On the Long-Run Evolution of Inheritance: France 1820-2050

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Abstract: This paper attempts to document and account for the long run evolution of inheritance. We find that in a country like France the annual flow of inheritance was about 20%-25% of national income between 1820 and 1910, down to less than 5% in 1950, and back up to about 15% by 2010. A simple theoretical model of wealth accumulation, based upon observed demographic trends, age-wealth profiles, growth rates, savings rates and returns to capital, can fully account for the observed U-shaped pattern and levels. Using this model, we find that under plausible assumptions the annual bequest flow might reach about 20% of national income by 2050. This corresponds to a capitalized bequest share in total wealth accumulation around or above 100%. Our findings illustrate the fact that when the average rate of return to private wealth r is permanently and substantially larger than the growth rate g (say, r=4% vs. g=1%), which was the case in the 19th century and is likely to happen again in the 21st century, then past wealth and inheritance are bound to play a key role for aggregate wealth accumulation and the structure of lifetime inequality. Contrarily to a widely spread view, modern economic growth did not kill inheritance.

* This preliminary draft probably includes a number of typos and omissions. All comments are welcome (piketty@ens.fr). A detailed data appendix is available on-line at www.jourdan.ens.fr/piketty/inheritance/ .

1. Introduction

There are basically two ways to become rich: either through one's own work, or through inheritance. In Ancien Regime societies, as well as during the 19th century and early 20th century, it was obvious to everybody that the inheritance channel was an important one. For instance, 19th century and early 20th century novels are full of stories where ambitious young men have to choose between becoming rich through their own work or by marrying a bride with large inherited wealth – and often opt for the second strategy. However, in the late 20th century and early 21st century, most observers seem to believe that this belongs to the past. That is, most observers – novelists, economists and laymen alike – tend to assume that labor income is now playing a much bigger role than inherited wealth in people's lives, and that human capital and hard work have become the key to personal material well-being. Although this is rarely formulated explicitly, the implicit assumption seems to be that the structure of modern economic growth have led to the rise of human capital, the decline of inheritance, and the triumph of meritocracy.

This paper asks a simple question: is this optimistic view of economic development justified empirically and well-grounded theoretically? Our simple answer is "no". Our empirical and theoretical findings suggest that inherited wealth will most likely play as big a role in 21st century capitalism as it did in 19th century capitalism – at least from an aggregate viewpoint.

This paper makes two contributions. First, by combining various data sources in a systematic manner, we document and establish a simple – but striking – fact: the aggregate inheritance flow has been following a very pronounced U-shaped pattern in France since the 19th century. To our knowledge, this is the first time that such long-run, homogenous inheritance series are constructed for any country.

Insert Figures 1, 2 & 3

More precisely, we define the annual inheritance flow as the total market value of all assets (real estate and financial assets, net of financial liabilities) transmitted at death or through inter-vivos gifts during a given year.[1] We find that the annual inheritance flow was about 20%-25% of national income around 1900-1910. It then gradually fell to less than 10% in the 1920s-1930s, and to less than 5% in the 1950s. It has been rising regularly since then, with an acceleration of the trend during the past 20 years, and according to the latest data point (2008), it is now close to 15% (see Figure 1).

If we take a longer run perspective, then the 20th century U-shaped pattern looks even more spectacular. The inheritance flow was relatively stable around 20%-25% of national income throughout the 1820-1910 period (with a slight upward trend), before being divided by a factor of about 5-6 between 1910 and the 1950s, and then multiplied by a factor of about 3-4 between the 1950s and the 2000s (see Figure 2).

These are truly enormous historical variations – but they appear to be well founded empirically. In particular, we find similar patterns with our two fully independent estimates of the inheritance flow. The gap between our "economic flow" series (computed from national wealth estimates, mortality tables and observed age-wealth profiles) and our "fiscal flow" series (computed from observed bequest and gift tax data) can be interpreted as a measure of tax evasion and other measurement errors. This gap appears to approximately constant over time, and relatively small, so that our two series deliver fairly consistent long run patterns (see Figures 1 & 2).[2]

If we use personal disposable income (i.e. national income minus taxes plus cash transfers) rather than national income as the denominator, then we find that the inheritance flow observed in the early 21st century is back to about 20%, i.e. approximately the same level as that observed during the 19th century and early 20th century (see Figure 3). This simply comes from the fact that disposable income was as high as 90%-95% of national income during the 19th century and early 20th century (when taxes and transfers were almost non existent), while it is now about 70% of national income. Whether one should use national income or disposable income as

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[1] It is critical to include both bequests (wealth transmitted at death) and gifts (wealth transmitted inter vivos) in our definition of inheritance, first because gifts have always represented a large fraction of total wealth transmission, and next because this fraction has changed a lot over time. More on this below. Throughout the paper, the words "inheritance" or "bequest" or "estate" will usually refer to the sum of bequests and gifts, unless otherwise noted.

[2] The data sources and methodologies used to construct these two series are exposed in section 2 below and in the extensive data appendices. In particular, the data appendices include the full annual series from which the decennial averages plotted on figure 1 and subsequent figures were computed.

the right denominator is a matter of perspective. 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 save, accumulate and transmit private wealth, then one should probably use disposable income. However to the extent that government expenditures are mostly useful (e.g. assuming that in the absence of public spending in health and education, then individuals would have to pay at least as much to buy similar services on the market), it seems more justified to use national income. One additional advantage of using national income as the denominator is that it tends to be better measured than disposable income. [3]

The second – and most important – contribution of this paper is to account for the observed historical evolution of inheritance, and to draw lessons for other countries and for the future. We show that a simple theoretical model of wealth accumulation based upon observed demographic trends, age-wealth profiles, growth rates, and savings rates and rates of return to capital, can fully account for the observed U-shaped pattern and levels of the aggregate inheritance flow over the entire 1820-2008 period. The simulated model uses real annual macroeconomic and demographic data and involves many effects, especially during the chaotic 1913-1949 period, with two World Wars and one Great Depression in little more than 30 years. However by performing various sensitivity checks in the simulated model, and by comparing with the steady-state patterns implied by a stylised version of the theoretical model, we are able to pinpoint the key factors which matter the most.

The first key ingredient is of course an appropriate modelling of savings behaviour. In order to reproduce the observed facts, one clearly needs some motive for long run savings. If individuals massively dissave when they are old, and die with zero wealth, as predicted by the most extreme form of the life-cycle theory, then the inheritance flow will be permanently equal to 0% of national income. There are many possible reasons why this does not happen in the real world (dynastic utility, utility-for-bequest, utility-for-wealth, precautionary savings, market imperfections). Presumably the exact combination of these savings motives varies a lot across individuals, just

[3] Disposable income can display large time-series and cross-country variations for purely definitional reasons. E.g. in France, disposable income would jump from 70% to about 80% of national income if one includes in-kind health transfers (such as insurance reimbursements), and to about 90% of national income if one includes all in-kind transfers (education, housing, etc.). See Appendix A.

like other tastes. We have nothing new to say on this issue. We simply take as given the fact that individuals do not dissave when old, and assume flat age-savings rates profiles, which as we show can come from different micro models.

The second key ingredient – and in our view the main lesson of this paper – is the following. When the rate of return to private wealth r is permanently and substantially larger than the growth rate g, and when the growth rate is small in absolute terms (say, r=4%-5% vs. g=1%-2%), which was the case in the 19th century and is likely to happen again in the 21st century, then past wealth and inheritance are bound to play a key role for aggregate wealth accumulation and the structure of lifetime inequality. This follows from the simple arithmetic of growth and wealth accumulation.

With r>g, wealth coming from the past is being capitalized at a faster rate than economic growth. Successors simply need to save a fraction g/r of the return to their inherited wealth in order to ensure that their wealth grows as fast as national income. In other words, r>g implies that there is no need to save out of labor income. On a steady-state growth path with constant wealth-income ratio β=W/Y, r>g is indeed fully equivalent to α>s, i.e. to the fact that the capital share is typically larger than the savings rate, i.e. aggregate consumption is larger than aggregate labor income.[4]

As we shall see, this simple arithmetic applies very well to the 19th century and the early 20th century. According to our computations, the 1820-1913 period looks very much like a quasi-steady-state, with the following parameters: g=1%, β=600%-700%, α=30%-40%, r=β/α=5%-6%, and s=8%-9%.[5] We find that most of the savings came from the return to inherited wealth. Given the low taxes prevailing at that time (after-tax rates of return were almost as high as pre-tax rates of return), this was not too difficult to achieve for wealth holders. It was sufficient to save a fraction s_K=g/r=15%-20% of their return to ensure that their wealth keeps growing as fast as national income. According to our best estimates, they were actually saving a bit more than

[4] To see why r>g and α>s are fully equivalent, multiply both sides of the first inequality by β: one finds the second inequality. In and out of steady-state, α is always equal to rβ (r=β/α is actually the very definition of the average rate of return to wealth). And in steady-state, s must be equal to gβ (this is the standard Harrod-Domar accounting equation, and it necessarily holds in steady-state, whatever the exact savings model might be).

[5] As we shall see, the 19th century was not strictly speaking a steady-state, since the aggregate wealth-income ratio was slightly rising (with a gradual accumulation of foreign assets). But as compared to the 20th century chaotic evolutions, it was very close to a steady-state growth path.

that, so that the aggregate wealth-income ratio and the inheritance-income ratio were slightly rising. Incidentally, we note that this 19th century quasi-steady state growth path corresponds almost exactly to the steady-state savings and wealth accumulation patterns implied by the standard, textbook dynastic model (s_K=g/r and s_L=0).

Now, what happened after 1913? The multiple shocks incurred by capital owners during the 1913-1949 period obviously broke down the previous steady-state, as should be evident from looking at the figures. What is more interesting, however, is that the decline in aggregate wealth-income ratio only explains about half of the decline in the inheritance-income ratio. According to our estimates, the other half of the explanation comes from the fact that the age structure of wealth was substantially altered by the 1913-1949 shocks. While the cross-sectional age-wealth profile had always been steeply rising (including at very high ages) until 1913, the immediate post-war pattern looks markedly different: it is the only time period which looks somewhat like an inverted U-shaped pattern, with individuals in their 50s somewhat richer than individuals in their 60s and older. This can be mechanically accounted for by the fact that even if capital shocks were age-neutral, it was simply too late for the elderly who had suffered major capital losses to accumulate wealth again. This structural sock, together with the exceptionally high growth rates observed during the 1949-1979 period (over 5% per year), and of course the general fact that capital accumulation takes time, explains why it took so long for the age-wealth profile to become upward-sloping again and for the inheritance flow to slowly recover.

Although many things have changed since 1913, we will see that the simple macroeconomic arithmetic described above also applies to a large extent to the late 20th century and to the 21st century. In particular, the r>g logic largely explains why the age-wealth profile gradually became upward sloping again. Theoretical formulas and simulation results will also show that the fact that savings now come as much from labor income than from capital income (probably due to wealth deconcentration, general income growth, and rising age expectancy), and the fact that people now die and inherit much later than before, are in a way less important than the r>g logic. In particular, what matters the most in order to account for the kind of high inheritance steady-state observed in the 19th century is the “r high, g small” combination. As long as r is as high as 5%-6% and g as small as 1%, then the steady-state inheritance flow is bound to be very high (around 20%-25% of national income), irrespective of where the savings come from. Intuitively, an inheritance-income ratio of about 20%-25% is exactly what one should observe in a fully stationary economy with zero growth, zero savings, an aggregate wealth-income ratio of about 600%-700%, and average age difference between decedents and heirs of about 30 years. The point is that this zero growth intuition also applies to a world with low growth and high return.[6]

Does this imply that we will converge back towards the same steady-state inheritance flow as the one prevailing during the 19th century? Not necessarily. According to our baseline scenario, based on current growth rates and rates of returns, the inheritance flow will keep increasing after 2010 but stabilize around 16%-17% of national income around 2050, i.e. at a lower level than the 19th century steady-state, which is due both to higher projected growth rates (1.7% rather than 1.0%) and to lower projected after-tax rates of return (3.0% rather than 5.2%). However in case growth slows down to 1.0% during the post-2010 period, and after-tax rates of return gradually rise to 4.5% (which would roughly correspond to the suppression of all capital taxes, and/or to a combination of capital tax cuts and a rising global capital share), then the model predicts that the inheritance flow will converge towards similar or higher than those observed during the 19th century level (20%-25%). In all plausible scenarios, the inheritance-income ratio in the coming decades will be at least 15%-20%, i.e. closer to the 19th century levels than to the levels prevailing during the 1950s-1970s. A come-back to the postwar levels would require pretty extreme assumptions, such as the combination of high growth rates (above 5%) and a prolonged fall in asset prices.

Now, the fact that aggregate inheritance flows return to 19th century levels obviously does not imply that the concentration of inheritance and wealth will return to 19th century levels. On distributional and normative issues, this macro paper has very little to say. We view the present paper mostly as a positive exercise in aggregate accounting of wealth, income and inheritance, and as a building block for future studies on inequality. In order to illustrate how our aggregate findings can be used for distributional analysis, however, we provide applications of our results to the measurement of the two-dimensional inequality in lifetime resources (labor income vs

[6] The simple formulas presented in section 5 below will make this simple intuition clearer.

inheritance). Although this part of the paper is merely temptative and illustrative, the general conclusion is clear. In the long run, wealth concentration seems to have been reduced by a factor of about 2 (e.g. the top 1% wealth share has declined from over 50% around 1900 to about 25% today, and the top 10% wealth share has declined from over 90% around 1900 to about 50% today), which is of course a very large evolution. However aggregate changes in inheritance-income ratios have been even bigger, as one can see from the figures, and cannot be ignored by distributional analysis. For instance, we find that the inequality in lifetime resources between the top 50% heirs and the bottom 50% workers will most likely be as large for the generations born around 2000 than for the generations born around 1850 – and possibly even larger in after-tax terms, given the currently high tax rates on labor income and relatively low tax rates on inheritance.

Do these findings apply to other countries? We certainly do not pretend that the fairly specific U-shaped pattern of aggregate inheritance flow found for France applies everywhere as a universal law. This U-shaped pattern is the product of a particular 20th century history (military, fiscal, demographic, growth, financial, regulation factors all played a role). It probably also applies to Continental European countries that were hit by similar capital and political shocks. For countries like the US and the UK, the long-run U-shaped pattern of aggregate inheritance flows was probably less pronounced than for France.[7] In fact, we do not really know: we tried to construct similar series for other countries, but unfortunately there does not seem to exist any other large country with estate tax data that is as long run and as comprehensive as the French data. For scholars, the good thing about the French bequest and gift tax is that it has been virtually unchanged since its creation in 1791. In particular, this has always been a relatively universal tax, in the sense that it applies to most types of assets, and most importantly that everybody is required to fill an estate tax return, no matter how small is estate this. In contrast, in most other countries, estate tax data is usually not available on a sufficiently long-run basis, and/or relates to only a small fraction of the population.[8]

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[7] See section 3 below.

[8] For instance, the U.K. did not see a modern estate tax before 1894, and the U.S waited until 1916. Most importantly, estate tax data in these two countries only relates to a few percentages of the total population.

In any case, even though we cannot make detailed cross country comparisons at this stage, we believe that the economic mechanisms revealed by the analysis of the French historical experience certainly apply to other countries as well. In particular, the r>g logic applies everywhere, and has important implications. For instance, it implies that in countries with very large economic and/or demographic growth rates, such as China or India, then the inheritance flow must be a very small fraction of national income.[9] With large growth, the wealth coming from the past (i.e. accumulated by one's parents and grand-parents) does not really matter: all what matters is new savings out of current income. Conversely, in countries with low economic growth and projected negative population growth, such as Spain, Italy or Germany, then inheritance is bound to matter a lot during the the 21st century, and the aggregate inheritance flow will probably reach higher levels than in France. More generally, a major difference between the US and Europe (taken as a whole) from the viewpoint of inheritance is that growth rates (economic and demographic) have been historically larger in the US, thereby making inheritance relatively less important. This has little to do with cultural differences: this is just the mechanical impact of growth rates and of the r>g logic, and this may not last forever. If we take a very long run, global perspective, and make the assumption that economic and demographic growth rates will eventually be relatively small everywhere (say 1%-2% per se), then the conclusion follows mechanically: inheritance will matter a lot pretty much everywhere.

The rest of this paper is organized as follows. In section 2, we describe the relationship between the present paper and the related literature. In section 3, we describe the methodology and data sources used to uncover the basic fact, i.e. the long-run U-shaped pattern of inheritance. In section 4, we present a decomposition of this basic fact into three components: an aggregate wealth-income ratio effect, a mortality rate effect, and a relative wealth effect (between decedents and the living). In section 5, we present theoretical results on steady-state patterns of wealth accumulation, age-wealth profiles, inheritance flows. These steady-state results are based upon a simple, highly stylized model with no demographic or macroeconomic shock. They allow for a better understanding of the main effects at play in the full

[9] Although most of the paper discusses the impact of economic growth rate g, the demographic growth rate n has a similar effect (see Appendix F).

fledged simulated model, which are presented in section 6. In section 7, we present several applications of our aggregate results to distributional analysis, including applications to the structure of lifetime inequality and the share of bequest wealth in total wealth, and we discuss a number of possible extensions. Section 8 offers concluding comments.

2. Related literature

This paper is related to several literatures. First, this work represents in our view the logical continuation of the recent literature on the long run evolution of top income and top wealth shares initiated by Piketty (2001, 2003), Atkinson (2005) and Piketty and Saez (2003). In this collective research project, we constructed homogenous, long run series on the share of top decile and top percentile income groups in national income, using income tax return data. The resulting data base now covers over 20 countries, including most developed economies over most of the 20th century.[10] One the main findings is that the decline in top income shares that occurred in most countries during the first half of the 20th century was largely due to the fall of top capital incomes, which apparently never fully recovered from the 1914-1945 shocks, possibly because of the rise of progressive income and estate taxes (the "fall of rentiers"). Another important finding is that the large rise in top income shares that occurred in the US (and, to a more limited extent, in other anglo-saxon countries) since the 1970s seem to be due to the unprecedented rise of top labor incomes (the "rise of working rich").

One important limitation of this literature, however, is that although we did emphasize the distinction between top labor incomes vs top capital incomes, we did not go all the way towards a decomposition of inequality between a labor income component and an inherited wealth component. Inequality is inherently two-dimensional: generally speaking, there are two ways to become rich, either through one's own work, or through inheritance.[11] There are several reasons why we were not able so far to offer such a clear-cut, two-dimensional decomposition. First, due to various legal exemptions, a growing fraction of capital income has gradually escaped from

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[10] See the two volumes edited by Atkinson and Piketty (2007, 2010) for a complete set of country studies and series. See Atkinson, Piketty and Saez (2009) for a recent survey. To a large extent, this project is a simple extension of Kuznets (1953) pioneering and innovative work. Kuznets was the first researcher to combine income tax return data with national accounts data in order to compute continuous top income shares series, using US data over the 1913-1948 period.

[11] At some level, the distinction between the two dimensions is obviously not as sharp as one might think. Labor income is partially inherited (and this sometime involves human capital investments which are directly financed by parents), and inherited wealth certainly requires human skills (and sometime explicit labor input from the children) in order to deliver a high return. E.g. the distinction between the labor and capital components of self-employment income is often somewhat arbitrary. Nevertheless we feel that this distinction is conceptually useful, both from a normative viewpoint (most people consider that individuals are somewhat more responsible for their labor income than for their inherited wealth) and from a positive viewpoint (the economic mechanisms at stake are fairly different).

the income tax base (which in several countries has almost become a labor income tax), and we did not seriously attempt to impute full economic capital income (as measured by national accounts) back into our income-tax-returns-based series.[12] This might seriously affect some of our conclusions (e.g. about working rich vs rentiers), and is likely to become increasingly problematic in the coming decades, so it is important to develop ways to correct for this. Next, even if we were able to observe (or impute) full economic capital income in income tax returns, this would not tell us anything about the share of capital income coming from one's own savings and the share originating from inherited wealth. In income tax returns, one does not observe where wealth comes from. For a small numbers of countries, long run series on top wealth shares (generally based upon estate tax returns) have also been constructed to complement top income shares series.[13] These series confirmed that there was a large decline in wealth concentration during the 1914-1945 period, apparently with no recovery so far.[14] However these series do not attempt to break down wealth into an inherited component and a life-cycle component: these works use estate tax data to obtain information about the distribution of wealth among the living, but not to study the level of inheritance flows per se.

This paper attempts to bridge this gap, making use of the exceptionally high quality of French estate tax data. We felt it was necessary to start by trying to reach a better understanding of the aggregate evolution of the inheritance-income ratio, which to us was very obscure when we started this research. However the next step is obviously to close this detour via macroeconomics and to integrate wealth and labor income distributions into the general picture.

