is the same in the non-corporate business sector as in the corporate sector. The German case is a good illustration of the pitfalls of standard practices for computing capital shares in the non-corporate sector. Since unification, net mixed income has been decreasing (from 10% of national income in 1991 to 7% in 2011) while the number of self-employed has been increasing (from 9% to 11% of the total employed population), so that in 2011 the average mixed income per self-employed is smaller than the average wage of salaried workers. As a result, should one assume that the self-employed earn the economy-wide average wage, then one would obtain negative capital shares (net of depreciation) in the non-corporate sector.[233]

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[230]See Japan Statistics Bureau (1989), *Historical Statistics of Japan*, Volume 3, Section 13-5.

[231]Destatis (2012), "National Accounts. Sector accounts, annual results 1991 onwards", released in February 2012. See our file "Income_1991-Today.xls".

[232]Additional yearly series are provided in a publication in German, Destatis (2012), "Volkswirtschaftliche Gesamtrechnungen", Fachserie 18 Reihe 1.4, released March 6, 2012. The raw data are also included in our file "Income_1991-Today.xls".

[233]The problem is only magnified when one tries to attribute sector-specific wages to the self-employed, since the self-employed tend to be in relatively high-wage sectors. Using EU-KLEMS data, we find that attributing

One likely explanation is that the flow of mixed income is under-estimated. As Askenazy, Cette and Sylvain (2011) note, the vast majority of German's corporations (about 80%) are small and medium companies that take the form of partnerships. These partnerships pay dividends to their partners. Some of these dividends include a labor income component – the implicit compensation of small and medium business managers/owners – and so should logically be treated as mixed income. But they are not, because partnerships are included in the corporate sector, not in the household (non-corporate) sector.[234] As a result, the flow of corporate dividend payments is in a sense somewhat over-stated.[235] The same logic is also at play in Italy where the network of small and medium enterprises is also very dense, and probably explains in part why the flow of dividends paid out is so much higher in these two countries than elsewhere in our sample.[236]

National wealth, 1991-2011

For national wealth, we use the 2012 edition of the Destatis sectoral balance sheets, which cover the period from January 1st, 1992 to January 1st, 2012.[237] The Bundesbank provides a finer breakdown of each sector's financial assets and liabilities in its quarterly financial accounts. We use the Bundesbank data to provide additional information on the composition of private wealth in Table DE.6c and DE.6d.[238] Since the Bundesbank financial accounts are slightly more up to date than the Destatis balance sheets, there is a very small discrepancy between

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sector-specific wages implies a wage bill of 189bn euros for the self employed in 2007, while net mixed income was only 163.5bn that year.

[234]Note that at the same time, partners and proprietors who only earn dividends will be correctly counted as self-employed in labor force surveys, so while mixed income is under-estimated, the number of self-employed is not.

[235]In addition, many of Germany's partnerships opt for the individual rather than the corporate income tax. Compared to a situation in which all corporations pay the corporate income tax and dividends are paid out after payment of the corporate tax, this also tends to inflate the flow of dividend payments in national accounts, as the partners use part of their dividends to pay the taxes of the partnership.

[236]In 2010 for example, distributed corporate profits amount to 11-12% of national income in Italy and Germany, vs. 4-5% in France and the U.S. In the 1980s, this flow was as high as 20% in Italy.

[237]Destatis (2012), "Balance sheets for the institutional sectors and the total economy, 1991-2011", released in September 2012 and downloaded in October; see our file "Wealth_1992-Today.xls".

[238]Financial accounts released and downloaded in October 2012. The raw data with the exact series code are also in our file "Wealth_1992-Today.xls".

the two sources for the most recent years.[239] The balance sheets will ultimately be updated to incorporate the revisions made in the financial accounts. Destatis does not yet publish flow-stock reconciliation accounts, so for Germany there are no "other volume change" statistics as in the U.S. and some other countries.

The national balance sheets of Germany are still in their infancy. The first comprehensive balance sheets were released in 2010. (Initial results for the 1991-2005 period were presented in 2008). While they follow the international guidelines, Germany's balance sheets have known shortcomings.[240] This has led us to make two minor modifications to the raw data.

First, inventories (AN.12 in ESA95), valuables (AN.13), land other than underlying buildings and structures,[241] subsoil assets (AN.212), non-cultivated biological resources (AN.213) and water resources (AN.214) are not yet included. These gaps are generally of secondary importance – overall, these assets account for about 7% of national wealth in France. The only non-trivial gap is land under cultivation. We upgrade the balance sheets accordingly.[242]

Second, we have corrected the data for the rest of the world sector. There is a sizable discrepancy between the foreign assets and liabilities reported in Destatis balance sheets and in the Bundesbank international investment position. At end 2011, the balance sheet reports gross foreign assets of €5,858bn and liabilities of €5,420bn, hence a net foreign asset position of €438bn. In the Bundesbank's international investment position, gross foreign assets reach €6,555bn, liabilities €5,710bn, and the net position is €845bn, that is, about 20% of national income larger. Although we have not been able to find any clear explanation for this

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[239]For the household sector, we replace the financial stock data in the balance sheets by the Bundesbank series, since the latter are slightly more up-to-date. This explains the tiny discrepancy between our wealth figures and the Destatis series.

[240]An article in the January 2008 Bundesbank Monthly Report provides useful methodological details: Deutsche Bundesbank (2008), "Integrated sectoral and overall balance sheets for Germany", Monthly Report, January 2008, vol. 60, no 1, pp.31-45.

[241]i.e., land under cultivation (AN.2112), recreational land and associated surface water (AN.2113), and other land and associated surface water (AN.2119).

[242]Specifically, we assume that cultivated land (both in the corporate and household sector) is worth 9 times the value of cultivated fixed assets (which are recorded as produced fixed assets in the balance sheets), which is approximately the ratio observed for France over this time period. See detailed computations in Data.DE2. We do not try to upgrade corporations' balance sheets to include inventories, which can be large – about 25% of national income in France.

discrepancy, plausible reasons include different valuation methods for non-listed equities (e.g., direct investments at book vs. market value) and the treatment of derivatives. Derivatives have been included in the IIP in 2010, but not yet in the external sector's balance sheet. Looking forward, it seems likely that Destatis balance sheets will be upgraded in order to match the IIP. Accordingly, for the rest of the world sector we use the IIP rather than the balance sheet (one additional advantage of the IIP is that it goes back to 1950). We make no correction to the reported private and government wealth data. The fact that Destatis balance sheets seem to understate Germany's external assets does not imply that they understate private and government wealth.[243]

Some other problems likely exist in the official German national accounts, for which we chose not to modify the official data. We briefly mention three of them below.

First, the value of land underlying buildings and structure is largely based on estimates, rather than detailed, census-like methods as in most other countries. The Bundesbank suggests these estimates may be downwards biased.[244] This might partly explain why the aggregate stock of real estate seems a smaller fraction of national income in Germany as in the other European countries in our sample. There is, however, no simple way to know the magnitude of the potential bias, and so we have not made any correction to the reported figures. We do not

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[243]If the whole difference between Destatis' and the Bundesbank's data for the external sector comes from the valuation of foreign direct investments, then the discrepancy does not affect household and government wealth, because households and the government have no (or very little) foreign direct investments. But the discrepancy probably affects our measure of Tobin's Q, as Destatis may understate corporations' gross assets (and to a lesser extent their gross liabilities). If the difference between Destatis' and the Bundesbank's data for the external sector do not only come from valuation of foreign direct investments, then the private and market-value national wealth series we report in Table DE.6a may also be under-estimated – by a maximum of 20% of national income in 2010.

[244]See the Bundesbank monthly bulletin quoted above, p. 41: "the valuation of building land areas are based on price information for new land for building development and therefore ignore possible price differences with regard to land that has already been built on. For this reason, the results with regard to market values are to be seen more as a lower limit." The estimates for building land rely on three key inputs. First are quadrennial census data on the total surface area of land by type of use (building, undeveloped, recreational, agricultural, forest) reported in Destatis' "Land- und Forstwirtschaft, Fischerei" (Fachserie 3 Reihe 5.1). There are no data before 1992. Second are statistics on the purchase values or building land, reported in Destatis' "Preise Kaufwerte für Bauland" (Fachserie 17 Reihe 5), which exist since 1964. Third are statistics on construction prices, reported in Destatis' "Preisindizes für die Bauwirtschaft" (Fachserie 17 Reihe 4). It is not entirely clear from the Bundesbank article how exactly these three data sources are combined to estimate the market value of German real estate.

believe that the bias is large, as survey data (which do not suffer from the same problems as the balance sheets) also indicate that the real estate capitalization is relatively low in Germany.[245]

A second issue with Germany's official data is the treatment of capital transfers. On average, capital transfers amount to more than 1% of GDP each year. As in other countries, we systematically include capital transfers in our measure of saving. This augments Germany's private saving flow by about 15%. There is, however, a huge capital transfer from the government to the private sector in 1995, when the government takes over the liabilities of Treuhand, the agency in charge of privatizing the East German enterprises. The government pays €125bn in "other capital transfers" and non-financial corporations receive the same amount. In principle, the liabilities of the government should increase by €125bn, and those of the private sector decrease by the same amount. However, this is not what we observe. The transfer does not apparently affect the financial position of the government.

The Treuhand operation explains why the private saving rate – including capital transfers – reaches 19% in 1995, vs. 10% on average around 1995. Should we use a 10% figure for 1995, the decomposition of capital accumulation into volume and capital gains effect would not change much. Over the 1991-2010 period, saving flows would account for 102% of capital accumulation rather than 107%; see Table DE.5a. Accordingly, even though the recording of capital transfers looks somewhat suspicious in 1995, we do not make any correction to the raw data.

Lastly, there are long standing difficulties with the measurement of "other equity", namely shares in GmBHs, cooperative societies, and other partnerships. These types of corporations are very common in Germany but until the adoption of ESA95 German statisticians did not estimate at all the value of their equity. Today, the Bundesbank still considers that its other equity estimates are "very tentative."[246] So in our view, it is entirely possible that currently published financial accounts substantially under-estimate the market value of the equities of

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[245]The relatively low German wealth-income ratio is also found in the Panel survey on Household Finances (PHF). See Kalckreuth et al. (2012) for a presentation of the PHF. A first analysis of the survey results was published (in Germany) by the Deutsche Bundesbank in March 2013.

[246]See Deutsche Bundesbank, "Financial Accounts for Germany 1991 to 2009", Special Statistical Publication 4, June 2010, p.12.

many German companies. This might partly explain why Tobin's Q is so low (about 0.5), and also why the financial wealth of German households appears relatively low.[247]

D.2 How we have dealt with territorial changes, 1870-1991

Constructing homogeneous national income and wealth series before 1991 is complicated by the numerous territorial changes Germany has experienced since 1870. Before describing the sources we use to build our 1870-1990 series, it is useful to clarify how we deal with territorial changes.

A first set of tables (Tables DE.1, DE.2, DE.3) does not make any correction for territorial change. Population and income levels in these tables simply refer to the boundaries of the time. That is, data for 1871 refer to the Reich including Alsace-Lorraine; data for 1923 to the post-Versailles-treaty Germany;[248] data for 1940 to the Reich including annexed territories (Austria, Sudetenland, and part of present-day Poland), data for 1945 to the territory occupied by the Allied Powers and USSR (the same territory as post-1991 Germany); data for 1950 to West Germany only (including Saarland and West Berlin); and data for 1991 to reunified Germany.

Table DE.3b provides basic corrections aimed at purging the evolutions of income and population levels from the effect of territorial change. All subsequent tables rely on these corrections, unless otherwise noted. The goal of the corrections is to construct a hypothetical German territory that is not affected by border changes. Over the sub-periods ranging from 1871 to 1918, 1923 to 1934, 1945 to 1949, 1950 to 1990, and 1991 to 2011, real national income and population growth rates in this hypothetical Germany reflect the trends within the fixed borders of the epoch. Then specific adjustments are made for growth rates in 1871, 1919-1923, 1935-1945, 1950, and 1991 to exclude the effect of territorial change.

More precisely, in 1871 the population of the whole Reich grows 4.5%, but 4.0% are accounted for by the inclusion of Alsace-Lorraine. Excluding Alsace-Lorraine population grows 0.5%. We

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[247]In 2010, the financial wealth of households and NPISH was about 210% of national income in Germany, the lowest level in our sample (230% in France; 286% in Italy; about 330% in the U.K. and U.S., and up to 400% in Japan).

[248]Germany lost a number of territories in 1919-1923, see below.

assume a similar per capita real income growth in Alsace-Lorraine as in the Reich (-0.4%), so that excluding Alsace-Lorraine real national income grows 0.1%.

Population in mid-1923 Germany is 7.6% less than population in mid-1918 Germany. In this period Germany loses Alsace-Lorraine, Memel, Danzig, Eupen and Malmedy, Saarland, North Schleswig, and Eastern Upper Silesia. Maddison (1995, p. 131) reports that these territories had a population of 7,330 thousands in 1918 out of a total of 66,811 thousands within the 1918 borders. So territorial losses cause a 11% population drop relative to 1918. Abstracting from these losses, German population should have grown (1-0.076)/(1-0.11)-1= 3.8% between 1918 and 1923. This is what we report in Table DE.3b.[249] We assume that per-capita income was the same in the truncated territories as in the Reich.[250] Consequently, the real growth rate of national income keeping borders fixed is equal to the real growth rate of per-capita income (within the changing borders of the time) times population growth (keeping borders fixed).

In 1935, the Reich regains Saarland, adding 1.8% to population and income. Abstracting from this, population grows 0.7% (Maddison, 1995) and real national income 10.4%.

For the 1938-1945 period, we report in Table DE.3b population growth rates that disregard the annexation of Austria and Sudetenland in 1938, of Wartheland, Dantzig West-Prussia, East Prussia, and Silesia in 1939, and of Bohemia and Moravia in 1940, as well as the loss of all territories East of the Oder-Neisse line in 1945. For 1938 and 1939, constant-border population growth figures are given by the Statistical Yearbook and reproduced in Hoffmann and Muller (1957). Figures for 1940 (+0.8%) and 1945 (+2.7%) come from Maddison (1995). We assume again that per-capita income is the same all over the Reich.

In 1950, East and West Germany are officially split. In 1949, East Germany had a population of 18,900 thousands (Ritschl and Spoerer 1997, p. 53). West Germany had about 49,813

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[249]We use the yearly 1918-1923 population growth figures of Maddison (1995, p. 104). Note that Maddison reports a 3.5% 1918-1923 population growth corrected for territorial change (rather than the 3.8% we compute using the same raw data), so we adjust Maddison's 1922 population growth accordingly (from 0.5% to 0.8%.)

[250]Strictly speaking, this is probably not true. Maddison (1995, p. 131) calculates that in 1913 per capita income was 2.4% higher in the truncated area than in the former Reich. This is negligible difference given our purposes in this research.

thousands inhabitants including Saarland and West Berlin (46,169 thousands excluding these areas). So the breakup of Germany causes a 27.5% population drop (18,900/(49,813+18,1900)). Population on the West German territory alone grows about 2% (Ritschl and Spoerer 1997, p. 53). Further, we know from the same source that real national income in West Germany grows about 12.5%. This is all we need to make our 1950 adjustment: should borders have remained the same, population would have grown 2% and real income 12.5%.[251] Here we don't have to assume that per capita real income is the same in the East and the West (a blatantly false assumption), since we have separate data on Eastern and Western incomes. Our adjustment implies that the division of Germany causes a mere 16.6% income drop (vs. 27.5% population drop), consistent with available evidence that in 1950 per capita income was already much lower in the East.

The last adjustment is for 1991. In 1990, population in East Germany was 16,111 thousands and population in West Germany 62,254 thousands (Ritschl and Spoerer 1997, p. 53). So unification means a 16,111/62,254=25.5% population increase. But Maddison (1995) reckons that between 1990 and 1991, population in West Germany alone grows 0.8%. Further, the Bundesbank reports that real GDP growth was 5.1% in the West. Because East Germany is poorer than West Germany, unification increases income by 8.1% only.

From Table DE.3b on, all the level data (e.g., population and national income) are corrected to exclude the effect of territorial changes. All the other data we report for Germany – such as saving rates and wealth-income ratios – reflect the economic situation within the boundaries of the time. That is, the 1970 wealth-income ratio we report in all our tables is the ratio observed in West Germany; the 1995 ratio is the one in unified Germany. We do not attempt to estimate saving and wealth in East Germany. Available evidence suggests that the private wealth-income ratio was lower in the East than in the West in 1990,[252] so in effect there is a

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[251]So per capita real income would have grown 10.3%, a bit more than in Barro-Ursua (7.3%) but much less than in Maddison (18.2%).

[252]Table DE.6g reports data from the Bundesbank suggesting that the private β was about 138% in East Germany in January 1991, vs. about 290% in West Germany. See Deutsche Bundesbank (1999), "Changes in households' asset situation since the beginning of the nineties", Monthly Report, January 1999 (see p. 45).

slight discontinuity in our wealth-income ratio series in 1991. However, this is not a concern for our analysis, because East Germany is very small, in economic terms, compared to West Germany. Unification means a population increase of 25% for West Germany, but a national income gain of about 8%, and a private wealth increase of less than 4%, so that practically there is little discontinuity in 1991. We find that West Germany's wealth-income ratio was about 290% in 1990, that reunified Germany's was 284% in 1991, and we estimate a residual capital loss of -2.1% in 1991. Importantly, (i) unification cannot explain the significant amount of capital losses on German wealth for the 1970-2010 period; (ii) our method to deal with border change is consistent at the flow and stock levels: in 1950-1990, both saving rates and wealth-income ratios reflect the situation in West Germany; from 1991-on both reflect the situation in reunified Germany.[253]

D.3   National income and wealth, 1950-1991

For the 1950-1991 period, we use the official national income accounts compiled for West Germany by the Statistiches Bundesamt / Destatis. The two key sources are (i) for the 1970-1991 period, the continuously updated annual accounts in euros published by Destatis (in German) and available online;[254] (ii) for the 1950-1970 period, the retrospective 1950-1991 accounts in Deutsche Marks published in 1991 by the Statistiches Bundesamt.[255] Data for 1950-1970 are not updated anymore. We use these official publications with no modification whatsoever.

Another Bundesbank article provides data for the government and corporations: Deutsche Bundesbank (1998), "Overall financial flows in 1997", Monthly Report, May 1998, p. 33. For more details, see Table DE.6g

[253]An alternative method to deal with unification would have been to compute saving and wealth series for East Germany in order to explicitly account for the relatively slower growth of private wealth in the East over the 1950-1990 period. However, this is fraught with difficulties given the poor quality of available national accounts data in East Germany (which were based on the material planning system rather than the U.N. System of National Accounts). See Merkel and Wahl (1991) for a tentative reconstruction of East Germany's income in the SNA framework.

[254]Destatis (2012), "Volkwirtschaftliche Gesamtrechnungen. Inlandsproduktsberechnung, Lange Reihen ab 1970", Fachserie 18 Reihe 1.5, released 6 March 2012 – our file "Income_1970-Today.xls". Supplementary series for the 1970-1991 period can be found in Destatis' Fachserie 18 Reihe S. 29, released August 2006 – our file "Income_1970-1991.xls".

[255]Statistiches Bundesamt (1991), "Volkswirtschaftliche Gesamtrechnungen 1950-1990: revidierte Ergebnisse," Facheserie 18 Reihe S. 15. The exact page numbers of the raw series we take from this paper publication are carefully documented in the sheet DataDE1b of "Germany.xls".

There are no official balance sheets covering the 1950-1991 period. But constructing reasonably accurate 1950-1991 wealth series does not pose major difficulties, for one simple reason: comprehensive financial accounts, by sector and by instrument, have been published by the Bundesbank since 1950.[256] In order to obtain complete balance sheets, we only need data on non-financial assets. For the household sector, we use the carefully documented estimates of Baron (1988). Baron put a great deal of effort to estimate current market values for German household wealth, based on wealth tax data. Non-financial assets tended to be taxed below their current market values, as the tax laws used supposedly "intrinsic" values (*Einheitswerte*) to assess wealth – and *Einheitswerte* were seldom updated. Baron provides detailed corrections to deal with the under-valuation of non-financial assets in tax returns, and we use his final estimates with no modification whatsoever (Baron, Table 31 p. 159-160).[257] For the government and the corporate sectors, we compute non-financial assets as the sum of fixed assets (machinery and equipment, dwellings, other buildings and structures, cultivated land, and intangible

[256]Complete flow and stock accounts for the 1950-1959 period are in Deutsche Bundesbank (1983), "Revidierte Ergebnisse der gesamtwirtschaftlichen Finanzierungs- und Geldvermögensrechnung für die Jahre 1950 bis 1959". Complete accounts for the 1960-1992 period are Deutsche Bundesbank (1994), "Ergebnisse der gesamtwirtschaftlichen Finanzierungsrechnung für Westdeutschland 1960 bis 1992". One peculiarity of early German financial accounts is that data published before 1998 used to isolate a separate "real estate" sector. This sector had little financial assets but large liabilities, namely mortgages contracted by households. It is important to always add the real estate sector's liabilities to households' liabilities, which is what the Bundesbank has been doing since 1998. For more details on this methodological point, see: Deutsche Bundesbank (1999), "Changes in households' asset situation since the beginning of the nineties," Monthly Report, January 1999, pp. 33-50. Another issue with the older accounts is that equity in private limited companies (GmbH), cooperative societies, and partnerships, was not recorded. We have upgraded the old accounts accordingly, on the basis of the amount of private equity holdings recorded in the new financial accounts.

[257]Baron reports on the value of households' non-financial assets net of liabilities (agricultural wealth – "Land- und fortswirtschaftliches Vermögen" – and real estate – "Grundvermögen"), financial assets (business assets – "Gewerbliches Reinvermögen" – and other financial assets – "Sonstigen Vermögen"), and liabilities (related to agricultural assets, to real estate, to business assets, and other liabilities). To compute households' gross non-financial assets, we add net agricultural wealth, net real estate, agricultural liabilities, and real estate liabilities. In 1953 for instance these items sum to DM 210.2bn, i.e., €107.5bn. This is the value we report in Table DE.6f, which presents the available raw historical estimates for German wealth, and this is the value that underlies our 1953 wealth-income ratio. Baron provides data for the beginning of 1953, 1957, 1960, 1963, 1966, 1972, 1974, 1977, and 1980. We fill in the gaps by linear interpolation. For the financial part of household wealth, Baron's data are usually fully consistent with the Bundesbank's official accounts, and we use the Bundesbank series. The only notable discrepancy is for debt. In 1980, household liabilities amount to €408bn as per the Bundesbank, but about €200bn as per Baron. This discrepancy explains why we find slightly lower total net household wealth than Baron.

fixed assets) and land underlying buildings and structures. We use data provided by Destatis on the value of fixed assets in the West German economy by sector and by type of asset, net of depreciation.[258] For land, there are no official data before 1991. We assume that land is worth 15% of the government's net-of-depreciation fixed assets throughout the period, the ratio prevailing in 1991. For the corporate sector, we assume that land follows the evolution of the net-of-depreciation value of dwellings. There is some margin of error involved here, so we do not attempt to provide pre-1970 data for the corporate sector.

D.4 National income and wealth, 1870-1950

There are no homogeneous official income statistics prior to 1950. We rely on non-official historical estimates.

D.4.1 National income and wealth, 1870-1914

National income, 1870-1914

For the period from 1870 to 1914, all our income data come from the 842 pages book by Hoffmann (1965), the reference work on historical German income and wealth, used by Maddison and many other scholars. There are known issues with Hoffmann's sometimes ill-documented series, and a whole literature has tried to improve upon them (e.g., Fremdling 1988). One problem is the large discrepancy between the different measures of national income in 1850-1870.[259] The available raw sources for this period are scant, and there is no reason to feel

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[258]1950-1988 series for the private sector's fixed assets and part of the public sector's are in Statistisches Bundesamt (1991), "Volkswirtschaftliche Gesamtrechnungen. Vermögensrechnung 1950-1991," Fachserie 18, Reihe S. 17, Wiesbaden. 1970-1991 series for the whole economy by type of assets are found in Destatis (2006), "Volkswirtschaftliche Gesamtrechnungen 1970 bis 1991," Fachserie 18, Reihe S. 29. The data in these two publications are gathered in our file "FixedAssets_1950-1991.xls". Additional data for the public sector for the 1950-1991 period are found in Statistiche Bundesamt (1991), "Volkswirtschaftliche Gesamtrechnungen. Revidierte Ergebnisse 1950 bis 1990," Facheserie 18 Reihese S. 15, as well as in various issues of the Statistical Yearbook (e.g., the 1978 Yearbook pp. 503 sq gives reproducible tangible assets by type of asset and sector for the 1970-1977 period). The exact references to the raw series and the minor adjustments made to them are precisely described in the sheets DataDE2 and DataDE2b.

[259]Burhop and Wolff (2005) provide a careful discussion of the various available historical national accounts. One of their key conclusion is that Hoffmann (1965) tends to under-estimate national income in the 1850s-1860s (hence to over-estimate growth over the 1850-1913 period. From 1870-on, the discrepancy between the various

more confident in any specific measure, so we discard pre-1870 data altogether.[260] Then, among the three measures of national income (output-, expenditure-, and income-based), we retain Hoffmann's expenditure-based. Burhop and Wolff attempt to make a number of improvements to this series, but they turn out to be quantitatively minor (see Burhop and Wolff 2005, Figure 6 p.626). In 1870-1913, the three measures of national income in Hoffmann closely track each other.[261]

One advantage of Hoffmann's expenditure-based income series is that they provide a readily usable decomposition of income into consumption, investment, and net exports. We directly use this decomposition with no adjustment whatsoever to compute national saving S in 1870-1913: $S = I + X - M + FY + FT$ (see Table DE.12b).

Regarding factor income shares, we provide a tentative decomposition on the basis of Hoffmann's data. We find that the capital share gradually increase from the 1870s to the eve of World War I, from about 20-25% of national income to 30%.[262]

National wealth, 1870-1914

There have been numerous attempts at estimating Germany's national wealth. The data are relatively reliable, for one key reason: a wealth tax has long been levied in Germany, first by the German States, later on by the Reich and the Weimar Republic. The first study of national wealth appears to be Krug's (1805), followed by Dieterici's (1846). Adolf Wagner (1903) was the first to publish comprehensive statistics on German income and wealth derived from tax data, followed by Steinmann-Bücher (1909). The best-known early work is the well-documented

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sources is more modest (Burhop and Wolff, 2005, Figure 1 p.616).

[260]We do, however, report Hoffmann's raw series as far back as 1850 in the sheet DataDE1c.

[261]Maddison (1995) uses Hoffmann's output-based measure of income, which explains why he reports slightly higher growth in per capita income over the 1870-190 period (1.5%) than we do (1.3%). Barro and Ursua (2010) use Burhop and Wolff's compromise estimate of income, obtained by averaging the three Hoffmann series and the income in Hoffmann and Muller (1959), and find 1.4% per capital growth in 1870-1910. It is impossible to know whether the true per capita growth rate was 1.3%, 1.4%, or 1.5%, and this is irrelevant given our long run focus. What matters is that over the entire 1870-2010 period, we find a real growth rate of per capita income of 1.7%, just like Maddison.

[262]Whether the low capital share obtained by Hoffmann in the 1870s-1880s is robust is a bit unclear – Hoffmann, in particular, finds a suspiciously low capital share of agricultural output (10%) in the 1870s, vs. 20-25% just before World War 1. This issue would deserve to be further investigated.

book by Helfferich (1913), then Director of the Deutsche Bank.[263] There was little research on wealth in the interwar; interest in the subject picked up with the work of Hoffmann (1965) and Goldsmith (1976).

The above-mentioned studies have different goals and rely on heterogeneous methods, while we are mainly interested in the market value of national wealth, which includes all the non-financial assets (fixed assets plus land) and the financial assets and liabilities of the household and government sectors. Accordingly, we start with modern concepts and data to compute our own national wealth series, and we then check the consistency of our series with the numerous estimates of the time.

Specifically, we first compute private wealth as the sum of the private sector's fixed assets, land, financial claims on the government, and Germany's net foreign assets. Net-of-depreciation fixed asset data come from Hoffmann (1965, Table 40 p.255), and are the sum of agricultural fixed assets, business assets, and houses. Land values are also from Hoffmann (1965, p.234). We assume that the whole public debt is held by the domestic private sector. The amount of public debt outstanding comes from the retrospective 1876-1975 statistical compendium of the Bundesbank, the reference primary source for the financial history of Germany.[264] The net foreign asset position comes from Hoffmann (1965, Table 43). The Reich starts with a roughly 0 position in 1870; by 1913, it has accumulated about 20bn marks in net foreign claims, i.e. about 40% of national income.[265] The resulting private wealth-national income ratio is in the 600-700% range throughout the 1870-1914 period.

To compute national wealth, we add the net wealth of the government. Available evidence

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[263]See Stamp (1919) and Eddie (1999) for more details on the early national wealth estimates in Germany.

[264]Deutsche Bundesbank, *Deutsche Geld- und Bankwesen in Zahlen 1876-1975*, Frankfurt: Knapp, 1976, 364p. We take the total debt of the public sector, i.e. of the central government, regions, and municipalities. Before 1876, we use the public debt series of Hoffmann (1965, Table 225). For pre-1876 public debt series, see Spoerer (2010), who provides in particular debt ratios for 19th century Prussia. The public debt seems to have followed a U-shape pattern, starting at about 40% of GDP in 1815, down to about 10% in the middle of the century, and back to 40%-50% at the end of the century. See data available online at http://www.esfdb.org/Database.aspx.

[265]There are many estimates of German foreign assets for the pre-World War I period, some of which are slightly higher – i.e., some authors have up to $6.25bn dollars in assets in 1913-1914 (26.25bn marks, 50% of national income). Keynes (1920, ft. 122) discusses the available estimates and considers that the most likely figure is $5bn, or about $20bn marks – which is the figure provided by Helfferich, net of foreign liabilities.

suggests that the government gradually accumulated a sizable amount of assets, from about 70% of national income in 1870 to close to 100% on the eve World War I. Unlike most other countries, in particular, most railways were publicly owned; their assets alone amounted to about 40% of national income in 1913.[266] As assets increased so did public debts: using the 1876-1975 compendium of the Bundesbank, we find that government liabilities gradually rose from 20-30% of national income in the 1870s to about 60% of national income on the eve of World War I.[267] This finding is consistent with Abbas et al. (2001) and Reinhart and Rogoff (2011). These authors, however, seem to discard municipal debt, i.e. they seem to only take into account the debts of the Reich and the Länder.[268] In any case public debt appear to be smaller than the government's assets before World War I, so that the government's net wealth is positive throughout the period (30%-60% of national income).

In the end, by our estimate national wealth is about 640% of national income on the eve of World War I (1910-1913), with private wealth accounting for 95% (610% of national income) and government wealth for the remaining 5% (30% of national income). This is close to the level found for the U.K. and France at the same time. If anything the U.K. and French national wealth-national income ratios seem to be slightly higher (closer to 700%), which could be explained by higher income growth in Germany in the late 19th and early 20th century, itself

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[266]Our data on the government's assets come from Hoffmann (1965, Table 40 p.255). We sum public buildings ("öffentliche Gebäude"), and public constructions ("öffentlicher Tiefbau"), net of depreciation. We also add the fraction of railways ("Eisenbahnen") owned by the government. As Wengenroth (2000 p. 106) reports, about 50% of railways were publicly owned in the mid-19th century; this fraction rose to 56% in 1870, 82% in 1880, and more than 90% in the early twentieth century. By construction, Hoffmann's series for the government's assets are consistent with his data for public investment, since his assets figures are simply constructed by cumulating net constant-price investments. Hoffmann's average net public investment rate is 2.7% in 1870-1913 – which is similar to the average real national income growth rate, hence consistent with an asset/income ratio s/g of about 100%. Note that government assets were probably even a bit larger than this, as the states owned a sizable fraction of land (about 10-15%, see Wengenroth, 2000, p. 104).

[267]In the early 1870s government debt decreases from about 30% to 20% of national income because of the transfer payments made by France.

[268]The Bundesbank reports that municipal debt (bonds issued by municipalities such as Berlin, Köln, etc.) increased from 5% of national income to about 20% in 1913. This fact explains why we find a total public debt of about 60% of national income in 1913 vs. 40% in Reinart-Rogoff and Abbas et al., and why our public debt series increases somewhat more rapidly in 1880-1913. Both Reinhart and Rogoff (2011) and Abbas et al. (2011) take their date from Flandreau and Zummer (2004) rather than from the retrospective 1876-1975 statistical compendium of the Bundesbank, as we do here.

largely due to faster population growth.

Contemporary pre-World War I estimates of German national wealth

Table DE.6f reports the raw wealth estimates obtained by the economists of the time. We use these figures to check the reliability of our own private and national wealth series and to provide further decomposition of the structure of national wealth. Consistent with our own computations, all contemporary estimates consistently suggest that national wealth was in the vicinity of 650% of national income prior to World War I, with fairly modest variation across authors.

Steinmann Bücher (1909) reports 330-358bn Marks in national wealth for 1909, including consumer durables (see Ronce, 1917, p.362). Excluding durables, national wealth is about 320bn Marks, i.e. about 725% of national income. This is somewhat more than what we find for that year (662%), consistent with the widespread view at the time that this author tended to exaggerate German wealth to some extent.[269]

Helfferich (1913) puts national wealth at 300bn Marks in 1911. Durables, he reckons, are worth 375 Marks per head (p.107). Without durables, national wealth comes to 275bn Marks, or 575% of national income, somewhat less than the 636% we find for 1911. Helfferich's estimate is well documented and widely considered the most reliable of the time, so it is worth taking a serious look at it.

Helfferich starts with the raw data reported in the Prussian wealth tax returns ("Steuerpflic-thiges Vermögen", i.e. net taxable assets). Such data exist for the years 1895, 1896, 1899, 1902, 1905, 1908, 1911, 1914, and 1917. For instance, there are 63.6bn Marks in net taxable assets in 1896, 70.0bn in 1899, 75.7bn in 1902, and 104.1bn in 1911 (Hellferich, 1913, p.106).[270] About

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[269]See the discussion of Steinmann Bücher's estimate in Stamp (1919, pp.469-470) and Ronce (1917).

[270]The figures for 1899 and 1902 are exactly the same as in *Statistisches Jahrbuch für den Preussischen Staat*, 1903, p.191. This Yearbook also reports the wealth of taxpayers with assets above 3,000 Marks, the exemption threshold for the income tax as well as a breakdown between urban and rural taxpayers. There are also break-downs by size of assets, see Dell (2008) for estimates of the distribution of wealth in Prussia based on the tax statistics.

3.7% of the Prussian population is subject to the wealth tax, which is 14% of the population when relatives are included.[271] Note that these figures are net of liabilities ("Kapitalwert der Schulden"), and that deductible liabilities are typically as high as 20% of reported gross assets.

Helfferich then makes three corrections to the raw tax data. (i) First, he inflates reported net taxable assets data by 20% in order to account for tax evasion (there is no mandatory wealth declaration) and the under-evaluation of farms (which, in contrast to other assets, are not reported at market value). In 1911 this adds 20.8bn Marks to the 104.1bn reported in Prussian tax returns.[272] (ii) Next, Helfferich estimates the amount of wealth legally exempt. Properties under 6,000 Marks are tax free. Those between 6,000 and 20,000 Marks are also exempt if the owner has less than 900 Marks in income per year. Legally exempt taxpayers, Helfferich reckons, have about 15.5bn Marks in wealth. That is, only 15.5 / (104.1 + 20.8 + 15.5) = 11% of assets are legally tax free. (iii) Lastly, furniture, ustensils, clothing, etc. (about 15bn Marks) and properties in impersonal ownership (5bn) are added.

The total net private wealth comes to 160bn Marks for Prussia, or 4,000 Marks per capita, and on the assumption of a like basis for the other States, 260bn for the Reich, or about 550% of national income. Helfferich then reckons that the government has 50bn in assets and 25bn in liabilities, so that national wealth comes to 260bn + 25bn = 285bn Marks, or 595% of national income, including durables.[273]

Helfferich checks this tax-based assessment against fire-insurance statistics. There are 80bn Marks of insured values in public institutions, 124bn in joint stock companies, and 18bn in mutual associations: overall 220bn Marks of reproducible capital is insured in the Reich. Adding

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[271]See *Statistisches Jahrbuch für den Preussischen Staat*,1903, p.191. However, Dell (2008, p.66) reckons that the number of potential tax units is about 37% of the population, which suggests that the tax only affects 0.037/0.37=10% of potential tax units.

[272]Note that this procedure is consistent with what is commonly done for estimating national income. Helfferich, for example, also estimates national income based on Prussian income tax returns, and upgrades the raw data by 10% to account for tax evasion. In contrast to wealth, income declaration was mandatory, even for exempt taxpayers.

[273]Helfferich's gross public assets are 10% higher than Hoffmann's, and his gross liabilities are 10% lower than those reported by the Bundesbank, so overall Helfferich's net public wealth is 20% higher than what we find – but both are overall remarkably consistent.

careful estimates for the market value of land and other properties not insured against fire, national wealth reaches 330bn Marks – more than the 285bn obtained from the tax data. Helfferich adopts a compromise estimate of 300bn Marks, which we report in TableDe.16 (275bn excluding durables, i.e. national wealth is 575% of national income).

Stamp (1919). The reasons why Helfferich puts more weight on his tax-based estimate than on fire insurance statistics are not entirely clear. At the very least, Stamp (1919) considers that both estimates should be weighted equally.[274] Stamp upgrades Hellferich's figure accordingly and puts Germany's national wealth at 292bn Marks (durables excluded), or 610% of national income. Stamp's estimate accords well with our own 636% figure obtained by a completely independent method.

A reason why we still find a marginally higher national wealth-national income ratio is that both Helfferich and Stamp assume equal per capita wealth across the Reich. But Hoffmann and Müller (1959) reckon that per capita relative income was about 3-5% smaller in Prussia. Using the same data and methodology as Helfferich, but assuming constant wealth-income ratios rather than per-capita wealth across Germany, national wealth would be about 10bn Marks higher than what Stamp reports – that is, about 630% of national income.[275] In sum, the Helfferich-Stamp effort at estimating Germany's wealth – widely regarded as the most reliable at the time – strikes us as very consistent with our own measure of national wealth based on the retrospective and independent accounts of Hoffmann (1965) and the Bundesbank (1976).

Wehrbeitrag data (1913). We have conducted a last check of the accuracy of our estimate of German wealth by analyzing the returns of the first German federal wealth tax, the Wehrbeitrag

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[274]One potential problem with Helfferich's tax-based estimate is that he uses net-of-liabilities data, and that reported liabilities are huge. We are unsure that they should fully be deducted from assets (see below the discussion of the Wehrbeitrag data).

[275]Even the assumption of constant wealth-income ratio might be too conservative. We have evidence from the States' wealth taxes that at least in some States the wealth-income ratio was higher than in Prussia. For example, in Hessen net household assets declared in 1907 are 4.4bn marks (*Statistisches Handbuch für das Gro§herzogtum Hessen*, 1909, p.211). Hoffmann and Müller (1959) have national income of about 717mn in 1909, so the private wealth-national income ratio exceeds 610%, with no allowance whatsoever for tax evasion and tax exempt assets (the wealth tax in Hessen covers about 13% of the population, which is much more than in Prussia.)

(defense levy). The Wehrbeitrag was enacted in July 1913 with a view to financing the war ahead. It was a comprehensive tax with rates ranging from 0.15% up to 1.5% for assets above 10mn marks. Wealth below 10,000 marks was tax-free, as was wealth below 30,000 marks for taxpayers with income below 4,000, and wealth below 50,000 marks for those with income below 2,000. (There were also exemptions for some stock holdings). The reference date for assessing assets values was December 31st, 1913. Detailed statistics on the wealth declared for the Wehrbeitrag, by German State and type of asset, are found in the 1919 *Statistiches Jahrbuch für das Deutsche Reich*, pp.261-263. The total net wealth declared is 182.4bn marks, of which 29.8bn is not taxable, so net taxable wealth is 152.5bn. This amount of wealth belongs to 1.2 million taxpayers, i.e. about 1.8% of the German population (67mn), and is broken down as follows: 152.5bn = 80.9bn property assets (Grundvermögen) + 25.5bn business assets (Betriebsvermögen) + 88.2bn financial assets (Kapitalvermögen) - 42.1bn liabilities (Schulden). The total net wealth declared (182.4bn) amounts to 360% of Germany's 1913/1914 national income. Following Helfferich it is reasonable to upgrade this figure by 20% in order to account for tax evasion and the under-valuation of rural estates.

What is the wealth of exempt taxpayers? Helfferich reckons that for Prussia's 1911 wealth tax, legally tax-free assets account for 15% of the raw net assets reported. But we know that more wealth is free from the Wehrbeitrag. The threshold is higher (10,000 marks vs. 6,000) and rentiers with up to 10 times the average wealth are exempt.[276] In 1913, Prussian net wealth is about 110bn marks in Prussia's wealth tax returns, but only 92bn in the Wehrbeitrag's returns, i.e. 20% less.[277] On that basis, the Wehrbeitrag data suggest that the 1913 net wealth of German households is 182.4bn (raw data) + 0.2 × 182.4bn (tax evasion following

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[276]Owners of fortunes worth 50,000 marks that yield 4% and that have no labor income are not subject to the tax, since their income is only 2,000 marks.

[277]The same pattern appears for the State of Hesse. For instance in 1907 there are 154,984 persons paying the wealth tax in Hesse. At end 1913, only 86,639 taxpayers from Hesse fill in a Wehrbeitrag return, of which 56,294 pay 0 tax, and only 30,345 pay a positive amount of tax. In other words, although the Wehrbeitrag has the advantage of covering all the German States, within each State it usually covers a smaller fraction of the population than the State-specific wealth taxes. Additional information on wealth taxation in Germany around World War I is found in *Die Deustche Vermögensbesteuerung vor und nach dem Kriege*, Statistik des deutschen Reichs, R. Hobbing, 1927, 271p. (not used in this research).

Hellferich) + 0.2 × 182.4bn (legal Wehrbeitrag-specific exemptions) + 0.15% × 182.4bn (legal non-Wehrbeitrag specific exemptions following Helfferich) = 283bn marks = 555% of national income. We emphasize that this figure is net of liabilities, and that reported liabilities are huge – about 22% of gross assets. Such levels of liabilities are odds with available evidence for other countries on the eve of World War I.[278] We don't have any good explanation for the huge amount of liabilities reported in German wealth tax returns, so we are unsure that they should fully be deducted from reported assets. That is why was see a private wealth/national income ratio $\beta = 555\%$ as a lower bound. Should liabilities not be deducted at all, β would reach 700%.

Although there are some margins of uncertainties, the huge amounts of wealth reported in tax returns mean that German private wealth could not be less than 550% of national income on the eve of World War 1, and was in all likelihood in the 550-650% range.

D.4.2 World War I and its aftermath: 1914-1949

National income and saving flows, 1914-1949

There is no single study covering in full this chaotic period. Many of the reference sources (such as Hoffman, 1965) do not provide data for the 1914-1924 period. For national income and its components in the interwar, we rely on Ritschl (2002), who provides a detailed reconstruction of Germany's national accounts for the 1925-1938 period.[279] For 1914-1924 and 1939-1950, we use the national income series of Ritschl and Spoerer (1997).[280] Those authors have no data for 1945. The raw statistical material is extremely thin. Based on the change in industrial

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[278]In France liabilities are less than 5% of reported gross assets in estate tax returns, whatever the age of decedents (Piketty, Postal-Vinay and Rosenthal, 2011, Appendix Table B10).

[279]In 1938, Ritschl's (2002) income data refer to the Reich excluding invaded territories, while the population figure we report in Table DE.1 for that year include Austria and Sudedentland. We upgrade Ritschl's income accordingly. Our 1938 real per capita income growth rate (+7.9%) is consistent with Ritschl (2002), Barro and Ursua (2010), Maddison (1995), and a bit below the (presumably inflated) figures reported in the 1941/1942 Statistical Yearbook (p.604) – namely, the Yearbook reports a 10.1% real growth rate of per capita income between 1837 and 1838 in the "Altes Reichsgebiet." Note that at odds with available evidence, Ritschl and Spoerer (1997, p. 51) report a -1.5% real per capita income growth between 1937 and 1938.

[280]Ritschl and Spoerer (1997) provide statistics on population and income including invaded territories. One difference is with Barro-Ursua who report +17.7% real per capita growth in 1939 and +15.3% in 1940. These rates, however, are much higher than those (presumably inflated) reported in the 1941-1942 Statistical Yearbook (respectively +7.3% and -1.0%), so we stick with Ritschl and Sporer (1997).

production and in agricultural production, Barro and Ursua (2010) estimate that real GDP per capita declined 15.8% from 1945 to 1946, and this is the figure we retain. We have checked that the profile of real per capita national income growth we obtain is consistent with the one obtained by Maddison (2007, 2010) and Barro and Ursua (2010).

We compute national saving as the sum of net domestic investment and net foreign investment (i.e., the current account balance). Ritschl (2002) provides the data for the 1925-1939 period. For the world wars and immediate post-war periods, we have attempted to make careful inferences from the available raw material, which is incomplete and at times quite uncertain.[281] We then compute government saving as the sum of the government's net lending/borrowing and net investment, and obtain private saving as a residual.[282] By construction, our public deficit series are consistent with the explosive dynamics of the public debt during the wars. They are also consistent with the extremely large World War 1 public deficits reported by Ritschl (2003, Table 14) – about 30-40% of national income in 1915-1916-1917.[283]

[281]In 1914-1919 and 1939-1946, we assume that net domestic investment was 0 (depreciation compensates gross investment). We do know that there were extremely large government expenditures, but it is impossible (and in some sense meaningless) to disentangle those into consumption and investment. For the 1920-1924 period, we assume a constant domestic investment rate equal to the 1925-1929 average (9% of national income), and for the 1946-1949 period equal to its 1950 value (16%). Regarding the balance of payments, for 1914-1918 we use the trade balance of Hardach (1973, Table 6, quoted in Ritschl, 2003, Table 7) and set net income payments to zero. In 1919-1924 we set net exports and income to zero, but net transfer payments to -5% of national income (in 1921-1924) consistent with available estimates of the amount of reparations paid by Germany in this period (e.g., Schuker, 1988, Table 12.). In 1940-1946, we assume that the Reich borrows 5% of national income per year to invaded and satellite countries, so the current account balance is -5%. This estimate could probably be refined, but it appears in line with historical evidence on the amount of German clearing debt during World War II (see discussion below of Germany's net foreign asset position during the 1914-1953 period). Lastly, for 1947-1949, we assume that the balance of payments is the same as in 1950.

[282]We compute government net lending/borrowing in year t as the difference between the government's net financial position at the end of t and the government's net financial position at the end of $t - 1$. For the hyperinflation years 1922-1923, we set net lending equal to 0: there is no way to meaningfully compute a government deficit/surplus when the public debt is being monetized on such a large scale. We similarly set net lending to 0 during the Allied Control Council administration from 1945 to 1949. As regards net public investment, we rely on Ritschl (2002) for the 1925-1939 period. Consistent with the level of public non-financial assets in 1914, 1924, 1939 and 1950 and war destructions, we assume constant net investment rates $i = -2.4\%$ in 1914-1924 and $i = 1.5\%$ in 1939-1950.

[283]Ritschl's deficits are in the 40-50% range, but our computation of net borrowing as the difference between t and t-1 net financial position amounts to excluding from public deficits the fraction that is immediately monetized through central bank purchases of public bonds, since we include in government financial assets the public bonds held by the Reichsbank (see below). This is the most consistent way to proceed if one wants to compute private

We carefully account for capital destructions during the wars after reviewing available estimates. During World War I destructions on the domestic territory can largely be neglected.[284] During World War 2, about 50% of dwellings are destroyed (Ritschl, 2003b), and Harrison (2000, Table 1.11 p. 37) reports that 17% of industry fixed assets are destroyed. Given the share of housing and other domestic capital pre-war domestic wealth, this implies a destruction of about 26% of the domestic capital stock.[285]

German national wealth, 1914-1949

We are not aware of any well documented study of national wealth in Germany in the 1914-1949 period. The economists of the time were certainly disheartened by the chaotic evolution of consumer price (the 1923 hyperinflation), asset prices, war destructions, and so on. So we had to return to the raw sources.[286]

Private wealth and the 1927 census: The key fact that makes estimating German wealth in the interwar possible is the existence of a wealth tax, created in the aftermath of the 1924 monetary reform. With the wealth tax comes a comprehensive wealth census conducted to establish the market value of all of Germany's wealth (and not only that of taxpayers) as of the end of 1927. The results of the census are found in the 1930 *Statistisches Jahrbuch für das Deutsche Reich*, pp.534-535. We know the total surface of agricultural land by German State

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net lending as national net lending minus government net lending.

[284]Germany also loses almost all its foreign assets during World War I, a large fraction as payments for its trade deficit during the war, and the rest – which we record as capital losses on the foreign asset portfolio – being confiscated, destroyed, or annihilated by inflation.

[285]The 17% figure reported by Harrison (2000) is for destructions of industry fixed assets in the Anglo-American zone. Because fighting and bombing was more intense on the Eastern front, the figure is only a lower bound for destructions on the entire German territory. To take into account the increased severity of destructions in the Russian zone, we assume that 25% of the overall 1939 German stock of "other domestic capital" is destroyed. To annualize the destructions, we assume that 50% of them take place in 1944-1945, and the rest equally from 1940 to 1944 – except for government assets, for which we assume for simplicity that all destructions take place in 1944-1945 (see detailed computations in Table DE.6f, DE.5a, and DE.5c).

[286]Note that Hoffmann (1965) does provide fixed capital stock data (agricultural fixed assets, business assets, houses) for the interwar. But there are two major issues. First, these series do not reflect market values: they are simply built by cumulating net investment flows. This problem can be neglected to some extent for the pre-World War I period (and indeed we neglected it), but it cannot be neglected when there are large swings in stock markets and asset prices are deeply depressed, as during the interwar. Second, there are no data on land.

and type of land (agricultural, forestry, vineyards, horticulture) and its value: 36.7bn marks. Similarly, we have information on the number of corporations by State and the value of their capital stock (132.8bn marks), and the number and the value of dwellings and undeveloped land (78.6bn marks, 48.9bn once deducted what belongs to corporations).[287] The total private wealth comes to 37bn (land) + 48bn (housing) + 133bn (other private capital stock) - 9bn (net foreign assets, more on these below) = 210bn marks, or 275% of national income.[288] Compared to the 1911 Stamp-Helfferich data point, the private wealth-national income ratio is halved.

From this data point for 1927, we obtain yearly 1914-1950 private wealth series by cumulating private saving flows and accounting for war destructions. The name of the game is to find the pattern of real rates of capital gains q consistent with the 1913, 1927, and 1950 values of the wealth-income ratio on the one hand, and observed saving flows and war destructions on the other. In order to obtain meaningful cyclical variation in q, we rely on the variations in the equity price index constructed by Gielen (1994).[289] There are four broad phases in equity prices. First, equities lose 70% in real term between mid-1914 and mid-1924.[290] There is then a short but sharp reversal from 1925 to 1927, with the index more than doubling. In the course of the Great Depression, the index is again almost halved: by 1932 it is back to its 1924-1925 level. Lastly, during the nazi regime there is a sharp recovery, with the index multiplied by three between 1933 and 1941: in real terms, by 1940 equities have returned to their 1913 level.[291] Admittedly, one should be cautious in interpreting variation in this type of index, which is sensitive to the sample of corporations included, the measurement of consumer price inflation, and so on. However, we believe it provides a good enough qualitative picture of the pattern of capital gains on private wealth in this chaotic period of time.

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[287]The corporate sector's liabilities amount to 80bn marks.

[288]Note that ideally we would like to have market values for mid-1927 rather than January 1st, 1928, we neglect this 6 month discrepancy. Our 210bn marks figure is roughly in line with the 232bn obtained by Dell (2008, p.154) using a completely different method (mostly Hoffmann's 1965 data; see Dell 2008 pp.132-134.)

[289]See also Bittlingmayer (1998) for an analysis of these data.

[290]The nadir is reached in 1920, and there is no clear trend but huge volatility from 1920 to 1924, so that in mid-1924 the equity index is still close to its historical low.

[291]From 1941 on, German equities are subject to price control so the index loses much of its meaning until 1948.

We find that we can account for the evolution of the private wealth-income ratio given private saving flows while being consistent with the broad dynamic of equity prices by assuming a constant rate of real capital gains $q = -13.9\%$ in the 1914-1923 period, $q = 10\%$ in 1925-1927, and $q = 3.7\%$ during most of the 1928-1949 period, with allowances made for the crash during the Great Depression and at the end of the war.[292] We have carefully checked that the implied amount of private wealth in the 1920s and 1930s is consistent with what is reported in tax returns. In mid-1924 for instance, we estimate that private wealth amounts to 120bn marks, which corresponds to a wealth-income ratio of about 220%, the nadir of the pre-World War II period, barely a third of the 1913 ratio. Given the population covered by the wealth tax and the tax rules, our estimate for 1924 is well in line with the amount of wealth declared in tax returns, namely 77.93bn marks at end 1923 and 64.07bn marks at end 1924.[293] One should not over-state the quantitive precision of the wealth-income ratio we obtain in the chaotic 1920s, but

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[292]That is, consistent with Gielen (1994), we set $q = -5.0\%$ in 1930 and 1932 and $q = -10\%$ in 1931. To take into account the economic depression in 1944-1946 (real national income per capita decreases -8.5% in 1944 and -15.8% in 1946) we set $q = -10\%$ in 1944 and $q = -20\%$ in 1946. Lastly, in 1945 there is a de facto default on the entire domestic public debt in addition to a stock market crash. To take this into account, we set $q = -55\%$ in 1945.

[293]See Statistiches Jahrbuch 1926 p. 424 (end-1923 data) and Statistiches Jahrbuch 1928, p. 552. (end-1924 data). The 77.93bn figure for end-1923 includes 30.598bn in agricultural land, 19.30bn in urban dwellings, 0.93bn in agricultural dwellings, 22.38bn in business assets, 6.14bn in financial assets, and 1.41bn in liabilities. The number of taxpayers is approximately the same as for the 1913 Wehrbeitrag (2.78mn in 1913 and 2.55mn in 1924, while total population has decreased from 67 million to 61.7 million) but the net wealth declared has been divided by 2.35 (183.2bn vs 77.93bn). The bulk of the fall owes to financial assets (88bn in 1913 vs. 6bn in 1924 – mitigated by the fall of liabilities from 42.1bn to 1.41bn). In end 1924, the main change is that liabilities now amount to 10.36bn (probably due to the reinstatement of some pre-hyperinflation debts); there is also a change in classification that makes it possible to directly compare the wealth reported in end 1924 to that reported in the 1913 Wehrbeitrag, asset class by asset class. Business assets (Betriebsvermögen) are down 50%, real estate (Grundvermögen incl. Landwirtschaft) down 35%, and financial assets down 90%. Averaging the end-1923 and end-1924 totals, declared wealth in mid-1924 comes to 71bn marks, 2.6 times less than in 1913. Dividing our estimated 1913 private wealth by 2.6 we would obtain a mid-1924 amount of private wealth of 125.0bn, very close to the 120bn we find using a completely different method. Of course, it is likely that the distribution of wealth, tax exemptions, and tax evasions changed between 1913 and 1924, so one should be careful not to draw too much from this kind of evidence. Interestingly, however, the 1927 Statistiches Jahrbuch (p. 477) provides data on the distribution of wealth by tax bracket suggesting that wealth concentration was still very high in end 1923, with inverted Pareto-Lorenz coefficient between 3 and 5. This suggests that the very low amount of reported wealth probably mainly reflects a general drop in aggregate wealth rather than a de-concentration of fortunes during the war and immediate post-war period. With existing data, however, it is impossible to properly separate out the two effects. See Atkinson (2006, pp. 13-16) for an analysis of German wealth tax data.

all available evidence points to a truly massive reduction in aggregate private wealth compared to 1913, with a private wealth-national income ratio markedly lower than in France and the U.K. in the 1920s (200-300% vs. 300-400% in France, and 400-500% in the U.K.).[294]

Government wealth: Government operated a growing number of businesses in the interwar. The first large publicly-owned company was the Reichsbahn, created in 1919 as a merger of existing railways. It employed close to one million workers, and significantly contributed to reparation payments. By the end of the 1920s the government also owned one of Germany's largest electricity company (Elektrowerke AG). And while the nazi regime generally maintained an appearance of private property as long as private businesses were willing to cooperate, it run a very large conglomerate, Hermann Göring Reichswerke, which included more than 300 companies at its peak in 1941-1942.[295]

To compute the government's assets, we rely on Hoffmann's (1965) public fixed assets data. These series, obtained by cumulating investment flows, give the book value of government's assets. We multiply railways assets by a market-to-book ratio in order to approximate the market value of the government's stake in the Reichsbahn.[296] We find that government assets were high in the interwar, close to 100% of national income up to World War II, at a time when private wealth was low. As a result, while government non-financial assets amounted to about 10-15% of domestic capital in the pre-World War I period, by our estimates they reached 20%-30% in the interwar, peaking at 40% in 1944-1945. This is entirely consistent with available

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[294]In January 1st, 1928, reported wealth is still very low (77.37bn marks of net assets for 2.76 million taxpayers), see Statistiches Jahrbuch 1930 p. 535 sq. In the 1930s, the fraction of taxpayers covered by the wealth tax decreases markedly (1.6% in 1931, 2.5% in 1935; see Dell, 2008, p. 130), making it harder to use tax data to measure the overall amount of private wealth.

[295]For an analysis of private property under nazi rule, see Buchheim and Scherner (2006).

[296]Our market-to-book ratio is equal to 100 in 1913 and then follows the evolution of the general equity price index constructed by Gielen (1994). Another – more data intensive – way to proceed would be to use the accounts of the Reichsbahn and other public companies and apply the financial ratios that prevailed for listed companies. For instance, as Wengenroth (2000, p. 111) reports, the Reichsbahn and Reichspost made 1.1bn in profit in 1929. Assuming a price/earnings ratio of 15, this would put the market value of these two companies at about 16.5bn marks, or about 20% of 1929 national income. Note, however, that the Reichspost made very little profit. Prices were deliberately kept low, in particular to make it impossible for Allied countries to use Reichspost profits for reparation payments.

evidence that the nazi regime eventually came to control up to 50% of Germany's capital stock (Wengenroth, 2000, p. 118). The nazi conglomerates were largely destroyed during the war, and the remainder dismantled in the immediate postwar period. The government, however, retained control of a number of large companies, most prominently Volkswagenwerk (whose ownership was transferred to the state of Lower Saxony and to the federal West German government), Saarbergwerke (after the end of French control), and the former holding companies of the states (e.g., VEBA, the former Prussian holding company).

Regarding government debt, our data come from the retrospective accounts of the Bundesbank (1976). As previously, we include the debts of the federal government, states, and municipalities.[297] From 1945 to 1948, Germany is in a state of default on its public debt. We consider that default takes place progressively in the 1945-1948 period, i.e. from mid-1945 to mid-1948, public debt gradually declines to its 1950 value (33% of national income).[298]

All the data we use on public debts refer to face values. It would be desirable to always use market values (i.e., taking into account the price at which bonds trade on markets) but we are not aware of consistent and comprehensive series on the market value of German public debt. This is not a big issue, however, because contrary to the U.K. and France, government debt in Germany has historically always been quite small. Leaving aside the 1990s and 2000s, there are only two periods during which public debt has exceeded 60% of national income: 1915-1919 and 1941-1945. In order to take into account the fact that public debt traded at large discounts during the wars,[299] i.e. that at market value the net position of the government was in some

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[297]Data are as at March 31st (end of fiscal year), we linearly interpolate them to December 31st. Linear interpolation is problematic during the 1923 hyperinflation and instead we use for end-1923 the Bundesbank estimate that short term public debt was 192 trillion in November 1923.

[298]Formally, default on the domestic public debt takes place in 1948 with the currency reform that converts most saving at a rate of 6.5 deutschmarks to 100 reichsmarks and completely wipes out all government securities (see, e.g., Lutz 1949, pp.125-126). Between 1945 and 1948 there is no functioning price system; Germany's economy is mostly characterized by barter and some fixed price transactions (most war controls subsisted until 1948), and government securities are practically worthless. Default on part of the foreign public debt took place at the 1953 London debt agreement – and up to 1953 we include in public debt the amount that was subsequently forgiven by foreign creditors in 1953, which explains why in the late 1940s and early 1950s, government debt is about 30% of national income rather than close to 0.

[299]German government issued in Switzerland traded at large discounts during World War II, typically at only

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sense better than what face value indebtedness suggest, we include the fraction of the debt held by the Reichsbank in the government's financial assets. This is equivalent to subtracting from government liabilities the fraction of the public debt that was monetized.[300] We find that about 10-20% of Germany's public debt is monetized during World War 1.[301] In the run-up to the 1923 hyperinflation, the ratio of public debt held by the Reichsbank to total public debt increases to 30-40%. During World War 2, 10-20% of the public debt is again monetized.

Overall, we find that government net wealth was strongly positive in the interwar, as the 1923 hyperinflation wiped out almost all of the public debt.[302] By our estimates, net public wealth accounts for up to 15-20% of national wealth in the 1920s and 1930s, up from 5% or so before World War I. It is only during World War II that the net position of the government turns negative, as public debt reaches close to 200% in 1944-1945. But thanks to the 1945-1948 default, net public wealth immediately turns positive again at the end of the war – just as it did at the end of World War I with inflation. As regards government wealth, Germany stands in sharp contrast to the U.K. and France, where public debts largely exceeded public assets in the 1920s, 1930s, and 1940s (and well into the 1950s for the U.K.).

Foreign wealth 1914-1953: Germany basically loses all its foreign assets during World War I and in the immediate post-war period, as the Allies seize the remaining assets (ships, marine cables, etc.) for reparation payments. In 1924, gross foreign assets and liabilities (excluding Versailles-treaty debts) both appear to be very small – about 10% of national income.[303] Versailles-treaty debt are gigantic, but we chose not to include them in our baseline measure of

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30-40% of par values; see Frey and Kucher (2000, p. 478).

[300]Reichsbank holdings are reported by the Bundesbank (1976, p. 36) and include Treasury bills and bonds (*Schatzwechsel und unverzinsliche Schatzanweisungen*), and *Darlehnskassenscheine*, i.e. notes of the Loan Bureau, which is how part of the public debt was monetized during World War I (see e.g., Webb 1984, p. 501). We also include in government financial assets the Mefo-bills, a form of public debt issued by nazi Germany to finance rearmament and secretly bought by the Reichsbank. Mefo (Metallurgische Forschungsgesellschaft, m.b.H) was a shell company created by Schacht, the Reichsbank president, which issued bills used as payments for the rearmament to circumvent international oversight which prohibited rearmament.

[301]This finding is fully consistent with the data reported by Ritschl (2003, Table 15).