The present paper is also very much related to the voluminous literature on savings behaviour, life-cycle models and intergenerational transfers. However as far we know

[12] Partial corrections were made for a number of countries, but there was no systematic attempt to develop an imputation method. One should be aware of the fact that for most countries (including France, the UK and the US), the series in our database really measure the share of top reported incomes (rather top economic incomes) in total income, and exclude tax-exempt capital income.
[13] See Kopczuk and Saez (2004) for the US, Piketty, Postel-Vinay and Rosenthal (2006) for France, and Roine and Waldenstrom (2007) for Sweden. These studies follow the pioneering studies by Lampman (1962), who uses US 1922-1956 estate tax tabulations to compute top wealth share series, and by Atkinson and Harrison (1978), who use 1923-1972 UK estate tax tabulations.
[14] Given the relatively low quality of available wealth data for the most recent period, especially regarding top global wealth holders, one should be modest about this conclusion.

our paper is the first attempt to account for the observed long run evolution of inheritance and wealth accumulation, and more generally to take a long run perspective on these issues. For instance, in their famous controversy about the share of inheritance in aggregate US wealth accumulation, Kotlikoff and Summers (1981, 1988), who argued that the inheritance share was as high as 80%, and Modigliani (1988), who argued that the inheritance share was as low as 20%, were both using a single data point for the aggregate inheritance flow.[15] We will return to this controversy when we use our results on aggregate inheritance flows to compute inheritance shares in the total stock of wealth. More generally, although the perception of a long run decline of inheritance relative to labor income seems to be relatively widespread, to our knowledge there are few papers that formulate this perception explicitly.[16]

MANY IMPORTANT REFERENCES MISSING HERE, TO BE COMPLETED

Finally, our paper is related to the late 19th century and early 20th century literature on national wealth estimates. At this time, many economists were computing estimates of national wealth, especially in France and in the UK. We will return to these estimates when we present our national accounts data base. What is interesting to note here is that although they rarely made it fully explicit the economists of the time had a fairly specific wealth accumulation model in mind. Namely, it was obvious to them that wealth accumulation (or at least most of wealth accumulation) came entirely from inheritance. French economists, who thanks to the universal estate tax could observe the aggregate inheritance flow B, were satisfied to find that their national wealth estimates W (obtained from direct wealth census data) were approximately equal to 30-35 times the inheritance flow B. They viewed 30-35 as the average generation length (which we later note H=D-I), and to them this W=(D-I)B was self-evident. In effect, they had a very specific wealth accumulation model in

[15] Namely, for year 1967. Moreover due to the limitations of US estate tax data, they disagreed about this single data point.

[16] E.g. Galor and Moav (2006) take as granted the "demise of capitalist class structure", but are not fully explicit about what they mean by this, and in particular as to whether this is an aggregate or a distributional effect. The very interesting paper by De Long (2003) takes an explicitly long term perspective on bequests and informally discusses the main effects at play. However his intuition according to which the rise of age expectancy per se should lead to a decline in the importance of inheritance relatively to labor income turns out to be wrong, for reasons discussed when we present theoretical results.

mind (all wealth derives from inherited wealth), which happened to be the exact opposite extreme to the life-cycle wealth accumulation model that many economists had in mind during the postwar period. Presumably, economists were in both cases very much influenced by the wealth accumulation patterns prevailing at the time they wrote. The advantage of having more years of data, i.e. of being able to observe the entire time period going from the 19th century to the early 21st century, is that we are able to clarify these issues (or so we hope).[17]

MANY IMPORTANT REFERENCES MISSING HERE, TO BE COMPLETED

[17] For standard references on this so-called "estate multiplier" literature (the W=(D-I)B formula was viewed as the "estate multiplier" formula), see Foville (1893) and Colson (1903). This literature disappeared shorly after World War 1, when economists realized that the formula was not working any more (or more precisely when they realized that it was necessary to increase the multiplier a lot to make it work). Shortly before World War 1, a number of economists also started realizing on purely logical grounds that the formula was not too simplistic, and that the key issue of interest was the age-wealth profile. See Mallet (1908) and Séailles (1910), who developed the so-called "mortality multiplier" literature, whereby wealth-at-death data is being reweighted by the inverse morality rate of the given age group in order to generate estimates for the distribution of wealth among the living (irrespective of whether this wealth comes from inheritance or not). This other way to use estate tax data was later followed by Lampan (1962), Atkinson and Harrison (1978), and more recent authors (see above). In a way, what we are trying to do in this paper is to reconcile these two approaches.

3. Data sources and methodology

The two main data sources used in this paper are national income and wealth accounts on the one hand, and estate tax data on the other hand. Before we present these two data sources in a more detailed way, it is useful to describe the basic accounting equation that we will be using throughout the paper in order to relate national accounts and inheritance flows. In particular, this is the accounting equation that we used to compute our "economic inheritance flow" series.

3.1. Basic accounting equation: B/Y = μ m W/Y

If there was no inter vivos gift, i.e. if all wealth transmission occurred at death, then in principle one would not need in any estate tax data in order to compute the inheritance flow. One would simply need to apply the following equation:

$$B_t/Y_t = \mu_t \; m_t \; W_t/Y_t = \mu_t \; m_t \; \beta_t \qquad (3.1)$$

With:

B_t = annual inheritance flow

Y_t = national income

W_t = aggregate private wealth

m_t = annual mortality rate = (total number of decedents)/(total living population)

μ_t = ratio between average wealth of the deceased and average wealth of the living

$\beta_t = W_t/Y_t$ = aggregate wealth-income ratio

Alternatively, equation (3.1) can be written in per capita terms:

$$b_t/y_t = \mu_t \; w_t/y_t = \mu_t \; \beta_t \qquad (3.2)$$

With:

b_t = average inheritance per decedent

y_t = average national income per living individual

w_t = average private wealth per living individual

Note that equation (3.1) is a pure accounting equation: it does not make any assumption about behaviour or about anything. For instance, if the aggregate wealth-income ratio is equal to 600%, if the annual mortality rate is equal to 2%, and if people who die have the same average wealth as the living (μ_t=100%), then the annual inheritance flow has to be equal to 12% of national income. In case old-age individuals massively dissave in order to finance retirement consumption, or annuitize all their wealth so as to die with zero wealth, as predicted by the pure life-cycle model, then μ_t=0%, and one would observe b_t=0%: there would be no inheritance at all, no matter how large the aggregate wealth-income ratio and the mortality rate might be. Conversely, in case people who die are on average twice as rich as the living (μ_t=200%), then for β_t=600% and m_t=2%, then the annual inheritance flow has to be equal to 24% of national income.

What kind of data do we need in order to compute equation (3.1)? First, we need data on the wealth-income ratio $\beta_t=W_t/Y_t$. To a large extent, this is given by existing national accounts data, as described below. Note that it is conceptually important to use private wealth as the numerator (i.e. the sum of all real estate and financial assets owned by private individuals, minus financial liabilities) rather than national wealth (i.e. the sum of private wealth and government wealth). This is an important conceptual distinction, since only private wealth can be transmitted at death to one's own children and other heirs, while government wealth cannot. Practically, however, this does not make a big difference, since private wealth usually represents over 90% of national wealth (see below). The choice of the denominator is less important, as long as one uses the same denominator on both sides of the equation. For reasons explained in the introduction, we will most of the time use national income (rather for instance than personal disposable income) as the denominator.

Next, we need data on the mortality rate m_t. This is the easiest part: demographic data is plentiful. Note that, in practice, children usually own very little wealth and receive very little income. In order to abstract from the large historical variations in infant mortality, and in order to make the quantitative values of the m_t and μ_t parameters easier to interpret, we define them over the adult population. That is, we define the mortality rate m_t as the adult mortality rate, i.e. the ratio between the number of decedents aged 20-year-old and over and the number of living individuals aged 20-year-old and over.[18] Similarly, we define μ_t as the ratio between the average wealth of decedents aged 20-year-old and over and the average wealth of living individuals aged 20-year-old and over.[19]

Finally, we need data to compute the μ_t ratio. This is the most challenging part, and in a way the most interesting part from an economic viewpoint. In order to compute μ_t we need two different kinds of data. First, we need data on the cross-sectional age-wealth profile. The more steeply rising the age-wealth profile, the higher the μ_t ratio. Conversely, if the age-wealth profile is hump-shaped, with massive dissaving at old age, then μ_t will be smaller. Next, we need data on differential mortality. For a given age-wealth profile, the fact that the poor tend to have higher mortality rates than the rich implies a lower μ_t ratio. In the extreme case where only the poor (say, zero-wealth individuals) die, and the rich never die, then the μ_t ratio will be permanently equal to 0% - even with a steeply rising cross-sectional age-wealth profile. There exists a voluminous research literature on differential mortality, and we simply borrowed the best available estimates from this literature.[20] We checked that these differential mortality factors are consistent with the age-at-death differential between wealthy decedents and poor decedents, as measured by estate tax data and general demographic data; they are consistent.[21]

Regarding the age-wealth profile, one would ideally like to use exhaustive, administrative data on the wealth of the living, such as wealth tax data. However such data generally does not exist for long time periods, and/or only covers relatively small segments of the population.[22] Wealth surveys do cover the entire population,

[18] Throughout the paper, “adult” will mean “20-year-old and over”.
[19] In practice, children wealth is small but positive, because parents sometime die early. In our empirical estimates, we do take into account children wealth, i.e. we add a (small) correcting factor to equation (1) in order to correct for the fact that the share of adult wealth in total wealth (both among the deceased and among the living) is slightly smaller than 100%. See the corresponding corrected equation (1) in Appendix A, section A2.
[20] See Appendix B, section B2. Our computations are based upon the mortality rates differentials broken down by wealth quartiles and age groups estimated by Attanasio and Hoynes (2000).
[21] See Appendix B, section B2. If anything, we probably over-estimate differential mortality a little bit. Consequently, our resulting μ_t series and inheritance series are probably (slightly) undes-estimated.
[22] A wealth tax was created in France in 1981, repelled in 1986, and created again in 1988 (ISF). This wealth tax currently covers only the top 2%-3% of the population. See Appendix B, section B2.

but they are not fully reliable (especially for top wealth holders, which might bias estimated age-wealth profiles), and in any case they are not available for long time periods.[23] The only data source offering long-run, reliable raw data on age-wealth profiles appears to be the estate tax itself.[24] This is wealth-at-death data, so one needs to use the differential mortality factors to convert them back into wealth-of-the-living age-wealth profiles.[25] This data source combines many advantages: it covers the entire population (nearly everybody has to file an estate tax return in France; more on this below), and it is available on a continuous and homogenous basis since the beginning of the 19th century. We checked that the resulting age-wealth profiles are consistent with those obtained with wealth tax data and (corrected) wealth survey data for the recent period (1990s-2000s); they are consistent.[26] This data source is further described below.

We have now described how we proceeded in order to compute our “economic inheritance flow” series using equation (3.1). There is however one important term that needs to be added to the computation in order to obtain meaningful results. In the real world, inter vivos gifts do exist and play an important role in the process of intergenerational wealth transmission and in shaping the age-wealth profile. In France, gifts have always represented a large fraction of total wealth transmission, and moreover this fraction has changed a lot over time. Not taking them into account would bias the results in important ways. The simplest way to take gifts into account is to correct equation (3.1) in the following way:

$$\mathbf{B_t/Y_t = \mu_t^* \, m_t \, W_t/Y_t} \qquad \textbf{(3.1')}$$

With :

$\mu_t^* = (1+v_t)\,\mu_t$ = gift-corrected ratio between decedents wealth and wealth of the living

$v_t = V_t^f/B_t^{f0}$ = observed fiscal gift-bequest ratio

B_t^{f0} = fiscal bequest flow (value of bequests left by decedents during year t)

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[23] In France wealth surveys start… See Appendix B, section B2.

[24] The fact that we use estate tax data to compute our economic inheritance flow series does not affect the independence between the economic and fiscal series, because for the economic flow computation we only use the relative age-wealth profile observed in estate tax returns (not the absolute levels).

[25] Whether one starts from wealth-of-the-living or wealth-at-death raw age-wealth profiles, one needs to use differential mortality factors in one way or another in order to compute the μ_t ratio.

[26] See Appendix B, section B2.

V_t^f = fiscal gift flow (total value of inter vivos gifts made during year t)

That is, equation (3.1') simply uses the observed, fiscal gift-bequest ratio during year t and upgrades the economic inheritance flow accordingly. Intuitively, the gift-corrected ratio $\mu_t^* = (1+v_t)\ \mu_t$ attempts to correct for the fact that the raw μ_t under-estimates the true importance of intergenerational wealth transmission (since decedents have already given away part of their wealth before they die, so that their wealth-at-death looks artificially low), and attempts to compute what the μ_t ratio would have been in the absence of inter-vivos gifts.[27]

Before we present and analyse the results of these computations, we give more details about our two main data sources: national accounts data and estate tax data. Readers who feel uninterested by these details might want to go directly to section 4.

3.2. National income and wealth accounts

National income and wealth accounts have a long tradition in France, and available historical series are of reasonably high quality.[28] In particular, the national statistical institute (Insee) has been compiling official national accounts series since 1949. Homogenous, updated national income accounts series covering the entire 1949-2008 period and following the latest international guidelines were recently released by Insee. These are the series we use in this paper for the post-1949 period, with no adjustment whatsoever. National income Y_t and its components are defined according to the standard international definitions: national income equals gross domestic product minus capital depreciation plus net foreign factor income, etc.

Prior to 1949, there exists no official national accounts series in France. However a very complete set of retrospective, annual income accounts series covering the entire 1896-1949 period was compiled and published by Villa (1994). These series use the

[27] Of course, this simple way to proceed is not fully satisfactory, since the individuals who made gifts during year t are by definition not the same as the individuals who die during year t (we will see below that on average gifts are made about 10 years before the time of death). In the simulated model, we re-attribute gifts to the proper generation of decedents; we will see that this creates time lags in the time profile of the inheritance-income ratio, but does not affect long-run levels in a significant away.

[28] All detailed national accounts series and references are given in Appendix A. Here we simply describe the main data sources and conceptual issues.

concepts of modern national accounts and are based upon a systematic comparison of previous series published by many authors. Villa also made new computations based upon raw statistical material. Although some of year-to-year variations in this data base are probably fragile, there are good reasons to view these annual series as globally reliable.[29] These are the series we used for the 1896-1949 period, with minor adjustments, so as to ensure full continuity in 1949. Regarding the 1820-1900 period, although a number of authors have produced annual national income series, we are not sure that the limited raw statistical material available for the 19th century makes such an exercise entirely meaningful. Moreover we do not really need annual series for our purposes. Therefore for the 19th century, we used decennial-averages estimates of national income (these decennial averages happen to be almost identical across the different authors and data sources), and we assumed fixed growth rates, savings rates and factor shares within each decade.[30]

The national wealth part of our macro data base requires more care than the national income part. It is only in 1970 that Insee started producing official, annual national wealth estimates in addition to the standard national income estimates. For the post-1970 period, the wealth and income sides of French national accounts are fully integrated and consistent. That is, the balance sheets of the personal sector, the government sector, the corporate sector, and the rest of the world, estimated at asset market prices on January 1st of each year, are fully consistent with the corresponding balance sheets of the previous January 1st and the income and savings accounts of each sector during the previous year, and the recorded changes in asset prices.[31] We used these official Insee series for the 1970-2009 period, with no adjustment whatsoever. We define private wealth W_t as the net wealth (tangible assets, in particular real estate, plus financial assets, minus financial liabilities) of the personal sector. Note that W_t is estimated at current asset market prices (real estate assets are estimated at current real estate prices, equity assets are estimated at current stock market prices, etc.). This is exactly what we want, since our objective is to

[29] In particular, the factor income decompositions (wages, profits, rents, business income etc.) series released by Villa (1994) rely primarily on the original series constructed by Dugé de Bernonville (1933-1939), who described very precisely all his raw data sources and computations. For more detailed technical descriptions of the Dugé and Villa series, see Piketty (2001, pp.693-720).

[30] We used the 19th century series due to Bourguignon and Lévy-Leboyer (1985) and Toutain (1987).

[31] The concepts and methods used in these Insee-Banque de France balance sheets series are broadly similar to the Flows-of-Funds and Tangible-Assets series released by the Federal Reserve and the Bureau of Commerce in the US.

relate aggregate private wealth to the inheritance flow, and since – according to estate tax law – the value of bequests is always estimated at the market prices of the day of death (or on the day the gift is made). Although this is of no use for our purposes, one can also define government wealth W_{gt} as the net wealth of the government sector, and national wealth $W_{nt} = W_t+W_{gt}$. According to the Insee estimates, private wealth during the 1990s-2000s has always represented around 90%-95% of national wealth. I.e. government wealth is positive but small: government tangible and financial assets only slightly exceed the value of government debt. During the 1970s-1980s, private wealth was equal to about 85%-90% of national wealth: government net wealth was somewhat bigger than it is today, both because public debt was smaller and because the government owned more tangible and financial assets (the public sector was bigger at that time, and the major privatization wave occurred in the late 1980s and early 1990s in France).[32]

Prior to 1970, we had to use various non-official, national wealth estimates. For the 1820-1913 period, national wealth estimates are plentiful and relatively reliable. This was a time of almost zero inflation (0.5% per year on average during the 1820-1913 period), so there was no big problem with asset prices. Most importantly, the economists of the time were literally obsessed with national wealth (which they found much more interesting than national income), and many of them were producing pretty sophisticated national wealth estimates. They used the decennial censuses of tangible assets organized by the tax administration (the tax system of the time relied extensively on the property values of real estate, land and unincorporated business assets, so such censuses were essential). They took into account the growing stock

[32] Here we assume implicitly that the corporate sector balance sheet can be neglected when looking at the structure of national wealth, i.e. we assume implicitly that Tobin's Q ratio (the ratio between the equity value of the corporate sector and its book value) is permanently equal to 100%. In practice, French national wealth accounts suffer from the usual valuation problem for corporate tangible assets (for which readily available market prices are often missing, so that national accounts statisticians generally use a mixture of perpetual inventory methods and market valuation methods), and the implicit Tobin's Q appears to be below 100%, typically around 70%-80% (see Appendix A, Table Ax). We have nothing new to say on this issue, and we feel we do not need to take stance. In particular, whether this is due to a general over-valuation of corporate tangible assets (e.g. because rates of capital depreciation are under-estimated, as suggested by Wright (2004), who also finds implicit Tobin's Q ratios around 70%-80% for the US corporate sector), or whether this involves issues of residual control rights valuation (e.g. stock market prices reflect prices for small marginal transactions, and one typically needs to pay a premium in order to purchase sufficient stock to take control of a corporation), we feel that our market value based definition of private wealth W_t is the correct wealth concept to be used for comparison with the inheritance flow. For other purposes, one might prefer to re-attribute the corporate value that is not included in marginal stock market valuation to the ultimate owners of corporations, and raise personal wealth accordingly (see e.g. Atkinson (1972, pp.6-7)).

and bond market capitalisation and the booming foreign assets, and they explained in a very precise and careful way how they made all the necessary corrections in order to avoid all forms double counting. We certainly do not pretend that these national wealth estimates are perfectly comparable to the modern, Insee estimates. In particular, these estimates are never available on an annual basis, and they certainly cannot be used to study short run business cycle issues. But as far as decennial averages are concerned, we consider that the margin of error on these estimates does not exceed 5%-10%. As compared to the enormous historical variations in aggregate wealth-income ratios and in the inheritance-income ratio, in which we are primarily interested in, such margins of errors are negligible. Note that according to these national wealth estimates, private wealth at that time accounted for around 97%-98% of national wealth, i.e. net government wealth was slightly positive but negligible.

The period 1914-1969 is the time period for which French national wealth estimates are the most problematic. This was a pretty chaotic time for wealth, both because of war destructions and because of large inflation and wide variations in the relative price of assets. Very few economists compiled detailed, reliable national balance sheets for this time period. We proceeded as follows. We used only two data points, namely the national wealth estimate for year 1925 due to Colson (1927), and the national wealth estimate for year 1954 due to Divisia, Dupin and Roy (1956). These are the two most sophisticated estimates available for this time period. They both rely on a direct wealth census method, and they both attempt to estimate assets and liabilities at asset market prices prevailing in 1925 and 1954, which is what we want. Moreover, Colson is the author of some of the most sophisticated pre-World War 1 national wealth estimates (we used his estimates for 1900 and 1913), and his 1925 computations are based on the same general method and sources as those used for 1900 and 1913. Divisia et al view the Colson 1900-1913-1925 estimates as their model, and they also attempt to follow the same methodology. To the extent that national wealth can be estimated during such a chaotic time period, this is probably the best one can find.

For the missing years, we estimated private wealth W_t by using a simple wealth accumulation equation and the private savings flow S_t coming by national income accounts. Of course, year-to-year variations in private wealth W_t can be due both to volume effects (savings) and to price effects (asset prices might rise or fall relatively to consumer prices). So the accumulation equation for private wealth takes the following form:

$$\mathbf{W_{t+1} = (1+q_{t+1})\,(1+p_{t+1})\,(W_t + S_t)} \quad \mathbf{(3.3)}$$

In equation (3.3), p_{t+1} is consumer price inflation between year t and year t+1, and q_{t+1} is what we call the rate of capital gain (or capital loss) between year t and year t+1, i.e. the excess of implicit asset price inflation over consumer price inflation. For the 1970-2009 period, since national income and wealth accounts period are fully integrated, q_t can indeed be interpreted as asset price inflation (relatively to consumer price inflation). For the pre-1970 period, q_t is better interpreted as a residual error term: it includes asset price inflation, but it also includes all the variations in private wealth that cannot be accounted for by savings flows. For simplicity, we assumed a fixed q_t factor during the 1954-1970 period (i.e. we computed the implicit average q_t factor needed to account for 1970 private wealth, given 1954 private wealth and 1954-1969 private savings flows), and we did the same for the 1925-1954 period, the 1913-1925 period, and for each decade of the 1820-1913 period. The resulting decennial averages for the private wealth-national income ratio $\beta_t = W_t/Y_t$ are plotted on Figure 4. Summary statistics on the accumulation of private wealth in France over the entire 1820-2009 period are given on Table 1.

Insert Figure 4: Private wealth as a fraction of national income in France, 1820-2008
Insert Table 1: Decomposition of private wealth accumulation in France, 1820-2009

Again, we do not pretend that the resulting annual series are fully satisfactory, and we certainly do not recommend that one uses them for short run business cycle analysis, especially for the 1913-1925 and 1925-1954 sub-periods, for which the simplifying assumption of a fixed capital gain effect makes little sense. However we believe that the resulting decennial averages are relatively precise. In particular, it is re-insuring to see that most of wealth accumulation in the medium and long run seems to be well accounted for by savings. This suggests that savings rates are reasonably well measured by our national accounts series, and that in the long run there exists no major divergence between asset prices and consumer prices. The fact that our private wealth series delivers economic inheritance flow estimates that are reasonably well in line with the observed fiscal flow also gives us confidence about our wealth estimates.

A few additional points about the long-run evolution of the wealth-income ratio might be worth noting. During the 1820-1913 period, the real growth rate g of national income was 1.0%.[33] The savings rate s was about 8%-9%, which implies that the savings-induced wealth growth rate $g_{ws}=s/\beta$ was generally larger than g. This explains why the wealth-income ratio was rising during the 19th century: savings were slightly higher than the level required for a steady-state growth path (i.e. the savings rate was slightly higher than $s^*=\beta g$=6%-7%). According to the 19th century national wealth estimates, the wealth-income ratio rose from about 550%-600% around 1820 to about 650%-700% of national income around 1900. Although the data is imperfect, it is well established that a very substantial fraction of this rise in the wealth-income ratio (and possibly all of it) went though the accumulation of large foreign assets.[34] Overall, the real growth rate of private wealth g_w during the 1820-1913 was 1.3% per year (vs g=1.0% for national income). According to our computations, on the basis of observed savings rate it should have been a bit higher, namely 1.4% for year. We attribute the differential between the observed wealth growth rate g_w and the theoretical, savings-induced wealth growth rate g_{ws} to changes in the relative price of assets, and we find a modest negative q effect (-0.2% per year).[35]

[33] All "real" growth rates (either for national income or for private wealth) referred to in this paper are defined relatively to consumer price inflation. Any CPI mismeasurement would translate into similar changes for the various growth rates without affecting the differentials and the ratios.

[34] According to available estimates, net foreign assets gradually increased from about 2% of private wealth in 1820 to about 15% around 1900, i.e. from about 10% of national income to about 100% of national income. See Appendix A, Table Ax.

[35] Taken literally, this would mean that while consumer prices have increased at 0.5% per year during the 1820-1913, asset prices have increased at 0.5%-0.2%=0.3% per year. Looking at the detailed decennial data (see Appendix A, Table Ax), one finds that the negative q effect comes mostly from the 1870s, and probably effects the capital losses following the 1870-1 war with Germany (France lost about 5% of its territory). Given the data imperfections however, there is no way one can be certain about a -0.2% relative price effect over a century: it could be that our 19th century savings rates are slightly over-estimated, or that the rise in the wealth-income ratio was slightly under-estimated. In any case, the important point is that volume effects appear to largely dominate relative price effects, i.e. our wealth data appears to be consistent with our income and savings data.

Regarding the 1913-1949 period, the important point to remember is that the fall in the aggregate wealth-income ratio that occurred in France at that time was not due – for the most part – to the physical destructions of the capital stock that took place during the wars. According to the best available estimates, the aggregate wealth-income W/Y ratio dropped from about 600%-650% in 1913 to about 200%-250% in 1949. I.e. it was cut by a factor of about 2.5-3. Physical capital destructions per se seem to account for at most one third of this total fall. The other two thirds are due to a large variety of factors, including relatively low savings rates during the chaotic 1913-1949 period (while national income kept growing), loss of foreign assets, post-war nationalization policies, and more generally capital losses, i.e. fall of the price of assets relatively to consumer prices.[36]

This is an important point to have in mind, since it suggests that the 1913-1949 fall in the aggregate wealth-income ratio is a phenomenon that might have occurred in many countries, including in countries whose territories were not directly hit by the wars (such as the UK and the US), although certainly in a less pronounced way than in France. We are not aware of complete series offering a similar decomposition of long run wealth accumulation for countries other than France, so we cannot really go much further in this direction. We simply note that according to available estimates, the wealth-income ratio in the US seems to have declined from about 650%-750% in the interwar period to about 450%-550% in the post period.[37] This would suggest that the fall has been about twice as small as in France (but still very substantial), and would be consistent with the above observations. QUOTE ATKINSON-HARRISON

Regarding the post-war period, the important point to be noted is that while capital gains have played an important role, the bulk of private wealth accumulation and private wealth recovery came from savings (see Table 1). Between 1949 and 1979, national income grew at 5.2% per year, while private wealth grew at 6.2% per year.

[36] This latter effect reflects the inflation shock incurred by the (limited) fraction of private wealth held in nominal assets (typically public debt), but also a general fall in asset prices between 1913 and 1949, including real estate and stock market prices. This itself was due to a variety of factors, including rent control, changing tax policy, etc. For detailed series, see Appendix A.

[37] Here we simply divide the 1916-2000 personal wealth series computed by Kopczuk and Saez (2004, Table A) by the 1913-1998 personal income series computed by Piketty and Saez (2003, Table A0). Note that these two series were not estimated in order to compute such a ratio, and that the resulting ratio is highly volatile. Also it is closer to a wealth-disposable income ratio than to a wealth-national income ratio, so the levels should generally be higher than for France.

Out of these 6.2% per year, 5.4% can be accounted for by savings, and 0.8% are left for capital gains. Between 1979 and 2009, national income grew at 1.7% per year, while private wealth grew at 3.8% per year. Out of these 3.8% per year, 2.8% can be accounted for by savings, and 1.0% are left for capital gains.

Of course, if one looks at the detailed decennial and annual data, one can see much bigger contributions of capital gains (or capital losses). E.g. between 1999 and 2009, national income grew at 1.4% per year, while private wealth grew at 6.7% per year, out of which 2.3% can be accounted for by savings and 4.3% by capital gains. The large rise of asset prices during the 2000s is largely responsible for the booming wealth-income ratio, which was gradually rising from about 200% in the 1950s to about 350% in the 1990s, before suddenly reaching 500%-550% in the 2000s (see Figure 4). According to the latest data (January 1st 2009), the wealth-income ratio declined from 563% in 2008 to 552% in 2009. How far this is going to continue and whether asset prices are going to keep falling is an issue on which we prefer to avoid taking a stance for the time being. We will consider various post-financial crisis scenarios when we come to simulations.[38]

The important point that we would like to stress, however, is that when we take a longer run perspective, then savings appear to be the main engine behind postwar wealth accumulation. During each single decade of the 1949-2009 period (including the 2000s), the growth rate of national income was substantially below the savings-induced growth rate of private wealth. The only exception was the 1960s: the savings rate was high (13.8%), but the growth rate of national income was so high (6.2%) that this was not sufficient to make private wealth grow faster. More generally, the savings rate was somewhat bigger during the 1949-1979 period (13.4%) than during the 1979-2009 (9.5%), but growth was so much smaller during the second period that the gap between income growth and savings-induced wealth growth was substantially bigger in the 1979-2009 period than in the 1949-1979 period. This is what explains – in an accounting sense – why the wealth-income ratio grew faster during the 1979-2009 period than during the 1949-1979 period. The capital gains effect appears to have been similar during the two subperiods (1.0% vs 0.8%). If we take the 1949-

[38] See section 4.4 below.

2009 period as a whole, the recovery of asset prices relatively to consumer prices appears to have been relatively steady – or at least less chaotic than one might think at first stance. According to our estimates, the 1949-2009 increase in asset prices (at 0.8%-1% per year) seems to have almost fully compensated the 1913-1949 fall in asset prices (at -2.4% per year), so that the overall capital gain effect between 1913 and 2009 appears to be fairly modest (-0.3%) (see Table 1).

Finally, note that if we were using disposable income rather than national income as the denominator, then the levels of wealth-income ratio reached in the 2000s would appear slightly higher than the levels observed in the 19th century, rather than slightly smaller (see Figure 5). For reasons explained in the introduction, we feel that it is somewhat more justified to look at the wealth-national income ratios, but this is a matter of perspective.

Insert Figure 5: Private wealth as a fraction of national income in France, 1820-2008

3.3. Estate tax data

Estate tax data is the key data source used in this paper. It plays an essential role for several reasons. First, because of various data imperfections (e.g. regarding national wealth estimates), we thought it was important to offer two independent measures of the long run evolution of the inheritance flow: one "economic flow" measure (based upon national wealth estimates and mortality tables, as described above) and one "fiscal flow" measure. This fiscal flow was obtained simply by dividing the observed aggregate bequest and gift flow reported to the estate tax (with a few corrections, see below) by national income, and therefore makes no use of national wealth estimates. Next, as was noted above, we need estate tax data in order to compute the gift-bequest ratio $v_t = V_t^f/B_t^{f0}$ (where B_t^{f0} is the value of bequests left by decedents during year t, and V_t^f is the value of inter vivos gifts made during year t), and in order to obtain reliable, long-run data on the age-wealth profile.[39] Finally, we used estate tax data in order to obtain information on the age structure of decedents, heirs, donors and donees, which we need for our simulations.

[39] In principle, this could be obtained from other sources, but estate tax data happens to be the only reliable, long-run sources on these two parameters.

French estate tax data is exceptionally good, for one simple reason. As early as 1791, shortly after the abolition of the tax privileges of the aristocracy, the French National Assembly introduced a universal estate tax, which has remained in force since then. This estate tax was universal because it applied both at bequests and inter-vivos gifts, at any level of wealth, and for nearly all types of property (both real estate and financial assets). The key characteristic of the tax is that the successors of all decedents with positive wealth, as well as all donees receiving a positive gift, have always been required to file a return, no matter how small the estate was, and no matter whether the heirs and donees actually ended up paying a tax or not. This followed from the fact that the tax was thought more as a registration duty than as a tax: filling a return has always been the way to register the fact that a given property has changed hands.[40]

Between 1791 and 1902, the estate tax was strictly proportional. The tax rate did vary with the identity of the heir or donee (children heirs and donees have always faced lower rates than other successors in the French system), but not with the wealth level. In practice the proportional tax rate was fairly small (1% for children heirs and donees), so there was really very little incentives to cheat. The estate tax was made progressive in 1902, and the tax rates were gradually increased for large estates. In 1902, the top marginal rate applying to children heirs was set to 5%; by the mid 1930s it was 35%; it remains today at 40%.[41] The fact that the tax became progressive did not affect the universal legal requirement to fill a return, no matters how small the bequest and gift was.

There is ample evidence that this legal requirement has been applied relatively strictly, both before and after the 1902 reform. In particular, the number of estate tax returns filled each year has generally been around 65% of the total number of adult decedents (about 350,000 yearly returns for 500,000 adult decedents, both in the 1900s and in the 2000s). This is a very large number, given that the bottom 50% of the population hardly owns any wealth at all: in every country and time period for

[40] This is reflected in the official name of the tax, which since 1791 has always been “droits de mutation à titre gratuit” (DMTG), rather “impôt sur les successions et les donations”.
[41] For a brief history of estate tax schedules in France, see Piketty (2001, pp.).

which we have data, the share of the bottom 50% in aggregate wealth never exceeds 10%, and is usually closer to 5%, or below. We do upgrade the raw fiscal flow reported in tax returns in order to take non-filers into account, but the point is that the corresponding correction is extremely small (generally around or less than 5%).[42]

The other good news for scholars is that the raw tax material has been well archived. Since the beginning of the 19th century, the tax authorities transcribed individual returns in registers that have been preserved (in paper format). In a previous paper we used these registers to collect large micro samples of Paris decedents every five year between 1807 and 1902, which allowed us to study the changing concentration of wealth and age-wealth profiles, among other things.[43] Ideally one would like to collect micro samples for the whole of France over the two-century period, but this has proved to be too costly so far.[44]

Therefore in this paper we rely mostly on aggregate estate tax data collected by the tax administration.[45] For the 1826-1964 period, we use the estate tax tabulations published on a quasi-annual basis by the French Ministry of Finance. For the whole period, these tables report separately the aggregate value of bequests and gifts reported in estate tax returns during the given year, which is the basic information that we need. Starting in 1902, these annual publications also include detailed tabulations providing information on the number and value of bequests and gifts broken down by size of estate and age of decedent or donor. These paper publications were abandoned in the 1960s-1970s, when the tax administration started compiling electronic files with nationally representative samples of bequest and gift tax returns. We used these so-called "DMTG" micro files for years 1977, 1984, 1987, 1994, 2000 and 2006. Although the data is not annual, it is extremely detailed. The DMTG micro-files include all variables reported in tax returns, including details on the value of estates, the various types of property, and the demographic characteristics of decedents, heirs, donors and donees.

[42] See Appendix B, Table B1. The non-filers correction is somewhat larger for the late 1950s and the 1960s (15%-20%), following the introduction of an exemption for low estates in 1956; this exemption was frozen in nominal terms, so its impact was short-lived.
[43] See Piketty, Postel-Vinay and Rosenthal (2006).
[44] We are currently collecting new Paris samples with information on the estates received by decedents during their lifetime, which allows us to develop direct, individual-level estimates of the inheritance share in total wealth accumulation (see Piketty, Postel-Vinay and Rosenthal (2009)).
[45] For more details, see Appendix B.

Although the French estate tax has generally applied to nearly all types of property and assets, there has always been a number of exceptions, and it is important to correct for these. So we proceeded as follows. Starting from the raw fiscal bequest flow B_t^{f0}, we first made an upward correction for non filers (see above), and we then made another upward correction for tax exempt assets. When the estate tax was first created, the major exception to the universal tax base was government bonds, which benefited from a general estate tax emption until 1850. Between 1850 and World War 1, very few assets were exempted (except very specific assets like forests). Shortly after World War 1, and again after World War 2, temporary exemptions were introduced for particular types of government bonds. In order to foster reconstruction, new real estate property built between 1947 and 1973 also benefited from a temporary exemption at the first time of transmission. Most importantly, a general exemption for life insurance assets was introduced in 1930. This exemption has become very popular in recent decades: life insurances assets were about 2% of aggregate net wealth in the 1970s and grew to about 15% of aggregate net wealth in the 2000s (and over 30% of financial assets). Using various sources, we estimate that the total fraction of tax exempt assets in aggregate private wealth gradually rose from less than 10% in 1900 to about 15% in the interwar period, 20% in the 1950s, 25% in the 1970s-1980s, and 30%-35% in the 1990s-2000s. The raw fiscal bequest flow was upgraded accordingly. We applied the same upward corrections to inter vivos gifts, leaving the gift-bequest ratio v_t unaffected. To the extent that gifts are less well reported to tax authorities than bequests, we probably under-estimate the true importance of gifts.

3.4. Other data sources: income and wealth surveys

In addition to national accounts and estate tax data, we also used other data sources at various points at the paper. For instance, we used income tax return files to compute the age-profile of labor income, which we need in our simulations.[46] We also used wealth surveys at various points, e.g. in order to compare the bottom wealth share measured with surveys and with estate tax data (which does not cover

[46] See Appendix D.

adequately the very bottom), or to compare the age-wealth profiles measured in surveys and estate tax and wealth tax data.[47] However wealth surveys raise serious problems, which explains why we did not use them more intensively.

First, as is well known, wealth tends to be under-reported in surveys, and there are reasons to believe that the bias might be particularly strong for top wealth groups. This is also true in income surveys, and this was certainly one of the main motivation for the recent research on top incomes using income tax returns. But because wealth is even more concentrated than income (currently, in developed countries for which we have data, top percentile wealth shares seem to be at least 20%-25%, and top decile wealth shares seem to be higher than 50%), under-reporting from top wealth holders is even more problematic than for income. This needs to be addressed very carefully before using such data.

Next, we want to stress that, in addition to this well-known limitation, one should also be extremely careful when using the information on bequests and gifts that is often available in wealth surveys. Most surveys include retrospective questionnaires where surveyed individuals are asked questions about their wealth trajectory, and in particular whether they received bequests or gifts in the past, when, how much, etc. We used the retrospective questionnaire of the French wealth surveys conducted in 1992, 1998 and 2004, and we found that the self-reported value of bequests and gifts reported in these questionnaires was less than 50% of the fiscal value actually reported in bequest and gift tax returns for the corresponding years (which itself is a lower bound of the true economic value). This does not reflect imperfect recall over long time periods: we found this low ratio by comparing self-reported and fiscal flows for the past four years before each survey (e.g. 2000-2003 for the 2004 survey, etc.). We see no obvious reason why one should expect the reporting rate to be higher in similar wealth surveys in other countries, such as the SCF in the US.

[47] Wealth surveys based upon samples of approximately 10,000 households were collected by INSEE in 1986, 1992, 1998 and 2004. See Appendix B.

4. The U-shaped pattern of inheritance: a simple decomposition

The accounting equation $B_t/Y_t = \mu_t^* \ m_t \ W_t/Y_t$ allows for a simple and transparent decomposition of changes in the inheritance flow. Here the important finding is that the long-run U-shaped pattern of the inheritance flow B_t/Y_t (see Figure 2 above) is the product of three long U-shaped curves. It is the combination of these three U-shaped effects that make the U-shaped pattern of inheritance particularly pronounced. We take these three terms in reverse order: the aggregate wealth-income effect W_t/Y_t, the mortality rate effect m_t, and the μ_t^* ratio effect.

4.1. The aggregate wealth-income ratio effect W_t/Y_t

We already described the U-shaped pattern the aggregate wealth-income ratio W_t/Y_t (see Figure 4 above). By comparing this pattern with the inheritance flow pattern (see Figure 2 above), one can see that the 1913-1949 decline in the aggregate wealth-income ratio explains about half of the decline in the inheritance-income ratio. Between 1913 and 1949, the aggregate wealth-income ratio dropped from about 650%-700% to about 200%-250%, i.e. was divided by a factor of about 3 (see Figure 4). In the same time, the inheritance-income ratio dropped from about 24% to about 4%, i.e. was divided by a factor of about 6 (see Figure 2).

4.2. The mortality rate effect m_t

Where does the other half of the decline in the inheritance-income ratio come from? By construction, it comes from a combination of μ_t^* and m_t effects. The simplest term to analyze is the mortality rate m_t. The demographic history of France since 1820 has been relatively simple. Population was growing at a small rate during the 19th century (less than 0.5% per year), and was quasi-stationary around 1900 (0.1%). The only time of sustained population growth during the past two centuries coincided with the well-known postwar baby-boom, with population growth rates around 1% per year in the 1950s-1960s. Population growth has been declining since then, and in the 1990s-2000s it was approximately 0.5% per year. According to official projections, population growth should be less than 0.1% by 2040-2050, with a quasi-stationary population after 2050, and a very small growth relying solely on migration flows.[48]

The evolution of mortality rates is easily explained by this evolution and by the evolution of age expectancy. Between 1820 and 1910, the (adult) mortality rate was relatively stable around 2.2%-2.3% per year (see Figure 6). This corresponds to the fact that French population was growing at a very small rate, and that adult age expectancy was relatively stable around 60, with a slight upward trend (see Figure 7).[49] In a world with a fully stationary population and a fixed adult age expectancy of 60, then the adult mortality rate (i.e. the mortality rate for individuals aged 20-year-old and above) should indeed be exactly equal 1/40 = 2.5%. Because the population was rising a little bit, the mortality rate was a bit below that.

Insert Figure 6: Mortality rate in France, 1820-2100

Insert Figure 7: Average age of decedents and heirs in France, 1820-2100

There was a purely temporary rise in mortality rates in the 1910s and 1940s due to the wars. Ignoring this, one can observe on Figure 6 a regular downward trend in the mortality rate during the 20th century, with a decline from about 2.2%-2.3% in 1910 to about 1.6% in the 1950s-1960s and 1.1%-1.2% in the 2000s. According to the latest official population projections, this downward trend is now over, and the mortality rate is bound to rise in the coming decades and stabilize around 1.4%-1.5% after 2050 (see Figure 6). This corresponds to the fact that the French population is expected to stabilize by 2050, with an age expectancy of about 85, which mechanically leads to a stationary mortality rate equals to 1/65 = 1.5%. The reason why the mortality rate is currently substantially below this steady-state level (according to official projections, the lowest historical values of the mortality rate correspond to the 2000-2010 period, with mortality rates as low as 1.1%-1.2%) is simply because the large baby-boom cohorts are not dead yet. When they die, i.e. around 2020-2030, then the mortality rate will mechanically increase, and so will the inheritance flow.

[48] See Appendix A, Tables A0 and A1.
[49] There was little increase in adult age expectancy during the 19th century, but there was a substantial decline in children mortality. See Appendix B, Table B1.

This simple demographic arithmetic is simple but powerful. In particular, in the coming decades this is likely to be a very big effect in European countries (Spain, Italy, Germany) where population growth is scheduled to be negative. When the aging cohorts die the mortality rate will increase substantially (and so will the inheritance flow) – even more than in France, where scheduled population growth is small but non-negative.

Coming back to the French evolution and to the 2000s, the interesting finding here is that the high levels of inheritance flow observed during the 2000s (around 15% of national income) can certainly not be due to a mortally rate effect: mortality has been at is lowest historical level during the 2000s (1.1%-1.2% per year, as opposed to 2.2%-2.3% per year in the 19th century and early 20th century). On the basis of morality rates, the inheritance flow in the 2000s should have been roughly twice as small as in 1900-1910, i.e. about 10% of national income rather than 15%.