[302]In 1925, some debts (especially mortgages) were reinstated, but typically at huge discounts – i.e., as low as 2.5% of face value for some government bonds.

[303]Cross-border positions for the interwar are provided by the 1976 Bundesbank compendium, p. 331.

foreign liabilities for two reasons: first, because exactly quantifying these debts is fraught with difficulties (most actors of the time themselves did not have a clear view of the total amount due as per the Treaty); second, because Germany did rapidly default on those obligations.

We nonetheless report tentative estimates of Versailles-treaty debts as a memo item in Table DE.6b. In London in 1921, the Reparation Commission fixed the reparation bill at 132bn gold marks. That same year, German national income was about 42.5bn gold marks, so the total reparation bill initially amounted to more than 3 times national income. Of the 132bn due as per the Treaty, however, Germany was only expected to service what was known as the "A" bonds – 12bn gold marks, for compensation of the war damages – and the "B" bonds – 38bn Goldmarks for the reimbursement of interallied war credits. "C" bonds (82bn) were contingent upon Germany's capacity to pay, and were never really expected to be serviced at all (Guinnane, 2004, p. 11; Ritschl, 2012, pp. 3-4). The "A" bonds alone amounted to about 25% of 1921 national income, and were comparable in size to the French indemnity of 1871 (5 billion francs, which was just 25% of French 1870 national income). Together, the "A" plus "B" bonds amounted to more than 120% of national income – which was comparable to the public debts incurred by France and the U.K. during the war. In 1929, the Young plan reduced the total reparation bill to 121bn gold marks, and at the Lausanne conference in 1932 they were formally reduced to 3bn that were never paid. In the end, available estimates suggest that Germany paid in total about 23bn marks through to 1932 (Schuker, 1988, quoted in Guinnane, 2004, ft 13).

As is well known, the Weimar Republic went on a borrowing spree, especially the states and municipalities. Even disregarding the reparation bill, Germany turns into a large net debtor in the interwar, with a net foreign position of about -40% in the early 1930s (the equivalent of 10% of national wealth) according to the statistics gathered by the Bundesbank in the 1976 compendium. One caveat is that estimates of foreign assets for the inter-war are probably on the low-end for the same reasons as they are today: they miss the foreign securities held offshore by individuals (Zucman, 2013). It was already well acknowledged by contemporaries that a sizable amount of foreign securities in private hands had left Germany since the end of World War I

(see, e.g., Keynes, 1920, chapter 5, III.1). Available Swiss data show a large increase in foreign fortunes managed by Swiss banks in the 1920s, and in all likelihood a sizable fraction of those belonged to German households.

In the early 1930s, Germany stopped interest payments and amortization on all its long-term foreign debts (but still serviced most of its short term debts, which was mostly to the U.K.). Germany did borrow a lot during World War II as it imported a huge amount of goods and services from occupied and satellite countries. Trade was structured through bilateral clearing agreements, and from 1941 to 1944 the overall German clearing debt increased at a pace of 5% of national income per year (Ritschl, 2001, Table 4 p. 330). By the end of the war, the clearing debt amounted to 30bn Reichsmark – the bulk of it being vis-a-vis France, the Netherlands, and Belgium. However, this clearing debt was artificially lowered, because the Reich massively overvalued the mark so as to render foreign goods cheap for Germany. Occhino, Oosterlinck and White (2006) for instance, consider that French-German bilateral clearing agreement overestimated the Reichsmark by 50%. At more realistic prices, Buccheim (1986) estimates that the true clearing debt of Germany by end of the war was three times larger as the official one, i.e. 90bn Reichsmarks, the equivalent of 100% of 1938 national income.

In 1953, the London debt agreement settled the foreign debts of Germany. Great care was devoted to precisely establishing the amounts due by the Federal government. The agreement stated that some pre-World War II debts would be reimbursed in the short term, while other repayments would be delayed until reunification, and yet another part would be cancelled; see Dernburg (1954, p. 549) and Guinnane (2004). Up to 1953 we include in government and foreign liabilities the debts that were subsequently cancelled in 1953. The cancellation of about 8bn marks in foreign debts (as well as sustained trade surpluses) help Germany move from a large net debtor position at the end of the war to a creditor position by the middle of the 1950s.[304]

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[304]The London debt agreement also explains why there is a large net capital transfer recorded in 1953 – which we include in our measure of government and national saving.

E France

E.1 Official national accounts series

E.1.1 National income, 1949-2010

French national accounts are constructed and published by the national statistical institute (Insee, Institut national de la statistique et des études économiques). Detailed series are available online in Excel format at http://www.insee.fr. New series are usually released in July n+1 (or September n+1). We use the 2011 edition of Insee's national accounts, which follow the 1993 SNA and have 2005 as base year. Insee provides a comprehensive, consistent, and homogenous set of income accounts by sector starting in 1949,[305] and we use them with no modification whatsoever.

E.1.2 National wealth, 1970-2010

Insee also provides annual wealth accounts by sector starting in end 1970.[306] These balance sheets follow the 1993 SNA / 1995 ESA standard, and we took our wealth data straight from Insee's website, with no modification whatsoever for the 1978-2010 period.[307] Yearly income and wealth accounts are synthesized in the "Tableau economique d'ensemble" (TEE).[308] All data series cover the current territory of France, defined as French mainland territory and overseas departments (Guadeloupe, Martinique, Guyane, Reunion).[309]

Generally speaking, our wealth and income series for France closely follow those reported

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[305]See our file "Income_1949_Today.xls". In September 2011 Insee switched from the 2000 to the 2005 base: all 1949-2010 series were revised accordingly. The changes are described in French here: http://www.insee.fr/fr/indicateurs/cnat_annu/base_2005/methodologie/comptes-nationaux-base-2005.pdf.

[306]Wealth accounts include both non-financial and financial balance sheets. Financial balance sheets are constructed by the Bank of France, and are also disseminated by the Bank – a complete set of 2005-base financial accounts is being constructed by the Bank of France, with data starting in end 1969.

[307]Post-1978 data are available online (see our file "Wealth_1978_Today.xls"). 1970-1978 data have not been put online by Insee/Banque de France yet. However they can be found in older Insee publications such as "25 ans de Comptes de patrimoines (1969-1993)", *Insee Resultats*, no.348, December 1994, 129p. There is very small discontinuity in 1978 and we made appropriate adjustments to as to ensure continuity (see our file France.xls for details).

[308]See our file "TEE_1949_Today.xls".

[309]Note however that this exclude so-called overseas territories (Nouvelle-Caledonie, Polynesie, Wallis-et-Futuna, etc.) and Monaco.

in Piketty (2010, 2011), and we refer to this work for additional references and details about French historical national accounts. There are a number of differences, however, some due to the fact that some updated Insee series have become available, and some other due to our attempt to better homogenize definitions and concepts across countries. One important limitation of the database constructed by Piketty (2010, 2011) is that it really focuses on private wealth (because of the focus on the intergenerational transmission of wealth) and pays insufficient attention to government and national wealth.

The main differences between the computations we report in our file France.xls and those reported in Piketty (2010, 2011) are as follows (full details are given in the Excel file):

(i) We include non-profit institutions serving households in the household sector (private wealth) rather than in the government sector, in order to be consistent with what we do for other countries (some of which do not isolate NPISH from households in their own accounts).

(ii) We compute real values using the GDP deflator rather than the CPI. Over the long run, both have evolved quite similarly: average GDP price inflation is 5.9% over the 1870-2010 period and CPI inflation 5.7%. There are short run differences, however. As a consequence, year-to-year real growth rates differ from those reported in Piketty (2010).[310]

(iii) Unless otherwise noted, all our wealth data points are mid-year estimates rather than beginning-of-year estimates.

(iv) In line with what we do for all the other countries, we include net capital transfers into saving flows. This raises private saving rates to some extent over the 1949-2010 period; as a consequence the capital accumulation and the residual capital gains effects were re-estimated for the 1924-1954 and 1954-1970 periods, and wealth-income ratios in these years slightly differ from the previous ones. Overall, the changes involved here are minor.

(v) In Table FR.1, ratios of private wealth to disposable income are computed using a modified concept of disposable income as to improve international consistency.[311]

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[310]Differences between GDP and CPI inflation can typically be as large as 2-3% in a given year, which translates into real income growth rates differences of 2-3%.

[311]That is, we include in disposable income pure transfers, whereas the national income series Y_{dt} used in

(vi) We use population series covering mainland territory and overseas departements, rather than only the mainland territory. This does not affect the wealth-income ratios and aggregate growth rates, but slightly reduces per capita levels.[312]

E.2   Historical non-official national accounts series

Regarding national income before 1949 and national wealth prior to 1970, we start with Piketty (2010, 2011) and extend this work over time along two dimensions: (i) we provide decennial estimates of income and wealth from 1700 on (vs. 1820 in Piketty, 2010, 2011) and (ii) we report yearly income, saving and population data from 1820 on (vs. 1896). Our comparative and national perspective on wealth also led us to make a few adjustments to some of the income and wealth data previously reported, as we explain below.

E.2.1   National income and population, 1700-1948

1700-1820 decennial estimates

1700-1820 population data are taken from Maddison (2010).[313] Regarding national income, we assume that real per capita growth is 0.2% per year from 1700 to 1810, and 1.5% from the 1810s to the 1820s, consistent with Maddison (2010). To obtain nominal values, we relied on the price series due to Labrousse (1933). Details are provided in Excel file France.xls.

1820-1896 yearly estimates

Piketty (2010, 2011) excluded pure transfers.

[312]As of 2010, the population of mainland France was equal to about 97,1% of total French population (62,8 millions out of 64,7 millions inhabitants, vs. 1,9 millions for overseas departement - DOM, *departements d'outre mer* -, including about half for Reunion, and about half for Guadeloupe-Martinique-Guyane). This ratio has been slightly declining over time, due to higher population growth in overseas departement (the ratio was about 98%-99% in the 1950s-1960s). See France.xls for details (see in particular Table FR.8b). Piketty (2010, 2011) wrongly divided income and wealth aggragates including DOM by population series excluding DOM (thereby overstating somewhat per capita levels). This is inessential for our purposes here.

[313]Specifically, Maddison reports population of 21,471mn in 1700, and 0.3% average yearly population growth over the 1700-1820 period; we assume 0.3% growth in 1700-1710, hence an average 1700-1710 population of 21,776mn, and similarly fixed population growth of 0.3% per year until 1810. We assume that adult population is 60% of total population, which is consistent with nineteenth century figures and low population growth of the eighteenth century. Post-1820 population data are from Piketty (2010), who uses a number of French official sources (such as Insee AR 1966, p. 22).

Yearly 1820-1896 national income data come from Bourguignon and Lévy-Leboyer (1985). Their 1820-1840 national income data were lowered by 0-10% in order to fit Maddison's per capita 1820-1910 growth rates, i.e. 1.0%-1.1% (rather than 0.8%-0.9%). Thus, by construction our 18th and 19th century national income series are fully consistent with Maddison's.

We also use the data from Bourguignon and Lévy-Leboyer (1985) to provide estimates of national saving (net domestic investment plus net foreign investment). According to Bourguignon and Lévy-Leboyer the national saving rate (weighted by real income) averaged about 9.5% in the 19th century, although one should not over-state the quantitive precision of such estimates. The important point is that since the real income growth rate g was about 1.2% in 1810-1910, a saving rate s of about 9.5% is consistent with a wealth-income ratio around 750%. This is well in line with the many available estimates of national wealth computed completely independently by the authors of the time (see below). Saving appear to be slightly higher in the second half of the century than in the first half – with both domestic and foreign investment on a rising trend.

Last, we compute private saving as national minus government saving. Government saving equals government investment plus government net lending/borrowing. We assumed net public investment rates of 0.5% of national income for the 1820-1896 period, which is in line with available estimates of the government non-financial assets (see below). We carefully reconstructed government net lending/borrowing from government budget data.[314] Overall, government saving was slightly negative (about -1% of national income), so that private saving slightly exceeded national saving (10.5% vs. 9.5%).

1896-1948 yearly estimates

From 1896 on we start with the yearly data reported in Piketty (2010, 2011), which rely on the detailed series constructed by Villa (1994). The key differences are as follows.

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[314]Net lending/borrowing is equal to the government's secondary surplus/deficit plus net capital transfers received. The key data source here is AR 1966, pp.484-485. To compute proper government surplus/deficits, it is important to exclude "extraordinary revenues" from government revenues, because these *ressources extraordinaires* include funds raised through the issuance of perpetuals and long term bonds. We include in government deficits a number of exceptional capital payments made by the French government (in 1825 and 1871-1873, see discussion of the public debt below).

First, private saving flows were recomputed from the expenditure side of Villa's accounts, as the difference between national saving (domestic investment plus net foreign investment) and government saving (government investment plus net lending/borrowing), while the estimates reported in Piketty (2010, 2011) relied on the income side. Because there is a discrepancy between the income and expenditure approach in Villa's series, the two measures of private saving differ. The discrepancy is sizable during the wars (when our new private saving seriees is larger than the previous one) and the interwar (when it is smaller). Over the whole century, the discrepancies cancel out and the choice of one particular series makes relatively little difference.[315]

Second, we subtracted the losses on foreign assets during World War I from war destructions, in order to ensure consistency with other countries. Theses losses now appear as capital losses in our decomposition results.[316]

E.2.2 National wealth, 1700-1913

1820-1913

The 1820-1913 estimates of national wealth reported in Table FR.6f are a synthesis of many contemporary estimates (see Piketty 2010, 2011 for detailed references). Composition of national wealth 1810-1913 is mostly taken from Lévy-Leboyer 1977 p.396 (compilation of many estimates; see also Foville 1893 pp.604-605), Colson (1903, vol.2, pp.282-283) and Danysz (1934, p.141). The 1780-1900 series on land and housing rental income and corresponding capital stock compiled by Turquan (1901 pp.4-5) and Toutain (1997 p.113) are consistent with the stock estimates reported here, just like the historical national wealth estimates published by Insee in

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[315]Note that Villa (1994) does not provide data on government investment during World War II (see Villa's file "long.xls", series IG). We assumed gross government investment rates of 0% in 1940-1944 and 10% between 1945 and 1948.

[316]As discussed in Piketty (2010, Appendix A, pp.42-43), foreign asset losses during World War I appear to be as large as physical destructions, so we simply divided the total war destruction estimates of Piketty (2010) by 2. Note that we attributed all war destructions to the private sector. Ideally one look like to attribute some destructions to the government, but the available raw material is too limited to make precise decompositions of war destructions. The consequences for our decomposition results are minimal.

1958.[317]

For 1913, we use Colson's (1918, p. 365) estimate. According to Colson, national wealth amounts to 302bn francs, and we report this estimate with no modification whatsoever. We use the composition estimates of Lévy-Leboyer (1977, p. 396: 63.8bn for land; 50.3bn in net foreign assets) and Toutain (1997, p. 113: 75.6bn for housing).

We draw on additional data sources for government wealth (see below), which leads us to revise the historical public and national wealth figure given in Piketty (2010, 2011). The main difference is that the series reported by Piketty (2010, 2011) show a moderate upward trend in the private wealth-national income ratio in France during the 1820-1913 period (from 550-600% at the beginning of the period to 650%-700% by the end of the period), while we find basically no trend (with ratios around 650%-700%). This is due to revisions in the numerator and the denominator (in particular, national income denominators used by Piketty 2010, 2011 for the 1820s-1840s were over-estimated). The figures now given in Table FR.6f supersede those given in Piketty (2010, Table A16). Though we view the updated series reported in the present work as more consistent (given available evidence), we should stress that these estimates cannot be used to make fine comparisons across countries or over time: they should be viewed as broad orders of magnitude.

In our view, the two robust findings from historical national wealth estimates for France and the UK are the following. First, all available estimates on wealth levels over the 1700-1913 two-century period show relatively high wealth-income ratios (say, between 600% and 800%), with no evidence of any significant long-run upward or downward trend. Next, all available estimates on wealth composition show that the steady decline in agricultural land was gradually compensated by the rise of housing and other domestic capital assets (and foreign assets, particularly in the UK). These two long-run findings are robust, but there is not much else that is really robust. In particular, the quality of the data does not allow us to analyze short-run or medium-run

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[317]See "Quelques données statistiques sur l'imposition en France des fortunes privées", *Bulletin Mensuel de Statistique*, Insee, 1958, p.34.

evolings, and/or trends of moderate magnitudes.[318]

1700-1820 decennial estimates

For the 1810-1819 decade, we use the corrected Chaptal estimate reported by Lévy-Leboyer (1977, p. 396), namely 63.2bn francs.[319]

For 1780, we use the estimate due to Lavoisier (1789). Lavoisier finds 38 billions livres tournois; his estimates refers to year 1788. Given price inflation in the 1780s, this is equivalent to about 33bn for 1780 (and about 30bn after exclusion of furniture and movables). The shares of land, housing and other domestic capital assets in the revised Lavoisier estimates are given by Mulhall (1899 p.591) and consistent with the 1780 estimate reported in the Insee 1958 compilation.

The 1700 and 1750 data points are rough estimates using computations reported by Bois-guillebert (1695), Vauban (1707) and Lavoisier (1789).[320] These are probably the most fragile estimates reported in our entire database. In particular, we should stress that Boisguillebert (1695) and Vauban (1707), unlike their quasi-contemporaries Petty (1664) and King (1696) (see below), and unlike Lavoisier almost a century later, do not provide complete balance sheets. They are mostly interested in estimating the total value of agricultural land. The estimates which they report for other assets are incomplete, and not very well documented. On the basis of their estimates, and of the later estimates by Lavoisier, we find however that the broad orders of magnitude are reasonably consistent. In particular, the general picture for the structure of national wealth for 18th century France is relatively close to the structure obtained by using U.K. estimates. Given that the authors in the two countries use different methods and data sources (and do not seem to be aware of the estimates made at the same time in the other country, or at least do not refer explicitly to one another), we find this reassuring. In particular,

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[318]Some of the raw estimates reported by Lévy-Leboyer, Foville and other authors sometime display large abrupt changes in wealth composition due to changes in methods or definitions; when such variations appear inconsistent or not well-documented, we choose to report moving averages. See Excel file.

[319]This estimate is for 1815. Chaptal gives 45 billions francs, but this seems too low in view of Lavoisier's estimate for 1788 and the increase in prices during the Revolution.

[320]See also historical estimates reported by Studenski (1958).

the estimates made by Vauban are well documented and appear to be relatively robust.[321] We again emphasize that these estimates should not be used to make fine comparisons between the two countries, or between the different sub-periods of the 18th century. But the broad long-run picture, and the orders of magnitude regarding national income, national wealth and its various components (in particular total land value), appear to be correct.

E.2.3 Private wealth

For private wealth, we use the same methods and sources as Piketty (2010, 2011). One minor change is that we draw on available asset price to provide a more realistic dynamics of residual capital gains in the interwar, and especially just before and during the Great Depression.[322]

E.2.4 Government wealth, 1700-1970

Public debt 1700-1800

No record of the face value of the public debt was kept before the Revolution, contrary to what happened in the U.K., and no government accounts published before the nineteenth century. Against this background, we take the ratio of public debt to GNP reported by Weir (1989, Table 1 p. 98) for 1788, namely 55%.[323] There are of course some uncertainties on

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[321]Vauban estimates the total national income of France around 1700-1705 to be about 2.3-2.4 billions livres tournois, and the total agricultural income to be about 1.2-1.3 billions livres (including about 600 billions in land rent, corresponding to about 12-13 billions in total land value). We adopt slightly more conservative estimates, with national income around 2,1 billions and total land value around 10 billions (Vauban's main objective is to convince the King that a broad based income tax can raise substantial revenues, and his estimates appear to be somewhat overstated). For a detailed, critical analysis of the estimates of national income and national wealth made by Boisguillebert and Vauban, and an interesting comparison with the estimates of Petty and King, see Studentski (1958, pp.26-60).

[322]That is, consistent with available equity price indexes, we set $q = +5\%$ in 1927, $+10\%$ in 1928, $+5\%$ in 1929, -5% in 1930, -10% in 1931. Also to reflect the collapse of the French economy following the defeat of 1940 we set q=-35% in 1940; and to take into account nationalizations -10% in 1944 and 1945. See Excel file.

[323]Specifically, Weir estimates government debt to be worth 3,878 million livres tournois, a figure that is decomposed as follows: 1,421 million of floating and short-term debt, 1,118 of life annuities (including tontines, i.e. group annuities in which payments to deceased subscribers were redistributed among survivors), and 1,339 million in perpetual bonds. Note that this estimate of France's public debt is not obtained by capitalizing interest payments at coupon interest rates (which would give a face value of the public debt) but on the contrary is as close as possible to the market value of the government debt. In particular, it takes account of the sharp depreciation of a number of perpetual bonds issued during the liquidation of Law's system. See Weir, 1989, ft. 17. Weir's figures are also fully consistent those reported by Sargent and Velde (1995, Table 1 p. 487) for

this ratio (particularly on the denominator), but two things are clear: government debt was substantially lower in France than in the U.K. where all estimates show public debt exceeding 100% of national income,[324] and France paid a higher interest rate, about 6%-7% vs. 3%-4% in the U.K.[325] We base our estimates of public debt in 1750 – about 40% of national income – on the debt payments reported by Weir (1989, p. 103) for the year 1753.[326] Lastly, there is little information before 1726, as available sources do not consistently record debt charges. On the basis of the various rent payments in the literature discussed by Weir (1989, ft. 21), we put the government debt at 30% of national income in the first decade of the 18th century.[327] What all sources and the literature make clear is that France was able to maintain its debt level at relatively low levels in the course of the 18th century through a series of partial defaults,[328] although at the price of relatively high financing costs.

Public debt 1800-1913

France enters the 19th century with a very low level of public debt, following a large scale default in 1797, the "two-thirds bankruptcy", which was the last outright default by the French

May 1789 (3,764 million livres, i.e. 63% of GNP). As for GNP, Weir retains an estimate of 6,977 million livres tournois, on the basis of Marczewski (1965) and making allowance of output in the service sector. This might be a bit too high. On the basis of the Bourguignon/Levy-Leboyer and Maddison data described above, our estimate of national income in the 1790s is about 5.0bn francs, i.e. about 5.1bn livres tournois (1 franc = 1.0125 livres), which would imply a public debt / national income ratio of 75% rather than 55%.

[324]Our sources for U.K. debt and interest payments are the same as used by Weir (1989, Table 1 p. 98). However, Weir reports face values and has a lower income denominator than us, while we report estimates of market values on the basis of Janssen et al. (2002). This explains why our UK public debt/ national income ratio is about 110% (vs. 180% in Weir's Table 1 – a figure which as Weir himself notes on p. 100 and on ft. 16 is too high).

[325]In the two cases computing yields is complicated by the fact that a substantial fraction of recorded debt charges include some amortization of non-perpetual debt. Amortization was particularly important in France (at least 30% of total debt charges, vs. less than 15% in the U.K.), because annuities were a large fraction of debt. The 6%-7% and 3%-4% yield figure are our best guesses after subtracting non-interest debt charges. See Weir (1989, p. 100) and our discussion of U.K. public finance statistics below.

[326]Total debt payments amounted to 72 million livres tournois (this figure excludes repayments but includes all annuity payments (which include some amortization), so it is a bit higher that the true interest charges). If we capitalize this at 6%, the public debt amounts to 1,2bn livres, i.e. about 40% of national income.

[327]This estimate is consistent, in particular, with the 24 million rent payments reported by Clamageran (1876) for 1699, which capitalized at 6% implies about 400mn livres of debt, i.e. about 20% of national income – a figure that most likely increased substantially in the course of the War of the Spanish Succession (1702-1713).

[328]See, e.g., Sargent and Velde (1995, p. 480) for a history of those defaults.

government.[329] Napoleon does not issue debt and runs balanced budgets, financing its wars by taxation and in-kind levies on occupied territories. So in 1815 the public debt is a modest 15% of national income, and probably even less in market value.[330] The debt then increases over the course of the 19th century from about 15% in 1815 to about 90% at the end of the century, before declining slightly to 75% on the eve of World War I. As explained by Fontvieille (1976, pp.1860-1868), this increase is partly driven by a number of exceptional capital payments made by the French government: 2 billion francs in 1815-1816 to foreign armies, 1 billion in 1825 to aristocrats supposedly spoiled by the French revolution (*le milliard des emigres*), and 7.5 billions in 1871-1873 to Germany (5 billion of pure transfers and 2.5 billion of *frais d'occupation*). We find that over the 1820-1910 period, government deficit is -1.5% per year on average, which can be decomposed as -2.2% in net interest payments, -0.4% in net capital payments, and +1.1% in primary surplus.[331]

Our public debt series for the 1810-1913 period come from the retrospective statistical compendium of Insee (1966), henceforth AR 1966, pp. 494-495. There are three main forms of public debt, and we include all of them.[332] First, up to the 1880s, almost all the public debt took the form of perpetual bonds – la *rente perpetuelle*, also labelled *dette perpetuelle* or *dette consolidee* (funded debt) in budgetary documents. A second form of debt appears in 1878 with the issuance of the first redeemable bonds (*rente amortissable*) with a maturity of 75 years. Those bonds gradually become quite important: in 1900, they account for about one-third of all government debt.[333] Lastly, when the government's net borrowing needs exceed the issuance of new *rentes* (either perpetual or fixed maturity), then the "floating debt" increases.[334] The

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[329]Two-thirds of the capital on perpetual bonds and life annuities was "reimbursed" to bondholders in the form of worthless *bons du 2/3*, see Sargent and Velde (1995, p. 512).

[330]The government bonds that have survived the two-thirds bankruptcy trade at a significant discount, see for instance Tapies (1845) for statistics on the quarterly prices of 5% *rentes* over 1799-1834.

[331]See Table FR.4e, in which we include net capital payments into the primary surplus.

[332]See TableFR.5c for a decomposition.

[333]Up to 1973, holders of perpetual and long-term bonds (more than 30 years) were nominally identified in the Great Book of the Public Debt (*Grand Livre de la Dette Publique*), which established ownership on public claims, and enabled bondholders to benefit from tax breaks on coupon payments. The last perpetual bonds were reimbursed in 1987.

[334]Note that there is a distinction in AR 1966 between "fixed maturity short-term debt" and "floating debt".

floating debt does not increase much over the course of the nineteenth century (from 0.1bn francs in 1820 to 1.5bn in 1913). But it skyrockets during World War I, and after the War it becomes more important than the funded debt itself.[335] Up to 1913, AR 1966 only provides public debt estimates for the beginning of each decade. We use data on the government's budget deficits (AR 1966 pp. 484-485) to reconstruct complete yearly debt series.[336] The debt data reported by Insee are face values, but there is no default and almost no inflation in the whole 19th century, so that in practice market and face values are extremely close to each other and we make no correction whatsoever to the AR 1966 figures.[337]

Public debt 1913-1970

The public debt surges during World War I, from 75% of national income in 1913 to close to 180% in 1919. Most of the increase comes from the floating debt, which includes "bons de la désense national". In addition, a fourth type appears in the interwar: the "dommages de guerre" introduced by the Bank of France in 1921 to pay the victims of war destructions. They amount to about 20% of national income in the 1920s and 1930s. From 1914 to 1929, the public debt trades at a large discount, sometimes as low as 50% of par values. Because private wealth estimated of the time include the holding of public debt at market value, it is key to put the government liabilities at market value too.[338] Note also that a number of new new issuers of public debt or quasi-public debt appear in the interwar (in addition to Treasury), such as Crédit

The former is negligible until World War I, to simplify the exposition we include it in "floating debt".

[335]Holders of short-term bonds and other floating debts were not nominally identified in the Grand Livre.

[336]Note that the "government's surplus/deficit" data reported in AR 1966 (p. 485) are not equal to the government's net borrowing, because the funds obtained through the issuance of perpetual and long-term bonds are recorded as resources (they are "extraordinary resources"). So by construction the "government's surpluses/deficits" reported in AR 1966 pp. 484-485 are equal to the fraction of the government's net borrowing needs which are not financed by the issuance of new *rentes* but by an increase in the floating debt (an increase which was only 1.4bn francs over the whole 19th century). So it is crucial to add the government's "extraordinary" resources to reported surpluses/deficits in order to obtain the true government net borrowing.

[337]Our debt figures are usually close to those reported by Reinhart and Rogoff (2011), Abbas et al. (2011), and Flandreau and Zummer (2004) for the end of the 19t century. All these authors appear to more or less directly use the Insee AR 1966 data, but with sometimes undocumented modification (e.g., in 1880, Insee reports 21.6bn in public debt but Flandreau and Zummer report 24.3bn; in 1890 26.2bn vs. 30.1bn).

[338]Note that already before the war, market values seemed a bit lower than nominal values. Colson reports that the total nominal value of perpetuals was 26bn francs at end 1913, but 22.5bn at market value. We disregard this discrepancy before World War I.

national and Caisse autonome d'amortissement (in charge of transforming short term debt – bons de la désense national – into medium or long term debt).

Our estimate of the public debt in 1925 includes all forms of debt ("funded" and "floating", i.e. basically long term and short term), all public debt issuers, and uses market rather than book value. Based on the careful work of Colson (1927), we estimate that the public debt is 295bn francs as at the end of March 1925, i.e. about 124% of national income.[339] This is the same figure as the one used in Piketty (2010, 2011).[340]

During World War II, public debt surged again, mostly because of the huge occupation payments imposed by Germany. Total payments amounted to more than 100% of pre-war GDP.[341] About a third was financed with taxes, and the rest with bonds and money creation (e.g., Occhino, Oosterlinck and Whute, 2006, Table 3). As domestic production collapsed – in 1944, national income reaches its twentieth century trough, about 100bn 2010 euros – the public debt / national income ratio exploded and exceeded 250% by the end of the war. The immediate post-war inflation rapidly brought the debt down. By the end of the 1940s, it is less than 50% of national income

Government non-financial assets, 1700-1970

Before the official balance sheets that start in 1970, there are no official estimates of government assets. For the eighteenth century, we assume that government assets amount to 40% of national income up to 1780, and then rise to 45% in the 1810s. For the 1820-1870 period, we reproduce the decennial government assets/national income ratio of Piketty (2010, pp. 39-40), namely 58% in 1820, gradually rising to 80% in 1870. These estimates rely on a number of pub-

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[339]This figure was obtained as follows. Colson (1927) reports on the total amount of funded debt at both nominal (227bn francs) and market values (172.1 bn: titres d'Etat exempts d'impot: 117.1bn + bons du Tresor et de la Defense national: 55bn). To his market value estimate, we add the amount of floating debt from Villa and Insee AR 1966; see detailed computations in France.xls.

[340]One caveat here is that it is unclear whether this includes foreign public debt or not.