4.3. The μ_t* ratio effect

So why has there been such a strong recovery in the inheritance flow since the 1950s-1960s? This is because of the μ_t* ratio effect. Here it is important to distinguish between the raw ratio μ_t and the gift-corrected ratio $\mu_t^* = (1+v_t)\,\mu_t$. We plot on Figure 8 the historical evolution of the μ_t and μ_t* ratios, as estimated using observed age-wealth-at-death profiles and differential mortality parameters (see section 3.1 above). We also show on Table 2 some of the raw profiles that we used for these computations.[50]

Insert Figure 8: The ratio between average wealth of decedents and average wealth of the living in France 1820-2008
Insert Table 2: Raw age-wealth-at-death profiles in France, 1820-2008

Between 1820 and 1910, the μ_t ratio was around 130%, i.e. on average decedents' wealth was about 30% bigger than the average wealth of the living, with a slight

[50] Note that the raw profiles reported on Table 2 do not take into account the differential mortality correction. If one were to use them to compute μ_t ratios without making any differential mortality correction, then one would find substantially bigger for values for μ_t than those reported on Figure 8, e.g. 169% instead of 134% for 1900. For detailed computations, see Appendix B.

upward trend, from about 120% in the 1820s to about 130%-140% in 1900-1910. This slight upward trend disappears once one takes inter vivos gifts into account: the gift-bequest ratio v_t was as high as 30%-40% during the 1820s-1840s, and then gradually declined, before stabilizing at about 20% between the 1870s and 1900-1910.[51] When we add this gift effect, i.e. when we take into account the fact that decedents have already given away about 30%-40% of their wealth when they die in the 1820s-1840s, and about 20% of their wealth when they die in the 1870s-1910s, we find that the gift-corrected μ_t* ratio was stable at about 160% during the 1820-1913 period (see Figure 8). During this entire period, age-wealth profiles were steeply increasing up until the very old (see Table 2).[52]

The 1913-1949 capital shocks clearly had a strong disturbing impact on age-wealth profiles. The data reveals that the age-wealth profile has gradually become less and less steeply-increasing at old age after World War 1, and shortly became hump-shaped in the aftermath of World War 2 (see Table 2).[53] Consequently, our μ_t ratio estimates declined from about 140% at the eve of World War 1 to about 90% in the 1940s (see Figure 8). The gift-bequest ratio was stable around 20% throughout this period, so the μ_t* went through a similar evolution.

One obvious explanation for this change in pattern is that even if the capital shocks of the 1913-1949 period (destructions, inflation, capital losses, etc., as described in section 3.2 above) affected all wealth holders similarly (young and old), which we do not really know, then it was too late for the elderly to recover from the shocks, while active and younger cohorts could earn labour income and save.

The more interesting part is the strong recovery of the μ_t and μ_t* ratios that took place since the 1940s-1950s. The raw age-wealth-at-death profiles have gradually become upward sloping again, and in the 1900s-2000s 70-to-79-year-old and 80-to-89-year-

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[51] We know relatively little as to why inter vivos gifts were so high in the early 19th century. This probably corresponds to the fact that dowries (i.e. large inter-vivos gifts at the time of wedding) were more common at that time.

[52] Differential-mortality age-wealth profiles are also increasing up until the very old (see Appendix B). Note that these are estimated profiles for the all of France. In Paris, where many of top wealth holders lived, observed profiles were even more steeply increasing, with an average wealth for the 80-to-89-year-old as large as 300% of the average wealth of the 50-to-59-year old around 1900. See Piketty, Postel-Vinay and Rosenthal (2006).

[53] The differential-mortality-corrected profiles look even more hump-shaped (see Appendix B).

old decedents have become about 20%-30% richer than the 50-to-59-year-old decedents.[54] As a consequence, the μ_t ratio gradually rose from about 90% in the 1940s-1950s to over 120% in the 2000s.

Next, and most importantly, the gift-bequest ratio v_t has increased enormously since the 1950s. The gift-bequest ratio was about 20%-30% in the 1950s-1960s, and then gradually increased to about 40% in the 1980s, about 60% in the 1990s and over 80% in the 2000s. This is an unprecedented high level since the 1820s: during the past 20 years, the annual value of inter vivos gifts has been about 60%-80% of the annual value of estates transmitted at death. To the extent that gifts are less well reported than bequests to the tax administration, it is hard to see how this tax-data-measured v_t ratio can be over-estimated. Note that the age differential between decedents and donors seems to have remained relatively stable around 7-8 years: on average, people give away wealth about 7-8 years before they die, i.e. not very much before. This is why the impact on the average age at which individuals receive wealth transfers has been relatively limited. We computed the evolution of the average age of "receivers" (weighting average age of heirs and average age of donees by the relevant amounts), and we found that the rise of gifts since the 1980s merely led to a pause in the historical rise in the average age of receivers (currently about 45-year-old), but certainly not to an absolute decline.[55]

The most plausible interpretation for this large increase in gifts seems to the rise in age expectancy: wealthy parents realize that they were not going to die very soon, and decided that they should help their children buy an apartment or start a business before they die.[56] There is an issue as to whether such a high level of gift-bequest

[54] Differential-mortality-corrected profiles are basically flat above age 50. In the wealth surveys conducted by Insee in the 1990s-2000s, age-wealth profiles tend to be slightly declining after age 50 (with 70-to-79-year-old and 80-to-89-year-old at about 90% of the 50-to-59-year-old level). However this seems to be largely due to top-wealth under-reporting in surveys. Using published wealth tax data (ISF) (see Zucman (2008, p.68)), we find that the fraction of the 70-to-79-year-old and 80-to-89-year-old that is subject to the wealth tax (i.e. with wealth above about 1 million €, given tax deductions) is about 200%-250% of the corresponding fraction for the 50-to-59-year-old (average taxpayers wealth is similar for all age groups). This very strong upward sloping age profile does not show up in wealth surveys, and it is possible that this is also under-estimated in estate tax data.

[55] See Appendix C. Note that the slight decline in average age of heirs plotted on Figure 7 for the post-2040 period corresponds to another effect, namely a slight rise in average age at parenthood.

[56] It is also likely that the tax incentives put in place during the 1990s-2000s in order to encourage inter vivos gifts played a role. Preliminary evidence on this seems to suggest, however, that the upward trend started before the tax incentives were put in place, so it is hard to identify the size of the tax

ratio is sustainable in the very long run, and we will take up this issue in the simulations.

For the time being, it is legitimate to add the gift flow to the bequest flow, especially given the relatively small and stable differential between age of donors and age of decedents. Consequently, we find that the gift-corrected μ_t* ratio has increased enormously since World War 2, from about 120% in the 1940s-1950s to over 180% in the 1990s and over 220% in the 2000s (see Figure 8).

To summarize: the long run decline in the mortality m_t seems to have been (partially) compensated by a long run increase in the μ_t* ratio. One obvious explanation as to why wealth tends to get older when age expectancy increases is because individuals wait longer before they inherit. Because there are many other effects going on, it is useful to clarify this simple effect with a simple stylized model, before moving on to the full-fledged simulations.

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effect per se. Note that according to on-line IRS data, the US gift-bequest ratio was about 20% in 2008 (about 45 billions $ in gifts were reported to the IRS, and about 230 billions in bequests were reported to the IRS). Unfortunately, the bequest data only relates to less than 2% of US decedents (less than 40,000 decedents, out of a total of 2.5 millions), and we do not really know what fraction of gifts were actually reported to the IRS. This is definitely an issue that would deserve further research. On-line IRS tables also seems to reveal steeply rising age-wealth-at-death profiles. This is consistent with the findings of Kopczuk (2007) and Kopczuk and Luton (2007).

5. Wealth accumulation, inheritance & growth: a simple steady-state model

Why is it that the long-run decline in mortality rate m_t seem to be compensated by a corresponding increase in the μ_t ratio? I.e. why does the relative wealth of the old seems to rise with age expectancy? More generally, what are the economic forces that seem to be pushing for a constant inheritance-income steady-state ratio (around 20% of national income), independently from age expectancy?

In order to highlight the key effects at play, we start by answering this question with a highly stylised steady-state model of wealth accumulation, inheritance and growth. In the next section, we will present simulation results based upon a full-fledged, out-of-steady-state version of this model, with observed demographic and macro shocks.

5.1. Notations and definitions

Demography. To simplify notations, we first assume a stationary population, and a deterministic demographic structure. Everybody becomes adult at age a=A, has exactly one kid at age a=H>A, and dies at age D>H. As a consequence everybody inherits at age a=I=D-H. Each cohort size is equal to 1, so that total population equals D, and total adult population equals D-A.[57] In this simple model, the (adult) mortality rate is stationary and is given by:

$$m_t = 1/(D-A) \qquad (5.1)$$

Example 1: Around 1900, we have A=20, H=30 and D=60, so that I=D-H=30, and m=1/(D-A)=1/40=2.5%.

Example 2: Around 2020, we have A=20, H=30 and D=80, so that I=D-H=50, and m=1/(D-A)=1/60=1.7%.

Production. We consider a standard two-factor production function, with exogenous labor productivity growth:

[57] All results can be extended to the case with a population N_t growing at rate n. See Appendix F.

$$\mathbf{Y_t = F(K_t,H_t) = F(K_t , e^{gt} L_t)} \qquad \textbf{(5.2)}$$

With: Y_t = national income
K_t = physical (non-human) capital
H_t = human capital = $e^{gt} L_t$
L_t = labor supply
g = exogenous labor productivity growth

Since population is stationary, so is labor supply L_t. We assume that all adults work from age a=A until some exogenous retirement age a=R<D, so that L_t=R-A.

Again for simplicity, we assume a closed economy (no foreign assets), and we assume away government debt (and government assets), so that private wealth W_t is exactly equal to the capital stock K_t. We note β_t the wealth-income ratio:

$$\boldsymbol{\beta_t = W_t/Y_t = K_t/Y_t} \qquad \textbf{(5.3)}$$

(aggregate wealth-income ratio = aggregate capital-output ratio)

Finally, we note $Y_t = Y_{Kt} + Y_{Lt}$ the functional distribution of income, with Y_{Kt} = capital income and Y_{Lt} = labor income. We note $\alpha_t = Y_{Kt}/Y_t$ the capital share in national income, and $1-\alpha_t = Y_{Lt}/Y_t$ the labor share. We define the rate of return to private wealth r_t by the following equation:

$$r_t = Y_{Kt}/W_t = \alpha_t Y_t/W_t$$

I.e.:

$$\boldsymbol{r_t = \alpha_t/\beta_t} \qquad \textbf{(5.4)}$$

E.g. if the wealth-income income ratio β_t = 600%, and the capital share α_t = 30%, then the rate of return to private wealth r_t = 5%.

In a world with a single type of assets (such as the highly stylized model presently described), the average rate of return to private wealth r_t is simply equal to the interest rate, i.e. the common return to all assets. However in real world discussions the interest rate often refers to the return to a particularly low yield and unrepresentative type of assets (namely public debt), which sometimes creates confusion. In order to facilitate the application of the model to data, we feel it may be clearer to use a different name to refer to the aggregate average return $r_t = \alpha_t/\beta_t$, which in the real world represents the average rate of return to all forms of private wealth owned by individuals, i.e. for the most part the return to housing capital (rental income of real estate, imputed or not) and the return to corporate and unincorporated business capital owned in stock and bonds (dividend, interest and the capital share of self-employment income).

To fix ideas and to simplify exposition, one can for instance assume a Cobb-Douglas production function $F(K,H)=K^{\alpha} L^{1-\alpha}$, which seems to a reasonably good approximation of the real world in the long-run. The Cobb-Douglas specification implies that the capital share α_t is permanently equal to α, so that the rate of return is simply an inverse function of the wealth-income ratio: $r_t = \alpha/\beta_t$. All results below can easily be extended to the more general case of a CES production function, which might be a bit more realistic.[58]

We note y_t, w_t, y_{Kt}, y_{Lt} the per adult averages of all aggregate variables: $y_t=Y_t/(D-A)$, $w_t=W_t/(D-A)$, $y_{Kt}=Y_{Kt}/(D-A)=r_t w_t$, and $y_{Lt}=Y_{Lt}/(D-A)$. We use subscripts for time t, parentheses for age a and superscripts for cohort x. E.g. $y_t(a)$ is the average income at time t of individuals aged a-year-old at that time, and y_t^x is the average income at time t of individuals who were born at time x (i.e. who have age a=t-x). When we refer to particular individuals or dynasties we use subscripts i. E.g. individual income is the sum of labor income and capital income: $y_{ti} = y_{Lti} + r_t w_{ti}$.

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[58] With a CES production function of the form $F(K,H) = [a K^{(\gamma-1)/\gamma} + (1-a) H^{(\gamma-1)/\gamma}]^{\gamma/(\gamma-1)}$, where γ is the elasticity of substitution between K and H (γ=1 corresponds to Cobb-Douglas, γ=0 to putty-clay, and γ=infinity to a linear production function with complete substitutability between capital and labor), one can easily show that in competitive equilibrium the capital share $\alpha = Y_K/Y = r \beta = a \beta^{1-1/\gamma}$. I.e. the capital share is an increasing function of the wealth-income ratio if and only if $\gamma>1$. To the extent that capital shares were slightly below normal levels in historical periods when the wealth-income ratio was below normal levels (e.g. in the 1950s), this suggests that γ is somewhat bigger than 1. However the assumption of competitive factor markets is quite heroic (e.g. rent control policies certainly played a big role at mid-20th century), and so is this inference process.

Age-labor income profile. For simplicity, we first assume that the cross-sectional age-labor income profile if completely flat. That is, we assume that at any given time t, adult individuals with age a>A have the same average (augmented) labor income $y_{Lt}(a)=y_{Lt}$ for all age groups a in [A;D], both before and after retirement age a=R. Augmented labor income is defined as net-of-pensions-related-payroll-tax labor income for working adults and pension income for retired adults. In effect, we are assuming that the pay-as-you-go pension system offers 100% replacement rates.[59]

Note that the real world, at least in France in the 1990s-2000s, is not very different from that. Individuals above 60 currently get an average (augmented) labor income equal to about 70%-80% of the average labor income of 50-to-59-year-old individuals, and individuals in their 20s and 30s get an average labor income equals to about 70%-80% of the average labor income of individuals in their 40s and 50s.[60]

Note that this assumption of a flat, cross-sectional age-labor income profile obviously does not apply to longitudinal profiles: with positive exogenous productivity growth g>0, in steady-state everebody's labor income y_{Lt} grows at rate g, i.e. longitudinal age-labor income profiles are monotically increasing.

Distribution functions for labor income and wealth. Note also that this assumption does not imply that there is no labor income inequality: we simply assumed that all age groups get the same average labor income y_{Lt}. One can very well integrate into this simple model the fact that there exists permanent, intra-cohort labor income inequality stemming from some exogenous heterogeneity in skills or luck or taste or effort. We note y_{Lti} the individual labor income of dynasty i at time t, and we note $G(y_{Li})$ the corresponding distribution function for $y_{Li}=y_{Lti}/y_{Lt}$ (i.e. the distribution function G(y) and the corresponding density function g(y) have a mean equal to 1). For the time being, assume that labor income inequality is fully deterministic and stationary, both during one's lifetime (a given individual i has a fixed

[59] That is, we assume that the pensions-related payroll tax rate τ_P is permanently set at a level such that $(1-\tau_P)Y_{Lt}/(R-A)=\tau_P Y_{Lt}/(D-R)$. Since we assumed each cohort size to be equal to one, and a fixed retirement age equals to a=R, the budget balance equation for the pension system simply leads to $\tau_P = (D-R)/(D-A)$. That is, in order to guarantee 100% replacement rate, the pension payroll tax rate needs to equal to the fraction of retirees in total adult population.

[60] See Appendix D, Table Dx. The total pension payroll tax rate is currently about 25% of gross labor income in France, i.e. not very far from $\tau_P = (D-R)/(D-A) = (80-60)/(60-40) = 33\%$.

labor income parameter $y_{Li}=y_{Lti}/y_{Lt}$ during his entire lifetime) and across generations (dynasties keep the same parameter $y_{Li}=y_{Lti}/y_{Lt}$).

Similarly, we note $H_{ta}(w)$ and $h_{ta}(w)$ the distribution and density function describing the wealth distribution among a-year-old individuals at time t.

Inheritance flow. We ignore the possibility of inter vivos gifts ($v_t=0$). Since everybody dies at age a=D, the ratio μ_t between average decedents wealth and average wealth of the living is simply given by the following equation:

$$\mu_t = w_t(D)/w_t \qquad (5.5)$$

We define B_t the aggregate inheritance flow as the total value of decedents' wealth at time t, i.e. $B_t = w_t(D)$. According to the accounting equation (3.1) we have:

$$B_t /Y_t = w_t(D)/Y_t = m_t \mu_t W_t/Y_t = m_t \mu_t \beta_t \qquad (5.6)$$

Alternatively, following equation (3.2), this can be written in per capita terms :

$$b_t /y_t = w_t(D)/y_t = \mu_t w_t/y_t = \mu_t \beta_t \qquad (5.7)$$

Note that since each cohort size is normalized to, per decedent bequest b_t is equal to the aggregate bequest flow B_t.

Savings behaviour. Now that we have specified the demographic and production sides of the economy, all we need to specify in order to compute steady-state age-wealth profiles and inheritance-income ratios is the savings behaviour. As was already stressed in the introduction, in order to generate the kind of inheritance-income ratio observed in the data, one needs to introduce some motive for long term savings and wealth accumulation. If individuals have finite horizons (i.e. do not care about what happens after they die), and face no imperfection in insurance and annuity markets, then they should just die with zero wealth, i.e. μ_t would be permanently equal to 0, and so would B_t. In the literature, there are two ways to model motives for long run savings: infinite-horizon, dynastic utility functions; and bequest-in-the-utility-function specifications, which we view as more general and more flexible. We take each of them in turn.

5.2. Steady-state inheritance flow in the dynastic model

In the dynastic model, each dynasty i is assumed to maximize a utility function of the following form:

$$U_{is} = \int_{t\geq s} e^{-\theta t} U(c_{ti}) dt \qquad (5.8)$$

Where θ is the rate of time preference, c_{ti} is the consumption flow of dynasty i at time t, and $U(c) = c^{1-\sigma}/(1-\sigma)$ is a standard utility function with constant intertemporal elasticity of substitution (IES). The constant IES is equal to 1/σ. Realistic values for the IES are usually considered to be pretty close to zero, and in any case smaller than one, i.e. σ is a parameter that is typically bigger than one.

As is well known, the steady-state rate of return r* in the dynastic model is uniquely determined by the modified Ramsey-Cass golden rule of capital accumulation:

$$r^* = \theta + \sigma g \qquad (5.9)$$

The special case g=0 implies r*=θ. With g>0, r*>θ is an increasing function of g. Equation (5.9) follows directly from the standard first-order condition describing the optimal consumption path.[61] Note that the steady-state rate of return r* is always larger than the growth rate g in the steady-state of the dynastic model.[62]

[61] See e.g. Bertola et al (2006, chapter 3). In case g=0 and r*<θ, everybody wants to borrow in order to consume more today than tomorrow, which cannot be a steady-state. In case g=0 and r*>θ, everybody wants to save and postpone consumption, which cannot be a steady-state either, since steady-state consumption must be stationary with g=0 (there can be no saving). A similar intuition applies to the case g>0, where everybody's steady-state consumption must be growing at rate g: if r*< θ+σg, then agents prefer a consumption path growing at rate less than g; conversely if r*> θ+σg, they prefer a consumption path growing at rate more than g; in both cases this cannot be a steady-state.

[62] Since σ is typically >1, one can be sure that r*=θ+σg>g. In the (unplausible) case where σ<1, then in theory one could have r*<g. However this would violate the transversality condition (the net present value of future income flows would be infinite), so this wouldn't be a steady-state.

Given that r^* is uniquely determined, all other aggregate variables are uniquely determined. Everything in steady-state has to grow at rate g. In particular, both national income Y_t and aggregate wealth W_t grow at rate g, so that the long run stationary aggregate wealth-income ratio $\beta^*=W_t/Y_t$ is stationary. With the Cobb-Douglas production function, the capital share α is fixed, and the steady-state wealth-income ratio β^* is uniquely determined by equation (5.4) above: $\beta^*= \alpha/r^*$.[63]

Note that although aggregate steay-state variables r^* and β^* are uniquely determined, there exists an infinity of steay-state distributions in the dynastic model. Since there is no shock, any wealth distribution H(w) such that the average wealth is equal to β^* times national income y^* is self-sustaining and can be a steady-state distribution. The labor income distribution $G(y_L)$ is irrelevant: it has no impact on steady-state aggregate variables (but it has an impact of course on the steady-state inequality in economic welfare between dynasties).