[341]See, e.g., Occhino, Oosterlinck and White (2006). At the 1940 armistice, occupation costs were set to 20 million Reichsmarks a day, i.e. 400 million francs a day, or 146 billion francs a year. In 1940 national income was about 361bn francs, so occupation costs were initially set at about 40% of national income per year. This was later reduced to 300 million francs per day. France also transferred a large amount of goods to the Reich through the imposition of massively distorted exchanges rates, in addition to forced labor.

lications by the economists of the time. They should be viewed as approximate and illustrative, as the methods upon which they rely are less sophisticated than those used to estimate private wealth. But we feel confident that the order of magnitude is correct: first, it is consistent with the moderate public investment flows of the time (i.e., with a 0.5% net investment rate and a 1.2% growth rate, one is bound to obtain non-financial assets worth about 40% of national income, to which land must be added); second, it is in line with what we find in other countries at the same time.[342]

From 1870 on, we report somewhat more sophisticated estimates for the benchmark years 1896, 1913, 1925, and 1954, and in order to provide yearly series period we fill in the gaps by cumulating government investment flows.[343]

The 1896 data point, 20bn francs, is the one obtained by Colson for 1898-1899. Colson (1903, vol. 2, pp. 276-283) reckons that national wealth in 1898-1899 was 229bn francs (pp. 277-279) and that private wealth was 239bn (p. 282). As he explains, the difference, -10bn francs, measures the net wealth of the government with government bonds at market value. By his estimate the market value of the public debt was 30bn francs (Colon, 1903, vol. 3 p. 256), so that public assets amounted -10+30=20bn, i.e. about 65% of national income. This is smaller than the 110% reported in Piketty (2010, 2011), but more in line with government investment flows and available estimates of public assets in other countries at the same time.[344]

For 1913, we use Colson's estimate of 32.8bn francs, which he obtained by the same method. That is, Colson (1918, vol. 3, pp. 362-378) reckons that national wealth was 303bn francs in 1913, a bit more than private wealth (297). As the market value of the public debt was 26.8bn (p. 344), government assets amounted to 303-297+26.8 = 32.8bn francs, i.e. around 73% of national income.

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[342]In 1870 Germany for instance, we find that government non-financial assets also amount to about 75% of national income.

[343]Investment flows are generally consistent with the pattern of nonfinancial assets / national income ratios reported below, see detailed computations in Table FR.5c.

[344]At the end of the nineteenth century we find that the German government has about 90% of national income in assets, which is more than Colson's estimate for France (65%). This is consistent with the fact that railways were gradually nationalized in Germany at the end of the nineteenth century, but were not in France.

For 1925 and 1954, we reproduce the estimates reported in Piketty (2010, 2011). The 1925 data point, 192bn francs (81% of national income) comes from Colson (1927, livre 3, pp. 485-483), and the 1954 data point, 28bn euros (124% of national income) from Divisia, Dupin, Roy (1956, vol. 3, pp.65-67). All relevant details can be found in Piketty (2010, Appendix A, pp. 39-45).

Government Financial assets

Up to 1969, financial assets of the government are equal to the central bank's claims on the government (bonds plus loans), and nothing more. From 1970-on we use the official Insee balance sheet. There is a beak in series in 1970, when official balance sheets become available: gross financial assets and liabilities of the government increase a lot. Bu this has no effect on the government's net financial position, which is what matters for our study.

F   United Kingdom

F.1   Official national accounts

F.1.1   National income, 1948-2010

The UK national accounts are currently constructed by the Office for National Statistics (ONS). The reference publication is "The Blue Book – United Kingdom National Accounts" (BB) edited each year by the ONS.[345] For the 1948-2010 period we use the official blue book series with no modification whatsoever.[346] The PDF version of the Blue Book for year n usually includes series

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[345]We used the 2011 edition of the Blue Book, downloaded from the ONS website in April 2012 from http://www.ons.gov.uk/ons/rel/naa1-rd/united-kingdom-national-accounts/2011-edition/index.html. All references to table numbering and variable names are given in the Excel file UK.xls.

[346]The only exception is that we treat financial intermediation services indirectly measured (FISIM) differently than the official accounts. UK statisticians treat FISIM on mortgages as intermediation consumption (which is standard), but they record a lot of FISIM (especially in recent years, because of very low central bank rates). As a result, households earn little net operating surplus (because they consume a lot of FISIM on their mortgages), which biases the net product of the housing sector (hence housing capital income) downward. To improve comparability with other countries, we set FISIM on mortgages to zero i.e., we add them to the housing sector's net product, and subtract them from financial companies profits. This has zero impact on GDP or national income, and is a pure transfer between the housing and financial corporations sectors. See detailed formulas and computations in the Excel file.

up to about $n-10$. Longer-run series using identical table numbering are available in the Blue Book on-line database on the ONS website.[347] There are some gaps in the online database, in particular for saving flows. We filled in the gaps by drawing for the most part on the careful work of Martin (2009).

One problem with the Blue Book data is that no estimate of the wage bill in the non-corporate business sector is available before 1987. We made assumptions in order to provide a decomposition of national income by production sector before 1987 in Table UK.9.[348] By construction our series on the share of corporate vs. non-corporate activity are consistent with all available macro indicators (in particular the number of individuals employed in agriculture vs. other sectors), and so they can reliably be used to study the long-run transformation of the UK economy. Given the limitation of the raw national accounts data, however, we caution the reader against using our series for short-run business cycle analysis. For the 1948-2010 period, we compute the shares of labor and capital in national income by assuming that the same factor income distribution holds in the non-corporate as in the corporate business sector (Table UK.11a). Given the uncertainty on the exact share of corporate vs. non-corporate activity, the above caveat also applies to our factor shares series. Given our long-run focus, any error here is irrelevant.

F.1.2   National wealth, 1975-2010

The online Blue Book database includes complete balance sheets by sector covering the 1987-2010 period. The ONS – and the previous administrative bodies, such as the Central Statistical Office – did construct complete annual balance sheets by sector starting as far back as 1957. Unfortunately, the detailed 1957-1986 balance sheets are not available online yet. One needs to return to earlier Blue Book paper publications, and the resulting series are not fully homogenous to the post-1987 series. Therefore, we proceeded as follows.

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[347]See e.g. Blue Book 2011 on-line database: http://www.ons.gov.uk/ons/rel/naa1-rd/united-kingdom-national-accounts/2011-edition/tsd---blue-book-2011-dataset.html.

[348]Specifically, we assume that the amount of wages paid in the non-corporate sector follows the evolution of mixed income. Detailed computations and robustness checks are provided in the Excel file.

For the 1975-2010 period all our private wealth series come from the Blue Book, either directly from the online database, or indirectly through earlier works that rely on official data (Blake and Orszag, 1999; Atkinson, 2012). In addition to the national balance sheets compiled by the ONS, the UK tax administration (HMRC)[349] has been compiling estimates of "identifiable personal wealth" since 1962, on the basis of inheritance tax returns and probate records, using the mortality multiplier technique.[350] By construction, these HMRC personal wealth aggregates are substantially smaller than the aggregate net wealth of the household sector obtained by the ONS.[351] Given our macroeconomic focus in this paper, we only use the national accounts estimates, which are based upon wealth census methods and are therefore more comprehensive and more suitable for our purposes.[352]

For government wealth, 1967-2010 data are from the Blue Book (annual balance sheets of the general government sector). Up to 1988 the official balance sheets severely under-estimate the government's assets, because they measure the government's equities in public non-financial corporations at book value (a few million pounds) rather than market value. In Table UK.6a we therefore present two sets of results. One reproduces the official BB series ("government wealth"). The other ("corrected government wealth") adds to the government's assets the net wealth of public sector corporations (i.e., the book-value of their assets minus their recorded

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[349]HM Revenue & Customs since 2005, formerly Inland Revenue and HM Customs & Excise.

[350]That is, HMRC multiplies the number of decedents by the inverse of the mortality rate for this age and gender group, and uses a survey-based correction for differential mortality between the rich and the poor. Mortality multiplier techniques have been used since the 1900s-1910s in order to study the wealth of the living from wealth-at-death data, both in France and in the UK. See the references given in Piketty (2011, section II.D).

[351]All HMRC personal wealth estimates are available on line on the HMRC website: see http://www.hmrc.gov.uk/stats/personal_wealth/menu.htm. See in particular the "reconciliation table" between HMRC and ONS estimates (see "Personal wealth statistics 2001-03 and 2005-07", HMRC, June 2011, Table 13.4). The raw ratio between "identified wealth" and "national accounts wealth" is typically about 50%. Once valuation differences and excluded wealth (e.g. small or joint properties do not require a probate to be transmitted at death) are taken into account, the ratio is typically about 70%-80%. Most of the remaining gap is due to non-transmissible, annuitized pension wealth (funded pensions make about 15%-20% of household wealth as measured by the national accounts).

[352]Estate multiplier techniques are useful not only to estimate aggregate wealth, but most importantly to study the distribution of wealth by age group and by wealth deciles. See e.g. Atkinson and Harrison (1978) and Piketty, Postel-Vinay and Rosenthal (2006).

equity liabilities). This correction typically adds 50-80% of national income in assets in 1967-1988, as the government owned a large number of companies from the post war period to the 1980s.[353]

F.2 Non-official national accounts series: Main sources

The UK – together with France – has the longest tradition of national accounts in the world. The first estimates of national income and wealth were published by Petty (1664) and King (1696), and were followed by many others, including Colquhoun (1815), Giffen (1878, 1889, 1890), Bowley (1920), Clark (1937), Campion (1939), Deane and Cole (1962) and Revel (1967).

Regarding national income, the reference historical series are those established by Feinstein and his coauthors (Feinstein, 1972, 1978; Matthews, Feinstein and Odling-Smee, 1982; Feinstein and Pollard, 1988), and we use them intensively. In particular, Feinstein's monumental 1972 book includes detailed annual series on national income and its components covering the 1855-1965 period, using concepts and methods which are reasonably close to official post-1948 blue book series.

Regarding national wealth, however, we choose for the most part to return to the original estimates made by contemporaries such as Petty, King, Colquhoun, Giffen, Campion and others, and to use these estimates in order to construct our own long run series. In effect, these contemporary estimates are close in spirit to modern, market-value, balance-sheet estimates of national wealth. In contrast, Feinstein and his co-authors are mostly interested in volume (constant-price) estimates of the reproducible capital stock that cannot easily be compared to modern national wealth estimates.[354] The book by Giffen (1889), *The Growth of Capital*, provides a detailed description and comparison of the methods, concepts and results of previous national wealth estimates, and is particularly useful for the earlier periods. For the period

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[353]Non-financial public corporations' assets are bout 40% of national income in assets in 1967, peak to 80% in the mid-1970s, and quickly decrease in the 1980s and 1990s (about 15% of national income since the end of the 1990s.)

[354]In particularly, Feinstein's estimates raise major difficulties for the measurement of land values. More on this later.

going from World War 1 to the 1970s, we heavily rely upon the personal sector balance sheets constructed by Solomou and Weale (1997) and Blake and Orszag (1999).

We provide annual series covering the entire 1855-2010 period, as well as decennial estimates for 1700-1850. All national income and wealth series were adjusted so as to cover the historical UK territory (Great Britain plus Ireland) throughout the 1700-2010 period.[355] Below we briefly describe the main sources we use for national income, as well as for private and government wealth. The following subsection will provide additional details on most of these data.

F.2.1   National income, 1700-1948

For the 1855-1948 period, we rely on the series constructed by Feinstein (1972), with minor adjustments described in the Excel file UK.xls so as to ensure homogeneity with official blue book series.[356] We provide estimates of the distribution of factor shares at the national level by imputing sectoral wages to the self-employed, drawing in particular on the works of Matthews, Feinstein, and Odling-Smee (1982, especially pp. 168-172) and Allen (2009). Consistent with these authors, the labor share reaches a trough in the early 1870s (the end of Allen's "Engel's pause"), then rises until the end of the 19th century, before declining in the years preceding World War I.[357]

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[355]Including Southern Ireland until 1920a, excluding Southern Ireland after 1920b, and excluding all overseas territories throughout the period. Note that the discontinuity in 1920b is rather limited (about 6.6% drop in population, but only 3.2% drop in national income) and is assumed not to affect the wealth-income ratio.

[356]Feinstein (1972) uses the national accounts concepts of the 1960s-1970s, so we made a number of minor adjustments to ensure continuity with the BB 1948-2010 series (which use ESA 1995 concepts). Note that the investment (and capital stock) series released by Feinstein (1972) for the 1855-1938 period were substantially revised upwards in subsequent work by Feinstein and his co-authors (see Matthews, Feinstein, and Odling-Smee, 1982, and Feinstein and Pollard, 1988). The gaps are particularly large for the 1855-1873 period (see Matthews, Feinstein, and Odling-Smee, 1982, p.121, note 2). We always use the latest revised series available. All details are given in the Excel file.

[357]All the details of our factor share computations, including computations of the imputed wage of self-employed individuals in the agricultural and non-agricultural sector, are in the Excel file UK.xls. Note that it is important to impute sector-specific wages to the self-employed (as Matthews, Feinstein, and Odling-Smee do) rather than an economy-average wage because the self-employed are in relatively low paying sectors (e.g., the average agricultural wage is about 60% of the economy-average wage through to World War I). For the pre-1948 period, given available data, this method to compute factor shares is also much preferable to the one that assumes the same factor income decomposition in the non-corporate sector as in the corporate sector (which we use for the post 1948 period).

For the 1700-1850 period, we proceed as follows. 1760-1850 estimates were computed backwards from 1855, using the 1760-1855 real growth rates of Feinstein (1978) and the composite price index series of O'Donoghue, Goulding, and Allen (2004), Gayer, Rostow and Schwartz (1953), and Schumpeter (1938).[358] For the 1700-1760 period, we start with the 1700 estimate due to King (1696), and we assume constant nominal growth between 1700 and 1760. The resulting 1700-1820 growth pattern is very close to Maddison (2007, 2010) and consistent with the 1700-1830 GNP estimates reported by Officer (2011 Table 8 pp.33-34).

F.2.2 National wealth, 1700-1975

Private wealth, 1700-1975

For the period from 1920 to 1975, we rely on the series constructed by Blake and Orszag (1999) for 1948-1975, and by Solomou and Weale (1997) for 1920-1948.[359] When we decompose wealth accumulation over this period, we take into account war destructions during World War II. Harrison (2000, Table 1.11 p. 37) reports that war destructions amounted to about 5% of domestic wealth; we assume that all destructions are for the private sector, and are equally split

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[358]Specifically, we assume real growth rates of national income equal to 1.8% over 1800-1855 and 1.0% over 1760-1800. Overall, the 1700-1850 period was one of zero inflation (+0.1% per year on average), with the moderate price increase during the French Revolution and Napoleonic wars entirely reversed by 1850. The available inflation series for the eighteenth and nineteenth century all show the same pattern, so the choice of the exact series does not matter a great deal. In the short run there are admittedly some variations across sources. In particular, O'Donoghue, Goulding, and Allen (2004) seem to slightly over-estimate the increase in prices during the Napoleonic wars (+3.3% per year in 1790-1810 by their estimate, vs. 2.6% in both Schumpeter, 1938, and Gayer, Rostow and Schwartz, 1953). So we constructed our price index by taking O'Donoghue, Goulding, and Allen (2004) for 1810-1855, Gayer, Rostow, Schwartz (1953) for 1790-1810, and Schumpeter's (1953) average of consumer and producer prices for 1760-1790. We set inflation rates to 0 over 1700-1760, consistent with available seventeenth century series (see for instance Gilboy, 1936). All details are provided in the Excel file notes and formulas.

[359]We made various minor adjustments so as to ensure continuity (see Excel file for full details). Blake and Orszag (1999) provide detailed, annual personal wealth series covering the 1948-1994 period (their 1975-1994 series follow very closely the official BB series). Solomou and Weale (1997) provide detailed, annual personal wealth series covering the 1920-1956 period and are also very close to the Blake-Orszag and BB series. Note that we attempt to follow throughout the period ESA 1995 definitions of net wealth. In particular our definition of net private wealth excludes non-marketable tenancy rights, which are often included in official ONS-BB UK balance sheets, but which are not considered as assets by the SNA. Non-marketable tenancy rights currently represent the equivalent of about 40% of UK national income (around 600 billions £in 2008-2011) and are scheduled to be eliminated from official UK balance sheets in 2012. See "Improvements to the non-financial balance sheet," ONS, february 2012.

over 1940-1944.

For the 1855-1920 period, we use estimates of the stock of private wealth available for the years 1855, 1875, 1885, 1913, and 1920 and we obtain annual figures using the private saving series constructed by Feinstein (1972) and assuming constant real rates of capital gains in each sub-period (1855-1875, 1875-1885, 1885-1913, and 1913-1920). We find that the residual capital gains are usually small, except in the 1913-1920 where real capital losses are about 16% per year.

Lastly, for 1700-1850, private wealth series were similarly interpolated on the basis of the private wealth estimates available for the years 1700, 1750, 1810 and 1855 and private saving flows.

Government wealth, 1700-1967

The Blake-Orszag (1999) and Solomou-Weale (1997) balance sheets only cover the personal sector, so we computed our own yearly public wealth series for the 1855-1967 period. For non-financial assets, we have official data from 1958 on.[360] Prior to 1958, we use two non-official estimates for 1865 (Giffen, 1989) and 1913 (Campion, 1939) and we interpolate using Feinstein's public net investment flows. Just like for the 1967-2010 period, we also compute an extended measure of government wealth which includes the net worth of non-financial public corporations.[361] For public debt, we use the public finance statistics assembled by Mitchell (1988, pp.575-645) for par values[362] and Janssen, Nolan, and Thomas (2002) for the market value of government securities (see discussion below of these two sources). We also try to account for the financial assets of the government, which are not very well documented but appear to have always been quite modest in comparison to public debts.[363]

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[360]BB series are only complete and consistent from 1967-on; for the 1958-1967 period see Revel (1967), Hibbert (1981), and Sbano (2008) for retrospective series on financial assets and liabilities by sector.

[361]Although there are no official balance sheets before 1958, we do have data on net investment rates of non-financial public companies (BB and Feinstein, 1972). These investments really take off in the late 1940s, so the net worth of non-financial public companies is negligible until that time. See Table UK.6g for detailed computations.

[362]See also Reinhart and Rogoff (2011) and Abbas et al. (2011). There are slight variations across sources, but they are negligible for our purposes.

[363]Throughout the 1855-1967 sub-period we include in the government's assets the Gilts held by the Bank of

For the 1700-1850 period, we have carefully reconstructed the public debt history of the U.K. based on the detailed public finance statistics in Mitchell (1988, pp.575-645) and Janssen, Nolan, and Thomas (2002).

F.3 National income and wealth: Detailed Sources

Here we provide additional details about the sources and methods used for our 1700-1950 national income and wealth estimates summarized in Table UK.6f.

F.3.1 1700

We use the national income and wealth estimates published by King (1696) for England, which we gross up on the basis of population in order to obtain UK estimates (keeping fixed the wealth-income ratio). That is, King's original estimates are $Y = £43.5$ million for national income and $W = £306.0$ million for national wealth, and they refer to an estimated English population of 5.300 million inhabitants (see King 1696, pp.41-49).[364] Given that total population for the UK (Great Britain and Ireland) is estimated to be 8.565 million in 1700,[365] we find a UK national income of $Y = £70.3$ million and a UK national wealth of $W = £494.5$ million (see Table UK.6f).[366] Needless to say, what matters for our purposes is the order of magnitude for the national wealth-national income ratio (here $\beta = W/Y = 703\%$) and its constituents rather than the precise levels of the numerator and denominator.[367]

England. The balance sheet of the Bank, presented in TableUK.7, based on Mitchell's data (1988, p. 651-661), shows that these assets peaked at about 20% of national income in 1946.

[364] According to King, this 5.3m total population (including 45% children and 10% servants) corresponds to 1.3m households. King also provides some estimates about long run population growth: according to him, England had 0.4m inhabitants around 1, 2m in 1066 and 5.3m in 1696 (this corresponds to annual growth rates of exactly 0.15% for both sub-periods).

[365] We use the UK population estimates reported by Maddison (2010, population table) for 1700 (8.565 million) and 1820 (21.239 million), and by Feinstein (1972) for 1855-1948 (and official BB estimates thereafter). We assume constant population growth over each sub-period 1700-1820 and 1820-1855, and an adult population share equal to 55% of total population throughout the period 1700-1855 (this is consistent with King's estimates and post-1855 series). See Table UK.2.

[366] That is, 43.5 x 8.565/5.300 = 70.3, and 306 x 8.565/5.300 = 494.5.

[367] To the extent that income and wealth averages were probably somewhat smaller outside England than in England, our national income and wealth figures are possibly somewhat overestimated. But some authors have argued that the initial King estimate was underestimated, possibly by about 20%-25% (see Lindert and Williamson 1982 p.393 Table 2, who propose to replace the £43.5m estimate by £54.4m). Also the fact that

Several points are worth mentioning.

(1) First, King's estimate is supposed to refer to year 1688. However King also provides estimates for 1695, which turn out to be lower than his 1688 estimate (due to the war against Holland and France).[368] It is clearly illusory to search for great annual or even decennial precision for this time period. So as a first approximation we choose to attribute King's estimate to the year 1700.

(2) Next, King's national wealth estimate (£306 million for England, 703% of national income) is the sum of three components: land (£180m, 414%), houses (£54m, 124%) and other capital goods (£72m, 166%). We include in the category "other capital goods" (£72m) the following categories used by King: "live stock, cattle, etc." (£25m); "stock in shipping, stores, materials, etc." (£28m); "money, precious metals, jewels, etc." (£14m). In order to follow the modern ESA 1995 definition, we exclude from "other capital goods" – and therefore from national wealth – household durable goods ("furniture, plates, etc.", which King estimates to be worth £14m, i.e. another 32% of national income; see Table UK.6f). King considers that net foreign assets are close to zero and does not give a precise estimate.[369]

(3) It should be noted that the sources and methods used by King (1696) are broadly similar to his predecessor Petty (1664) – but that King's estimates are probably more accurate. In particular, both compute aggregate land value and land rent by multiplying estimates of average rent per acre by estimates of total numbers of acres (obtained from a combination of tax and topographical sources). Both consider that land values are generally equal to 18 years of land rent (i.e. land is "reckoned at 18 years purchase", "capitalisée au denier 18" in French, following

we find the same 1700-1820 real growth as Maddison and other existing estimates (see above) suggests that the overestimate cannot be very large. We use the UK population estimates reported by Maddison (2010, population table) for 1700 (8.565 million) and 1820 (21.239 million), and by Feinstein (1972) for 1855-1948 (and official BB estimates thereafter). We assume constant population growth over each sub-period 1700-1820 and 1820-1855, and an adult population share equal to 55% of total population throughout the period 1700-1855 (this is consistent with King's estimates and post-1855 series). See Table UK.2.

[368]In order to analyze the consequences of the war on each country's wealth and public finances, King (1696, pp.63-69) also provides national income estimates for England vs France vs Holland in 1688 and 1695.

[369]Given the territorial differences, our estimates are quantitatively consistent with the net worth estimates reported by Lindert (1986, Table 3, p.1144).

the terminology of the time). That is, the rate of return on land is assumed to be 1/18=5.6% per year. For instance, King (1696) estimates that total land rent is £10 million (so that total land value is £180 million), and that total housing rent is £3 million (so that total housing value is £54 million). According to King and Petty, the rate of return on other capital goods varies across assets, but is generally higher than for land and for housing, typically 1/12=8.3% rather than 1/18=5.6%. Assuming an average rate of return of 6.0% on other capital goods, total capital income in King's estimates amounts to Y_K =£17.3m (13.0+4.3), the capital share is $\alpha = Y_K/Y = 40\%$ (17.3/43.5), and the aggregate rate of return is $r = Y_K/W = \alpha/\beta = 5.7\%$ (17.3/306).

Petty's estimates of wealth-income ratios and capital shares for year 1664 are broadly similar, but involve a lower wealth-income ratio, due to a lower estimate of aggregate land value. That is, Petty (1664, pp.5-9) estimates that national income in 1664 England is Y =£40.0m, including total capital income Y_K =15.0m£, so that the capital share is $\alpha = Y_K/Y = 37.5\%$ (15/40). Petty breaks down capital income into land rent (£8.0m) and other capital income (including housing rent) (£7.0m). He estimates national wealth to be equal to W =£236.0m (i.e. $\beta = W/Y = 590\%$), including land (£144m, 360%), houses (£30m, 75%) and other capital goods (£62m, 155%),[370] which corresponds to an aggregate rate of return is $r = Y_K/W = \alpha/\beta = 6.4\%$ (15/236). The main difference with King is due to land and to housing. Giffen (1889, pp.72-83) offers a careful comparison of Petty and King and concludes that King is more reliable (in particular, King seems to give higher and more realistic estimates of land rent, while Petty omits to gross up the fiscal values of the time), so we choose to use King's ratios.[371] However it should

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[370]Petty's other capital goods can be further decomposed into live stock, cattle, etc., stock in shipping, stores, materials, etc., gold and silver. The categories and amounts are broadly similar to King, except that Petty estimates total coined gold and silver in circulation to be only £6m, while King finds £14m, probably because the latter includes bullion and jewels (in any case, both authors rightly stress that gold and silver are a very small part of national wealth). Here we also exclude household durable goods (£14m) from Petty's national wealth estimate (which would otherwise be £250m instead of £236m).

[371]Note that Petty's lower wealth-income ratio is partly compensated by a higher rate of return, so that the capital shares are almost the same in both estimates. Petty's higher rate of return is due to the fact that he chooses to reckon housing values at 12 years' purchase (r =8.3%) rather than 18 years (r =5.6%), while for land values he uses the same 18 years coefficient as King. It is difficult to believe that houses were a so much riskier asset than land, so it is likely that most of gap has to do with a confusion between gross and net returns (houses

be clear that both estimates are approximate: the true wealth-income ratio is probably closer to 703% (King) than to 590% (Petty), but given the uncertainties about both the numerator and the denominator, the only really safe conclusion might be that it is somewhere in the 600%-750% range.[372]

(4) Both Petty and King compute some estimates for human wealth, which they do by capitalizing labor income at some given rate of return, typically $r = 6\%$. For instance, Petty (1664, pp.9-10) proposes to capitalize labor income at 6% so as obtain an estimate of human wealth ("labor stock") equal to £417m (£25m divided by 6%), and a total estimate of human and non-human wealth of £667m.[373] This corresponds to an augmented wealth-national income ratio well above 1500% (667/40=1668%) – a natural consequence of the fact that 100% of national income is now being capitalized at rates of return around 6%. King (1696) provides similar computations. These computations have some similarities with total human and non-human wealth recently published by the World Bank (2006). However modern national accounts guidelines have consistently – and in our view rightfully – refused to include human capital in the list of assets and liabilities, first because humans cannot be sold on a market (to some extent they could at the time of King and Petty), and next because the study of the accumulation of human assets would raise major conceptual difficulties (in particular because the education and health services which serve to accumulate such assets are largely viewed as consumption goods, i.e. goods that have a consumption value per se, independently of the accumulation of an asset; so that the most basic distinction upon which national accounts are built, i.e. consumption goods vs capital goods, would collapse).[374]

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incur more depreciation than land). Petty and King generally refer to net returns, but they are not always fully precise about this (particularly Petty).

[372]In particular it should be noted that both Petty and King estimate labor income as a difference between national income (which they get by multiplying population by what they view as a reasonable estimate of average income) and capital income (which they obtain via their census type estimates of land and housing rent, acres and other capital goods). They both find a labor share around 60% and a capital share around 40%, but it is clear that there is significant uncertainty about these factor shares. Allen (2005, Table 9, p.36) offers interesting estimates of aggregate income and rents over the 1300-1850 period (showing a large increase of rent share in agricultural income; see also Table 13 p.40, and Table 14 p.41).

[373]£417m human wealth + £250m non-hunan wealth (including the £14m in durable goods).

[374]For a discussion of these issues, see e.g. Vanoli (2002 pp.385-387).

(5) Neither Petty nor King decompose national wealth into private and government wealth. The implicit assumption is that the latter is negligible, and we indeed find that government net wealth was probably around zero. Although fully comprehensive public accounts were not made available to Parliament until 1857, archives were kept at the Exchequer and used in the middle of the nineteenth century to publish retrospective accounts starting in 1688.[375] These accounts give the par value of central government debt, about 23% of national income in 1700.[376] Another and more consistent measure is the market value of government debt, which can be obtained by capitalizing the flow of interest payments at the market interest rather than the official issuance rate (Janssen, Nolan, and Thomas, 2002).[377] In the aftermath of the Glorious Revolution and until the end of the War of the Spanish Succession in 1713, the public debt trades at a large discount and for 1700 the market value of the public debt appears to be about half the nominal value, i.e. about 11% of national income (the figure we report in Table UK.6f). On the assets side, we have no direct estimate, but on the basis of the various 18th and 19th century estimates surveyed by Giffen (1889, pp.72-114), it is reasonable to set the government's non-financial assets to 30% of national income. We neglect financial assets (e.g., Treasury balances). As a consequence net government wealth appears to be slightly positive (+19% of national income), and private wealth appears to be close to national wealth (684% instead of 703%).

(6) Finally, one important additional advantage of King's estimates over Petty's is that

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[375]See Mitchell (1988, pp.570 sqq.)

[376]As at the end of September 1699, the "funded plus unfunded debt" of the central government was £15.4 million (Mitchell, 1988, p.600). This figure excludes terminable annuities (and some residual debt charges which were regarded as outside the permanent charge of the national debt) and needs to be slightly upgraded, by about 7% (see Clark, 2001, Table 4, for statistics on the share of perpetual bonds – "funded debt" –, short term debt – "unfunded debt", i.e. notes issued without an act of Parliament –, annuities – terminable and life –, and other liabilities in government debt.) Applying the 7% correction factor, the par value of public debt in mid-1700 comes to £15.8 million, i.e. 23% of national income. Note that Reinhart and Rogoff (2011) also report a 23% debt figure for 1700, but this similarity masks three differences: (i) they do not try to account for terminable annuities, (ii) they divide Mitchell's "funded plus unfunded debt total" by a GDP estimate from http://www.ukpublicspending.co.uk/ which turns out to be lower than King's national income (£60.5mn vs. £70.3); (iii) their debt figure for 1700 refers to September 29, 1700 whereas ours refers to an average of September 29, 1699 and September 29, 1700.

[377]The data are reported in Hills et al. (2010).

King provides some relatively sophisticated computations about saving rates. First, King (1696, pp.48-49) estimates that aggregate saving is equal to £1.8m, which corresponds to an annual saving rate $s = 4.1\%$ (1.8/43.5). Unfortunately, he does not attempt to relate this saving flow to the wealth stock. But the most impressive part of King's work is his famous "social table", in which he provides the distribution of incomes, expenses, and saving for a large number of social groups, including "temporal lords", "baronets", "knights," "gentlemen", "farmers", "artisans & handcrafts", "cottagers and paupers", etc. King's estimates of saving flows by income group show large positive savings at the top and negative savings at the bottom (expenses larger than incomes) – but unfortunately King offers no discussion as to how this might lead to an equilibrium distribution. (The only convergence force seems to be the larger average family size at the top, but this is not discussed explicitly. One could also think of negative random shocks at the top as an equilibrating force).

(7) The original documents written by Petty and King are short and readable (26 pages for Petty, 45 pages for King). The main results and tables obtained by Petty-King have been reproduced in various forms by several authors, including Giffen (1889, pp.72-80), Feinstein (1978, p.33), Lindert and Williamson (1982, pp.388-393), Stone (1984, pp.116-120). It is worth returning to the original documents, however, so as to gather a better sense of the sources and methods used by these two authors.[378]

F.3.2   1750 and 1810

We use the national wealth estimates reported by Giffen (1889, pp.110-111). The estimate for year 1750 was computed by Giffen as a synthesis of various existing mid-18th century estimates. In the same way as the 1700 estimate, we grossed up the 1750 figure from its value for England

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[378]Note that the national income and wealth estimates of King (1696) are extensively quoted by his contemporary Davenant (1698, 1699), who also provides a number of additional, unpublished details about King's computations, e.g. the decomposition of the total land and cattle estimates into different types of land and cattle. Petty (1664) also provides separate estimates about houses in London vs. the rest of the country, etc. Both King and Petty clearly had a policy agenda in mind. In particular Petty's main purpose is to show that with a broad tax base the King of England could easily get ample fiscal resources – up to £4m per year with a 10% tax – in order to fight the war with Holland and France.