What about the steady-state age-wealth profile $w_t(a)$, the μ_t ratio and the inheritance flow? Here the important point to notice is that in all steady-state savings $S_t=s^*Y_t$ entirely come from capital income $Y_{Kt}=r^*W_t$. That is, the marginal propensity to save out of labor income s_L is equal to zero, while the marginal propensity to save out of capital income s_K is equal to g/r^*. This follows from the fact that in this deterministic model, the consumption path of every dynasty (poor or rich) grows at rate g in steady-state. Since labor income grows at rate g, zero-wealth dynasties no need to save out of labor income: they can simply consume 100% of his labor income at each period. However wealth does not naturally grows at rate g, so if wealthy dynasties do not save, and instead consume the full return to their inherited wealth, then their future consumption will not grow. In order to make sure that their wealth and future capital income grows at rate g, they need to save a fraction $s_K=g/r^*$. Now, because $r^*<g$, $s_K=g/r^*<100\%$. I.e. wealthy dynasties consume a positive fraction $1-g/r^*$ of the return to their inherited wealth and save the rest.[64] With $s_L=0$ and $s_K=g/r^*$, the individual consumption and savings steady-state equations are given by:

[63] In the more general case of CES production function (see above), $\alpha^*=r^*\beta^*=a\beta^{*1-1/\gamma}$, i.e. $\beta^* = (a/r^*)^{\gamma}$.
[64] Since σ is typically >1, one can be sure that $r^*=\theta+\sigma g>g$. In the (unplausible) case where $\sigma<1$, then in theory one could have $r^*<g$. However this would violate the transversality condition (the net present value of future income flows would be infinite), so this wouldn't be a steady-state.

$$\mathbf{c_{ti} = y_{Lti} + (1\text{-}s_K)\, r^*w_{ti} = y_{Lti} + (r^*\text{-}g)\, w_{ti}} \qquad (5.10)$$

$$\mathbf{s_{ti} = s_K\, r^*w_{ti} = g\, w_{ti}} \qquad (5.11)$$

What does this imply about the steady-state, cross-sectional age-wealth profiles? With this savings behaviour, it takes a very simple form (see Figure 9 for the special case with A=20, H=30, D=70, i.e. I=D-H=40):

If A≤a<I, then $w_t(a) = 0$
If I≤a≤D, then $w_t(a) = w_t^{old}$

Since s_L=0, young individuals have zero wealth until the time they inherit.[65] Then, at age a=I, everybody inherits (some inherit very little or nothing at all, some inherit a lot, depending on the steady-state distribution), and average wealth $w_t(a)$ jumps to some positive level w_t^{old}. Now, the interesting point is that in the cross-section all age groups with age a between I and D has the same average wealth $w_t(a)=w_t^{old}$. This is because the growth effect and the savings effect exactly compensate each other. In steady-state, everything grows at rate g. Take individuals with age a>I at time t. They inherited a-I years ago, at time s=t-a+I. They received average bequests $w_{t-a+I}(I)$ that are smaller than the average bequests $w_t(I)$ inherited at time t by the I-year-old, namely: $w_{t-a+I}(I) = e^{-g(a-I)}\, w_t(I)$. But although they received smaller bequests, they saved a fraction $s_K=g/r^*$ of the corresponding return, so at time t their wealth has become: $w_t(a) = e^{s_K r^*(a-I)}\, e^{-g(a-I)}\, w_t(I) = w_t(I) = w_t^{old}$.

Insert Figure 9: Steady-state cross-sectional age-wealth profile in the dynastic model

Given this age-wealth profile, the average wealth over all age groups w_t is given by: $w_t=(D\text{-}I)w_t^{old}/(D\text{-}A)$. It follows that the steady-state ratio $\mu^* = w_t(D)/w_t$ is given by:

$$\mathbf{\mu^* = w_t(D)/w_t = (D\text{-}A)/(D\text{-}I) = (D\text{-}A)/H} \qquad (5.12)$$

[65] Note that due to our realistic demographic structure, generations overlap in this model : when adults are aged between A and I, their parents are still alive. Implicitely we are assuming that parents care about their children utility for consumption only after they die (otherwise we would need to model inter vivos gifts explicitely). Implicitely we are also assuming that adults aged between A and I cannot borrow against their future inheritance (e.g. because their parents do not want them to do that).

We summarize these observations in the following proposition:

Proposition 1: In the steady-state of the dynastic model:

(1) The rate of return r* and the wealth-income ratio $\beta^*=W_t/Y_t$ are uniquely determined: $r^* = \theta + \sigma g$ and $\beta^*= \alpha/r^*$

(2) There is no saving out of labor income, and all savings come from the return to inherited wealth: $s_L=0$ and $s_K=g/r^*$ ($s_K<1$ since $r^*>g$)

(3) Any wealth distribution H(w) such that the aggregate wealth-income ratio equals β* is a steady-state. The labor income distribution $G(y_L)$ is irrelevant

(4) The steady-state ratio μ* between average wealth-at-death and average adult wealth is uniquely determined by demographic parameters: $\mu^* = (D-A)/H$

(5) So is the μ* m* product: $m^*=1/(D-A)$, so $\mu^* m^* = 1/H$

(6) **The steady-state inheritance flow $B_t/Y_t = b_y^* = \mu^* m^* \beta^* = \beta^*/H$ is independent of age expectancy and mortality rate**

(7) The steady-state inheritance flow β*/H is a decreasing function of growth rate g

From our viewpoint, the most interesting part of proposition 1 is result n°6. It says that in steady-state a decline in m_t is entirely compensated by an increase in μ_t. I.e. a society with higher age expectancy D (and therefore lower mortality rate $m_t=1/(D-A)$) will also have older wealth (and therefore a higher $\mu_t=(D-A)/H$), so that the steady-state inheritance flow will remain the same: people die less often, but they die with higher relative wealth. The reason is simply that with higher age expectancy, one has to wait longer before inheritance, so that the entire wealth profile is shifted to older age groups.

Example. Assume r*=5%, α=30%, β* = 600%.

- Around 1900, we have A=20, H=30 and D=60, so that I=D-H=30. In steady-state, m*=1/(D-A)=2.5%, μ*=(D-A)/H=133%. The inheritance flow is equal to 2.5% times 133% times 600% = 20% of national income.
- Around 2050, we have A=20, H=30 and D=80, so that I=D-H=50. In steady-state, m*=1/(D-A)=1.7%, μ*=(D-A)/H=200%. The inheritance flow is equal to 1.7% times 200% times 600% = 20% of national income.

Although this is a very crude model, we believe that this results provides the right intuition for the observed historical U-shaped pattern of inheritance, and in particular for why the historical decline in mortality rates was to some extent compensated by an historical rise in the relative wealth of decedents. Moreover, as we see below, this simple intuition generalizes to more general savings behaviour.

Before we move to more general savings behaviour, note that the discontinuous age-wealth profile obtained in this model (see Figure 9) is obviously an artefact due to the deterministic demographic structure, and would immediately disappear once one introduces demographic noise (as there is in the real world), without affecting the results. E.g. assume that individuals, instead of dying with certainty at age a=D, die at any age on the interval [D-d;D+d], with uniform distribution. Then individuals will inherit at any age on the interval [I-d;I+d]. To fix ideas, say that A=20, H=30, D=70 and d=10, i.e. individuals die at any age between 60 and 80, with uniform probability, and inherit at any age between 30 and 50, with uniform probability. Then the steady-state age-wealth profile will look as follows:

If $A \leq a \leq I-d$, then nobody has inherited, so $w_t(a) = 0$
If $I-d \leq a \leq I+d$, then a fration (a-I+d)/2d has already inherited, and for those individuals the growth and capitalization effects again cancel each other, so that $w_t(a)$ is simply a linear fraction of age: $w_t(a) = (a-I+d)w_t^{old}/2d$
If $a \geq I+d$, then everybody has inherited, and since the growth and capitalization effects cancel each other, the age-wealth profile is flat: $w_t(a) = w_t^{old}$

Average wealth $w_t = [\ 2d\ w_t^{old}/2 + (D-I-d)\ w_t^{old}]/(D-A) = (D-I)w_t^{old}/(D-A)$ remains the same as before, and so do all other results. The corresponding steady-state age-wealth profile is represented on Figure 10. In the real world, there are several other kinds of demographic noise (age at parenthood is not the same everybody, both parents usually do not die at the same time, there is differential mortality, there are inter vivos gifts, etc.), and we take all of these into account in the simulations. The important point, however, is that the basic intuition provided by proposition 1 is essentially unaffected by demographic noise.

5.3. Steady-state inheritance flow in more general savings models

The steady-state savings behaviour implied by the dynastic model (s_L=0, s_K=g/r) is interesting, but rather extreme. There are several ways to relax this. First, within the infinite-horizon dynastic model, one can easily generate positive savings out of labor income (s_L>0), and reduced savings out of capital income (s_K<g/r), by assuming that the public-pension replacement rate is below 100%.[66] More generally, if one introduces uncertainty and shocks about future labor income, then this will also generate positive precautionary savings out of labor income (s_L>0, s_K<g/r).[67]

Another simple way to generate less extreme savings behaviour is to assume that individuals have finite horizons but derive utility from their wealth at death $w_t(D)$, e.g. because they derive utility from leaving a positive bequest.[68] That is, assume that individuals i maximize a utility function of the form:

$$\mathbf{U_i = U(\ c_i\ ,\ w_i(D)\ )} \qquad \mathbf{(5.13)}$$

Where:

$w_i(D)$ = end-of-life wealth (i.e. wealth of individual i at time $t=x_i+D$, with x_i = birth cohort of individual i)

c_i = end-of-life value of lifetime consumption flows c_{si} ($x_i+A<s<x_i+D$)

Note w_{Li}* the capitalized, end-of-life value of the lifetime labour income flows accruing to individual i, w_{Bi}* the capitalized, end-of-life value of the lifetime inheritance flows accruing to individual i, and $w_i^*= w_{Li}^*+ w_{Bi}^*$ the total end-of-life value of lifetime resources accruing to individual i. The lifetime budget constraint can be written as follows: $c_i + w_i(D) \leq w_i^*= w_{Li}^*+ w_{Bi}^*$. Now assume that U(c,w(D)) takes the following

[66] One can easily show that s_L is a decreasing function of the replacement ratio $y_P/(1-\tau_P)y_L$ and of the rate of return, and an increasing function of retirement length D-R. The average savings rate out of capital income s_K will decline because there is now life-cycle wealth in addition to inherited wealth, and life-cyle savers will consume part of their wealth when they are old. See Appendix F for formulas.

[67] This requites an explicit modelling of shocks and of insurance and annuity markets imperfections, and we certainly do not want to get into that in this paper.

[68] With a little bit of imagination, one can interpret bequest-in-the-utility-function modelling as a reduced-form specification capturing both utility for bequests per se and (more generally) utility for wealth, e.g. utility for the security brought by wealth in a world with shocks and imperfect markets, utility for the prestige and power conferred by wealth, etc.

simple form: $U(c,w(D)) = (1-s_B) \log(c) + s_B \log(w(D))$. Then utility maximization will lead each agent I to devote a fraction s_B of his lifetime resources to bequest and a fraction $1-s_B$ to consumption: $w_i(D) = s_B w_i^*$ and $c_i = (1-s_B) w_i^*$. In effect, this implies different savings rate out of labor income $s_L=s_B$ and out of (inherited) capital income $s_K=1+\log(s_B)/r(D-I)$. Note that depending on parameters this could very well generate savings rates out of labor income s_L that are smaller or larger than savings rates out of (inherited) capital income s_K. E.g. in case $s_B e^{r(D-I)} < 1$, then $s_K<0$, i.e. successors consume not only the full return to their inherited wealth, but also part of the capital. This derives logically from the fact that under standard utility maximization assumptions individuals treat labor resources and inheritance resources in the same way. In the real world, there are lots of reasons why they might not so (e.g. parents do not like that, and/or psychological reasons, and/or there is intergenerational transmission of the taste for bequests), and it might be more appropriate to model separate mental accounts for labor and inheritance resources. Other factors that might lead to $s_K.>s_L$ include subsistence-consumption effects (or relative consumption effects): to the extent that inherited wealth is more concentrated than labor income, then individuals drawing with zero or little inheritance will devote most of their income to finance their subsistence consumption (or the minimal consumption viewed as subsistence consumption, given average consumption), and in effect will save less. This explanation for $s_L<s_K$ (i.e. workers save less because they are poorer) is probably more plausible than the intuition captured by the infinite-horizon model.[69]

Now, whatever the micro reasons why s_K and s_L might differ (or not), the point we want to stress here is simply that the intuition captured by Proposition 1 will go through. All what really matters is that the age-savings rate profile is flat. To see this, assume that individuals from all age groups have the same savings rate out of labor income s_L and out of capital income s_K. These savings rate s_L and s_K could come from any of the micro models referred to above. Then one can easily show that the steady-state age-wealth profile, μ ratio and inheritance flow will be given by the following simple formula:[70]

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[69] In the infinite-horizon dynastic model, the intuition why $s_L=0$ and $s_K=g/r$ has nothing to do with distribution effects: it would also hold with an egalitarian wealth distribution and a very inegaliterian labor income distribution, i.e. with poor capitalists and rich workers.

[70] For an extension of these formulas to the case with partial old-age dissaving by life-cycle savers, i.e. with s_K varying with age, see Appendix F.

Proposition 2: Assume flat savings rates s_L and s_K out of labor income and capital income. I.e. all individuals i with income $y_{ti}=y_{Lti}+rw_{ti}$ save $s_{ti}=s_L y_{Lti}+s_K rw_{ti}$. Then in steady-state we have the following:

(1) The rate of return r* and the wealth-income ratio $\beta^*=W_t/Y_t$ are uniquely determined: $\beta^*= s/g$ and $r^*=\alpha/\beta^*$ (where $s=\alpha s_K+(1-\alpha)s_L$). Note that in steady-state, r* is necessarily such that $s_K r^*\leq g$ (with equality iff $s_L=0$).

(2) **The steady-state ratio μ* between average wealth-at-death and average adult wealth is uniquely determined by the following formula:**

$$\mu^* = [1-e^{-(g-s_K r^*)(D-A)}]/ [1-e^{-(g-s_K r^*)H}]$$

(3) The steady-state inheritance flow $B_t/Y_t = b_y^* = \mu^* m^* \beta^*$ is uniquely determined

(4) μ* is always >1 and is a decreasing function of g and of s_L. If $s_K r^*=g$ (i.e. $s_L=0$), then $\mu^*=(D-A)/H=\mu^{*max}$ (see Proposition 1).

Proof: See Appendix F

Proposition 2 is a generalization of Proposition 1 and includes it as a special case. I.e. in case all savings come from capital income, then μ*=(D-A)/H, and we are back to Proposition 1: the steady-state inheritance flow B_t/Y_t is independent from age expectancy, and for r*=5%, α=30%, β* = 600% is equal to 20%. In case savings partly come from labor income, then μ* will be lower than (D-A)/H, and B_t/Y_t will be lower than 20%. This can help explain why the B_t/Y_t ratio might not return all the way towards the early 20th century levels: in case savings now come partly from labor income and partly from capital income then inheritance-income ratios are bound to stay at lower levels than during the 19th century quasi-steady-state, as we shall see in the simulations below.

However the important point is that for small growth rates g, then μ* will not be much lower than (D-A)/H (and B_t/Y_t will not be much lower than 20%). One can see that by applying the formula given in proposition 2.[71] E.g. assume g=1% and uniform savings $s=s_K=s_L=6\%$, so that in steady-state β*=600%. Assume the capital share α=30%, so that r*=5%. Then for A=20, H=30, D=60, i.e. I=D-H=30, we have μ*=129%. This is lower than the μ*=133% obtained under the assumptions $s_L=0$ and

[71] See Appendix D for detailed computations.

s_K=g/r, but not very much lower. With A=20, H=30, D=80, i.e. I=D-H=50, we get μ*=181% instead of μ*=200%. In order to get a more substantial decline in μ*, and therefore in the steady-state inheritance flow, one needs to assume much larger growth rates. E.g. with g=5%, then one gets μ*=116% for the 19th century demographic parameters (D=60) and μ*=135% for the 21st century demographic parameters (D=80). With infinite growth, then μ* would converge to 100%, independently from the demographic parameters, which would imply that a society with a higher age expectancy has a lower inheritance flow (because of the reduced mortality effect). But for plausible growth rates, the key result is that the steady-state inheritance flow declines only modestly when age expectancy increases.

Finally, note that although s_Kr>g cannot be a closed-economy long-run steady-state, one can very well have s_Kr>g during fairly long periods of time, especially in an open economy setting. The reason why s_Kr>g cannot hold in steady-state is that this will lead to excessive savings, a continuous rise in wealth-income ratio … 19th century apocalyptic view = quite justified…

6. Simulations

We now come to the simulations. Our simulated model is conceptually very simple. We start from observed demographic data, we take observed national-accounts aggregate values for all macroeconomic variables (growth rates, factor shares, tax rates, rates of return, savings rate), and we simulate the savings side making different assumptions about savings behaviour in order to see whether we can replicate observed age-wealth profiles, μ_t ratios and inheritance flows.

More precisely, we constructed a relatively complete, annual demographic data base on the age structure of the living population and of decedents in France over the 1820-2008 period. In the real world, bequest and gift flows accrue to individuals in several different payments during their lifetime: usually both parents do not die in the same year, sometime they receive gifts from their parents, and sometime they receive bequests and gifts from individuals other than their parents. We used the detailed estate tax returns micro-files available since the 1970s (and the historical tabulations broken by age group available for the earlier period), as well as detailed historical demographic data on age at parenthood, in order to compute the exact fraction of bequest and gift flow accruing to each cohort (and transmitted by each cohort, in the case of gifts) during each year of the 1820-2008 period. In the simulated model, the value of bequests is endogenous and depends on the wealth at death of the relevant cohorts. But the fractions of the aggregate bequest flow going to each cohort are taken from observed data. Regarding gifts, in some variants we take the observed gift-bequet ratio v_t, and in some other variants we check that long run patterns are unaffected if we assume other gift-bequest ratios (see below). In both cases, we take the age structure of donors and donees from our extended demographic data base, on the basis of observed data.

Regarding the economic side of the model, we proceeded as follows. We start from observed factor shares in national accounts: $Y_t = Y_{Kt}+Y_{Lt}$. We used national accounts tax and transfer to compute aggregate, net-of-tax labor and pension income. We used various data sources to estimate the age-labor income profile (including pension income and other replacement income) throughout the period.[72] On this basis we attributed an average net-of-tax labor and pension income to each cohort for each year of the 1820-2008 period. We took the average net-of-tax rate of return to private wealth r_t, which was simply computed by dividing net-of-tax capital income by our private wealth estimates W_t.

We did two main series of simulations, one for the 1820-1913 quasi-steady-state period, and one for the 1900-2008 U-shaped period (which was then extended to the future). In the first series, we started from the observed age-wealth profile in 1820, and attempted to simulate the evolution of the profile during the 1820-1913 period. In the second series, we started from the observed age-wealth profile in 1900, and attempted to simulate the evolution of the age-wealth profile during the 1900-2008 period. In both cases, the cohort level transition equation for wealth is the following:

$$\mathbf{W_{t+1}(a+1) = (1+q_{t+1})\ [W_t(a) + s_{Lt}Y_{Lt}(a) + s_{Kt}r_tW_t(a)]} \qquad \mathbf{(6.1)}$$

(+ bequests and gifts received – bequests and gifts transmitted)

The only parameters on which we need to make assumptions are the labor-income and capital-income savings rates s_{Lt} and s_{Kt}. We make various assumptions on these and analyze the extent to which we replicate observed age-wealth profiles, μ_t ratios and resulting inheritance flows. However in all simulations we make sure that the aggregate savings $s_t=(1-\alpha_t)s_{Lt}+\alpha_t s_{Kt}$ (where α_t is the observed, after-tax capital share) is equal to the observed private savings rate s_t, which according to national accounts data has been relatively stable around 8%-10% in the long run (see Figure 11).[73]

[72] For the recent period (1990s-2000s), we used income tax returns files to compute the age-labor income profile. For older periods, we used national accounts estimates of aggregate pension income and historical series on labor participation rates above 60. Our resulting age-labor income profiles display very high replacement rates for the elderly in the 1990s-2000s (about 70%-80%), and much lower replacement rates for earlier periods (about 50% for the 1950s-1960s, 30% in the interwar, and 10% for the early 20th century and 19th century, when very few workers were covered by public, pay-as-you-go pension shemes). See Appendix D.

[73] Note that savings rates varied widely during the 1913-1949 period, with low (or negative) savings during both world wars, very high savings rates during the reconstruction period of the 1920s (20%), and moderate savings during the 1930s (see Appendix A). Decennial averages are not very meaningful for this period, and on figure 11 we plot the 1913-1949 average savings rate for the 1920s, 1930s and 1940s. In the simulations, we of course use real, annual data.

Therefore, by construction, in all variants the simulated model perfectly reproduces observed demographic data and observed aggregate macroeconomic series. In particular, by construction, all simulated series perfectly reproduce the aggregate wealth-income ratio $\beta_t = W_t / Y_t$. The name of the game is the following: what assumptions on savings behaviour also allow us to reproduce the observed dynamics of age-wealth profiles, μ_t ratios and inheritance flows?

Our main conclusion is summarized on Figure 12. By making relatively simple assumptions on savings behaviour (namely, flat age-savings rate profile for the entire period, uniform savings rate for labor and capital income for the 1913-2008 subperiod, and all savings from capital income for the 1820-1913 subperiod), we are able to reproduce relatively well the observed evolution of the inheritance flow over almost two centuries.

Insert Figure 12: Observed and simulated inheritance flow, France 1820-2050

We certainly do not infer from these findings that our rudimentary assumptions on savings rates provide an adequate description of individual saving behaviour. There is little doubt that individual saving behaviour involves a complex mixture of motives (dynastic, utility-for-wealth, precautionary, life-cycle, etc.) varying a lot across agents, like other tastes. However our findings show two things. First, at the aggregate level, actual savings rates cannot differ too much from the flat profile posited here.[74] Next, the results and intuitions obtained from the stylized model of the previous section also apply in a full-fledged simulated model with real world demographic and macroeconomic shocks.

[74] As a matter of fact, if one uses Insee Household budget surveys available for 1978, 1984, 1989, 1994, 2000 and 2006, one finds age-savings rates profiles that are rising until age 40-49, but almost flat above above age 40-49: sligltly declining in 1978-1984-1989, flat in 1994-2000, slightly rising in 2006 (in any case these variations across age groups are very small as compared to variations over permanent income quartiles). To the extent that wealth and capital income are adequately measured in such surveys, average savings rates also to be flat with respect to income composition (labor share vs capital share). See Antonin (2009).