(500.0 £million, including household durable goods) to its value for the UK (£685.6 million, excluding durables) on the basis of population.[379] The estimate for year 1810 was taken by Giffen directly from Colquhoun's 1812 UK data point, and we took it as published by Giffen (again excluding durable goods). These estimates appear to be conceptually and quantitatively comparable to the estimates for 1700 and for 1855-1913, both in terms of total level and in terms of composition by asset type (land, housing, other domestic capital goods). Net foreign assets are undistinguishable from 0 in 1750 and 1810.[380]

Regarding public debt, we use again the long-run series on the market value of central government debt constructed by Janssen, Nolan, and Thomas (2002). The explosion of UK public debt during the 18th century and early 19th century is a well-known and nonetheless striking fact (see, e.g., Clark 2001). It is even more striking when one uses nominal values (in which case the debt amounts to 178% of national income in 1810) rather than market values (102% of national income), because the public debt again trades at a large discount during Napoleonic wars.[381] For our purposes, however, it is more meaningful to always use market values. First, for a conceptual reason: when the debt takes the form of perpetuals, as was

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[379]That is, 685.6 = (500 × 12,504/8,500) - 50.0. See Table UK.6f.

[380]Brezis (1995) argues that the UK was a net debtor for most of the 18th century. In her central scenario, the 1750s foreign debt is £24.8mn, i.e. about 23% of national income, with a lower bound around zero and an upper bound as high as £47.3mn (44% of national income); see Brezis (1995, Tables 3 and 4, p.53). Her computations rely on an initial 1700 position close to 0 (£2mn, i.e. about 3% of national income) and on current account deficit estimates which were criticized as too high by Nash (1997). So we retain the low-end scenario (0%). All authors agree that the U.K. turns into a net creditor in the late eighteenth century or early nineteenth, thanks to a positive current account balance driven by large positive transfers from the East and West Indies in the 1790s (about 4% of national income per year if we take the average of the studies discussed by Brezis, 1995, p.63) and net exports in the first decades of the nineteenth century. Table UK.12b reports decennial estimates of the balance of payments taken from Tables 2 and Table 5 of Brezis (1995). Table UK.4f shows that these estimates are consistent with a 0 net position in 1700 and 1810 (i.e., the implied residual capital gains / volume changes not accounted for by saving flows are close to 0).

[381]We report both long run market and nominal values in Table UK.5e. Our estimate for par value public debt in 1750 (81% of national income) differs from Reinhart and Rogoff's (107%) because of denominator differences: our national income estimate (£102.8) is substantially higher than their GDP figure (£72.6). Although this is not entirely clear, the ultimate source of Reinhart and Rogoff GDP seems to be the work of Lawrence Officer (2011), as reported on http://www.measuringworth.com/ukgdp/ and http://www.ukpublicspending.co.uk. There is of course a lot of uncertainty on the yearly and even decennial patterns of national income in eighteenth century UK, so short-run discrepancies in debt/GDP ratios across authors for this time period are not surprising. From the 1770s-on, our national income is well in line with Reinhart and Rogoff's GDP.

the norm until Word War I, there is no capital to be reimbursed. If the government wants to

decrease the debt, it cannot simply wait for its bonds to mature but has to repurchase perpetuals

on the markets (or convert them into terminable annuities) and pay market prices.[382] Second,

for a consistency reason: we are interested in the market value of national and private wealth,

so it is important that to use the same valuation method for both.[383] The British government

did not default once in the 18th century, but it suspended the convertibility of the Bank of

England's notes in 1797, before returning to the gold standard at par in 1819.

Regarding government's non-financial assets, we assume that they rise to 40% of national

income in 1750, and then to 50% of national income by 1810. There does not seem to exist

sufficient data to know exactly the magnitude of this rise of government assets, but there are

good reasons for assuming that such a rise indeed took place, and that the order of magnitude

is about right.[384] In any case, there is no doubt that net government wealth turned strongly

negative during the 18th century, from +19% of national income in 1700 to -52% in 1810

according to our estimates.

From the 1750 and 1810 data points for national and net government wealth, we compute

private wealth as a residual, and we obtain decennial estimates based on available private sav-

ing flows and by assuming constant residual real capital gains in 1700-1750 (0.0% per year),

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[382]Just like stocks, the market value of perpetual bonds is determined by the expected flow of future payments. The difference is that the the payments are in principle fixed, so that they are directly reduced by inflation. This (along with maybe fears of default, e.g. because of military defeat) explains the drop in the market value of the public in 1790s and early 19th century.

[383]In particular, the SNA explicitly state that bonds should be recorded at their market value.

[384]It is generally the case that periods of large and rising government debt also coincide with smaller but significant rise in government assets – simply because the government compels other public or quasi-public institutions to purchase some of its new debt. We observe this phenomenon in Japan since the 1990s, in today's United States or in 1945 France. Historical balance sheets published by the Bank of England confirm this general pattern. In Table UK.7 we report long-run series on the BoE's balance sheet. In normal time the BoE has about 5% of UK national income in assets and liabilities. The three big exceptions are (i) the 1810s-1830s, where liabilities reach 10%, with about 5% in government securities; (ii) the period from the 1930s to the 1960s, with holdings of public securities in the 10-20% range, both peaking at close to 20% in the aftermath of World War II. And lastly (iii) since 2009 the BoE's balance sheet is back to 1946 level, and about a quarter of the public debt is held by the BoE. Now if the Bank of England alone increased its holdings of public debt by 5% at the end of the eighteenth century and early nineteenth century, then it does not seem unreasonable to assume that the government sector taken as a whole increased its holdings by about 10%. Note that prior to 1855 we do not attempt to isolate government financial and non-financial assets.

1750-1790 (-0.1%), 1790-1810 (-1.2%) and 1800-1812 (-0.7%). Private saving is equal to national minus government saving. Thanks to the exhaustive and detailed public finance records kept by Treasury (Mitchell, 1988), government saving rates are very reliable, but there are large uncertainties on domestic and foreign investment rates (hence on national saving).[385] Reassuringly, however, we find that although our saving and wealth series come from independent sources, identifiable saving flows account for virtually 100% of private wealth accumulation over the 1700-1790 period. It is only in 1790-1810 that we need non-zero capital losses, and the overall pattern of residual capital losses we find for the full 1700-1810 period is consistent with the evolution of the price of perpetuals (which are a large asset class for households): the debt trades at par in 1750, but only at an average of 60% during the French revolutionary wars, with the bulk of the losses occurring in the 1790-1800 decade. Over the whole 1710-1810 period, we find that we need small residual capital losses (and/or measurement issues) to account for the wealth dynamics for the private sector: savings account for about 120% of wealth accumulation and valuation losses / measurement issues the remaining 20%.

From the decennial estimates of private wealth we obtain decennial estimates of national wealth by adding the net wealth of the government. Strikingly, we find that as a first order approximation national wealth appears to have been relatively stable around 700% of national income throughout the 1700-1810 period, despite the large drop in net government wealth. That is, the rise of government debt appears to have been absorbed by a corresponding rise in private wealth, from about 700% in the early 18th century to about 800% after the Napoleonic wars.[386] This is probably the most important and substantive result of our analysis of 18th century UK wealth accumulation: in effect, the rise of UK public debt during the 18th century was matched

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[385]Gross domestic investment rates from 1760 to 1855 are from Feinstein (1978 p. 91), and we assume that depreciation is 3% of national income in 1760-1810 and 4% in 1810-1855 (see Table UK.12d). Before 1760 we assume that net domestic investment is constant and equal to its estimated 1760s value (5% of national income). Foreign investment data are from Brezis (1995, Table 2 and Table 5).

[386]Note that the increase in private wealth would have been even larger if we valued government bonds at par value (e.g. private wealth would be close to 900% of national income in the 1820s). So although the private sector has saved a lot to finance the wars, the increase in wealth has been tempered by real capital losses (and gains for the government).

by a corresponding increase in private saving (with net private saving rates of about 20% in the 1790s, and 15% in the 1800s and 1810s), as predicted by the Ricardian equivalence theorem (maybe it is not too surprising if the latter was formulated by Ricardo in 1817 UK).[387]

If we relate the change in national wealth to national saving, we find that saving flows can account for virtually 100% of national wealth accumulation (Table UK.4d). Extreme caution is of course required when interpreting this result, given the uncertainties on saving data: in low-growth environment ($g = 1\%$ in the 18th century), small changes in s can have enormous effects on $\beta = s/g$ hence on residual capital gains. What is beyond doubt, given the good quality of public finance statistics, is that the government did make large capital gains: we find that on average government saving was -3.1% of national income over 1700-1810, so that with saving flows alone the government's position should have decreased from 19% of national income in 1700 to -191% in 1810 (see Table UK.4e). It is thanks to +138% of net capital gains (i.e., depreciation of perpetuals) that the 1810 position was a more favorable -52%. These capital gains, though very substantial, do not mean that bondholders earned a negative return on their investments: on net they received a cumulated flow equivalent of 91% of 1810's national income over the 1700-1810 period from their holdings of public bonds: +229% in interest payments minus 138% in real capital losses. The large interest payments (an average of 3.6% of national income per year) were the driving force of the government deficit. In fact, the primary balance was almost exactly 0.[388]

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[387]On the historical UK public debt experience, see also Barro (1987) and Clark (2001).

[388]In order to properly compute government saving and interest payments, it is critical to subtract from both the payments made to terminable annuity holders: these payments are mostly principal repayments rather than interest payments (e.g., in a 10-years annuity, a debt of 100 is settled in 10 yearly payments of 10 (+ interest)). In effect the raw receipts/expenditure data in Mitchell (1988, pp.578 sqq.) substantially under-estimate the government's saving by wrongly counting permanent annuity payments, which are nothing but a form of debt redemption, as current expenditure. On the other hand, one should keep in mind that Mitchell's expenditure series exclude all capital investment – both ordinary investment (about 0.5% of national income on net) and more importantly extraordinary investment made during the wars – and this omission tends to bias upwards the government's net surplus. Extraordinary military investments/expenditure can be backed out by looking at the growth of the nominal value of the public debt during the War of the Spanish Succession (1702-1713), the American War of Independence (1776-183) the French Revolutionary War (1793-1801) and the Napoleonic Wars (1803-1815). As the detailed computations in UK.xls show, with the corrections for permanent annuity payments and extraordinary military expenditure, we are able to perfectly reproduce the dynamics of the 1700-1913 public

F.3.3 1855, 1865, 1875 and 1885

We use the national wealth estimates reported by Giffen (1889 Table C p.43, and pp.110-111 for 1855). They were directly computed by Giffen using various sources, in particular data from the schedular income tax (income capitalization method). These estimates could probably be improved, but they measure the right concept (namely, the various items of market-value national wealth), and they are reasonably well documented by Giffen.[389] We again exclude household durable goods ("movable property not yielding income") from national wealth. Although the durable goods categories are not fully homogenous over time, the fact that durables always represent around 40%-60% of national income suggests that the changes cannot be too large.

The asset categories used by Giffen allow us to isolate government non-financial assets (about £300mn in 1865, i.e. 34% of national income) but do not allow to fully isolate net foreign assets (they are split between net foreign public funds, other profits and foreign investments, etc.). So we used estimates of net foreign assets from Feinstein (1972, Table 50 p.T110) and Matthews, Feinstein, and Odling-Smee (1982, Table 5.2 p.128), and computed other domestic capital goods as a residual.[390]

In his writings, Giffen (1878, 1889, 1890) repeatedly stresses that the growth of UK capital during the 19th century is particularly remarkable if we compare it to the evolution UK public debt: typically, he (rightly) points out that UK national wealth is around 11-13 times larger than UK nominal public debt in 1875-1885, while it was only 3-4 times larger in 1810-1820.

debt on the basis of the government's receipts and expenditure reported in Mitchell (1988).

[389]See in particular Giffen (1889, pp.1-71), as well as Giffen (1878, 1890). In the 19th century UK income tax system, the various forms of capital income (rent, interest, profits etc.) were taxed under various "schedules", thereby producing annual, reliable series on the various tax bases which Giffen could then capitalize using various sources on rates of return. Giffen also used other sources, in particular inheritance tax data, in order to ensure that both fiscal sources delivered the same quantitative growth of UK wealth since the early 19th century (see in particular Giffen, 1878). There seems to be an inconsistency between the growth of wealth reported by Giffen between 1875 and 1885 (+14.7% in nominal terms) and the pattern of national income growth in this time period in Feinstein (1974) – namely, 0 growth. One possibility is that Giffen does not sufficiently take into account the equity bear market in his estimation (-2% per year over this 10 years period). Another possibility is that Feinstein's 1885 national income is too low. With the data we have it is impossible to tell. In light of this issue, in Table UK.6f we divide Giffen's 1885 estimated wealth stocks by Feinstein's estimated 1890 national income.

[390]Full details, formulas and consistency checks are given in the Excel file.

To him this is a more natural reference point than national income (which he almost never uses). Yet it is also interesting to relate debts and income. In the first half of the 19th century, government interest payments average 5.6% of national income – in effect a huge transfer from taxpayers to bondholders, since the primary government surplus is +5.0%. This is the golden era for bondholders, who over the 1810-1855 period receive cumulated payments equivalent to 221% of 1855's national income from their holdings of public debt: +170% of interest payments and +51% in capital gains, driving positive capital gains for the private sector as a whole. That is, we find that capital gains may account for up to 40% of private wealth accumulation over 1810-1855. But we also find that these gains essentially offset past losses, so that over the full 1700-1910 period private saving flows can account for close to 90% of private wealth accumulation.

In the second half of the 19th century (1855-1910), against the backdrop of roughly balanced budgets and with growth picking up (+2.1%) the public debt decreases, from 114% of national income in 1855 to 34% in 1910. As yields remain very low (2-3%), interest payments are significantly lower in the 1855-1910 period (1.2% of national income on average) than in the first part of the century.

The opposite dynamics is at play for net foreign interest payments, which increase from 1.2% in 1810-1855 to a staggering +5.0% in 1855-1910, driving a huge current account surplus (+4.1% on average), so large that in the 1880s and in the decade preceding World War I, foreign investments exceed domestic investments. On the basis of identified current account surpluses alone, we find that the net position of the UK should have increased from 39% of national income in 1855 to 153% in 1910, which is slightly lower than what available estimates give (173%). Of course, given the data limitations that we face it is impossible to tell whether this reflects real positive net capital gains for the UK, or measurement issue. The only safe conclusion is that current account balances are broadly in line with the evolution in the net position, which would be consistent with the findings of Meissner and Taylor (2006) that the UK did not enjoy a

substantial "privilege" from being the center of the world monetary system.[391]

F.3.4   1901 and 1913

We use the national wealth estimates reported by Craigie (1902 pp.595-596) and by Campion (1939 pp.65 and 84). These were computed by Craigie and Campion and are broadly homogenous to the Giffen estimates. Regarding government non-financial assets for instance, Campion reports a £1.1bn figure for 1913 (46% of national income), which is consistent with Giffen's 1865 figure and public investment flows over 1865-1913. The remarks made above regarding durable goods and net foreign assets also apply here.[392]

F.3.5   1920 and 1950

The private wealth estimates come from the annual series obtained using Soloumou-Weale, Blake-Orszag and BB series (see above). The market-value government debt figures again come from Janssen, Nolan, and Thomas (2002), and we also report par values from Mitchell (1988), which are consistent with both Reinhart and Rogoff (2011) and Abbas et al. (2011). Regarding government assets, our estimates are based on the 1913 data point due to Campion (1939), the 1957 detailed and rigorous balance sheets of Revel (1967, pp.46-55) and public investment flows in the 1913-1957 period.[393]

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[391]Our computations, however, abstract from the question as to whether the UK earned a particularly high yield on its foreign assets.

[392]Campion's estimates refer to Great Britain and were grossed up to apply to the UK. Our resulting estimates for UK national wealth in 1913 are still somewhat below the estimates given Goldsmith (1985). The latter raise a number of difficulties, however. See discussion below.

[393]From 1855-on we also explicitly try to measure the financial assets of the governments (net of non central government debt). Over the 1855-1967 period we set these net financial claims equal to the public bonds held by the Bank of England (see Table UK.7). Other assets appear to be negligible, at least in the early twentieth century, e.g., in 1914 Suez Canal shares and Exchequer balances were valued at £48mn, i.e. 2% of national income. In 1967, other financial assets are valued by the official blue book series at 30% of national income, so in effect there is a break in our government gross financial assets series in 1967. On that same year there is a discontinuity of the same of order of magnitude for liabilities, as in 1967 we also include other government liabilities (i.e., other than central government liabilities) which turn out to be close to 30% of national income as well (e.g., local government debt). So the 1967 discontinuity in the government's gross financial positions does not affect its net financial position and net worth. See Table UK.5c for detailed computations.

F.3.6 Differences with earlier series

Our private wealth-national income series have the same general pattern but differ slightly from the 1920-2010 series presented by Atkinson (2012, figure A), because of small definitional differences both for the numerator and denominator. Regarding the numerator, Atkinson includes household durable goods in private wealth but excludes pension wealth (this is justified given his focus on intergenerational wealth transmission, but given our international, macro, capital accumulation perspective, we do the opposite, following SNA guidelines). Regarding the denominator, Atkinson uses factor-cost national income, while we use market-prices national income (again to facilitate international comparisons: the frontier between direct and indirect taxes is somewhat arbitrary).

Our series differ more substantially from the 1855-1965, annual capital-output series reported by Feinstein (1972, Table 20, pp.T51-T53, col. 8), because of more substantial definitional differences. According to the Feinstein series, the capital-output ratio declined from about 450%-500% in the 1850s-1870s to 400%-450% in the 1880s-1930s and 300%-350% in the 1940s-1960s. The denominator is gross domestic product. However the capital concept used at the numerator is very different from our aggregate wealth concept: Feinstein uses the "gross stock of reproducible fixed assets", which he computes by cumulating past flows of gross fixed capital formation, with no allowance for depreciation. In other tables (see Tables 43-46, pp.T96-T105), Feinstein also gives series for the "net stock of reproducible fixed assets" (taking into account depreciation), in which case the numerator and the capital-output ratio would be substantially smaller – typically about 30%-40% smaller (so that the ratio would fall from about 300%-350% to 200%-250% between the 1850s-1870s and the 1940s-1960s). Feinstein's concept of "net stock of reproducible fixed assets" would be equivalent to "fixed assets" (AN11) in the ESA95 classification (in particular, it excludes land value).[394] The starting point of the Feinstein series is very high (with a net reproducible capital stock of 2.45 billions £ in 1855, at a time when

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[394]In ESA 95, Non-financial assets (AN) = Produced assets (AN.1) + Non-produced assets (AN.2:land, subsoil assets), and Produced assets = Fixed assets (AN.11: dwellings, other buildings and structures, machinery and equipment, etc.) + Inventories (AN.12) + Valuables (AN.13).

national income was slightly above 0.6 billion £), but it was not obtained by a census estimate for 1855 or by cumulating previous flows (no saving or investment flow prior to 1855 is given by Feinstein), but rather by working backwards from estimates of the capital stock for the 1920s and the 1950s. That is, given the limited saving and investment flows observed between the 1850s and the 1920s or 1950s, one needs to assume a very high starting point in the 1950s in order to account for the final point; but of course another possibility is capital gain and/or mis-measured saving or investment flows.

Last, our series substantially differ from those reported by Goldsmith (1985, Table A7, pp.232-236), who finds higher wealth-income ratio than we do in the mid-18th century (about 850% of national income), and declining ratios through to World War I (about 600% in 1913). Goldmisth's wealth-income ratio for the 1760-1860 period are artificially high because of land. Goldmisth uses Feinstein's (1978) land value estimates expressed in constant prices, and attempts to reflate them. This double-price adjustment introduces important errors because the price index used by Feinstein to deflate land values differs from the one used by Goldmisth to reflate them, so that eventually Goldsmith obtains much too high land values for the mid-18th century and early 19th century. This problem illustrates the pitfalls of Feinstein's and Goldmisth's "volume" perspective on capital and the confusion between market price balance sheets and volume estimates of capital stocks. In this case it is obvious why the market-value estimates of wealth at current price should be preferred.[395] In the end there is nothing robust in the higher wealth-income ratio found by Goldmisth for the 1760-1850.

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[395]Goldmisth himself notes (1985, p. 234) that his land values "differ considerably from the contemporary estimates for tall land".

G   Italy

G.1   Official national accounts series

G.1.1   National income series, 1960-2011

Italy's national income accounts are published by Istat, the Italian National Institute of Statistics. As of July 2012, Istat disseminates two types of series, all complying with ESA95. First is a set of series using 2005 as base year, covering the 1990-2011 period for economy-wide aggregates and 1995-2011 for the different institutional sectors.[396] Second is a set of 2000-base year series, covering the 1970-2010 period for the main aggregates and 1990-2010 for the sectors.[397] We use the most recent series and extend them backward using the 2000-base year data in order to obtain homogenous 1990-2011 accounts. When they exist, discrepancies between the old and the new base are negligible.[398]

Istat does not disseminate anymore pre-1990 sectoral income accounts. However, official pre-1990 series can be retrieved thanks to the the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs, Ameco.[399] The series in Ameco are fully consistent with the 2000 base-year data available on Istat's website. They go back to 1960 for the main aggregates, and to 1970 or 1980 for the different sectors. These are the series we use, when available, for the 1960-1990 period. All the computations are detailed in the sheet "DataItaly" of Italy.xls, with links to the raw Istat and Ameco files mentioned above.

There are some gaps in Ameco over the 1960-1980 period, in particular for sectoral saving. To fill in these gaps, we turn to the series of Pagliano and Rossi (1992) who provide a detailed reconstruction of Italy's saving for the 1951-1990 period.[400] Specifically, our 1960-1980 series

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[396]See the file Income_1990_Today.xls

[397]See the file Income_1970_1990.xls

[398]One exception relates to the international accounts (exports, imports, and income flows with the rest of the world), which have been substantially revised following the publication in 2011 of new balance of payments estimates by the Bank of Italy.

[399]See the files Ameco_FullDatabase.xlsx and Ameco_SelectedVars.xlsx.

[400]The series in Pagliano and Rossi (1992) are the same as those presented pp.388-400 in the Appendix of the book edited by Ando, Guiso and Visco (1994) devoted to saving and wealth in Italy. They are based on SNA68 concepts, therefore they are in principle not completely comparable to modern ESA95 Istat/Ameco data. In practice, however, there are no major continuity problems; see the detailed computations and checks in Italy.xls.

for net government interest payments, contributions to social insurance plans, total monetary government transfers, government net saving, direct taxes, and net personal saving come from Pagliano and Rossi (1992, Tables 13 and 20) and are spliced (with appropriate scaling) onto the Ameco data.[401] Overall, Italian income accounts strike us as fairly consistent over the 1960-2011 period, and we feel that they are of reasonably high quality.

One fairly minor exception is worth mentioning. As in other countries that follow ESA95, we have information on the value added of households' housing sector: it is, by definition, equal to the operating surplus of the household sector. However, Ameco series (and previous SNA68 accounts) always aggregate households' mixed income and operating surplus, so it is not possible to isolate the value added of the housing sector before 1990. Further, we feel that the 1990-2011 figures for household's operating surplus have some margin of error. The gap between gross and net operating surplus is large, implying a high rate of depreciation, with fixed capital consumption / gross housing product ratios as high as 54% in 1990 (but gradually decreasing to 40% in 2011). One should take the Italian housing product series with some care, especially for the early 1990s.

To compute factor shares in national income, we proceed as follows. For the 1990-2011 period, we assume that the same factor income decomposition holds in the non-corporate business sector as in the corporate sector. Based on this assumption, we can compute the implied labor income of self-employed workers. It is equal to the capital share in the corporate sector times the net product of the non-corporate business sector minus compensations paid by non-corporate businesses. Over the 1990-2000 period, the implied wage of self-employed workers is equal to around 53% of the average wage of salaried workers.

As there is no available data on mixed income before 1990, the only way to break self-employment income into labor and capital for this time period is to attribute an imputed wage to the self-employed. To ensure continuity with our 1990-2011 series, we assign the self-

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[401]In a companion paper, Marotta and Pagliano (1992) provide a reconstruction of Italy's sectoral accounts for the 1970-1979 period; we use their data for the 1970-1979 corporate income tax.

employed 53% of the average compensation of salaried workers. By our estimates, the capital share (excluding government interest) in factor-price national income averages 31% over 1980-2010 vs. 22% in France. This finding is consistent with the high capital share in the Italian corporate sector (34% of the corporate sector's net product against 20% in France).

G.1.2   National wealth series

Istat does not currently publish comprehensive balance sheets for all institutional sectors of the economy. But the Bank of Italy has compiled complete financial accounts (at both flow and stock levels) since 1950, and it publishes the complete balance sheet (financial plus non-financial wealth) of the household sector, starting in 1995. These series comply with ESA95 guidelines.

Private wealth

To construct homogenous January 1st, 1966 to January 1st, 2011 balance sheets for the household sector, we rely on three key data sources. For the whole period, financial asset and liability figures come straight from the Bank of Italy's financial accounts.[402] 1996-2011 non-financial asset data come from the Supplements to the Bank of Italy's Statistical Bulletin.[403] These official data benefit from a decade of important methodological improvements, described in a 2008 conference volume edited by the Bank of Italy.[404] Lastly, non-financial asset data for the 1966-1995 period come from Brandolini et al. (2007), who devote considerable effort to constructing a homogeneous 1966-2003 balance sheet for the household sector, using unpublished official data.[405] All these raw series, and the minor adjustment made to them, are gathered in

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[402]1966-1995 financial accounts come from the Bank of Italy's Historical Tables; 1996-2011 accounts come from the Bank of Italy's Supplements to the Statistical Bulletin. Both are available online at http://bip.bancaditalia.it/. The historical and modern series were spliced with no adjustment.

[403]"Household Wealth in Italy, 2010", Supplements to the Statistical Bulletin, Monetary and Financial Indicators, Year XXI, number 64, 14 December 2011, Table 3A.

[404]See Bank of Italy (2008), papers presented at the conference held in Perugia, 16-17 October 2007, available online.

[405]In particular, Brandolini et al. (2007) estimate dwellings at market value by combining real estate price series (based on semi-annual surveys of real estate agents) with census data which indicate that households own around 91% of the total Italian dwelling stock. The main correction we make is that we exclude consumer durables from household assets in order to be consistent with ESA95 guidelines. Note also that Brandolini et al. (2007) only focus on the assets of "consumer households," and exclude producer households (i.e., sole proprietorships and parterships). Official post 1996 accounts, by contrast, include both consumer and producer households.

the file "Wealth_1966_Today.xls".[406]

There are two minor discontinuities in the resulting 1966-2011 balance sheet. The Bank of Italy's financial accounts include non-profit institutions serving households, while non-financial wealth accounts exclude them.[407] And the financial accounts for the 1951-1994 period have not been fully revised in order to comply with ESA95 guidelines. But these inconsistencies are negligible as compared to the threefold increase in the Italian private wealth to national income ratio (from 222% in 1966 to 666% in 2011).

Contrary to what happens in the U.S., Japan, France, and Australia, the Bank of Italy does not currently publish flow-stock reconciliation accounts. In particular, there are no data on "other volume changes", that is, on the changes in wealth that cannot readily be assigned to capital gains or saving flows. But the Bank of Italy considers that other volume changes are limited. For instance, even "the large earthquake in the Abruzzo region in April 2009 had a limited impact on total household wealth in Italy. The value of all residential property located in the affected areas is estimated to be below 0.1% of total net Italian household wealth".[408]

Government wealth

The main issue with the Bank of Italy's balance sheets is that they only cover the household sector. This means, in particular, that we do not know the value of Italian's corporations non-financial assets (especially land). Accordingly, we are unable to report any result for Italy's

We upgrade the data from Brandolini et al. (2007) accordingly.

[406]Pagliano and Rossi (1992) provide household balance sheets for the 1951-1990 period (Table 21 p. 39) that we could in principle use to extend our own private wealth series to 1950. But the non-financial stock data in Pagliano and Rossi (1992) are based on the perpetual inventory method, not on modern census-type wealth estimates, which is the reason why Brandolini et al. (2007) discard them. Pagliano and Rossi (1992) find extremely high values for dwellings in the early 1950s: they report a dwelling stock basically constant in current prices over the 1950-1960 decade, which implies a high wealth-income ratio in the early 1950s, sharply decreasing over the 1950s (see Ando, Guiso and Visco, 1994, p. 87). We caution the reader against using these 1950s perpetual inventory method-based balance sheets, which do not give a good picture of the market value of Italian households' wealth.

[407]This inconsistency could be corrected for the 1995-2011 period (and based on this correction, one could also correct the historical 1950-1994 financial accounts). However, given the very small net holdings of NPISH, this did not seem worthwhile to us, and we stuck to the raw official figures.

[408]"Household Wealth in Italy, 2010", Supplements to the Statistical Bulletin, Monetary and Financial Indicators, Year XXI, number 64, 14 December 2011, p. 6.

Tobin's Q and book-value national wealth.

To estimate the non-financial assets of the government, we rely on a recent paper by Istat that provides estimates for 2006, 2007 and 2008.[409] Istat reports a stock of government non-financial assets worth 52% of national income. We keep this ratio constant over the 1970-2010 period. This assumption is obviously unsatisfactory, and we hope that retrospective non-financial balance sheets will be published in the future to help us improve it. There are four reasons, however, why feel that Istat's estimate is reliable and our assumption justified. First, a 52% ratio is consistent with the observed investment patterns of the Italian government. Over the 1970-2010 period, the government net investment rate has been 1.1% of national income; with a 1.9% real growth rate of national income, and absent real capital gains, this implies a long-run non-financial assets/national income ratio of 1.1/1.9 = 61%, close to the figure given by Istat. Second, government net investment has been quite constant over time (at around 1-2% of national income) and there has never been in Italy any active policy to sell real assets in order to improve the government's net position (Fabrizio, 2008). Third, in all countries for which we have complete official balance sheets for the government sector, non-financial assets to national income ratios exhibit a remarkable stability between 1970 and 2010.[410] Lastly, one has to keep in mind that the net financial position of the Italian government has dropped from -33% of national income in 1970 to -122% in 2010. In comparison to this key development, the uncertainty concerning the government's non-financial position is minor: it cannot substantially affect our analysis of government and national wealth accumulation in Italy.

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[409]See Table 3.1 p. 31 of Istat (2011), "Compilation of Annual Balance Sheets for Nonfinancial Assets: Methodological Approach, Main Outcomes and Open issues in the Italian Experience," paper presented at the Conference on strengthening sectorial position and flow data in the macroeconomic accounts, jointly organized by the IMF and the OECD, February 28-March 2, 2011.

[410]In the U.S., the ratio of the general government's non-financial assets to national income is exactly the same in 1970 and 2010 (80%); in Canada this ratio equals 62% in 1970 and 51% in 2010; in Australia it is 100% in 1970 and 134% in 2010 (and the increase can be fully accounted for by the discovery of important subsoil assets). The main exception is Japan, where government non-financial assets have increased from 68% in 1970 to 164% in 2010, in line with the exceptionally high rate of government fixed asset investment.

G.2 Historical non-official national accounts series

There is a rich tradition of research on household wealth in Italy. Stamp (1918), Zamagni (1980), and Baffigi (1908) discuss the large body of literature produced between the mid-nineteenth century and the first World War. A first wave was based on estate-multiplier techniques and delivered results that Gini (1914) criticized as much too low, in particular because they underestimated tax evasion. Carefully combining estate-multiplier, census-type and capitalization techniques, Gini (1914) put the amount of private wealth at about $W = 116$ billion lire in 1914 (4,484 million pound sterling, see Stamp 1918, p. 478). Gini's estimate is widely considered the most reliable for the pre-World War I period. Like other authors of the time, Gini had in mind a concept of wealth very comparable to what we find in modern household balance sheets, namely the market value of all tangible and financial assets in private hands.[411] As national income was about $Y = 20$ billion lire in 1914, the implied wealth-to-income ratio $\beta = W/Y$ is 580%.[412]

A 580% wealth-income ratio is marginally smaller than what we find on the eve of World War I in France, Germany, and the U.K., where β is in the 600-700% range. Whether this slight discrepancy reflects real differences in economic development or merely estimation issues would deserve to be further studied. We leave this task to future research. The important point to note is that the most reliable historical data reveal a broad pattern for the wealth-income ratio which is the same in Italy as in other European countries, with β reaching its pre-World War I level only in the mid-2000s.

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[411]In the second edition of his book, published in 1962, Gini made critical comments on the perpetual inventory method that came to dominate wealth-accounting in the post World War II period (see the Appendix of the 1962 edition entitled "Human labour and natural resources in the formation, destruction and reconstruction of wealth").

[412]Baffigi (2011) provides a reconstruction of Italy's income accounts covering the 1860-2011 period. He puts market-price GDP at 22.7 billion lire in 1914 (within the boundaries of the time). Assuming the same capital depreciation / GDP ratio as in France (11%), one gets a a 20.2 billion lire net domestic product. Based on Feis (1961), Goldsmith (1985, p. 250) puts Italy's net foreign liabilities at about 2 billion lire in 1914, which would likely imply a national income marginally below the 20.2 billion net product.

H Canada

H.1 Official national accounts series

Canada's national income and wealth accounts are produced by Statistics Canada. Both are based on the 1993 System of National Accounts (SNA93), but are disseminated in a presentation that differs from that retained by many countries and international organization. Most countries present their accounts in the following traditional sequence: production, generation of income, allocation of primary income, secondary distribution of income, use of disposable income, capital account, financial account, other changes in assets, and balance sheet. Statistics Canada, by contrast, currently organizes its accounts in five tables: aggregate income-based GDP and expenditure GDP, income and outlay, capital account, financial flow accounts, and national balance sheet.

All our series for Canada come directly from the 2012 edition of Canada's economic accounts, which is the last vintage of accounts based on SNA93 and covers the 1960-2011 period.[413] Starting with the 2013 edition, Statistics Canada plans to shift to SNA08, revise its historical series, and adopt the more traditional "sequence of accounts" presentation. The series we report here are likely to be affected by this important revision, but they are the best data available at the time we conducted this research.

H.1.1 Income accounts, 1960-2011

One implication of the presentation retained by Statistics Canada until 2012 is that GDP from the income approach is not equal to compensation of employees plus operating surplus and mixed income. Rather, net domestic product at factor costs is broken into: (i) wages & social contributions paid by all domestic sectors, (ii) net corporate profits, (iii) interest and miscellaneous investment income (which includes for instance interest paid on corporate debt, which are deductible from corporate profits, as well as mortgage payments), (iv) accrued net income of farm operators from farm production, (v) net income of non-farm unincorporated

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[413]The raw data are gathered in our files "Income_1961_Today.xls" and "Wealth_1970_Today.xls".

businesses, including rents; and (vi) an inventory valuation adjustment (the net holding gain or loss incurred by businesses on their inventories as a result of price changes).

In the sheet "DataCanada" of our file "Canada.xls", we first report the official, raw data from Statistics Canada, and then we rearrange them in order to present them in the more conventional framework that breaks domestic product into compensation of employees, operating surplus, and mixed income. More precisely, we construct operating surplus and mixed income as follows:

- Operating surplus = net corporate profits + inventory valuation adjustment + a fraction of interest and miscellaneous investment income;

- Mixed income = accrued net income of farm operators from farm production + net income of non-farm unincorporated businesses including rents + a fraction of interest and miscellaneous investment income.[414]

These rearrangements do not affect the analysis, but allow us to keep a consistent analytical presentation for country's income in our cross-country database. In addition to this, two other minor points about Canada's income accounts are worth mentioning here.

First, the housing sector net product series reported in Table CA.9 only cover owner-occupied dwellings, because in the current presentation of Canada's national accounts it is not possible to exactly isolate the tenant-occupied housing activities of households.[415] This means that we tend to under-estimate the true value added of Canadian households' housing activities. On the other hand, we somewhat over-estimate the net product of the owner-occupied housing sector, because the value-added series disseminated by Statistics Canada (which are the ones we report)

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[414]More precisely, we allocate "interest and miscellaneous investment income" in proportion to corporate profits on the one hand and to (net income of farm + net income of non-farm unincorporated businesses) on the other. See "Canada.xls" for detailed computations. In principle some of the "inventory valuation adjustment" should also be included into mixed income, but this can be neglected as a first approximation. With the shift to SNA08, interest and miscellaneous investment income, accrued net income of farm operators, net income of unincorporated businesses and inventory valuation adjustment will disappear and will be implicit in the computations of mixed income and operating surplus, just like in other countries.

[415]Note however that Statistics Canada disseminates data on the economy-wide housing sector. They show that owner-occupied dwellings account for about 70-75% of Canada's housing activity; see the supplementary data on the housing sector in the "DataCanada" sheet of Canada.xls.

are gross of some property taxes.[416] So some care is needed when comparing Canada's housing product statistics to those of other countries in our database.

Second, Statistics Canada produces its own estimation of the imputed wage of self-employed workers.[417] So for our computation of the labor share, we simply add this official estimate of labor income in the non-corporate sector to the data on compensations paid by corporations and the government.

H.1.2 Wealth accounts, 1970-2011

Statistics Canada publishes extremely detailed balance sheets and financial flow accounts, with about 30 distinct sub-sectors.[418] There are two sets of data: a set of book value estimates and a set at market values. We report market values. The raw Canadian balance sheets include consumer durables in assets; to ensure consistency with other countries we exclude them. This is the only modification we make to the stock data. At the time of this study, Statistics Canada does not disseminate flow-stock reconciliation accounts to isolate capital gains from other volume changes. So all our capital gains estimates for Canada de facto include other volume changes. This issue will be addressed with the adoption of SNA08.

In addition to land, Statistics Canada also provides estimates for the value of a number of natural resources: timber, energy, and mineral resources. These assets are not included in published balance sheets, and we do not attempt to include them in national wealth. We report the value of natural resources other than land as a memo item in Table CA.6a. Natural resources

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[416]The reason is that most sectoral value added figures are presented at basic prices rather than at factor costs. Value added at basic prices is equal to value added at market price minus taxes on products (net of subsidies), such as value-added taxes, excise duties, import taxes, etc. (code D21 for taxes and D31 for subsidies in ESA95 classification). Value added at factor costs deducts, in addition, other taxes on production (net of subsidies), such as a number of property taxes and non-social-contribution payroll taxes (code D29 for taxes and D39 for subsidies in ESA95).

[417]More precisely, we have data on wages and social contributions paid in the business sector. The business sector covers the whole economy less public administration, non-profit institutions and the rental value of owner-occupied dwellings, and one of the business sector wage series disseminated by Statistics Canada includes the imputed labor income of the self-employed.

[418]There are also complete flow-of-funds statistics (including household financial assets and liabilities) as well as fixed assets and agricultural land series since 1960, so that in principle we could start our investigation of Canada's wealth in 1960 rather than in 1970.

appear to have fluctuated between 50% and 120% of national income in 1960-2010, with no clear trend.[419]

H.2   Pre-1960 income series

Historical official and non-official income and wealth accounts are plentiful. In this research we simply use them to provide wealth-income ratios in 1860, 1895, the 1910s, 1920s, and 1955 in Table CA.6e. We leave the construction of complete yearly income and wealth series to future research, but below we indicate the raw sources that could be used to do so.

The first official estimate of national income dates back to 1920, and was published in the *Canada Year Book* for 1922-23. Revised, detailed estimates and methods for the 1926-1974 period were published in 1975 in a three-volume book edited by Statistics Canada, "National Income and Expenditure Accounts" (volume 1: annual estimates 1926-1974, ; volume 2: quarterly estimates, 1926-1974; volume 3: guide to the national income and expenditure accounts: definitions, concepts, sources and methods). Official series of fixed capital, obtained by applying the perpetual inventory method, similarly exist since 1926.[420] All of these data have subsequently been reproduced in the the second edition of the *Historical statistics of Canada*, jointly produced in 1983 by the Social Science Federation of Canada and Statistics Canada.[421] Section F of this book contains data on national income, expenditure, fixed capital, and related aggregates from 1926; on income produced, by industry, from 1919 to 1926; and on gross capital formation from 1901 to 1930. Other Sections contain detailed information on many other aspects of economic activity in Canada.[422]

Prior to 1926, non-official income accounts covering the 1870-1926 period have been assem-

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[419]The order of magnitude is comparable to the one found by the World Bank (2011). In the World Bank's *Wealth of Nations*, Canadian subsoil assets, forest, and agricultural land are worth about 60% of national income in 1995, 2000, and 2005, vs. about 50%, 70%, and 85% respectively in Statistics Canada's data.

[420]See Statistics Canada (1974), "Fixed Capital Flows and Stocks, 1926-1974"

[421]*Historical statistics of Canada*, 2nd edition, F. H. Leacy (ed), Ottawa: Statistics Canada, 1983.

[422]For example, balance of payments and international position in Section G; government finance in Section H, from the start of Confederation in 1867 to the mid-1970s. This book, and all its series, are freely accessible online at http://www.statcan.gc.ca/pub/11-516-x/3000140-eng.htm.

bled by Urquhart (1986, 1993).[423] Urquhart provides detailed data on gross national product, but no data on depreciation. We assume that national income is 92% of gross national product, consistent with the 8% depreciation rates estimated in other countries at the end of the nineteenth century.

H.3   Pre-1970 non-official national wealth series

Generally speaking, early estimates of national wealth used five different techniques, summed up by Stamp (1922, pp. 9-10) as follows: "(1) Based on data arising through taxation of income—notably the United Kingdom. (2) Based on data arising through the annual taxation of capital—notably United States. (3) Based on data arising through taxation of capital at irregular period—death duties—notably Italy and France. (4) The inventory—an aggregation of various forms of wealth built up from various sources, insurance, etc.—notably France and Germany. (5) The census—notably Australia." Most of the early estimates for Canada's wealth use the inventory method.

1860 The very first attempt at estimating national wealth seems to be Sir Henry Parnell's, in 1830. Parnell puts the value of farms, urban real estate, industrial and commercial buildings in the then settled parts of Canada at £60 million (see Mulhall, 1896, p. 431). On the basis of 1£=C\$4.615, this implies a stock of Canadian real estate worth about C\$277 million in 1830. But this estimate does not take into account such capital assets as cattle, farm implements, and shipping, nor the net foreign asset position. Further, there is, to our knowledge, no data on Canada's national income in 1830, so we do not use Parnell's estimate in this research.

We rather start with the first reasonably exhaustive estimate of Canada's national wealth, which appears in the inaugural issue of the statistical yearbook of the Confederation, the *Year Book and Almanac of Canada* for 1867 (p. 18).[424] According to Firestone (1958, p. 372), this estimate can be attributed to Arthur Harvey, the editor of the 1867 *Year Book*. Harvey mostly

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[423]Malcolm Urquhart was also one of the lead editor of the first edition of the *Historical statistics of Canada*, Malcolm C. Urquhart and Kenneth A.H. Buckley (eds.), Cambridge: Cambridge University Press, 1965.

[424]Available online at http://www.statcan.gc.ca/yearbook-annuaire/index-eng.htm.

uses data from the decennial census for 1860, and provides a breakdown of the domestic capital stock K into public and private capital. His C\$1,136 bn figure for the "honestly realized property of British America" refers to the private capital stock, and includes C\$546 mn (almost 200% of national income) for the value of farms (excluding agricultural implements—25 mn—and horses, cattle, etc.—120 mn—but probably including some agricultural dwellings), as well as 200C\$ mn (about 75% of national income) for "real estate in cities, towns and villages." Harvey's "honestly realized property" excludes the value of the railways of the Provinces, though Canada's railways are mostly privately owned. We add them back.[425] We also deduct consumer durables ("other personal property," 75 million), and add -110 million of net foreign assets.[426] The resulting private wealth of Canada comes to C\$1,070 million, or about 385% of national income.[427]

According to Harvey, government non-financial assets ("canals, harbors, light houses and public buildings constructed by the Governments") reach about C\$35 million in 1860. The 1867 *Year Book* also provides (p. 23) the consolidated balance sheet of the province of Canada, as at June 30th 1865. The public debt ("direct debt funded") is 61 million and, in addition to the canals, harbors and other tangible assets, the government has invested about 27 million in the railways. Overall, assuming that the government balance sheet was the same in 1860 and 1865, available evidence suggests that the Canadian government had in 1860 about 20% of national income in both assets and liabilities. National wealth is thus equal to private wealth, i.e., 385% of national income.

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[425]Harvey estimates the railways to be worth C\$150 million, of which 27 million belong to the government. So we add 123 million to the private sector and 27 million to the public sector

[426]Available estimates of Canada's net foreign asset position start in 1900, but Urquhart (1986) provides comprehensive data on Canada's balance of payments from 1870, including on interest and dividends paid and received. In 1870 net capital income payments amount to C\$5.4 million. On the basis of a 4% yield, which is close to the yield observed in the early twentieth century, the implied net liabilities of Canada amount to about 135 million Canadian dollars, or 40% of national income. We assume that the same 40% ratio holds true in 1860, which implies net foreign liabilities of C\$110 mn.

[427]To our knowledge there are no data on Canada's national income in 1860, since Urquhart's (1986) series start in 1870. We assume that nominal growth was the same over the 1860s as over the 1870s, i.e., 2.3%. This is consistent with Maddison, who reports average annual real growth rates of 2.7% in the 1860s, at a time when inflation was probably slightly negative (the wholesale price index drops from 80.2 in 1867, the first available year, to 79.8 in 1870).

1895 The second data point we use is Mulhall's (1896) domestic capital stock estimate for 1895. Mulhall reports detailed statistics on both earnings and wealth, drawing mainly on the 1891 census. He puts national income Y at £183 million (C\$890 million on the basis of 1£=4.866C\$) and domestic capital K at £1,003 million (C\$4,881 million), which implies a domestic capital/national income ratio $\beta = K/Y = 548\%$. Domestic capital includes land (about 125% of national income), houses (about 90% of national income), and eight other categories of domestic capital goods (cattle, railways, factories, furniture...). The sharp decrease of agricultural land, from about 200% in 1860 to 125% in 1895, is fully consistent with the evolution of the share of the agricultural sector in national income. Urquhart (1986) estimates that agriculture accounts for 38% of gross national product in 1870—hence probably for more than 40% in 1860. In 1895, the share of agriculture is down to 26%.

The main problem with Mulhall's (1896) estimate is that his national income figure seems to be somewhat over-estimated. Urquhart (1986) reports a gross national product of 633 million Canadian dollars in 1895, which is almost one third less than Urquhart's C\$890 mn. We keep all of Mulhall's wealth-income ratios, but scale back his absolute figures to make them consistent with Urquhart's more reliable figures (see the formulas in Tables CA.6e).[428] Just like for all our other national wealth series, we exclude consumer durables ("furniture," about 30% of national income), and add to the domestic capital stock K the net foreign asset position.[429] The resulting national wealth / national income ratio is the same as the one based on Harvey's data for 1860, i.e. about 390%. But one key difference is that the ratio of the domestic capital stock K to national income ratio is now significantly higher (around 520%, against 425% in 1860) owing to the huge inflows of British capital during the last four decades of the nineteenth century. The rising indebtedness of Canada exactly mirrors the rising net asset position of the U.K., which increases from about 40% of national income in 1855 to 100% in 1885.

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[428]The only exception is housing, for which we report Mulhall's raw data, as they are based on presumably reliable censuses of urban properties.

[429]Urquhart (1986) reports net foreign capital income payments of C\$30 mn for 1895; capitalized at a rate of 4%, the net foreign liabilities come to C\$750 million, i.e. 130% of national income. This very high ratio is fully consistent with the international balance sheets constructed by Viner (1924) from the year 1900 onward.

Mulhall (1896, p. 330) reports a stock of public debt of £64 million, or about 50% of national income, but does not give comparable figures for the government's assets.

1911 and 1918 The third estimate of Canada's national wealth, for 1911, appears in the *Journal of the Canadian Bankers' Association*," Toronto, January 1916, p. 90-92. This is the estimate reproduced by Stamp (1918, p. 487) in his study on the wealth of the chief powers, and one of the few that Stamp considered satisfactorily reliable (it is a "Grade II estimate," i.e. Stamp considers that there is a 10-20% margin of error, while most estimates for other countries have margins of error in excess of 30%). The Canadian Bankers' Association mostly uses data from the 1911 census, and puts the total national wealth at £2,285 mn, that is, C$11,119 mn. Detailed data on wealth composition are provided (farm values, mines and forests, railways, urban real property, etc.). The estimate appears to be net of foreign liabilities,[430] so we only subtract consumer durables (which we assume, based on the available data for 1895 and 1918, to be equal to 30% of national income). The resulting national wealth / national income ratio β is 511%.

In order to have a meaningful data point for the 1910 decade, we average this 1911 figure with the 1918 figures provided by Coats (1919) just after World War I.[431] Just like the CBA, Coats uses the inventory method, and gives detailed figures for land, agricultural buildings, implements, livestock, mines, railways, and so forth. Coats notes that his estimate of a C$19 billion national wealth figure probably involves double-counting; on the other hand, he seems to somewhat under-estimate the rise in prices that took place during World War I. So we simply report Coats's raw domestic capital stock figure, and deduct consumer durables and Canada's

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[430] "We must deduct $3,500 million as the mortgage outside investors hold against us," p. 91-2. But this gross liabilities figure probably refers to 1913-1914 rather than 1911; in order to obtain a homogeneous 1911 estimate, we disregard this 3,500 million figure and retain Viner's (1924) figure of 2,900 million for 1911 instead (note that Viner has 3,529 million in gross liabilities as at 1913).

[431] Coats also provided an estimate for 1915 based on probate returns from Ontario, which he grosses up on the basis of population. Because the raw source is here quite limited, and the estimate not detailed, we do not use Coats's probate return-based figure in this research. Two other estimates of the time that we don't use are Crammond (1912) and Giffen (1903), because both authors simply estimate wealth as a multiple of national income, without trying to draw on available census data.

net foreign liabilities.

1920-1933 From 1923 to 1936, the Dominion Bureau of Statistics published official national wealth series. The first estimate, for 1920, can be found in the *Canada Year Book, 1922-1923* (p. 806-807). All of the estimates are derived by the inventory method; like previous non-official estimates they include farm and urban land, but exclude undeveloped natural resources. For our 1920s data point, we simply average the estimates given by the Dominion Bureau of Statistics for 1926 (*Canada Year Book, 1929*, p. 828) and for 1929 (revised figure provided in *Canada Year Book, 1936*, p. 879). The Bureau of Statistics does not disentangle agricultural land from agricultural buildings, implements, machinery and livestock, but rather includes all this into "farm values." In order to provide comparable land value figures, we adjust the "farm values" figures provided by the Bureau by assuming that land is 53% of the overall value of farm, the figure reported by Coats (1919). As usual, we simply adjust the Bureau's official statistics by subtracting consumer durables and adding the net foreign asset position. From 1926 on, all our data for the net foreign asset position are from Statistics Canada.

1955 The Dominion Bureau of Statistics discontinued its national wealth series after 1933. So our next data point is for 1955, and comes straight from Goldsmith (1985, p. 202). Specifically, Goldsmith reports a national capital stock K (land plus reproducible tangible assets) worth C\$103.7 billion. Subtracting consumer durables and adding the net foreign asset position (from the official Statistics Canada international investment position), national wealth comes to C\$83.8 billion, or 332% of national income. This is the figure we report in Table CA.6e.

Overall, Canada's national wealth appears to follow a marked U-shaped pattern over the twentieth century. Although early balance sheets have significant margin of errors, all the estimates of the time suggest that national wealth was in the vicinity of 500-550% from the late nineteenth century to the eve of World War I. Then, available data – the official statistics of the 1920s, Goldsmith's (1985) estimate, and the official 1970-on balance sheets – paint the same picture: the national β appears to continuously decline from the 1920s to the 1970s, when it

reaches a through of about 280%. Lastly, from the late 1970s-on, the national wealth-income ratio continuously rises to more than 400% today.

I Australia

I.1 Official national accounts series, 1960-2011

The Australian Bureau of Statistics (ABS) is in charge of compiling Australia's income and wealth accounts. Both currently follow the 2008 System of National Accounts standard (SNA08).[432]

I.1.1 National income, 1960-2011

All published income accounts are for fiscal years that start July 1st and end June 30th. We keep this convention and do not try to convert official fiscal-year series into calendar-year data. Thus, in our file "Australia.xls" as in the rest of the text below, 2011 refers to the period from July 1st, 2010 to June 30th, 2011. ABS has recomputed all pre-2009 series to comply with the new SNA, so we have official, homogenous SNA08-based statistics that start in 1960.[433] Australia is the only country in our sample that has already adopted SNA08; all other countries use versions of SNA93. This does not raises major comparability issues, as the revisions introduced by SNA08 have been fairly modest.

The only notable issue concerns the treatment of real asset ownership transfer costs (see Section A above for a general discussion of the issues raised by transfer costs).

According to the 2008 SNA, transfer costs should be indistinguishably included in the value of the associated assets (SNA 2008, 13.34) and depreciated over the period during which the acquirer expects to hold the associated asset.

However, ABS statisticians do not currently follow this standard. First, they include all transfer costs on dwellings, construction other than dwelling, and land, as a separate "ownership transfer cost" item in the balance sheets.[434] In addition, it seems that they depreciate these

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[432]The last SNA93-based accounts were published in 2008, and the first SN08 accounts in 2009.

[433]See the file Income_1960_Today.xls.

[434]As at July 2011, for instance, A\$ 157 billion of ownership transfer costs were recorded as assets in households'

costs at too high a rate. In the mid-2000s for instance, total consumption of fixed capital (including on ownership transfer costs) / gross housing value-added ratios are as high as 60% in the raw Australian data.[435] It has been long-standing practice in the Australian national accounts to write off the whole of the amount of ownership transfer costs as consumption of fixed capital in the same period as transactions occur. Apparently this practice has not changed with the adoption of the 2008 SNA despite the fact that a positive stock of transfer costs are now recorded in the balance sheets. As a matter of fact, depreciation rates in the housing sector are much too volatile and high during real estate booms, when dwellings often change hands.

Accordingly, we have corrected the Australian data to improve comparability with the other countries in our dataset: we subtract ownership transfer costs from both depreciation and assets. This boils down to treating all ownership transfer costs as current expenditure.

Aside from ownership transfers, the only other point worth mentioning about Australian income accounts relates to factor income shares. ABS does not currently break the wage bill paid by domestic sectors into wages paid by corporations, government, and non-corporate businesses.[436] As a result, we cannot compute the labor and capital share in the corporate sector, nor can we apply the factor income decomposition of the corporate sector to the non-corporate business sector. We deal with self-employment by assuming that 25% of net mixed income is capital income, and the remaining 75% labor income.

I.1.2 Private, government, national, and foreign wealth

Official ABS balance sheets start in 1989. Data are as at June 30th; as for other countries, we recompute mid-year (in this case mid-fiscal year, i.e. January 1st) wealth series. Below we

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balance sheets, which is around 14% of national income.

[435]Note that in "Australia.xls" we only report series on the housing activity of households. Table 49 of ABS annual national accounts provides a complete analysis of the housing sector, including the housing activity of corporations and government. They turn out to be negligible: in 2010-2011, sectors other than households account for only 2% of the gross value added of the total housing sector.

[436]However, ABS *Government Financial Statistics* provide compensations paid by the general government since the end of the 1990s. There is also data on wages paid in the agricultural sector (available from 1990 only). We use this information to provide an idea of the structure of national income by production sector from 2000 onwards, see "Australia.xls" and the more detailed explanations in the sheet "DataAU."

describe the minor adjustments we have made to the official 1989-2001 balance sheets, and how we have extended the data to 1960 by drawing on a number of official sources.

Private wealth

For the 1989-2011 period, our net private wealth series is the one reported by ABS, with the only difference that we subtract from assets the value of households' "ownership transfer costs," as discussed above. We extend the series to 1960 as follows. Until 2007, the Treasury compiled its own measure of private sector wealth, starting in 1960, using similar concepts and methods as ABS (with assets valued, as far as possible, at current market prices). The Treasury drew on financial assets, liabilities, and housing (dwelling plus underlying land) statistics produced by the Reserve Bank of Australia (RBA), Australia's central bank.[437] By construction, from 1989 onward, Treasury/RBA and ABS data are fully consistent. So for the period ranging from 1960 to 1989, we simply splice the Treasury household net worth and housing series (Goldbloom and Craston, 2008, Table 1 p. 56) onto the ABS figures. The household sector always includes non-profit institutions.[438]

Government wealth

For the 1989-2011 period, our government wealth data come from the ABS balance sheets, with one notable modification. Australia is the only country in our sample that includes the value of subsoil assets in the balance sheets. Subsoil assets are assigned to the government, irrespective of who exploits them. (The government also owns timber and spectrum, but the value of these assets is negligible).[439] We exclude all these assets from the government's assets,

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[437]RBA disseminates quarterly balance sheets for the household sector from 1988 onwards (RBA series 20, http://www.rba.gov.au/statistics/tables/) and simplified household balance sheets (housing assets, financial assets, total assets, and debts) that start in March 1977 (RBA series B21).

[438]ABS provides satellite balance sheets for non-profit institutions for fiscal years 1999-2000 and 2006-2007. As at June 2007, the net worth of non-profit institutions amounted to 101.7 bn A$, that is 2% of household net worth.

[439]The government then grants extraction rights to the private sector and earns royalties ("rents on natural assets" in the SNA classification). The value of the stock of subsoil assets (and of native forest) is estimated by applying net present value techniques which take into account the current level of production, prices, costs, and discount rates (Ryan, Thomson and Sincock, 2003). The royalties earned by the government are small compared to the net present value of Australia's subsoil assets: in effect, the government subsidizes subsoil exploitation

and report a memo item in Table AU.6a. With the resource boom of the second half of the 2000s, the value of subsoil assets has considerably increased – from about 25% of national income in the 1990s to close to 60% in 2010. So our correction makes a large difference to the net position of the government. [440]

There are two reasons why excluding subsoil assets is the correct way to proceed for our purposes. First, it is necessary to ensure consistency within our database. More fundamentally, failure to exclude subsoil assets would cause double-counting. Since the government grants extraction rights to the private sector in exchange of small fees, subsoil assets are capitalized in the equity values of the corporations in the resource sector. Through this channel, subsoil assets are already included in our measure of private and market-value national wealth. Natural resources push Australian equity prices upward, and there is no need to specifically account for subsoil assets in top of that.

In order to extent the government's balance sheet to 1960, we proceed as follows. There are official data on fixed assets,[441] so all we need is the government's net financial position. We use RBA statistics on the amount of public debt outstanding and on intra-governmental holdings of public debt securities.[442] The net wealth of the Australian government follows an inverted U-shaped pattern, starting from 40% of national income in 1960, up to 90% in the early 1980s, and down to 50% in the mid 1990s. Rising net assets over the 1960s and 1970s are well

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(e.g., for regional of industrial development purposes). Gregory and Sheehan (2011) estimate that about 80% of Australia's resource-sector is foreign-owned today, so the subsidy is partly to the rest of the world. Note also that corporations have a "permission to use natural resources assets," but this only corresponds to the right to use spectrum licenses granted to mobile phone operators (these rights were worth A$ 2 billion as at June 2011). Subsoil assets extraction rights granted to private sector companies are counted as resources leases (which translate into a flow of rent payments) rather than licenses (which would translate into an permit asset being recorded in the corporate sector's balance sheet), as recommended by the 2008 SNA (17.340 and sqq).

[440]The recent increase in subsoil assets is mostly a price rather than volume effect. New subsoil assets have been discovered, especially in recent years, but over the medium-run, additions of new resources have been in line with depletion (see the 2012 Statistical Yearbook, pp. 121-126).

[441]For land, see discussion below of book-value national wealth.

[442]Specifically, for the total amount of government securities outstanding we use RBA series E10 for the 1974-1989 period, and then various issues of Australia's statistical yearbook for the 1960-1974 period (these yearbooks are all freely available online on the ABS website starting with the 1908 edition). See the file "Australia.xls" for detailed references and computations.

accounted for by the combination of high public investment rates (2-3% of national income) and high inflation rates (which reduces the real value of the public debt). The drop in net government wealth in the 1980-1995s owes to a rising public debt and decreasing investment. Since the mid 1990s, the public debt has decreased, which has a led to a moderate improvement in the government's net position.[443]

Book-value national wealth and foreign wealth

By definition, the book-value of national wealth is the sum of all produced non-financial assets and non-produced non-financial assets. ABS provides capital stock series starting in 1960. These statistics give the value of all produced non-financial assets in the economy by type of asset (e.g., dwellings) and by sector (e.g., households). Non-produced assets are exhaustively covered by the 1989-2011 official balance sheets. For the 1960-1988 period, we proceed as follows. Available RBA/Treasury data enable us to compute the value of the land owned by households (both land underlying dwellings and unbuilt plots of land). We assume that, in other sectors of the economy, land values have followed the same evolution as in the household sector.

To estimate the book-value of national wealth, it is necessary to include subsoil assets – since there are no equity prices involved here, failure to account for subsoil assets would lead us to under-estimate Australia's wealth. This is what we do in TableAU.6b.[444] Subsoil assets and other natural resources amounted to 23.6% of national income in 1989. We keep this ratio constant through to 1960. The margins of error involved are negligible as compared to the magnitude of Australia's book-value national wealth to national income ratio, which ranges from 450% to 700%.

Pre-1989 data on foreign assets and liabilities come from Foster (1996), who provides a reconstruction of Australian national accounts covering the 1950-1995 period. The data are

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[443]Should we include subsoil assets in the balance sheet, the increase in net wealth would be spectacular, with net asset reaching 125% in 2010, in sharp contrast to the other countries in our database.

[444]We proceed similarly for Canada, the other country in our database that provides yearly data on subsoil assets – with the key difference that Canada, contrary to Australia, does not yet include subsoil assets in the balance sheets, but simply report those as a memo item.

available online on RBA's website.[445] They show that Australia has been a sizable net debtor for a long time, with a net foreign asset position of -16% of national income in 1960, down to about -70% in 2010. There are no other volume change data available for foreign wealth.

I.2 Historical non-official national accounts series

There appears to be many historical estimates of national income and wealth in Australia. We have gathered some of those,[446] but we have not used them in the present research.

J Spain

At the time we conducted this research, Spain did not have official, comprehensive SNA balance sheets. But there were detailed financial balance sheets on the one hand – following the 1995 ESA / 1993 SNA standard – and official estimates of the market value of household real estate compiled by the Bank of Spain on the other. We draw on these official data sets to provide estimates of the market value of private and national wealth in our file Spain.xls. It should be noted that the Bank of Spain itself published a series on the ratio of household wealth to GDP ("Riqueza total de los hogares. Ratio sobre PIB"). This ratio is fully consistent with the wealth-income ratios we report in Spain.xls.[447]

In the absence of integrated balance sheets, however, the Spanish wealth data are of somewhat lower quality than for the 8 countries included in our core database. In particular, we probably slightly under-estimate the wealth-income ratio – and the Bank of Spain as well – because there is no data on the real assets other than housing held by individuals – in our computations, those are assumed to be equal to 0. Another issue is that the real estate estimates

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[445]See http://www.rba.gov.au/statistics/frequency/occ-paper-8.html and our file "DataFoster96.xlsx".