6.1. Simulating the 1820-1913 quasi-steady-state

The most interesting period to simulate and investigate is maybe the 1820-1913 period. As was already stressed, this is because this time period looks very close to the theoretical stead-state described in the previous section, with s_K close to g/r, and s_L close to 0.

The first thing to notice is that the 1820-1913 period was a time when the rate of return to private wealth r was much bigger than the growth rate g. Generally speaking, factor shares appear to have been relatively stable in France over the past two centuries, with a capital share generally around 30% (see Figure 13). Note however that according to the best available data, the capital share during the 19th century was somewhat higher than during the 20th century (30%-40%, vs 20%-30%). Dividing capital shares by aggregate wealth-income ratios, we get average rates to private wealth r of about 5%-6%, much larger than the growth rate, which on average was 1.0% (see Figure 14).

Insert Figure 13: Factor shares 1820-2008
Insert Figure 14: Growth rate vs rate of return 1820-1913
Insert Figure 15: Capital share vs savings rate France 1820-1910

We performed several simulations. If we assume uniform savings rates on labor and capital incomes, we under-predict slightly the evolution of the inheritance: the predicted inheritance-income ratio in 1900-1910 is about 18%-19%, instead of 22%-23%. Most importantly, we predict an age-wealth profile in 1900-1910 that is flat after age 60 (or even slightly declining after age 70), while the observed ratio is steeply increasing, including for the very old. This has a limited impact on the aggregate inheritance-income ratio, because at that time few people died after age 70. But this is an important part of the observed data, and we interpret this as a sign that uniform savings are an inadequate description of actual savings behaviour at that time. If we assume that all savings came from capital income, which implies an average savings rate s_K of 25%-30% instead of 8%-10%,[75] then we can predict adequately both the evolution of the inheritance-income ratio and the evolution of the age-wealth profiles.

We also did various sensitivity checks by varying the gift-bequest ratio v_t. In particular, in one variant, we set v_t=0% for the entire 1820-1913 period, i.e. we assumed no inter vivos gifts: 19th century wealth holders were assume to hold on their wealth until the die. Of course, this leads us to under-predict the observed inheritance (bequests plus gifts) flow at the beginning of the period. The interesting finding, however, is that we get approximately the same inheritance-income ratio at the end of the period (about 22%-23%) than the observed ratio with gifts (but with a much more steeply increasing age-wealth profile). This validates our methodological choice of adding gifts to bequests. The existence of inter-vivos gifts has an impact on the timing of inheritance receipts, but very little impact on the long run aggregate flow of aggregate wealth transmission.

6.2. Simulating the 20th century chaotic U-shaped pattern

We proceeded in the same way for the 20th century. Whether we assume uniform savings or class savings, the model predicts a decline in the μ_t ratio during the 1913-1949 period. The channel through which this effect operates is the one that we already described, i.e. it was too late for the elderly to start re-accumulating wealth again after the shocks. Note however that we get a better fit by assuming that aggregate savings behaviour has shifted from class savings to uniform savings during the 1913-1949. For instance, if we look at the inheritance-income ratio at its lowest point, i.e. during the 1950s (4.3%), we get 5.3% with uniform savings and 5.9% with class savings. Intuitively, this structural change in savings behaviour could come from the large decline in wealth concentration that occurred during that time: top wealth holders were much less prosperous than prior to World War 1, and they were not able to save as much. It could even be that they saved even less than labor earners, for instance if they tried to excessively maintain their living standards. The other possible interpretation as to why we slightly over predict the observed 1950s inheritance flow (even with the uniform savings assumption) is because the capital

[75] Which given the very large wealth concentration of the time (see section 7.2 below) does not seem unrealistic.

shocks of the 1913-1949 disproportionally hit elderly wealth holders, e.g. because they held hardly hit assets such as government bonds.[76] In the simulated model, we simply assumed that the shocks (both the destruction shocks and the capital losses) hit all wealth holders in a proportional manner. Finally, it is possible that the gradual rise in age expectancy that occurred during this period led to a rise in life-cycle savings out of labor income. The data we use in this paper does not really allow us to fully settle this issue. In any case, note that the fit with simple uniform savings behaviour is already quite good (see Figure 12).

Regarding the post 1949 period, the main finding is that we do not need to assume any form of class savings to replicate the observed recovery of the inheritance-income ratio. In fact, full class savings would lead us to over predict this recovery, with an inheritance flow of 16.8%, vs 14.4% with uniform savings, vs 13.8% with reverse class savings (i.e. zero savings from capital income), vs 14.6% in the observed data. We interpret this as evidence in favour of the uniform savings assumption as an adequate way to describe aggregate savings behaviour. Note also that these various savings assumptions all lead to predict a recovery in the inheritance-income ratio, due to a recovery of the μ_t ratio, especially since the 1970s (because of the lower growth rates). This confirms the intuitions from the stylized model: what matters the most in the long run is the $r>g$ logic. Note also that, as predicted by the theoretical formulas, the absolute level of g matters even more than the r-g differential. In the 1949-1979, the r-g differential was actually quite large: g was big, but r was even bigger: the capital share was somewhat smaller than what it is today (mostly because of the low rental income prevailing in the housing sector), but relatively to the low value of aggregate private wealth it was actually quite large, with an implicit average return r around 8% (and above 10% in the 1950s). However growth was about 5%-6% per year, which slowed down considerably the rise of the μ_t ratio. After the 1970s, when growth slowed down, this rise was more rapid, and so was the recovery of the inheritance-income ratio.

[76] The micro data on individual estate tax returns in Paris collected by Piketty, Postel-Vinay and Rosenthal (2006, 2009) appears to be consisistent with interpretation.

6.3. Simulating the 21st century: towards a new steady-state?

Here we need to be extremely prudent. Performing simulations for the 21st century is obviously an important of the motivation for the historical research reported in this paper. But it is fairly clear that such simulations require making assumptions on parameters which are hard to predict. We tried several scenarios on the basis of various assumptions which we view as equally plausible.

In our baseline scenario, we simply assume that after 2010 the growth rate will be the same as the average 1979-2009 average (1.7%), the savings rate will be the same as the 1979-2009 average (9.4%), and that the capital share will be the same as the 2008 value (26% in factor-price national income, a level that has been approximately constant since the late 1980s, but significantly larger than the level observed in the late 1970s-early 1980s). In all simulations, we assumed that national income was going to decline by 2.0% in 2009 (the current average forecast), and that asset prices were falling as much between 1/1/2009 and 1/1/2010 than between 1/1/2008 and 1/1/2009 (the latest observation available), i.e. by about 5% on average. In the baseline scenario, on the basis of the historical evolutions described in section 3.2 above, we assumed that asset prices will remain the same (relatively to consumer prices) after 2010.

In this baseline scenario, we predict that the inheritance-income ratio will keep increasing somewhat after 2010, but will soon stabilize at about 16%. There are several reasons why this new steady-state level is substantially below the 20%-25% 1820-1913 steady-state. First, our projected growth rate (1.7%) is small, but bigger than the 19th century growth rate (1.0%). Next, our projected after-tax rate of return is substantially smaller than the 19th century level. This is due both to the lower factor-price capital share, and to the much higher tax rates. If we include both direct income taxes and product taxes (the incidence of which can be discussed), then the after-tax rate of return in 2008-2009 is only about 3.0%, and this is also the value we use for the post 2010 period. This relatively low value is also due to the fact that asset prices have increased a lot during the 2000s, and did not decline all that much so far.

Of course, whether asset prices are going to keep falling during the coming years, and more generally their behaviour during the coming decades, is very much an open issue. On the basis of historical evolutions (see section 3.2 above), our preferred scenario is one where asset prices stabilize relatively to consumer prices in the coming years and decades. But we would certainly not bet on that, so we also simulated a "prolonged crash scenario", where we assumed that asset prices would keep falling until 2015 at the same pace as in 2008-2009. We assumed that the capital share would however remained constant, which on the basis of its extreme stability during the past 20 years (in spite of large asset price movements) seem plausible. The interesting result is that under this prolonged crash scenario the inheritance-income ratio by 2040-2050 would be approximately the same as under the baseline scenario (about 15%). This is because the fall in asset prices will be compensated by a rise in the rate of return. In order to get a substantial decline in the inheritance-income ratio, one would need to introduce the assumption of a large rise in growth rates in the coming decades. With a 5% growth rate after 2010, and a constant savings rate, the inheritance-income ratio would be only 6% by 2050. With a 5% growth rate after 2010, but with a rise in savings rate to 25%, so as to preserve a reasonably high aggregate wealth-income ratio (and so as to neutralize this channel), the inheritance-income ratio would be only 12% by 2050.

However we do not view this economic boom scenario as the most likely one. An alternative and plausible scenario that we simulated involves a growth slowdown to 1.0% after 2010, and a gradual increase of the after-tax rate of return from 3.0% to 4.5% between 2010 and 2030, which could be due either to a rise in the capital share (say, because of increased international competition to attract capital) and/or to capital tax cuts (which could also be triggered by international competition), at the expense of labor. Under this scenario, the inheritance-income ratio will converge towards a new steady-state around 22%-23% by 2050-2060, i.e. approximately the same level as the one prevailing at the beginning of the 20^{th} century.

Finally, we made simulations assuming that the gift-bequest ratio v_t did not rise after 1980, i.e. was frozen to its 1980 value (28%) during the 1980-2050, as opposed to the observed gradual rise up to 40% during the 1980s, 60% during the 1990s and 80% during the 2000s (in the other scenarios we assumed this parameter will remain at its 2000s level after 2010). This is an important sensitivity check, because the large rise of gifts in the recent decades played an important role in the overall analysis. We find a predicted inheritance-income ratio of 15% in 2050, instead of the 16% in the baseline scenario. This suggests that the gift levels observed during the recent decades are not fully sustainable (they partly reflect anticipation effects due to tax incentives), but almost fully sustainable (in the long run whether gifts represent 28% or 80% of bequests does not make such a big difference). We also re-simulated the entire 1900-2050 period assuming there was no gift at all. The conclusion is that this has a very small impact on the long run pattern, which again validates the way we treated gifts.

7. Applications to distributional analysis & directions for future research

Although this is mostly an aggregate paper, we now want to illustrate and discuss how our results on aggregate inheritance-income ratios can be used and extended to study distributional issues.

7.1. The share of inheritance in total lifetime resources

The first application of our inheritance flow approach is that it provides an easy way to compute the share of inheritance in total lifetime resources. Take a given cohort born in year x. Note W_L^x the lifetime value of the labor income flow accruing to this cohort, capitalized at mid-life. Note W_B^x the lifetime value of all bequests and gifts received by this cohort, also capitalized mid-life. Note $W^x = W_L^x + W_B^x$ the total lifetime resources. We define $\alpha^{*x} = W_B^x/W^x$ the share of inheritance in the total lifetime resources of cohort x.

Of course α^{*x} is independent of the time of life at which we compute lifetime capitalized values (mid-life or beginning-of-life or end-of-life or else), as long as we use the same rates of returns to discount labor and inheritance flows.[77] For empirical illustration purposes, we find it convenient to compute capitalized values at mid-life, because this is roughly the time when individuals receive bequests and gifts (so that we do not need to discount inheritance flows) and because lifetime labour income at that time is roughly equal to life length times annual labour income.

More precisely, take the stylized model introduced in section 5, with the simple deterministic, stationary demographic structure: everybody becomes adult at age A, has one kid at age H, inherits at age I=D-H, and dies at age D; each cohort size is normalized to 1, so that total (adult) population is equal to (adult) life length (=D-A). Define "mid-life" as "age I". The lifetime inheritance resources W_B^x of cohort x

[77] Using the same average rate of return to private wealth r_t to discount all flows looks like the most logical solution, and this what we do here. To the extent that borrowing rates tend to higher than this average rate, and that low wealth individuals tend to get lower rates of return than average, this simplifying assumption might however lead to over-estimate the labor share and under-estimate the inheritance share, possibly in a non-negligible way.

capitalized at age I are simply equal to the bequests left by decedents during year t=x+I, which in the stylized model are all transmitted to cohort x:

$$\mathbf{W_B{}^x = B_t = b_t} \qquad \mathbf{(7.1)}$$

(with year t=x+I)

Note that since each cohort size is normalized to 1, per dececent bequest b_t and aggregate bequests B_t are identical.

The lifetime labour resources $W_L{}^x$ of cohort x can be written as a sum running over the adult life of cohort w, i.e. from year s=x+A to year s=x+D:

$$W_L{}^x = \int_{x+A\leq s\leq x+D} e^{r(x+I-s)}\, y_{Ls}{}^x\, ds \qquad (7.2)$$

Under the assumption of a flat cross-sectional age-labour income profile, all cohorts and age groups alive at time s have the same average labour income $y_{Ls}{}^x = y_{Ls}(a) = y_{Ls}$. Expressing y_{Ls} as mid-life labour income times the growth factor, i.e. $y_{Ls} = e^{g(s-t)}\, y_{Lt}$ (with year t=x+I), equation (7.2) can then be re-written:

$$W_L{}^x = \int_{x+A\leq s\leq x+D} e^{(r-g)(x+I-s)}\, y_{Lt}\, ds$$

I.e. :

$$\mathbf{W_L{}^x = \lambda\ (D\text{-}A)\ y_{Lt}} \quad \mathbf{(7.3)}$$

With: $\lambda = [e^{(r-g)(I-A)} - e^{(r-g)(I-D)}]/(r-g)(D-A)$, and year t=x+I

Lifetime labor resources capitalized at mid-life $W_L{}^x$ are equal to annual labor income prevailing at mid-life y_{Lt}, times (adult) life length D-A, times a correcting factor λ. Intuitively, the correcting factor λ corrects for difference between the lifetime profile of labor income flows and the lifetime profile of inheritance flows. In the stylized model with deterministic demographic structure, all inheritance flows come at age a=I, while labor income flows come from age a=A until age a=D: the flows received before age a=I are smaller in size but needs to be capitalized; the flows received before age a=I are larger in size but needs to be discounted. The important point is that in practice the correcting factor λ is very close to 100%. In case r-g=0%, then the growth and capitalization effects cancel each other, so λ is exactly to 100%. In the real world, r-g is positive. But when inheritance happens around mid-life, which will approximately be the case during the 21st century (with A=20, H=30, D=80, then I=D-H=50 occurs exactly at mid-adult life), and for reasonable values of r-g, simple computations using the formula given above show that λ remains very close to 100%.[78] E.g. with A=20, H=30 and D=80, then λ=100% for r-g=0%, λ=100% for r-g=0%, λ=102% for r-g=1% and λ=114% for r-g=3%. In the 19th century and early 20th century, inheritance occurred before mid-life (with A=20, H=30, D=60, then I=D-H=30 occurs exactly at the third of adult life), so that the correcting factor was below 100%. E.g. with A=20, H=30 and D=80, then λ=100% for r-g=0%, λ=100% for r-g=0%, λ=91% for r-g=1% and λ=79% for r-g=1%.[79] Flows of resources accruing earlier in life are worth more from a lifetime, capitalized value perspective. Since inheritance flows were received relatively earlier in life one century ago (relatively to labour income flows), this effect implies that – other things equal – the relative importance of labour income has increased over time: the correcting factor was slightly below 100% a century ago and is now slightly above 100%.[80]

Finally, note that because of demographic stationarity, average labor income y_{Lt} times life length D-A is by definition equal to aggregate Y_{Lt} (multiplying by adult life length or by population is the same thing). So equation (7.3) can be re-written:

$$\mathbf{W_L^x = \lambda\ (D\text{-}A)\ y_{Lt} = \lambda\ Y_{Lt}} \qquad \mathbf{(7.4)}$$

[78] The intuition can be confirmed by writing first order developments from the formula given above: $\lambda = [e^{(r-g)(I-A)} - e^{(r-g)(I-D)}]/(r-g)(D-A) = 1 + (r-g)(2I-A-D)$. With $I=(A+D)/2$, the first-order term disappears.
[79] See Appendix D for the complete results of these computations.
[80] To the extent that rising age expectancy diminishes the importance of inheritance relatively to labor income, this is the channel through which this purely demographic effect operates. Note however that this is a relatively small effect, especially if one takes into account the (after-tax) r-g differential has diminished since the early 20th century (we take this into account in the simulations). Note also in practice the correcting factor λ is further pushed towards 100% by the non-flat age-labor income profile (young workers tend to get lower wages, which diminishes the capitalized value of early labor income flows; this importance of this effect might have risen over time, and we do not take into account).

Combing equations (7.1) and (7.4), and using the Cobb-Douglas property (Y_{Lt}=(1-α)Y_t), one gets a very simple formula for the share of inheritance in total lifetime resources α^{*x} :

$$\alpha^{*x} = W_B^x/(W_L^x+W_B^x) = B_t/(B_t+\lambda(1-\alpha)Y_t)$$

If we note $b_{yt}= B_t/Y_t$ the inheritance-income ratio studied throughout this paper, then one can see that b_{yt} and α^{*x} are very closely related:

$$\boldsymbol{\alpha^{*x} = b_{ty}/(b_{ty}+\lambda(1-\alpha))} \qquad \textbf{(7.5)}$$

(again with year t = x +I)

We summarize these observations in the following proposition:

Proposition 3. Define $\alpha^{*x} = W_B^x/(W_L^x+W_B^x)$ the share of inheritance in total lifetime labor income and inheritance resources accruing to cohort x. Then in the stationary, deterministic demography model (A,H,I,D) we have:

(1) **The inheritance share α^{*x} is given by: $\alpha^{*x} = b_{yt}/(b_{yt}+\lambda(1-\alpha))$**

With $b_{yt}= B_t/Y_t$ = inheritance flow-national income ratio at time t=x+I

1-α = labor share in national income

$\lambda = [e^{(r-g)(I-A)} - e^{(r-g)(I-D)}]/(r-g)(D-A)$ = factor correcting for the cohort-x lifetime profile of labor income flows relative to inheritance flows

(2) For r-g=0%, or for r-g small and mid-life inheritance (I = (A+D)/2, e.g. A=20, I=50, D=80), then λ = 100% (first-order approximation). Generally, λ close to 100%.

(3) **The inheritance share α^{*x} in lifetime resources can be larger or smaller than the capital share α in national income.** In case λ = 100%, then the inheritance share $\alpha^{*x} = b_y/(b_y+1-\alpha)$ is larger than the capital share α if and only if $b_y>\alpha$, i.e. if and only if the inheritance flow is larger than the capital share.

The inheritance share α* is obviously not a very good measure of inequality, since it does not take into account intra-inheritance and intra-labour income inequality (we do that below). However we feel that α* is in a way a better indicator of the functional distribution of ressources than the usual capital share α – or at least that both should viewed as complementary.

Note that proposition 3 does not rely on any assumption about savings behaviour: it holds for any savings behaviour and associated steady-state inheritance-income ratios. Note that it also holds out of steady-state: if r_t is non stationary, one simply needs to take into account the relevant time profile of r_t in the λ formula.

In order to compute the true α*, however, one also needs to taken into account the fact that the real world demographic structure is not deterministic and the fact that individuals receive bequests and gifts at different point in their life. We used the simulated model to compute the true α* for cohorts born between 1850 and 2000 (for the latest cohorts we used our baseline scenario projections), and we obtained the pattern plotted on Figure 16.

Insert Figure 16: The share of inheritance in lifetime ressources received by cohorts 1850-2000

More precisely, Figure 16 reads as follows. For 19th century cohorts, average bequests and gifts receipts (capitalized at age 50) represented about 32% of average lifetime labor income resources (also capitalized at age 50). This percentage then fell abruptly and was about 8%-9% for cohorts born in the 1920s-1930s (whose parents were severely hit by the capital shocks), and about 10%-12% for the baby-boom cohorts, who had to rely a lot on themselves in order to accumulate wealth. This percentage has increased continuously since then, and according to our computations the cohorts born since the 1970s will derive inheritance resources that will be on average more than 20% of their labor income ressources.

It may be useful to put real numbers on this. For cohorts born the 1960s, who have been inheriting during the 2000s, the average lifetime labor income resources (capitalized at age 50, i.e. in the 2010s), amount according to our computations to about 2 millions €, while average inheritance resources amount to about 330 000 € (all computations are expressed in 2009 euros). This leads to a lifetime inheritance/labor ratio of about 16%, and this is what we plot on Figure 16 for the

1960s. One has to keep in mind that in 2008, French national income was about 1,700 billions €, and aggregate private wealth was about 9,500 billions €. Divided by about 47 millions adults, this yiels a per adult national income of about 35,000€, and per adult wealth of about 200,000€ (i.e. β=W/Y=w/y=560%). The labor share in (factor-price) national income was 76%, so per adult, pre-tax labor income was about 28,000€. If we were to multiply this by 60 (approximated average adult life length for these cohorts), we would find average lifetime labor income resources of about 1.7 millions €. The reason why we find about 2 billions € in average labor income resources is due to the λ effect (and also to the fact that in the simulations we take into account the true, non-flat age-labor income profile). Average inheritance (bequests plus gifts) per decedent in 2008 was about 220% of average per adult wealth, i.e. about 440,000€. The fact that we only find 330,000€ in average lifetime bequests and gifts receipts for the cohorts born in the 1960s remains to be fully understood. This could be due to several factors, including the fact that the current gift levels are not completely sustainable (i.e. the members of the 1960s cohort who have already received large gifts will receive relatively low late bequests, according to our simulated models). These computations clearly need to be further refined.

Note that these lifetime resources ratios are all pre-tax ratios. I.e. labour income is pre-tax labour income (including pre-product taxes), and inheritance is pre-estate tax inheritance. In practice, average labour income tax rates tend to substantially higher than average inheritance tax rates.[81] This implies that the inheritance share would be higher in after-tax terms, especially for the postwar cohorts. Making this correction would probably push the inheritance-labor lifetime ratio to a higher level for the recent cohorts than for the 19th century cohorts. However a proper analysis of taxation should take into account tax progressivity (both for labor income and for inheritance), as well as a number of complicated tax incidence issues, and we leave this for future research.[82]

[81] Dividing observed estate tax receipts by our estimated inheritance flow, we find an average inheritance of about 5% throughout the 20th century (see Appendic A). Direct taxation of wealth transmission has always been much less important than taxation of the capital income flows. Note however that flow taxes on capital income have a strong effect on pre tax equilibrium inheritance.

[82] See Piketty and Saez (2009, in progress).

7.2. Labor-based vs inheritance-based inequality

Now that we have computed the inheritance share in average lifetime resources, we are in a position to put inequality back into the picture. We do this by making simple assumptions about the intra-cohort distributions of labor income and inheritance, taken from the recent literature on top income shares and top wealth shares. The distribution of labor incomes appears to have relatively stable in the long run in France, with a top 10% wealth share around 26%, and a top 1% wealth share around 6%. Although estimates for the bottom parts of the distributions are less precise, the relevant wage shares also appear to have been relatively stable, with a bottom 50% wealth share around 30%, and a middle 40% wealth share of about 44%. I.e. the bottom 50% labor earners earn about 60% of average labor income, the middle 40% labor earners earn about 110% of average labor income, and the top 10% labor earners earn about 260% of average labor income (and the top 1% about 600%).[83] We assume that this intra-cohort distribution of labor income applies uniformly to all cohorts born between 1850 and 2000.

Regarding the intra-cohort distribution of inheritance receipts, we make the following assumptions. According to available estimates, the top 1% wealth share was about 50% around 1900-1910, and the top 10% wealth share was as high as 90%.[84] We assume that the bottom 50% wealth share was 5% and that the middle 40% wealth share was also 5%. I.e. the bottom 50% heirs received about 10% of average inheritance, the middle 40% heirs received about 12% of average inheritance, and the top 10% heirs received about 900% of average inheritance (and the top 1% about 5000%). A large drop in wealth concentration occurred during the 1914-1945 period. According to available estimates, the top 1% share dropped to about 25%-30% in the 1950s-1960s and remained approximately constant since then, while the top 10% share dropped to about 50%-60% and remained approximately constant since then. We make the following simplifying assumptions. For cohorts born between 1850 and

[83] See Piketty (2001, 2003). These are merely illustrative numbers, ignoring many issues. In particular, this is a gender-free paper: we ignore the fact that there are systematic inequalities between men and wormen (implicitely we do as if there was full equality between men and women; otherwise the bottom 50% share would have to be put at a lower level). This is clearly an issue that should be addressed in future research.
[84] See Piketty, Postel-Vinay and Rosenthal (2006).

1870, we assume the 1900-1910 distribution of inheritance applies uniformly. For cohorts born after 1920, we assumed that the new, less concentrated distribution applied uniformly. More specifically, we assume a constant top 1% share of 25%, a constant top 10% share of 50%, a bottom 50% share of 10%, and a middle 40% share of 40%. This is approximately the current distribution of inheritance. I.e. the bottom 50% heirs received about 20% of average inheritance, the middle 40% heirs received about 100% of average inheritance, and the top 10% heirs received about 500% of average inheritance (and the top 1% about 2500%). We assumed a linear evolution of shares between cohort 1870 and cohort 1920.[85]

Again, it may be useful to put real numbers on this. In 2008, average private wealth per adult was approximately 200,000€ (see above). The bottom 50% of the distribution owns about 20% of this on average, i.e. 40,000€. The middle 40% own about 100% of average wealth, i.e. 200,000€. The top 10% of the distribution owns about 500% of average wealth, i.e. about 1 million €. The top 1% of the distribution owns about 2500% of average wealth, i.e. about 5 millions €. These are numbers for the cross-sectional distribution of wealth among the living. For numbers on average inheritance receipts, one needs to multiply these numbers by about 220% (i.e. the current value of the μ* ratio). One can also do similar computations with the wealth shares prevailing around 1900-1910. One can see that the major evolution since 1900-1910 is the development of middle class (the middle 40%), which did not exist a century ago. For the bottom 50%, however, there has been little change: they owned virtually nothing a century ago, and they still own almost nothing.

Applying these assumptions to the lifetime inheritance-labor income resources ratios plotted on Figure 16, we obtained the inequality indicators plotted on Figures 17 to 19. These are illustrative indicators of inequality in two-dimensional inequality framework. They illustrate the relative importance of aggregate vs distributional long run changes. For instance, when we compare the top 50% heirs with the bottom 50% labor earners (see Figure 17), there is essentially no distributional effects, since the relevant wealth shares and labor income shares in the intra-cohort distributions have

[85] We know from observed data that the evolution was not linear (see Piketty, Postel-Vinay and Rosenthal (2006)). However there are so many effects going on in these lifetime inequality computations that we feel it is preferable to start by making such simplifying assumptions, so as to be able to identify the effects at work.

remained approximately constant. Therefore all the historical variations in this ratio come from aggregate changes in the importance of inheritance relative to labor income. We find that in the 19th century, the top 50% heirs received in inheritance about 100% of what the bottom 50% labor earners received in labor income throughout their lifetime. Then this ratio dropped to 25%-30% for cohorts born in the 1920s-1940s. According to our computations, this ratio has now well recovered, and will be about 70%-80% for cohorts born in the 1980s-2000s. This is really an indicator of inequality between normal people. For instance, if we take the cohort born in the 1960s, the bottom 50% labor earners are people who will earn about 1,1 millions € during their entire lifetime, i.e. approximately 15,000€ per year during 60 years (plus the capitalization effect, see above, which well may be over estimated for this population). These are roughly minimum wage individuals. In comparison, the top 50% earners will on average get about 700,000€-750,000€ in bequests and gifts throughout their lifetime, i.e. about 70% of what the first group obtained by working. Note again that these are pre-tax numbers. Given that labor tax rates are substantially larger than estate tax rates, the hierarchy between these two groups is probably reversed by the tax system. Whether this is fair or not is a complicated issue, which we take up in another paper.[86]

Insert Figure 17: Top 50% inheritance vs bottom 50% lifetime labor income received by cohorts 1850-2000
Insert Figure 18: Top 10% inheritance vs average lifetime labor income received by cohorts 1850-2000
Insert Figure 19: Top 1% inheritance vs average lifetime labor income received by cohorts 1850-2000

We also provide inequality indicators involving top 10% heirs and top 1% heirs. Here the historical changes in wealth concentration clearly played a big role – though a bit smaller than the aggregate effects. For instance, one can see that although there has been no observed change in wealth concentration since the 1950s, the lifetime resources received by the top 1% heirs have increased considerably, rising from the equivalent of 200% of average lifetime labor resources for cohorts born in the 1920s

[86] See Piketty & Saez (2009).

to almost 600% of average lifetime labor resources for cohorts born since the 1980s. Of course, this is still much less than for 19th century cohorts: at that time, top 1% heirs received on average the equivalent of 1600% of average lifetime labor income. In other words, they could have a pretty confortable life without working: this was the rentiers class. With 600% of average lifetime labor income, one cannot live as confortably as with 1600%. Note however that 600% corresponds almost exactly to what the top 1% labor earners are making. In other words, for cohorts born in the 1980s-1990s, the top 1% heirs will receive as much (and in fact substantially more in after tax terms) in inheritance than what the top 1% labor earners will earn in labor income during their entire lifetime. This is major change as compared to the cohorts born in the 1920s-1950s: for these cohorts the top 1% heirs were getting about 200%-300% of average lifetime labor income, i.e. less than twice than less than top 1% labor earners. This illustrates we believe an important change in the economic and social structure. For mid-20th century cohorts, material well being required hard work and large labor income: for the first time maybe in history, there was no way one could live as well by simply receiving inheritance. However for the more recent cohorts this is much less so.

7.3. The share of inheritance in total wealth accumulation

Our inheritance flow results can also be used to provide estimates of the share of inheritance in aggregate wealth accumulation. In the 1980s, there was a famous controversy about the share of inheritance in aggregate US wealth accumulation, opposing Kotlikoff and Summers (1981, 1988) and Modigliani (1988). Kotlikoff and Summers argued that the inheritance share was as high as 80%, while Modigliani (a strong proponent of life-cycle theory) argued that the inheritance share was as low as 20%. Given that they were both using basically the same data, and actually a single data point for the US aggregate inheritance flow (namely, for year 1967), this was a pretty large confidence interval, and this controversy was certainly confusing for many scholars and students (including myself). We do not use any US data in this paper, so we cannot directly comment on their specific computations. However our long run inheritance flow series for France shed some light on this controversy. First, even though there are reasons to believe that the U-shaped long run pattern of the inheritance flow is particularly pronounced in France (and probably more pronounced than in the US), it is clear from our findings that one should not use a single data point in order to infer steady-state estimates. Capital accumulation takes time, and it is important to take a longer run perspective on these issues.

Next, in addition to their disagreement about the measurement of the inheritance flow (which the limitations of US estate tax data did not allow them to fully resolve), Kotlikoff-Summers and Modigliani also had a major conceptual disagreement. They did not use the same definition for the inheritance share in aggregate wealth accumulation, and this difference in definition accounts for the biggest part in their 80% vs 20% disagreement. Namely, Kotlikoff-Summers defined the inheritance share as the share of capitalized bequests in aggregate wealth, while Modigliani defined the inheritance share of non-capitalized bequests in aggregate wealth. I.e. Kotlikoff-Summers used the following formula for bequest wealth W_{Bt}:

$$W_{Bt}/Y_t = \int_{s<t} B_{st}/Y_s \exp(r_{st} - g_{st}) \, ds \qquad (7.6)$$

With: B_{st} = bequests received at time s by individuals that are still alive at time t
r_{st} = cumulated return to capital between time s and time t
g_{st} = cumulated growth rate between time s and time t
B_{st}/Y_s = bequest-income ratio (assumed to be stationary)

Assuming that everybody dies at age D and inherits at age I (with D-I=H), which both Kotlikoff-Summers and Modigliani did, and assuming we are on a steady-state growth path, equation (7.6) becomes:

$$W_{Bt}/W_t = B_t/W_t \, (e^{(r-g)H} - 1)/(r-g) \qquad (7.7)$$

Modigliani used the same definition, except that he did not include any capitalization factor for past bequests, so that for him the bequest share W_{Bt}^*/W_t was given by:

$$W_{Bt}^*/W_t = B_t/W_t \, (1-e^{-gH})/g \qquad (7.8)$$

Now, in a world with g=r=0, both formulas are identical, and everything boils down to the “estate multiplier” formula used by early 20th century economists:[87] $W_B=W_B^*=(D-I)B$, i.e. bequest wealth equals the bequest flow times the generation length (about 30 years). But in a world with g>0, and r>g, whether one uses formula (7.7) or formula (7.8) obviously makes a big difference. In effect, Kotlikoff-Summers were defining life-cycle savings as labor income minus consumption, while Modigliani was defining life-cycle savings as labor income plus capital income minus consumption. I.e. Modigliani was counting savings out of capital income (including the capital income deriving from inherited wealth itself) as life-cycle savings.

We applied both definitions to our French inheritance flow series, and to the observed patterns of growth rates and rates of returns, and obtained the results plotted on Figure 20. Several observations are called for. First, and unsurprisingly, we find a very pronounced U-shaped pattern for the inheritance share in aggregate wealth, which is simply the lagged equivalent to the inheritance flow series. Next, and most importantly, we see that for the 19th century the Kotlikoff-Summers definition yields inheritance shares above 100% (about 130%-140%), while the Modiglini definition delivers inheritance share below 100% (about 70%-80%). The same pattern applies for the 21st century. This simply follows from the fact that according to our findings, nearly all of wealth came from inheritance during the 19th century, and most of the savings came from the return to inherited wealth. Since Kotlikoff-Summers include the full return to capital into their capitalized bequest share definition (including the fraction of the return that was actually consumed by heirs), they are bound to find an inheritance share above 100%. Conversely, since Mogliani treats heirs who do not consume the full return to their inherited wealth as life-cycle savers (which is quite counter-intuitive), he is bound to find an inheritance share below 100%.

Insert Figure 20: The share of inheritance in aggregate wealth accumulation France 1900-2050

Even though the Kotlikoff-Summers definition is – in our view – logically more consistent than the Modigliani definition, we feel that none of them is fully

[87] Except that early 20th century economists implicitely assumed that the inheritance sshare in aggregate wealth was equal to 100%. See section 2 above.

satisfactory. In particular, it seems to us that a logically consistent definition should deliver a 100% estimate for the inheritance share in the 19th century. Most importantly, it is clear that in the real world there are both heirs (who thanks to their inheritance could consume more than their labor income) and life-cycle savers (who received no or little inheritance, but accumulated wealth out of their labor income). With a purely aggregate, representative-agent definition, one cannot take this into account.

We propose the following definition. Take aggregate wealth W_t, and divide the living population into two groups: “heirs” and “savers”. “Heirs” are defined as the set of living individuals whose current wealth w_{it} (at the present date) is smaller than the capitalized value w_{Bit} of the inheritance they received in the past. Note W_{tH} the total current wealth of these individuals and W_{BtH} the total capitalized value of the inheritance they received in the past. “Savers” are defined as the set of living individuals whose current wealth w_{it} (at the present date) is larger than the capitalized value w_{Bit} of the inheritance they received in the past. Note W_{tS} the total current wealth of these individuals and W_{BtS} the total capitalized value of the inheritance they received in the past. We then define total bequest wealth $W_{Bt}= W_{tH} + W_{BtS}$, and the inheritance share in aggregate wealth as W_{Bt}/W_t.

The advantage of this definition is that it is always between 0% and 100%, and that it delivers an inheritance share of 100% (or just below 100%) for pure rentiers societies of the 19th century type. The inconvenient of this definition is that it very demanding in terms of data. One needs to know the correlation between labor income, inheritance and savings behavior. In particular, note that the inheritance share according to this definition can have little relationship with inheritance flows. E.g. one can imagine extreme cases with very large inheritance flows but very small inheritance share in aggregate wealth, in case heirs quickly eat up all of their wealth. In order to illiustrate how this works we computed approximative estimates of the inheritance share of total French wealth using this alternative definition (see Figure 20). These estimates are based on simplifying assumptions (namely, uniform savings rates for “heirs” and “savers”, and a correlation of 0.5 between labor income and inheritance, with exogenous linear-Pareto functional forms for wealth and labor income distributions), and should be viewed as merely illustrative. To push these computations further, one would need to properly integrate distributional dynamics into the model.

TO BE COMPLETED

7.4. Transmission of inequality over more than two generations

The concepts of inheritance shares (in total lifetime resources, or in total wealth accumulation) defined above make no difference between the wealth accumulated by the previous generation and the wealth accumulated several generations ago: this is all "inheritance". However from a normative viewpoint this seems to make a difference. Apparently most people feel that when inheritance derives directly from one's parents labour income savings, then somehow the resulting inequality in lifetime resources is "less unfair" than if it derives from wealth accumulated two centuries ago. E.g. one often hears the argument that the parents have already paid taxes on their labor income, while one rarely hears this argument for the grand-parents and grand-grand-parents. This is a major issue that needs to be addressed in future research, and that will again require a proper modelling of intergenerational shocks and correlations, and a proper modelling of these implicit normative criteria.[88] We did simple, preliminary computations of the following form. Assume we shift from the current estate tax to an alternative estate tax where have the choice between paying the tax on the estate they received from their parents, or on the capitalized value of the estate that their parents received from their own parents. One simple question to ask is: how much would that cost in terms of tax revenues. Preliminary computations suggest that the cost would have been large if such a reform had been applied in the 1960s-1980s (when most of the estates derived directly from the parents' own savings), but that this cost is bound to converge towards very low levels (below 10% of total estate tax receipts) in the 21st century.

7.5. Public pensions vs private wealth accumulation

[88] See above.

In this paper, unfunded pay-as-you-go pensions were not treated as wealth. They were instead treated for what they are, i.e. replacement income for the elderly, financed by compulsory payroll tax on workers. Pensions do play an role in the analysis: they make the age-augmented labor income profile much flatter than what it would be otherwise. Of course, an important question is: what would have happened in the absence of public, compulsory pension schemes? On this issue this paper has very little to say. Presumably, workers would have increased their savings and accumulated more wealth. To what extent would this have raised the aggregate wealth-income ratio, and reduced the long-run rate of return? We do not know.

Historical evidence clearly shows that saving for retirement is only one among many motives for wealth accumulation. The aggregate wealth-income ratio was around 600%-700% in the 19th century (at a time when retirement was not much of an issue, since average age at death was about 60), and it is again very high in today's France (in spite of the fact that public pensions offer replacement rates around 80%). But this surely does not mean that in the absence of public pensions the aggregate wealth-income ratio would not have risen throughout the 20th century. By how much exactly is hard to say.

At some level the question is not very well formulated. Public, pay-as-you-go pension schemes are an important part of the real world, and presumably there are reasons why they were introduced in the first place, namely because of highly volatile returns to capital.[89] We find it hard to analyze the interplay between public pension schemes and private wealth accumulation without introducing explicitly these reasons into the picture. We find it also very hard to address these questions without taking explicitly into account distributional issues. For instance, the current annual flow of pension income transferred from active to retired workers is about 15% of national income in France. It is tempting to compare this number with the inheritance flow going in the other direction, and which is also about 15% of national income. However what is misleading in this comparison is obviously that these are not the same people: the

[89] In France a funded public pension sheme was introduced in 1928. But it collapsed during the 1930s and World War 2. In the 1950s-1960s, poverty rates among the elderly were very high, and led to a strong demand for increasing replacement rates (and payroll tax rates). The current financial crisis will probably not contribute to make funded pensions more popular in France. The probability of large cuts in the public pension system in the coming decades is probably close to zero.

distribution of pension income is relatively egalitarian (a bit more than the distribution of labor income), while the distribution of inheritance is highly concentrated, with a top 10% share of about 50%, and the the bottom 50% of the population receiving almost no inheritance at all. Addressing this issue would require again a proper modelling of distributions, and falls beyond the scope of the present paper.

7.6 Inheritance vs human capital investments & other family transfers

Ideally one would also like to take into account parental transfers that do not take the form of explicit bequests and gifts – which we did not attempt to do in the present paper. For instance, household expenditure surveys provide estimates of regular inter-households monetary transfers, which are often not recorded as gifts by the estate tax system. The corresponding transfers are generally relatively small (usually less than 2% of national income), and would not affect our findings very much. The more challenging part, both conceptually and empirically, has to do with human capital investments. From a normative viewpoint, it would clearly be desirable to treat in the same way parents who give 100,000€ in inter vivos gifts and parents who pay 100,000€ in tuition fees for their children. There are several difficulties, however. First one would need to include public educational spending: a big part of human capital investment is financed by taxes, presumably in order to equalize opportunities between children with unequal parents. Next, educational goods are partly investment goods and partly consumption goods. Developing a conceptual and empirical framework that can address simultaneously inheritance issues (bequests and gifts in the traditional sense) and human capital investment is an important challenge for future research.

8. Concluding comments

What have we learned from this paper? In our view, the most important contribution of this paper is to pinpoint that there is nothing inherent in the structure of modern economic growth that should lead a long run decline of inherited (non-human) wealth relatively to labor income. In very long run, there does not seem to be any decline in aggregate wealth-income ratios and capital shares. From an aggregate viewpoint, wealth and capital income are likely just as important in the 21st century as they were in the 19th century: in the very long run private wealth-national income ratios seem to be more or less stable around 600%, and capital shares relatively stable around 30% of national income. With such unchanged macroeconomic parameters, the simple arithmetic of growth and wealth accumulation is likely to operate pretty much in the same way in the future as it did in the past. In particular, the r>g logic implies that past wealth and inheritance are bound to play a key role in the future.

Now, does this mean that the rise of human capital did not happen? No. It did happen, in the sense that human capital is what made long run productivity growth and self sustained economic growth possible. We know from the works of Solow and from the modern endogenous growth literature that (non-human) wealth accumulation alone cannot deliver self-sustained positive growth. I.e. human capital is what made g>0. In the 19th century and early 20 century, most economists were unable to think about self sustained growth, precisely because they were unable to conceptualize the idea of sustained productivity growth that would not originate in capital accumulation. For instance, Karl Marx clearly had in mind a model where all growth originates in capital accumulation, which led him to apocalyptic conclusions: the wealth-income rises indefinitely, leading either a rising capital share and falling labor share, or to a fall in rates of returns, and in any case to non sustainable long run economic, social and political outcomes. In his view, and in the view of most economists, it was obvious r>g, since g was implicitly assumed to be zero. With g=0 and r>0, the law of compound interest is indeed very powerful, and can produce highly unbalanced long run outcomes. Human capital is what made long run growth sustainable, both from a macro and distributional viewpoint.