[446]See the "Pre1960Series directory" in the CountryData directory devoted to Australia. Knibbs (1918), for example, gives detailed estimates for 1915 (Stamp considers this as "perhaps the most thorough and complete attempt that has yet been made to ascertain national wealth." (p. 483)).

[447]The Bank of Spain reports that the household wealth / GDP ratio peaked at about 670% at the end of 2007; given that national income is about 82% of GDP according to the official national accounts, this is consistent with private wealth exceeding 8 times national income at the peak of the housing bubble.

only start in 1987, so it not possible to estimate private wealth data before. In view of these two limitations, we have chosen not to include Spain in our core dataset.

K   Detailed decomposition results for wealth accumulation

In this section we start by giving more details on the wealth accumulation equations summarized in section 3 of the paper. We then present the full decomposition results for the 1970-2010 period (summarized in the paper, section 4) and for the 1870-2010 period (summarized in the paper, section 5).

K.1   Additive vs. multiplicative decomposition

K.1.1   Additive decomposition of wealth accumulation

Wealth or capital accumulation between years t and $t + n$ can generally be decomposed into a volume effect and a relative price effect:

$$W_{t+n} = W_t + S_{t,t+n} + KG_{t,t+n}$$

where:

W_t is the amount of wealth (or capital) in year t;

$S_{t,t+n} = S_t + S_{t+1} + ... + S_{t+n-1}$ is the total saving (or investment) flow between year t and $t + n - 1$, and captures a volume effect;

$KG_{t,t+n}$ is the total capital gains or losses between year t and $t + n$ and capture a relative price effect.[448]

In this equation, W_{t+n}, W_t and S are expressed in constant prices, using some reference price index. The choice of a reference price index is an important issue. One attractive option would

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[448]In our database our wealth data points are mid-year estimates (obtained by averaging end of $t - 1$ and end of t wealth amounts). By contrast, our saving flows are for year t. So in effect there is slight inconsistency (logically we would like to have mid-year to mid-year saving flows) but given our long-run focus it is completely irrelevant and we disregard it.

be to use the consumer price index, so that KG would measure the excess of asset price inflation over consumer price inflation. But as we discuss below, in most countries GDP deflators are of higher quality and so in this research we mostly use GDP deflators to compute real values.

In a one-sector model with no relative price effect, KG would be equal to 0. That is, wealth in year $t + n$ would simply be equal to wealth in year t plus total savings between years t and $t + n - 1$.

We note Y_t national income at time t (in constant prices) and define g the geometric average real income growth rate between years t and $t+n$: $Y_{t+n} = Y_t \cdot (1+g)^n$. We note $\beta_t = W_t/Y_t$ the wealth-income ratio in year t. Lastly, we define define s^* the uniform-growth-weighted average saving rate between year t and $t + n$:

$$s^* = \frac{S_{t,t+n}}{Y_t + (1+g)Y_t + ... + (1+g)^{n-1}Y_t} = \frac{S_{t,t+n}}{\frac{(1+g)^n - 1}{g}Y_t}$$

With these definitions in hand, the wealth-income ratio $\beta_{t+n} = \frac{W_{t+n}}{Y_{t+n}}$ can be written as the sum of three components.

Additive decomposition of wealth accumulation:

$$\beta_{t+n} = \beta_{ini} + \beta_{sav} + \beta_{kg}$$

with:

$$\beta_{ini} = \frac{W_t}{Y_{t+n}} = \beta_t\frac{1}{(1+g)^n} = \text{component coming from initial wealth}$$

$$\beta_{sav} = \frac{S_{t,t+n}}{Y_{t+n}} = \beta^*\left(1 - \frac{1}{(1+g)^n}\right) = \text{component coming saving flows}$$

$$\beta_{kg} = \frac{KG}{Y_{t+n}} = \text{component coming from capital gains}$$

$$\beta^* = \frac{s^*}{g} = \text{Harrod-Domar-Solow steady-state wealth-income ratio}$$

In the absence of capital gains, β_{t+n} is simply the weighted average of the initial wealth-income ratio β_t and the Harrod-Domar-Solow wealth-income ratio β^*. Further, as $n \to +\infty$, and in the absence of capital gains (or if capital gains are purely transitory), $\beta_{t+n} \to \beta^*$. In

the long run the initial capital stock does not matter any more, and the wealth-income ratio converges towards the Harrod-Domar-Solow steady-state.

As long as n is finite, however, the initial stock does matter. Take $t = 1950$, $t + n = 2010$. With $g = 2\%$, then $(1 + g)^n = 3.28$, and $1/(1 + g)^n = 0.30$. Capital accumulation takes time: even after 60 years, the initial stock matters for 30%, and cumulated savings for 70%. Of course with larger growth the initial stock matters less. That is, if $g = 3\%$, then $(1 + g)^n = 5.89$, and $1/(1 + g)^n = 17\%$.

To estimate the additive decomposition equation of wealth over the 1970-2010 period, we simply need some estimate of the initial and final capital stocks β_t and β_{t+n}, and of total saving flow $S = S_{t,t+n}$ between 1970 and 2010. Total capital gains are estimated as a residual: $KG = W_{t+n} - W_t - S$. It is straightforward to compute the full decomposition $\beta_{t+n} = \beta_{ini} + \beta_{sav} + \beta_{kg}$ and the share of total wealth accumulation coming from each channel.

In practice when we decompose wealth accumulation, rather than using the uniform-growth-weighted average saving rate s^*, we use for convenience the simpler real-income-weighted saving rate s defined by:

$$s = \frac{S_{t,t+n}}{Y_t + Y_{t+1} + ... + Y_{t+n-1}} = \frac{s_t Y_t + s_{t+1} Y_{t+1} + ... + s_{t+n-1} Y_{t+n-1}}{Y_t + Y_{t+1} + ... + Y_{t+n-1}}$$

where s_t is the saving rate in year t. This simple income-weighted average saving rate s slightly differs from the uniform-growth-weighted average saving rate s^* because growth rates g are not constant, but the gap is negligible and irrelevant for our purposes. Using the income-weighted average saving rate, we can compute the extra saving rate Δs necessary to fully account for observed wealth accumulation:

$$\Delta s = \frac{\beta_{kg}}{\beta_{sav}} s = \frac{KG}{S} s$$

K.1.2 Multiplicative decomposition of wealth accumulation

Multiplicative decomposition with yearly balance sheets

The additive decomposition is fine when capital gains or losses are purely transitory and play no role in long run wealth accumulation. But when there is a permanent rate of capital gain $q > 0$ (or $q < 0$), for instance because there is a permanent mis-measurement of saving or investment flows (e.g., because R&D is counted as intermediate consumption), it is better to adopt the following multiplicative decomposition:

$$W_{t+1} = (1 + q_{t+1})(W_t + s_t Y_t) = (1 + q_{t+1})(1 + g_{wst+1})W_t \tag{1}$$

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

$q_{t+1} =$ capital-gains-induced wealth growth rate.

Alternatively, we could write $W_{t+1} = (1 + q_{t+1})W_t + s_t Y_t$, i.e. saving and investment are made at the end of the period and do not benefit from capital gains. This makes very little difference given that q is usually small, and the multiplicative form is a bit more convenient to work with so we retain it.

Dividing equation 1 by Y_{t+1} and noting $g_{t+1} = \dfrac{Y_{t+1} - Y_t}{Y_t}$ the growth rate of national income we obtain:

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

Cumulating over n years we get the following **multiplicative decomposition of wealth accumulation:**

$$\beta_{t+n} = \frac{(1 + q)^n (1 + g_{ws})^n}{(1 + g)^n} \beta_t$$

with:

$(1 + g_{ws})^n = (1 + g_{wst+1}) \times ... \times (1 + g_{wst+n})$: cumulated saving-induced wealth growth rate

$(1 + q)^n = (1 + q_{t+1}) \times ... \times (1 + q_{t+n})$: cumulated capital-gains-induced wealth growth rate

$(1 + g)^n = \dfrac{Y_{t+n} - Y_t}{Y_t} =$ cumulated growth rate of national income

With annual balance sheets, one compute annual rates $g_{wst+1}, q_{t+1}, ..., g_{wst+n}, q_{t+n}$ and cumulate them in order to compute the average rates g_{ws} and q. From this one can define the share of total wealth growth coming from savings as $g_{ws}/(g_{ws} + q)$, and the share coming from capital gains as $q/(g_{ws} + q)$. Alternatively, one can define the share of total wealth accumulation coming from initial wealth as β_{ini}/β_{t+n} (with $\beta_{ini} = \beta_t/(1 + g)^n$), the share coming from saving as $(1 - \beta_{ini}/\beta_{t+n}) \times g_{ws}/(g_{ws} + q)$ and the share coming from capital gains as $(1 - \beta_{ini}/\beta_{t+n}) \times q/(g_{ws} + q)$. Note that these shares differ from those coming coming from the additive decomposition $\beta_{t+n} = \beta_{ini} + \beta_{sav} + \beta_{kg}$.

Multiplicative decomposition without yearly balance sheets

Assume we do not have annual balance sheet series but that we observe initial and final capital stocks β_t and β_{t+n}. Assuming a uniform rate of capital gains q between years t and $t + n$, as well as a uniform saving rate $s_t = s$ and growth rate $g_t = g$, the dynamic equations can be rewritten as follows:

$W_{t+1} = (1 + q)(W_t + sY_t)$

$W_{t+2} = (1 + q)(W_{t+1} + sY_{t+1}) = (1 + q)^2 W_t + s[(1 + q)^2 Y_t + (1 + q)(1 + g)Y_t]$

$W_{t+n} = (1 + q)^n W_t + sY_t[(1 + q)^n + (1 + q)^{n-1}(1 + g) + ... + (1 + q)(1 + g)^{n-1}]$

That is:

$$W_{t+n} = (1 + q)^n \left[W_t + s \cdot Y_t \frac{\left(\dfrac{1+g}{1+q}\right)^n - 1}{\dfrac{g - q}{1 + q}} \right]$$

Now define the corrected Harrod-Domar-Solow steady-state wealth-income ratio as follows:

$$\beta_q^* = \frac{s(1 + q)}{g - q}$$

We have the following equation:

$$\beta_{t+n} = (1 + q)^n \left[\beta_t \frac{1}{(1 + g)^n} + \beta_q^* \left(\frac{1}{(1 + q)^n} - \frac{1}{(1 + g)^n} \right) \right] \tag{2}$$

For given β_t, β_{t+n}, g and s, there exists a unique q solving equation 2, with $q > 0$ if and only if $\beta_{t+n} < \beta_t \frac{1}{(1+g)^n} + \beta^*(1 - \frac{1}{(1+g)^n})$ and $q < 0$ if the reverse inequality holds. There is no closed formula for q, but it can easily be computed by numerical methods (in practice a simple tatonnement process works very well). We use equation 2 many times in this research in order to compute real rates of capital gains in time periods when there is no official yearly balance sheets and fill in the gaps in our wealth series. A few notes are in order here.

First, equation 2 computes the uniform q corresponding to uniform saving rates s and growth rates g. In practice, even when we do not have annual balance sheets series, we generally have annual series on s_t and g_t, and so we can (and do) make use of these yearly series to compute more accurate estimates of q. That is, if savings happen mostly at the beginning of the period the required capital gain effect $q > 0$ will be smaller than if they are concentrated at the end of the period. In practice however, it makes relatively little difference.

Second, note that with $q = 0$, equation 2 boils down to:

$$\beta_{t+n} = \beta_t \frac{1}{(1+g)^n} + \beta^* \left(1 - \frac{1}{(1+g)^n}\right)$$

Third, equation 2 can also be rewritten:

$$\beta_{t+n} = \frac{(1+q)^n(1+g_{ws})^n}{(1+g)^n}\beta_t \quad \text{with} \quad (1+g_{ws})^n = 1 + \frac{\beta_q^*}{\beta_t}\left[\frac{(1+g)^n}{(1+q)^n} - 1\right]$$

Fourth, the corrected Harrod-Domar-Solow formula $\beta_q^* = \frac{s(1+q)}{g-q}$ shows that permanent capital gains per se do not generate capital accumulation. As long as $q < g$, $\beta_q^* = 0$ if $s = 0$. So in the long run saving flows always explain 100% of capital accumulation in the multiplicative framework, including in the presence of capital gains.

Fifth, in this research we always use net-of-depreciation income and saving series, but the corrected Harrod-Domar-Solow formula can be extended to the case where s is the gross-of-depreciation saving rate and δ is the depreciation rate (assumed to be proportional to capital stock, so that in effect it operates like a negative rate of capital gain):

$$\beta_q^* = \frac{s(1 + q - \delta)}{g - q + \delta}$$

Lastly, in case we prefer to assume that savings and investment are made at the end of the period and do not benefit from capital gains, i.e., $W_{t+1} = (1 + q)W_t + sY_t$, then the corrected Harrod-Domar-Solow formula writes:

$$\beta_q^* = \frac{s}{g - q}$$

K.2 Detailed decomposition results for the 1970-2010 period

The main decomposition results for the 1970-2010 period are presented in the paper (section 4). Here we provide a number of supplementary results (see Appendix Figures A122-A142 and Appendix Tables A99-A107). For the most part, the results are self-contained. Detailed formulas can be found in the corresponding Excel files as well as in the country-specific Excel files. A number of specific issues, however, require particular attention.

K.2.1 Private saving vs. personal saving

First, we provide separate decomposition results for private wealth accumulation using personal (household) saving rather than total private saving, i.e. excluding corporate retained earnings. In most countries, a substantial fraction of private saving and investment takes place through corporate retained earnings: about 40-50% in the US, Japan, Canada and Australia, and over 60% in the UK. There are exceptions, however. In Germany and France, only about 20% on net private savings took place through retained earnings on average during the 1970-2010 period; in Italy, less than 5%.[449] It is far beyond the scope of the present paper to explore the various explanations for these cross country variations. It is likely that differences in tax rules (e.g., provisions against double taxation of dividends are more common in Germany and France than

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[449]Note that the share of household vs. corporate saving in total private saving depends on whether one looks at net saving flows (as we do in this research) or gross flows. Because depreciation is higher in the corporate sector, the share of retained earnings is higher when one looks at gross saving flows – over 50% in Germany and France.

in the U.S. and the U.K.) and financial intermediation systems play role. Pure accounting differences also probably matter.[450]

When we exclude retained earnings from the private saving flow, then in most countries savings alone are far too small to explain the observed evolution of wealth-income ratios. The residual capital gain is positive everywhere and usually large (accounting for up to 81% of private wealth accumulation in the U.K., for example). But such capital gains are spurious, in the sense that they mostly correspond to the accumulation of retained earnings within corporations in order to finance new investment and new acquisitions (thereby leading to rising stock prices), rather than to a true relative price effect. In particular, they can easily be accounted for in a one sector capital accumulation model (there is no need to introduce relative prices). In effect, instead of distributing more dividends, U.S. corporations choose to re-invest the equivalent of 3.1% of national income in net retained earnings, which according to our estimates generate an extra residual capital gain of 0.8% per year over the the 1970-2010. This corresponds to a stock market real appreciation of about 2%-3% per year. Instead of receiving more dividends, U.S. wealth holders can choose to realize their capital gains when they so wish. Presumably corporations do not distribute more dividends because private wealth holders prefer to have some of their wealth accumulation to take place in corporations, either for tax reasons or because they trust corporations to make wiser investment choices than they would on their own.

We observe the same phenomenon in every rich country, but with varying intensities, and that is why we consider it much more meaningful to decompose private wealth accumulation using the total private saving flow (households + corporate). One limitation of our approach, however, is that we attribute all retained earnings of U.S. corporations to the U.S. personal sector (and similarly for other countries). Ideally, one should re-attribute a fraction of retained earnings to foreign shareholders, and part of foreign retained earnings should similarly be re-attributed to domestic shareholders. Part of the retained earnings of domestic corporations

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[450]For instance, many large firms – and their corresponding retained earnings- - seem to be registered in the personal rather than in the corporate sector in Germany and Italy

should also be attributed to the government. Unfortunately national accounts series – at least in the form they are currently released – do not report such bilateral flows in a systematic manner, so we cannot do that for the time being. Given that the net foreign asset positions of the various countries are not very large (so that each country receives and gives approximately the same quantities of retained earnings), and government ownership in corporations has become fairly small, any errors here can probably be neglected, at least as a first approximation.[451]

K.2.2 Private wealth vs. national wealth decomposition

Generally speaking, it is worth stressing that the measurement of government wealth raises a number of specific difficulties. In particular, government non-financial assets are mostly made of buildings and equipment used by public administration, schools, public hospitals, etc., most of which are not sold very often, so that their market value can be difficult to determine. In addition, historical monuments are rarely valued.[452] Natural resources – forests, mountains, subsoil assets etc. – are not valued until the time they are exchanged on a market and/or used for economic activity. In practice, the recorded value of government non-financial assets appears to be relatively stable – around 50%-80% of national income – throughout the 1970-2010 in most countries of our sample.[453] The main exception is Japan, where government non-financial assets gradually rose from about 50% of national income in 1970 to around 100% in 1990 and as much as 150% by 2010.[454]

In principle, the market value of government-held financial assets and liabilities (i.e. public debt) is easier to measure, with two caveats. First, countries with large nominal public debt often have a significant fraction of their public debt held by various public entities (local government

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[451]Our method is probably more problematic for the 1950s-1960s (and to some extent for the 1970s), when government ownership was more prevalent.

[452]In France for example, historical monuments are valued when there are observable investment series – e.g., when large reparation work is undertaken, or when a new monument is built (such as the Louvre pyramid).

[453]There are limited cross-country variations: in the US, government non-financial assets are stable around 70%-80% on national income; in Germany, the UK, Italy and Canada, they are stable around 50%-60%; in France they are stable around 50%-60% until the early 2000s and then rise up to 80%-90% in the period. See Tables US.6a, DE.6a, FR.6a, etc.

[454]We discuss the patterns in Japanese public assets and debts in Section G devoted to Japan.

debt held by central government, central government debt held by social security funds, etc.).
So it is critical to consolidate the balance sheet at the level of the entire government sector (including all government levels: central, local, social security and all forms of public bodies and agencies under public control).[455] This is what SNA international guidelines require to do, and all countries in our sample seem to follow this rule rigorously.

So for instance in 2010 Japan's government sector balance sheet involves very large public debt (264% of national income), but even larger public assets (278% of national income, including 150% in non-financial assets and 128% in financial assets), so Japan's net government wealth appears to be slightly positive (+14%). In contrast, Italy has smaller public debt (156% of national income), but much smaller assets (88%, including 52% non–financial and 36% financial), so that Italy's net government wealth appears to be strongly negative (-68%).[456]

The last difficulty has to do with the valuation of government participation in publicly owned companies, many of which have been privatized in rich countries since the 1970s (particularly in the energy, telecom, transportation and banking sectors). In principle, according to SNA 1993 international guidelines, national accountants should report on the financial asset side of the government balance sheet the fair market value of its equity participation in public companies - on the basis of stock prices observed for publicly traded companies in comparable production sectors (in the same way as for non publicly traded, privately owned businesses). However not all countries have published retrospective balance sheets following these rules for the earlier part of the period. We made a number of corrections to the originally published balance sheets so as to ensure maximum continuity, but it is possible that we still underestimate somewhat the value of publicly owned corporations in the 1970s and early 1980s.[457]

It is possible that we under-estimate the value of government wealth in the 1970s (say by

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[455]Throughout the paper, when we refer to "governement sector" or "government wealth", we always refer to the consolidated government sector in the broadest sense (as defined by SNA guidelines).

[456]See Tables JP.6a and IT.6a.

[457]In particular, we re-attributed the residual book value of public corporations to the UK government. The effect of the correction is substantial for the 1970s and early 1980s, but might still be somewhat under-estimated (see UK section). More on this below.

about 50% of national income - probably an upper bound),[458] in which case the decline in government wealth would be even larger.

K.2.3 Gross vs. net saving

In our view, it is perfectly possible that national accounts under-estimate saving and investment flows by substantial amount, and that this explains some of our findings on the importance of capital gains in 1970-2010 wealth accumulation. In particular, UK official balance sheet series do not include estimates for "other volume changes" (new construction permits, discovery of national resources, etc.), which for other countries we included with saving-induced volume effects – as opposed to residual price effects. If "other volume changes" in the UK were of similar magnitude as in countries like the US or France, then the share of wealth growth accounted for by volume effects would rise from 55% to about 65% in the multiplicative decomposition.[459] In case unmeasured saving and investment flows – due in particular to R&D spendings – represent the equivalent of about 3% of national income, then there would be no UK puzzle at all.

It is also worth recalling that statisticians estimate net saving and investment flows first by computing gross flows, and then by deducting estimates of capital depreciation. Because the depreciation provisions and allowances reported in the books of private corporations are not homogenous over time and across countries (and are often severely polluted by tax optimization behavior), statisticians produce their own, homogenous estimates of capital depreciation, on the basis of various assumptions about average depreciation rates for each type of capital good and about the age distribution of these capital goods. National accountants do their best, but it

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[458]In particular, public assets for France and Italy seem a bit too low for this period. E.g. according to official balance sheets the government share in national wealth is only 15%-20% in the 1970s and early 1980s in France, vs as much as 25%-30% in Germany and the UK, which does not seem entirely plausible given the size of the public sector in France at that time.

[459]It is also possible that Australian series under-estimate other volume changes (discovery of new natural resources were very important in Australia over this period, and they are difficult to account for at a proper market value at the time they are made). In the country tables US.4, JP.4, etc., we separately report the results obtained for saving flows strictly speaking and for "other volume changes". In the US other volume changes represent an average annual flow of 1.0% of national income over the 1970-2010 period, vs 7.7% for private saving (see Table US.4b); in France they represent 0.9% of national income, vs 11.1% for private saving (see Table FR.4b).

is fair to say that this a complex process which involves many potential measurement errors. This can have serious consequences about the measurement of net saving and investment flows – especially given that capital depreciation generally represent between one half and two thirds of gross flows.

E.g. in the UK, gross private saving flows were on average 21.0% of national income over the 1970-2010 period, but capital depreciation flows were 13.6% of national income, so that net private saving flows were only 7.3% of national income. Capital depreciation flows seem to be fairly similar across countries and display no obvious inconsistency. In particular, countries with lower net savings like the UK or the US do not display higher depreciation rates. But it could be that true capital depreciation rates in the UK are actually lower than in other countries and than currently estimated (say, because of ill-measured differences in composition or age structures of machines and equipments), so that net saving rates are under-estimated by a non-negligible amount (say, by the equivalent of 1%-2% of national income). We have no strong reason to suspect that this is the case - but we have no strong reason to exclude it either. The point is that a moderate error on depreciation would be sufficient to explain a significant part of the UK puzzle.

K.3   Detailed decomposition results for the 1870-2010 period

The main decomposition results for the 1870-2010 period are presented in the paper (section 5). A number of additional decomposition results are provided in Appendix Tables A108 to A137. Specifically, we provide detailed additive and multiplicative decomposition results for each sector of the economy (private, government, foreign) in the U.S., Germany, U.K., and France, for each of the main subperiods (1870-1910, 1910-1950, 1950-1980, and 1980-2010). These results are self-contained, and the interested reader is referred to AppendixTables.xls and the country-specific Excel files for all details.

K.4 The formula $\beta = s/g$ with bequest taste and lifecycle saving

In the paper (section 3), we show that the saving rate s in the formula $\beta = s/g$ can be interpreted as the intensity of the taste for bequest in a simple model with bequest in the utility function. We also mention the fact in a more general model with lifecycle saving then the equilibrium saving rate $s = s(\lambda)$ would also depend positively on the fraction of lifetime λ that is spent in retirement. I.e. following the Modigliani triangle logic one should see more lifecycle saving when one expects to spend more time in retirement (and/or if one expects larger consumption needs during retirement, e.g. due to health shocks). Here we provide a simple model that can be used to generate such a formula.

Instead of assuming that each generation leaves one period, we now assume that each generation leaves two periods: one period from adulthood to retirement, one period from retirement to death. The fraction λ is given by: $\lambda = (D - R)/(D - A)$ (where $A =$ age at adulthood, $R =$ age at retirement, $D =$ age at death). Say, if $A = 20$, $R = 60$ and $D = 80$, then $\lambda = 1/4$. For simplicity, we model this continuous-time, overlapping generation process as a discrete process where the life of each generation can be broken down into two components (one from age A to R, and one from age R to D), leaves bequest at the end of life, and receives bequests at the beginning of (adult) life.[460]

More precisely, we consider the same exogenous-growth, bequest-in-the-utility-function model as in the paper (section 3.3), and we now assume that each generation t has to divide its lifetime consumption into two components: working-life consumption c_{1t} and retirement-life consumption c_{2t}. We assume that the budget constraint can be written as follows:

$$c_{1t} + c_{2t} + b_{t+1} \leq y_t = y_{Lt} + (1 + r_t)b_t$$

In effect, we are assuming that both types of consumption take place at the end of life, and

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[460]In practice, individuals inherit at age $I = D - H$ (where $H =$ age at parenthood), so I is typically between A and R, and often closer to R than to A (e.g. with $D = 80$ and $H = 30$, $I = 50$). In order to have $I = A$, one would need a very large rise in the age at parenthood (i.e. one would need $H = 60$). Inter vivos gifts however tend to bring I closer to A. See Piketty 2010 (section 5, and appendix E) for a continuous time OLG model along those lines (i.e. interacting inheritance and life-cycle forces in a realistic way). The simple discrete model presented here is merely illustrative.

that the only difference between the two is that retirement-life consumption must be funded into some pension fund or health insurance account, so that it can be interpreted as wealth accumulation.[461] The simplest case is when the utility function is defined directly over consumption levels c_{1t} and c_{2t} and the increase in wealth $\Delta b_t = b_{t+1} - b_t$ and takes a simple Cobb-Douglas form: $V(c_1, c_2, \Delta b) = c_1^{(1-\lambda)(1-s)} c_2^{\lambda(1-s)} \Delta b^s$. We then have: $b_{t+1} = b_t + s \cdot y_t$, $c_{1t} = (1-\lambda) \cdot (1-s) \cdot y_t$ and $c_{2t} = \lambda \cdot (1-s) \cdot y_t$. Defining total wealth accumulation w_{t+1} as the sum of bequest wealth b_{t+1} and pension wealth c_{2t}, we find that $\beta_t = w_t/y_t \rightarrow \beta = s(\lambda)/g$, with $s(\lambda) = s + \lambda \cdot (1-s)$. In a more sophisticated model with a realistic continous time structure for consumption and bequest streams, the corrected saving rate $s = s(\lambda, r, ...)$ will be a complex function of the fraction of lifetime that this spent in retirement, the rate of return, etc. (see Piketty, 2010, section 5 and appendix E).

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[461] In effect, c_{2t} can be interpreted as the ressources devoted to an old-age insurance fund that is used to finance extra terminal health or consumption spendings that are not well covered by the existing public pension and health insurance system. The corresponding ressources are funded but produce no return because of a strong liquidity requirement. Needless to say, this is a highly simplified model of lifecycle saving.

References

This list includes all references cited in the Appendix, except those which are also cited in the main text. It also excludes unsigned administrative publications (whose references are given in footnotes).

Abbas, S.M. Ali, Nazim Belhocine, Asmaa El-Ganainy and Mark Horton "Historical Patterns and Dynamics of Public Debt – Evidence from a New Database," *IMF Economic Review*, 2011, vol.59(4), pp.717-742.

Allen, Robert C., "English and Welsh Agriculture, 1300-1850," working paper, Nuffield College, Oxford, January 2005, 54 pp.

Allen, Robert C., "Engel's Pause: Technical Change, Capital Accumulation, and Inequality in the British Industrial Revolution," *Explorations in Economic History*, 2009, vol.46, pp.418-435.

Anderson, Paul, "The Apparent Decline in Capital-Output Ratios," *Quarterly Journal of Economics*, 1961, vol.75(4), pp.615-634.

Ando, Albert, Luigi Guiso and Ignazio Visco (eds.), *Saving and the Accumulation of Wealth. Essays on Italian Household and Government Saving Behavior,* Cambridge: Cambridge University Press, 1994, 415p.

Askenazy, Philippe, Gilbert Cette and Arnaud Sylvain, *Le Partage de la Valeur Ajoutée,* Paris: La Découverte, 2011, 124p.

Atkinson, Anthony B., "Concentration Among the Rich," Working Paper, UNU-WIDER, 2006, 33p.

Atkinson, Anthony B., "Wealth and Inheritance in Britain from 1896 to the present," Working Paper, Nuffield College, 2012, 42p.

Atkinson, Anthony B. and Alan Harrison, *Distribution of Personal Wealth in Britain,* Cambridge: Cambridge University Press, 1978, 330p.

Arai, Haruhito, "Estimating Imputed Rent for Owner-occupied Dwellings in the Japanese System of National Accounts," ESRI Discussion Paper Series No. 141, 2005.

Baffigi, Alberto, "Estimates of Private Wealth in Italy After Unification: Historiography and Statistical Methods," Bank of Italy Research Paper A11, 2008.

Baffigi, Alberto, "Italian National Accounts," Bank of Italy Economic History Working Paper 18, 2011.

Balke, Nathan S. and Robert J. Gordon, "The Estimation of Prewar Gross National Product: Methodology and New Evidence", *Journal of Political Economy,* 1989, vol.97(1), pp.38-92.

Baron, Dietmar, *Die personelle Vermgensverteilung in der Bundesrepublik Deutschland und ihre Bestimmungsgrunde,* Frankfurt/M., Bern, New York, Paris: Peter Lang, 1988, 320p.

Baron, Jean-François, "Les Comptes de Patrimoine et de Variations de Patrimoine, Base 2000," note methologique de l'Insee, 2008, 117p.

Barro, Robert J., "Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom, 1701-1918", *Journal of Monetary Economics,* 1987, vol.20, pp.221-247.

Barro, Robert J. and José F. Ursua, Macroeconomic Data, 2010, available online at http: //rbarro.com/data-sets/.

Bittlingmayer, George, "Output, Stock Volatility, and Political Uncertainty in a Natural Experiment: Germany, 1880-1940," *Journal of Finance*, 1998, vol.53(6), pp.2243-2257.

Blake, David and Michael Orszag, "Annual Estimates of Personal Wealth Holdings in the United Kingdom since 1948," *Applied Financial Economics*, 1999, vol.9, pp.397-421.

Blodget, Samuel, *A Table improved on the plan of Sir William Petty, and other statistical writers, for a classing, and a valuation of tariff of exchange for the white people of the United States, for 1805*, 1806.

Bond, Charlotte A., Teran Martin, Susan H. McIntosh and Charles I. Mead, "Integrated Macroeconomic Accounts for the United States," *Survey of Current Business*, 2007, vol.87(2), pp.14-31.

Boskin, Michael J., Marc S. Robinson, Terrance O'Reilly and Praveen Kumar, "New Estimates of the Value of Federal Mineral Rights and Land," *American Economic Review*, 1985, vol.75(5), pp.923-936.

Boskin, Michael J., Marc S. Robinson, and Alan M. Huber, "Government Saving, Capital Formation, and Wealth in the United States, 1947-85," in Robert E. Lipsey and Helen Stone Tice (eds.), *The Measurement of Saving, Investment, and Wealth*, Chicago: University of Chicago Press, 1989, 861p.

Boskin, Michael J., Ellen R. Dulberger, Robert J. Gordon, Zvi Griliches and Dale W. Jorgenson, "Consumer Prices, the Consumer Price Index, and the Cost of Living," *Journal of Economic Perspectives*, 1998, vol.12(1), pp.3-26.

Bourguignon, François and Maurice Lévy-Leboyer, *L'économie française au 19e siècle,* Economica, 1985, 362p.

Brandolini, Andrea, Luigi Cannari, Giovanni D'Alessio and Ivan Faiella, "Household Wealth Distribution in Italy in the 1990s," in *International Perspective on Household Wealth*, Edward N. Wolff (ed.), Edward Elgar Publishing, 2006, pp.225-275.

Brezis, Elise S., "Foreign Capital Flows in the Century of Britain's Industrial Revolution: New Estimates, Controlled Conjectures" *Economic History Review*, 1995, vol.48(1), pp.46-67.

Buchheim, Christoph, "Die besetzen Länder im Dienste der deutschen Kreigswirtschaft während des Zweiten Welkriegs," *Viereljahreshefte für Zeitgeschichte*, 1986, vol.34, pp.117-145.

Buchheim, Christoph and Jonas Scherner, "The Role of Private Property in the Nazi Economy: The Case of Industry," *Journal of Economic History*, 2006, vol.66(2), pp.390-416.

Burhop, Carsten and Guntram B. Wolff, "A Compromise Estimate of German Net National Product, 1851-1913, and Its Implications for Growth and Business Cycles" *Journal of Economic History*, 2005, vol.65(3), pp.613-657.

Carpenter, Seth B., Jane E. Ihrig, Elizabeth C. Klee, Daniel W. Quinn and Alexander H. Boote, "The Federal Reserve's Balance Sheet and Earnings: A Primer and Projections," Finance and Economics Discussion Series, Division of Research & Statistics and Monetary Affairs, Federal Reserve Board, 2013, 63p.

Clark, Gregory, "Debt, Deficits, and Crowding Out: England, 1727-1840," *European Review of Economic History*, 2001, vol.5(3), pp.403-436.

Coats, R.H., "National Wealth and Income of Canada," *The Monetary Times*, January 3 1919, vol.62, pp.19-21.

Copeland, Morris A., *Trends in Government Financing,* Princeton: Princeton University Press, 1961, 207p.

Copeland, Adam M., Gabriel W. Medeiros and Carol A. Robbins, "Estimating Prices for R&D Investment in the 2007 R&D Satellite Accounts," BEA technical paper, 2007, 58p.

Corrado, Carol, Charles Hulten, and Daniel Sichel, "Measuring Capital and Technology: An Expanded Framework," in *Measuring Capital in the New Economy*, Carol Corrado, John Haltiwanger and Dan Sichel (eds), Chicago: University of Chicago Press, 2005, pp.11-46.

Crammond, Edgar, "Imperial Defence and Finance," *The Nineteenth Century and After*, August 1912, vol.72, pp.228-29.

Curcuru, Stephanie E., Tomas Dvorak and Francis E. Warnock, "Cross-Border Returns Differentials," *Quarterly Journal of Economics,* 2008, vol.123(4), pp.1495-1530.

Curcuru, Stephanie E., Charles P. Thomas and Francis E. Warnock, "On Returns Differentials," *Journal of International Money and Finance,* 2013, forthcoming.

Davenant, Charles, *Discourses on the Public Revenues and on the Trade of England*, London: 1698, 2 vol., 434p.

Davenant, Charles, *An Essay Upon the Probable Methods of Making a People Gainers in the Balance of Trade*, London: 1699, 312p.

Davis, Joseph H., "An Annual Index of U.S. Industrial Production, 1790-1915," *Quarterly Journal of Economics,* 2004, vol.119(4), pp.1177-1215.

Davis, Morris, Andreas Lehnert and Robert Martin, "The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing," *Review of Income and Wealth,* 2008, vol.54(2), pp.279-286.

Deane, Phyllis and William A. Cole, *British Economic Growth, 1688-1959: Trends and Structure*, Cambridge: Cambridge University Press, 1962, 350pp. (second edition, 1967).

Dekle, Robert, "Alternative Estimates of Japanese Saving and Comparisons with the U.S.: Can the Capital Gains to Land be Included in Saving?," Working Paper No. 52, Columbia University Center on Japanese Economy and Business, 1991.

Dell, Fabien, *L'Allemagne inégale. Inégalités de revenus et de patrimoine en Allemagne, dynamique d'accumulation du capital et taxation de Bismarck à Schröder : 1870-2005*, Ph.D. Thesis, Paris School of Economics, 2008.

Dernburg, H.J., "Germany's External Economic Position," *American Economic Review*, vol.44(4), 1954, pp.530-558.

Dieterici, Karl Friedrich Wilhelm, *Der Volkswohlstand im Preussischen Staate,* Berlin: Druck und Verlag von Ernst Siegfried Mittler, 1846.

Divisia, François, Jean Dupin and René Roy, *A la recherche du franc perdu*; vol. 3: Fortune de la France, Paris: Serp, 1956.

Dougherty, C.R.S.,, "On the Secular Macro-Economic Consequences of Technical Progress," *Economic Journal*, vol.84(335), 1974, pp.543-565.

Dugé de Bernonville, Léopold, "Les revenus privés," *Revue d'Economie Politique*, 1933–1939 (yearly publication; see Piketty 2001, p.781 for full references).

Eddie, Scott M., "Estimating the Value of Land from Prussian Wealth Tax Data," mimeo, University of Toronto, 1999.

Fabrizio, Stefania, "Should Italy Sell Its Nonfinancial Assets to Reduced the Debt?," International Monetary Fund Policy Discussion Paper, 2008.

Fack, Gabrielle and Camille Landais, "Charitable Giving and Tax Policy in the Presence of Tax Cheating: Theory and Evidence from the U.S. and France," working paper, 2011, 52p.

Feinstein, Charles, *National Income, Expenditure and Output of the United Kingdom, 1855-1965*, Cambridge: Cambridge University Press, 1972, 244p.

Feinstein, Charles and Sidney Pollard, *Studies in capital formation in the United Kingdom 1750-1920*, Oxford: Clarendon Press, 1988, 477p.

Feis, Herbert, *Europe: the World's Banker, 1870-1914*, New York: A.M. Kelly, 1961.

Fernandes, Nuno, Miguel A. Ferreira, Petro Matos and Kevin J. Murphy, "Are U.S. CEOs Paid More? New International Evidence", *Review of Financial Studies*, vol.26(2), 2013, pp.323-367.

Firestone, O. J., *Canada's Economic Development, 1867-1953*, Income and Wealth Series VII, London: Bowes & Bowes 1958, 384p; see Part 4: "Historical Review of National Income and National Wealth Estimates in Canada", pp.327-384.

Flandreau, Marc and Frédéric Zummer, *The Making of Global Finance 1880-1913*, Paris: OECD, 2004, 148p.

Foster, Rob A., "Australian Economic Statistics 1949-50 to 1994-95," Reserve Bank of Australia Occasional Paper 8, 1996.

Fremdling, Rainer, "German National Accounts for the 19th and Early 20th Century: A Critical Assessment", *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte*, vol.75(3), 1988, pp.339-357.

Frey, Bruno S., and Marcel Kucher, "History as Reflected in Capital Markets: The Case of World War II," *Journal of Economic History,* vol.60(2), 2000, pp.468-496.

Gayer, Arthur D., W.W. Rostow and Anna J. Schwartz, *The Growth and Fluctuation of the British Economy, 1790-1850*, 2 vols., Oxford: Clarendon Press, 1953, 169p.

Gielen, Gregor, *Können Aktienkurse noch steigen: Langfristige Trendanalyse des deutschen Aktienmarktes*, Wiesbaden: Gabler, 1994, 66p.

Gilboy, Elizabeth W., "The Cost of Living and Real Wages in Eighteenth Century England," *Review of Economics and Statistics*, vol.18(3), August 1936, pp.134-143.

Giffen, Robert, "Recent Accumulations of Capital in the United Kingdom", *Journal of the Royal Statistical Society*, vol.41(1), 1878, pp.1-39.

Giffen, Robert, "Accumulations of Capital in the United Kingdom in 1875-85," *Journal of the Royal Statistical Society*, vol. 53(1), 1890, pp.1-49.

Giffen, Robert, "The Wealth of the Empire, and How it Should be Used," *Journal of the Royal Statistical Society,* vol. 66(3), 1903, pp.582-598.

Gini, Corrado, *L'Ammontare e la composizione della ricchezza delle nazioni,* Torino: Fratelli Bocca, 1914, 709p. (second edition: Unione Tipografico, 1962).

Glyn, Andrew, "Functional and Personal Distribution", in *Oxford Handbook of Economic Inequality,* Wiemer Salverda, Brian Nolan, and Timothy M. Smeeding (eds), Oxford: Oxford University Press, 2009, 768p.

Goldbloom, Anthony and Andrew Craston, "Australian Household Net Worth," *Economic Roundup,* 2008, vol.2, pp.51-58.

Goldsmith, Raymond W., "The Growth of Reproducible Wealth of the United States of America from 1805 to 1950", in *Income and Wealth of the United States: Trends and Structure,* Income and Wealth Series II, Cambridge: Bowes & Bowes, 1952, pp.247-328

Goldsmith, Raymond W., *A Study of Saving in the United States,* Princeton: Princeton University Press, 1955 (vol. I: Introduction; Tables of Annual Estimates of Saving, 1897 to 1949; Vol. II: Nature and Derivation of Annual Estimates of Saving, 1897 to 1949).

Goldsmith, Raymond W., *The National Wealth of the United States in the Postwar Period,* Princeton: Princeton University Press, 1962, 429p.

Goldsmith, Raymond W., "The National Balance Sheet of Germany, 1850- 1972," *Konjunkturpolitik,* 1976, vol.(22-23), pp.153-172.

Goldsmith, Raymond W., *The National Balance Sheet of the United States 1953-1980,* The University of Chicago Press, 1982, 247p.

Goldsmith, Raymond W. and Robert Lipsey, *Studies in the National Balance Sheet of the United States,* Princeton: Princeton University Press, 1963, 2 volumes.

Gompers, Paul A., Joy L. Ishii and Andrew Metrick, "Corporate Governance and Equity Prices," *Quarterly Journal of Economics,* 2003, vol.118(1), pp.107-156.

Gordon, Robert J., "The Postwar Evolution of Computer Prices," in *Technology and Capital Formation,* Dale W. Jorgenson and Ralph Landau (eds), Cambridge: MIT Press, 1989, pp.77-125.

Gordon, Robert J. (ed.), *The Measurement of Durable Goods Price,* Chicago: University of Chicago Press, 1990, chapter 1, pp.3-39.

Gregory, Bob and Peter Sheehan "The Resources Boom and Macroeconomic Policy in Australia," Australia Economic Report, Center for Strategic Economic Studies, Victoria University, 2011.

Griever William L., Gary A. Lee and Francis E. Warnock, "The U.S. System for Measuring Cross-Border Investment in Securities: A Primer with a Discussion of Recent Developments," *Federal Reserve Bulletin,* October 2001, pp.633-650.

Guinnane, Timothy W., "Financial *Vergangenheitsbewältigung*: The 1953 London Debt Agreement," Economic Growth Center Yale University Working Paper, 2004.

Hayami, Yujiro and Yoshihisa Godo, *Development Economics,* Oxford: Oxford University Press, 2005, 448p.

Hall, George J., and Thomas J. Sargent, "Interest Rate Risk and Other Determinants of Post-WWII US Government Debt/GDP Dynamics," *American Economic Journal: Macroeconomics*, 2011, vol.3(3), pp.391-414.

Hall, Robert E., "The Measurement of Quality Change from Vintage Price Data," in Zvi Griliches (ed.), *Price Indexes and Quality Change*, Cambridge: Harvard University Press, 1971.

Hall, Robert E., and Dale Jorgenson, "Tax Policy and Investment Behavior," *American Economic Review*, 1967, vol.57(3), pp.391-414.

Hall, Robert E., and Ricardo Reis, "Maintaining Central-Bank Solvency under New-Style Central Banking," working paper, Hoover Institution, Stanford University, and Columbia University, 2013, 37p.

Hardach, Gerd, *Der Erste Weltkrieg,* München: Deutscher Taschenbuchverlag, 1973.

Harrison, Mark (ed), *The Economics of World War II: Six Great Powers in International Comparison,* Cambridge: Cambridge University Press, 2000, 332p.

Hibbert, Jack, "National and Sector Balance Sheets in the United Kingdom," *Review of Income and Wealth*, 1981, vol.27(4), pp. 357-71.

Hills, Sally, Ryland Thomas and Nicholas Dimsdale "The UK Recession in Context," *Bank of England Quarterly Bulletin*, 2010 Q4, pp. 277-291.

Hoenack, Stephen, "Historical censuses and estimates of wealth in the United States", pp.177-218, in *Measuring the Nation's Wealth*, J. Kendrick ed., Report to US Congress Joint Economic Commitee, Government Printing Office, 1964.

Hoffmann, Walther G., *Das Wachstum der Deutschen Wirtschaft Seit der Mitte Des 19. Jahrunderts,* Berlin: Springer, 1965.

Hoffmann, Walther G. and Josef H. Müller, *Das Deutsche Volkseinkommen 1851-1957,* Tübingen: J.C.B. Mohr, 1959.

Horioka, Charles Y., "The Flow of Household Funds in Japan," *Public Policy Review*, 2008, vol. 4(1), pp.37-51.

Hsieh, Chang-Tai, "What Explains the Industrial Revolution in East Asia? Evidence From the Factor Markets," *American Economic Review*, 2002, vol. 92(3), pp.502-526.

Hulten, Charles R., "The Measurement of Capital," in *Fifty Years of Economic Measurement: The Jubilee of the Conference on Research in Income and Wealth*, Ernst R. Berndt and Jack E. Triplett (eds), 1991, pp.119-158.

Hulten, Charles R., and Frank C. Wykoff, "The Estimation of Economic Depreciation Using Vintage Asset Prices," *Journal of Econometrics,* 1981, vol.15, pp.367-396.

Janssen, Norbert, Charles Nolan and Ryland Thomas "Money, debt and prices in the United Kingdom," *Economica*, 2002, vol.69(275), pp.461-479.

Jones, Alice Hanson, *American Colonial Wealth*, Arno Press, 3 vol., 1977.

Jorgenson, Dale W. and J. Steven Landefeld, "Blueprint for Expanded and Integrated U.S. Accounts. Review, Assessment, and Next Steps," in *A New Architecture for the U.S. National Accounts,* Dale W. Jorgenson, J. Steven Landefeld and William D. Nordhaus (eds), Chicago: University of Chicago Press, 2006, pp.13-112.

Jorgenson, Dale W., "A New Architecture for the U.S. National Accounts," *Review of Income and Wealth,* 2009, vol.55(1), pp.1-42.

Kalckreuth, Ulf von, Martin Eisele, Julia Le Blanc, Tobias Schmidt and Junyi Zhu, "The PHF: A Comprehensive Panel Survey on Household Finances and Wealth in Germany," Deutsche Bundesbank discussion paper 13/2012, 2012, 48p.

Kendrick, John W., *Productivity Trends in the United States*, General series, no. 71, Princeton: Princeton University Press, 1961.

Keynes, John M., *The Economic Consequences of the Peace*, New York: Harcourt, Brace and Howe, 1920.

Koga, Maiko, "Why is the Rate of Decline in the GDP Deflator so Large?," Economic Commentary 2003-02, Bank of Japan, Research and Statistics Department, 2003.

Kopczuk, Wojciech and Emmanuel Saez, "Top Wealth Shares in the United States, 1916-2000: Evidence from Estate Tax Returns," *National Tax Journal*, 2004, vol.57(2, part 2), pp.445-488.

Kotlikoff, Laurence, "The Structure of Slave Prices in New Orleans, 1804-1862," *Economic Inquiry*, 1979, vol.17, pp.496-518.

Krug, Leopold *Betrachtungen über den Nationalreichtum des Preussischen Staates und über den Wohlstand seiner Bewohner* , 2 volumes, 1805.

Kuznets, Simon, *National Income and Its Composition, 1919-1938,* National Bureau of Economic Research, 1941, 929p.

Kuznets, Simon, *National Product in Wartime,* National Bureau of Economic Research, 1945.

Kuznets, Simon, *National Product since 1869,* National Bureau of Economic Research, 1946.

Kuznets, Simon, "Proportion of Capital Formation to National Product," *American Economic Review,* 1952, vol.42(2), pp.507-526.

Kuznets, Simon, *Shares of Upper Income Groups in Income and Savings,* National Bureau of Economic Research, 1953, 707p.

Kuznets, Simon, *Quantitative Aspects of the Economic Growth of Nations: V. Capital Formation Proportions: International Comparisons for Recent Years, Economic Development and Cultural Change*, vol.8(4), Part 2, 1960, pp.1-96.

Kuznets, Simon, *Capital in the American Economy: Its Formation and Financing,* Princeton University Press (for NBER), 1961.

Labrousse, Ernest, *Esquisse du mouvement des prix et des revenus en France au 18e siècle,* Dalloz, 1933.

Lee, Jennifer, and Andrew G. Schmidt, "Research and Development Satellite Account Update. Estimates for 1959-2007," *Survey of Current Business*, 2010, vol.90(12) , pp.16-27.

Lévy-Leboyer, Maurice, "L'étude du Capital et l'Histoire des Recensements Fonciers en France au XIXe Siècle," in *Pour une Histoire de la Statistique*, Insee, 1977, vol.1, pp.393-416.

Lewis, Cleona, *America's Stake in International Investments*, Washington D.C.: Brookings Institution, 1938, 710p.

Lavoisier, Antoine, *La richesse territoriale du Royaume de France,* Paris, 1789, 66p.

Lindert, Peter, "Unequal English Wealth since 1670," *Journal of Political Economy*, 1986, vol.94(6), pp.1127-1162.

Lindert, Peter and Jeffrey Williamson, "American Incomes Before and After the Revolution", 2011, NBER Working Paper, 50p.

Lutz, Friedrich August, "The German Currency Reform and the Revival of the German Economy", *Economica*, vol.16(62), 1949, pp.122-142.

Maddison, Angus, *Monitoring the World Economy, 1820-1992*, OECD, 1995, 255p.

Maddison, Angus, *The World Economy - A Millennial Perspective*, OECD, 2001, 383p.

Maddison, Angus, *Contours of the World Economy 1-2030 AD - Essays in Macro-Economic History*, Oxford University Press, 2007, 448p.

Maddison, Angus, "Historical Statistics of the World Economy: 1-2008 AD," updated tables, 2010 (www.ggcc.net/maddison).

Marczewski, Jean, "Le Produit Physique de l'Economie Francaise de 1789 a 1913 (comparaison avec la Grande Bretagne)," *Cahiers de l'Institut de Science Economique Appliquee*, AF4, Paris, 1965.

Marotta, Giuseppe and Patrizia Pagliano, "Income and Saving in Italy: a Reconstruction. I: Income Accounts by Institutional Sector," Termi di discussione del Servizio Studi 169, Banca d'Italia, 1992.

Martin, Bill, "Resurrecting the U.K. Historic Sector National Accounts", *Review of Income and Wealth,* 2009, vol.55(3), pp.737-751.

Matthews, Robert C.O., Charles Feinstein and John C. Odling-Smee, *British Economic Growth 1856-1973*, Oxford: Clarendon Press, 1982, 712p.

Mayes, David, and Garry Young, "Improving the Estimates of the UK Capital Stock", *National Institute Economic Review,* 1994, vol.147(1) February, pp.84-96.

Mead, Charles Ian, "R&D Depreciation Rates in the 2007 R&D Satellite Accounts," BEA technical paper, 2007, 13p.

Meissner, Christopher M. and Alan M. Taylor, *Losing Our Marbles in the New Century? The Great Rebalancing in Historical Perspective,* National Bureau of Economic Research, working paper 12580, 2006, 57p.

Merkel, Wilma and Stefanie Wahl, *Das geplünderte Deutschland. Die wirtschaftliche Entwicklung im östlichen Teil Deutschlands von 1949 bis 1989*, Schriften des Instituts für Wirtschaft und Gesellschaft, Bonn, 1991, 106p.

Milgram, Grace, "Appendix II: Estimates of the Value of Land in the United States Held by Various Sectors of the Economy, Annually, 1952 to 1968" in Raymond W. Goldsmith (ed.), *Institutional Investors and Corporate Stock – A Background Study,* UMI, 1973, 459p.

Mitchell, Brian R., *Historical Statistics of the United Kingdom,* Cambridge: Cambridge University Press, 1988, 900p.

Mitchell, Brian R., *International Historical Statistics,* Palgrave Macmillan, Fifth edition, 2003, 3 volumes.

Moskowitz, Tobias J. and Annette Vissing-Jorgensen, "The Returns to Entrepreneurial

Investment: A Private Equity Premium Puzzle?," *American Economic Review*, 2002, vol.92(4), pp.745-778.

Mulhall, Michael G., *Industries and Wealth of Nations,* London, New York, and Bombay: Longmans, Green, and co., 1896, 520p.

Mulhall, Michael G., *The Dictionary of Statistics*, fourth edition, London: George Routledge and Sons, 1899, 892p. (first edition: 1884). See in particular pp. 589-595; available online at http://archive.org/stream/cu31924014542637#page/n619/mode/2up.

Nash, R.C., "The Balance of Payments and Foreign Capital FLows in Eighteenth Century England: A Comment", *Economic History Review*, 1997, vol.50(1), pp.110-128.

Nordhaus, William D. and Edward C. Kokkelenberg, eds, *Nature's Numbers: Expanding the U.S. National Economic Accounts to Include the Environment,* Washington, D.C.: National Academy Press, 1999, 250p., available online at http://www.nap.edu/.

O'Donoghue, Jim, Louise Goulding and Grahame Allen "Consumer Price Inflation since 1750," *Economic Trends*, Office for National Statistics, vol. 604, March 2004.

Occhino, Filippo, Kim Oosterlinck and Eugene N. White "How Occupied France Financed Its Own Exploitation in World War II," NBER working paper 12137, March 2006, 55p.

Officer, Lawrence H., "What Was the UK GDP Then? A Data Study," Working Paper, University of Illinois at Chicago, 2011, 98p, and MeasuringWorth, 2013, http://www.measuringworth.com/ukgdp/

Pagliano, Patrizia and Nicola Rossi, "Income and Saving in Italy: a Reconstruction. II: The Italian Saving Rate: 1951 to 1990 Estimates", Termi di discussione del Servizio Studi 169, Banca d'Italia, 1992.

Paish, Frank Walter, "Saving in the United States", *Journal of Political Economy*, 1956, vol.64(4), pp.335-340.

Picart, Claude, "Evaluer la rentabilité des sociétés non financieres," *Economie et Statistique*, 2004, vol.372, pp.89-116.

Piketty, Thomas, "On the Long-Run Evolution of Inheritance: France 1820-2050," Working Paper, Paris School of Economics, 2010, 424p.

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

Piketty, Thomas, Gilles Postel-Vinay and Jean-Laurent Rosenthal, "Inherited vs. Self-Made Wealth: Theory and Evidence from a Rentier Society (Paris 1872-1937)," PSE Working Paper, 2011.

Reinhart, Carmen M. and Kenneth S. Rogoff, "This Time is Different Chartbook: Country Histories on Debt, Default, and Financial Crises," NBER Working Paper, 2010, 128p.

Reinhart, Carmen M. and Kenneth S. Rogoff, "From Financial Crash to Debt Crisis," *American Economic Review,* 2011, vol.101(5), pp.1676-1706.

Reis, Ricardo, "The Mystique Surrounding the Central Bank's Balance Sheet, Applied to the European Crisis," *American Economic Review,* 2013, vol.103(3), pp.135-140.

Revel, Jack, *The Wealth of the Nation - The National Balance Sheet of the United Kingdom, 1957-1961*, Cambridge: Cambridge University Press, 1967, 484p.

Ritschl, Albrecht, "Nazi Economic Imperialism and the Exploitation of the Small: Evidence from Germany's Secret Foreign Exchange Balances, 1938-1940," *Economic History Review,* vol.54(2), 2001, pp. 324-345.

Ritschl, Albrecht, *Deutschlands Krise und Konjunktur. Binnenkonjunktur, Auslandsverschuldung und Reparationsproblem zwischen Dawes-Plan und Transfersperre 1924-1934,* Berlin: Akademie-Verlag, 2002.

Ritschl, Albrecht, "The Pity of Peace: Germany's Economy at War, 1914-1918 and Beyond," mimeo, 2003.

Ritschl, Albrecht, "Modern Germany, 1815-1990," in Mokyr, Joel (ed.), *Oxford Encyclopedia of Economic History,* Oxford: Oxford University Press, 2003b, pp. 409-417.

Ritschl, Albrecht, "The German Transfer Problem, 1920-1933: A Sovereign Debt Perspective," CEP Discussion Paper No. 1155, July 2012.

Ritschl, Albrecht and Mark Spoerer, "Das Bruttosozialprodukt in Deutschland nach den amtlichen Volkseinkommens- und Sozialproduktsstatistiken 1901-1995," *Jahrbuch für Wirtschaftsgeschichte*, 1997, vol.2, pp.27-54.

Ronce, P. "Une Evaluation Allemande de la Richesse Publique de l'Allemagne," *Journal des économistes*, 1917, n.3 (juin), pp.361-370.

Ryan, Luisa, Rebecca Thomson and Adam Sincock, "Accounting for Subsoil Assets in the Australian National Accounts," Australian Bureau of Statistics, 2003.

Sargent, Thomas J. and Françis Velde, "Macroeconomic Features of the French Revolution", *Journal of Political Economy,* 1995, vol.103(3), pp.474-518.

Sbano, Teresa, "New Historical Data for Assets and Liabilities in the UK," *Economic and Labor Market Review*, vol.2(4), April 2008, pp.40-46.

Schuker, Stephen A., *American "Reparations" to Germany, 1919-1933: Implications for the Third-World Debt Crisis*, Princeton: Princeton Studies in International Finance, 1988, 166p.

Schumpeter, Elizabeth B., "English Prices and Public Finance, 1660-1822," *Review of Economics and Statistics*, vol.20(1), February 1938, pp.21-37.

Shiller, Robert J., *Irrational Exuberance*, Princeton: Princeton University Press, 2nd edition, 2005, 344p. See data at http://www.irrationalexuberance.com.

Solomou, Solomos and Martin Weale, "Personal Sector Wealth in the United Kingdom, 1920-1956," *Review of Income and Wealth*, 1997, vol.43(3), pp.297-318.

Solow, Robert M., "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics*, vol.39(3), August 1957, pp.312-320.

Spoerer, Mark, "The Evolution of Public Finances in Nineteenth-Century Germany," in *Paying for the Liberal State: The Rise of Public Finance in Nineteenth-Century Europe*, Jose Luis Cardoso and Pedro Lains (eds.), Cambridge: Cambridge University Press, 2010, 303p. See data at http://www.esfdb.org/Database.aspx.

Stamp, Josiah C., "The Wealth and Income of the Chief Powers," *Journal of the Royal*

Statistical Society, vol.82(4), 1919, pp.441-507.

Stamp, Josiah C., *Wealth and Taxable Capacity*, London: P.S. King and Son, 1922, 195p.

Steinmann Bücher, Arnold, *350 Milliarden deutsches Volksvermögen*, Elsner, 1909.

Stone, Richard, "The accounts of society," Nobel Memorial Lecture, 8 December 1984.

Strutt, H. C., "Notes on the Distribution of Estates in France and the United Kingdom," *Journal of the Royal Statistical Society*, 73(6), 1910, pp.634-644.

Studenski, Paul *The Income of Nations*, New York: New York University Press, 1958, 554p (2nd edition, 1967).

Summers, Robert and Alan Heston, "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988," *Quarterly Journal of Economics* , 1991, vol.106(2), pp.327-368.

Tapies, Fontvieille de., *La France et l'Angleterre – Ou Satistique morale et physique de la France comparee a celle de l'Angleterre*, 1845, Paris: Guillaumin.

Triplett, Jack E., "Price and Technological Change in a Capital Good: A Survey of Research on Computers," in *Technology and Capital Formation*, Dale W. Jorgenson and Ralph Landau (eds), Cambridge: MIT Press, 1989, pp.127-313.

Urquhart, Malcolm C., "New Estimate of Gross National Product, Canada, 1870-1926: Some Implications for Canadian Development," in *Long-Term Factors in American Economic Growth*, Stanley L. Engerman and Robert E. Gallman (eds.), NBER Book Series Studies in Income and Wealth, Chicago: University of Chicago Press, 1986, 898p.

Urquhart, Malcolm C., *Gross National Product of Canada, 1870-1926: The Derivation of the Estimates*, McGill-Queen's University Press, 1993, 736p.

Vanoli, André, *Une histoire de la comptabilité nationale*, Paris: La découverte, 2002, 655p.

Velde, François R. and David R. Weir, "The Financial Market and Government Debt Policy in France, 1746-1793," *Journal of Economic History,* 1992, vol.52(1), pp.1-39.

Villa, Pierre, "Un siècle de données macroéconomiques", *Insee Résultats*, 1994, number 303-304 (série Economie génŕale number 86-87), 266p.

Viner, Jacob, *Canada's Balance of International Indebtedness, 1900-1913*, Harvard economic studies, Cambridge: Harvard University Press, 1924, 318p.

Wagner, Adolph, *Statistik des Volks- oder Nationaleinkommens und -Vermögens, besonders mit Verwertung der Steuerstatistik*, IX. Tagung des Internationalen Statistischen Instituts, Berlin: J. Sittenfeld, 1903.

Wahl, Jenny, "Slavery in the United States," EH.Net Encyclopedia, edited by Robert Whaples, 2008.

Wallis, John Joseph, "American Government Finance in the Long Run: 1790 to 1990," *Journal of Economic Perspectives,* 2000, vol.14(1), pp.61-82.

Webb, Steven B. "The Supply of Money and Reichsbank Financing of Government and Corporate Debt in Germany, 1919-1923," *Journal of Economic History,* 1984, vol.44(2), pp.499-507.

Weir, David R., "Tontines, Public Finances, and Revolution in France and England, 1688-1789," *Journal of Economic History,* 1989, vol.49(1), pp.95-124.

Wengenroth, Ulrich, "The rise and fall of state-owned enterprise in Germany", in P.A. Toninelli (ed.), *The Rise and Fall of State-Owned Enterprise in the Western World,* Cambridge: Cambridge University Press, 2000, pp.103-127.

Wilkins, Mira, *The History of Foreign Investment in the United States to 1914,* Harvard studies in business History, Cambridge: Harvard University Press, 1989, 1055p.

Wilkins, Mira, *The History of Foreign Investment in the United States 1914-1945,* Harvard studies in business History, Cambridge: Harvard University Press, 2004, 1009p.

Wolff, Edward, "Trends in Aggregate Household Wealth in the U.S., 1900-1983," *Review of Income and Wealth,* 1989, vol.35(1), pp. 1-30.

World Bank, *Where is the Wealth of the the Nations? Measuring Capital for the 21st century,* Washington D.C.: World Bank, 2006.

Wright, Stephen, "Measures of Stock Market Value and Returns for the U.S. Nonfinancial Corporate Sector," *Review of Income and Wealth,* 2004, vol.50(4), pp.561-584. An Extended Version is available online.

Young, Alwyn, "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience," *Quarterly Journal of Economics,* 1995, vol.110(3), pp.641-680.

Zamagni, Vera, "The Rich in a Late Industrialiser: the Case of Italy 1800-1945," in *Wealth and the Wealthy in the Modern World,* W.D. Rubinstein (ed.), Croom Helm, 1980.

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