What we add to this debate is threefold. First, by re-analyzing 1820-1913 patterns, we find that it is maybe not too surprising if some of the economists of the time (such as Marx) had such an apocalyptic view of capitalist development. As a matter of fact, growth was very close to zero (g=1.0%), a lot smaller than rates of return (r=5%-6%). Most of wealth was inherited, and the concentration of wealth reached phenomenal levels. The aggregate wealth-income ratio was actually slightly rising (with a limited fall in rates of return, due to the accumulation of foreign assets), and so was wealth concentration.[90] Retrospectively, this really looks like a rentier society, and a place where one does not want to live in. Although this was a quasi-steady-state from an economic viewpoint, this was clearly not a social and political steady-state.

Next, looking at the 21st century, we stress that a world with g positive but small is not completely different from a world with g=0. The rise of human capital made long run growth possible. But if the long run rate of productivity growth is small, then the r>g logic will have the same consequences as before.

Finally, our findings suggest that well designed government policy can to some extent make a difference and counteract this logic. In particular, tax policies, by reducing the gap between r and g (but not too much, because everybody needs capital), can limit the extent to which wealth perpetuates itself over time and across generations, both from an aggregate and from a distributional viewpoint.

[90] In 1913, the top 1% share was 72% of the total estate flow in Paris, vs 65% in 1902 and 55% in 1887. For the whole of France, the top 1% share rose from about 45% in 1887 to about 55% in 1913. See Piketty, Postel-Vinay and Rosenthal (2006).

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INCOMPLETE LIST, TO BE COMPLETED

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Figure 1: Annual inheritance flow as a fraction of national income, France 1900-2008

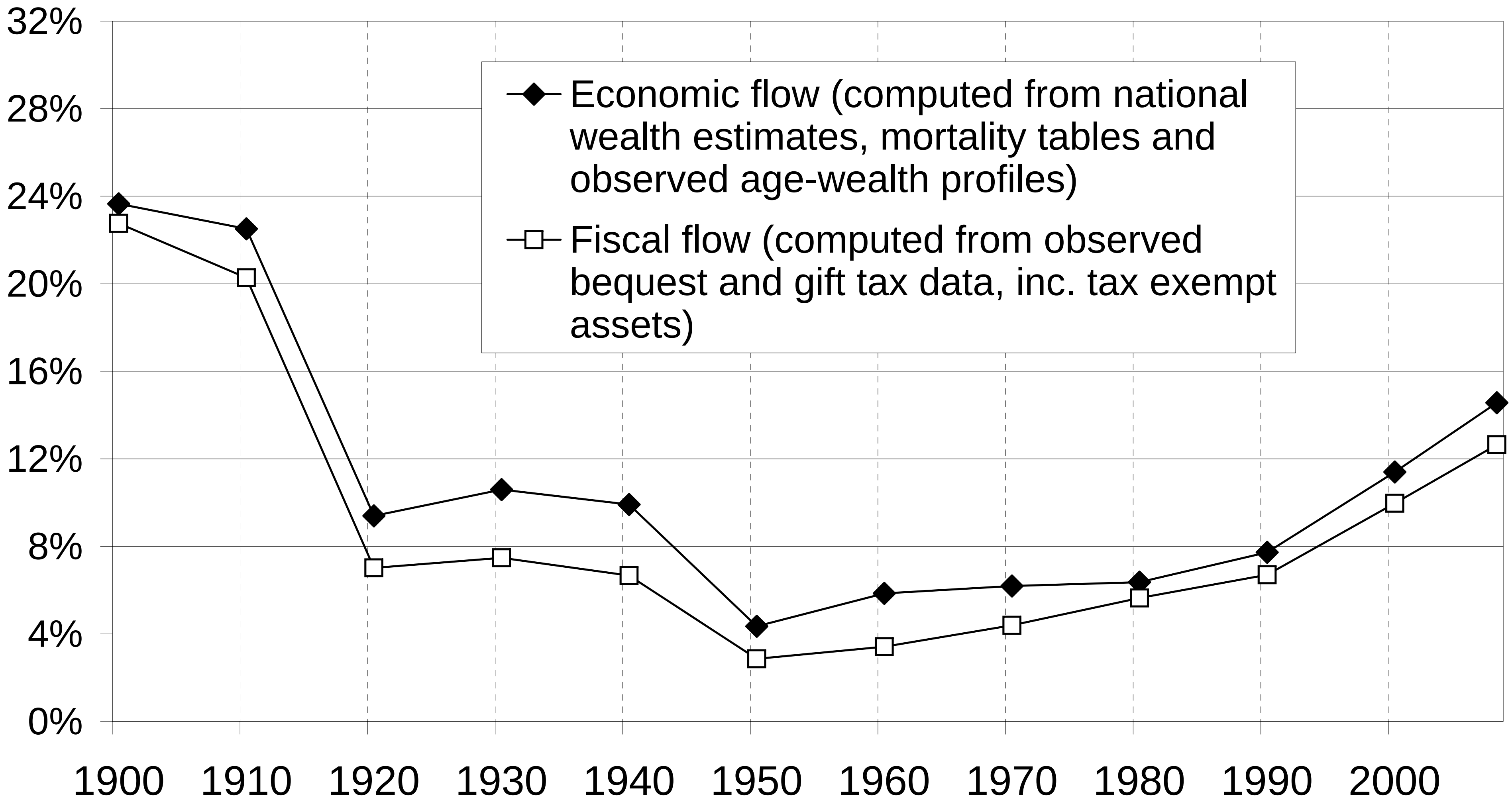


Figure 2: Annual inheritance flow as a fraction of national income, France 1820-2008

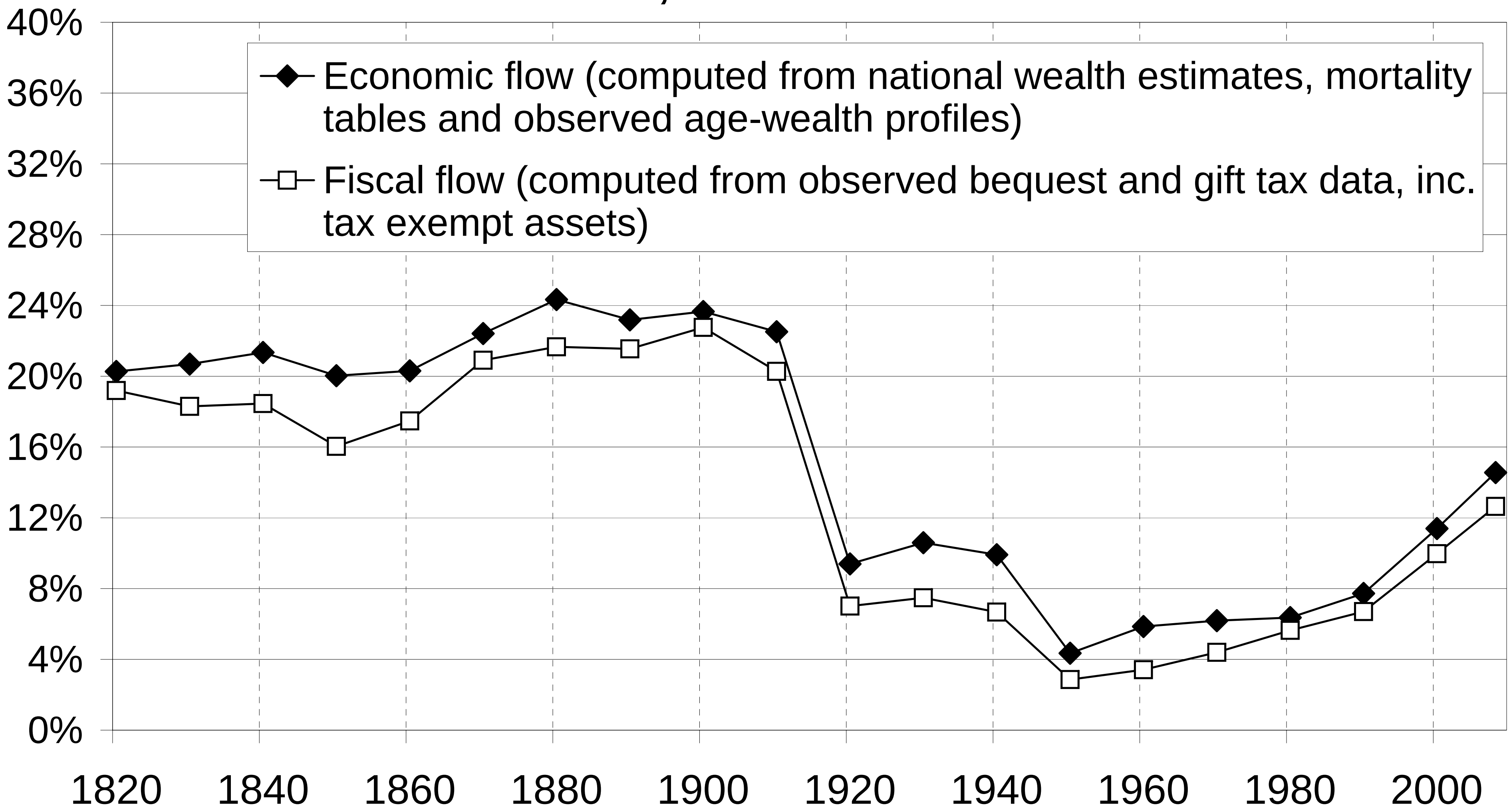
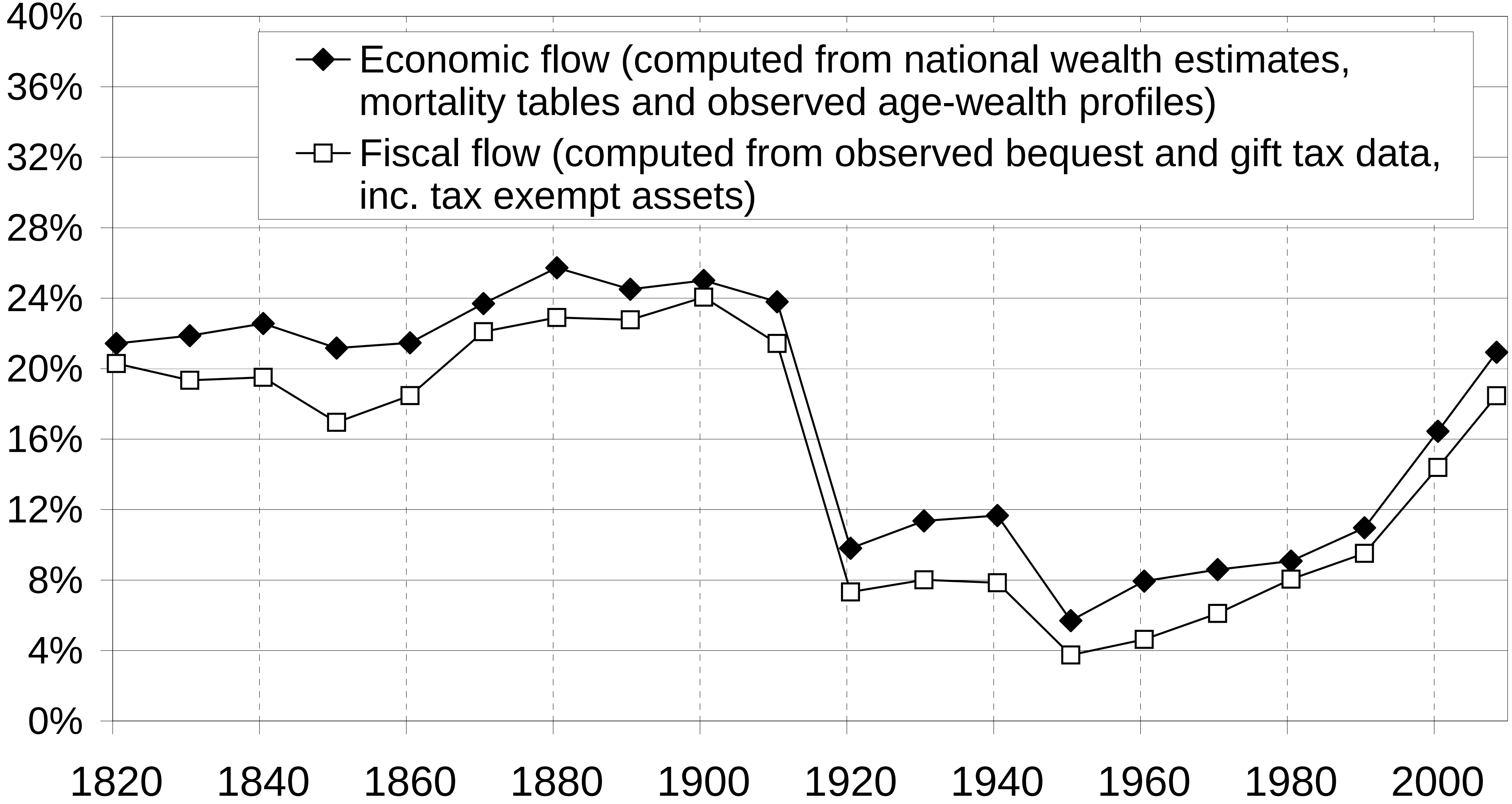


Figure 3: Annual inheritance flow as a fraction of disposable income, France 1820-2008



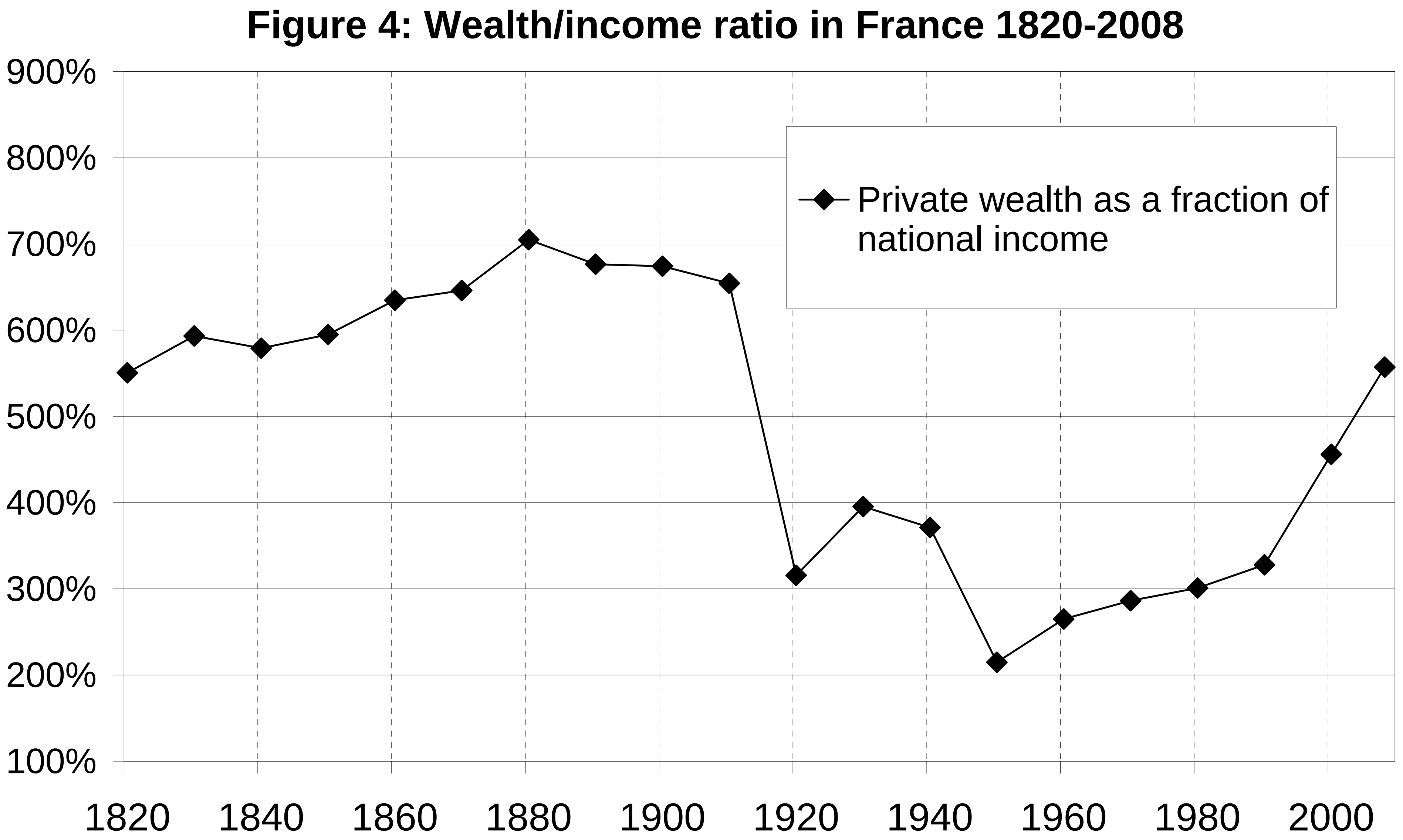


Figure 4: Wealth/income ratio in France 1820-2008
900%
800%
700%
600%
500%
400%
300%
200%
100%
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
Private wealth as a fraction of national income

Table 1: Accumulation of private wealth in France, 1820-2009

	Real growth rate of national income g	Real growth rate of private wealth g_w	Savings-induced wealth growth rate $g_{ws} = s/\beta$	Capital-gains-induced wealth growth rate q	*Memo: Consumer price inflation* *p*
1820-2009	1.8%	1.8%	2.1%	-0.3%	*4.4%*
1820-1913	1.0%	1.3%	1.4%	-0.2%	*0.5%*
1913-2009	2.6%	2.4%	2.8%	-0.3%	8.3%
1913-1949	1.3%	-1.7%	0.7%	-2.4%	*13.9%*
1949-1979	5.2%	6.2%	5.4%	0.8%	*6.4%*
1979-2009	1.7%	3.8%	2.8%	1.0%	*3.6%*

Figure 5:Wealth/disposable income ratio France 1820-2008

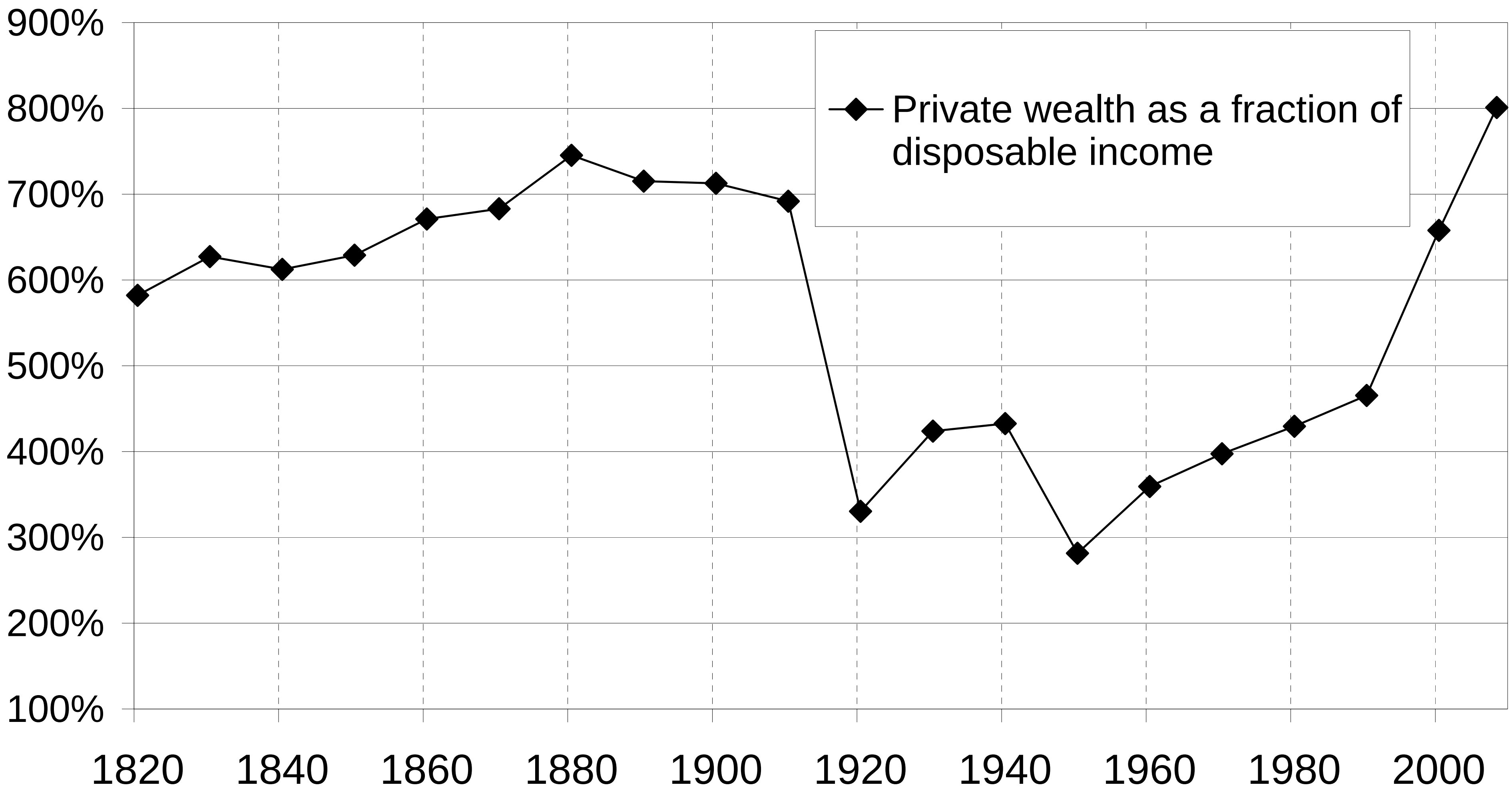


Figure 6: Mortality rate in France, 1820-2100

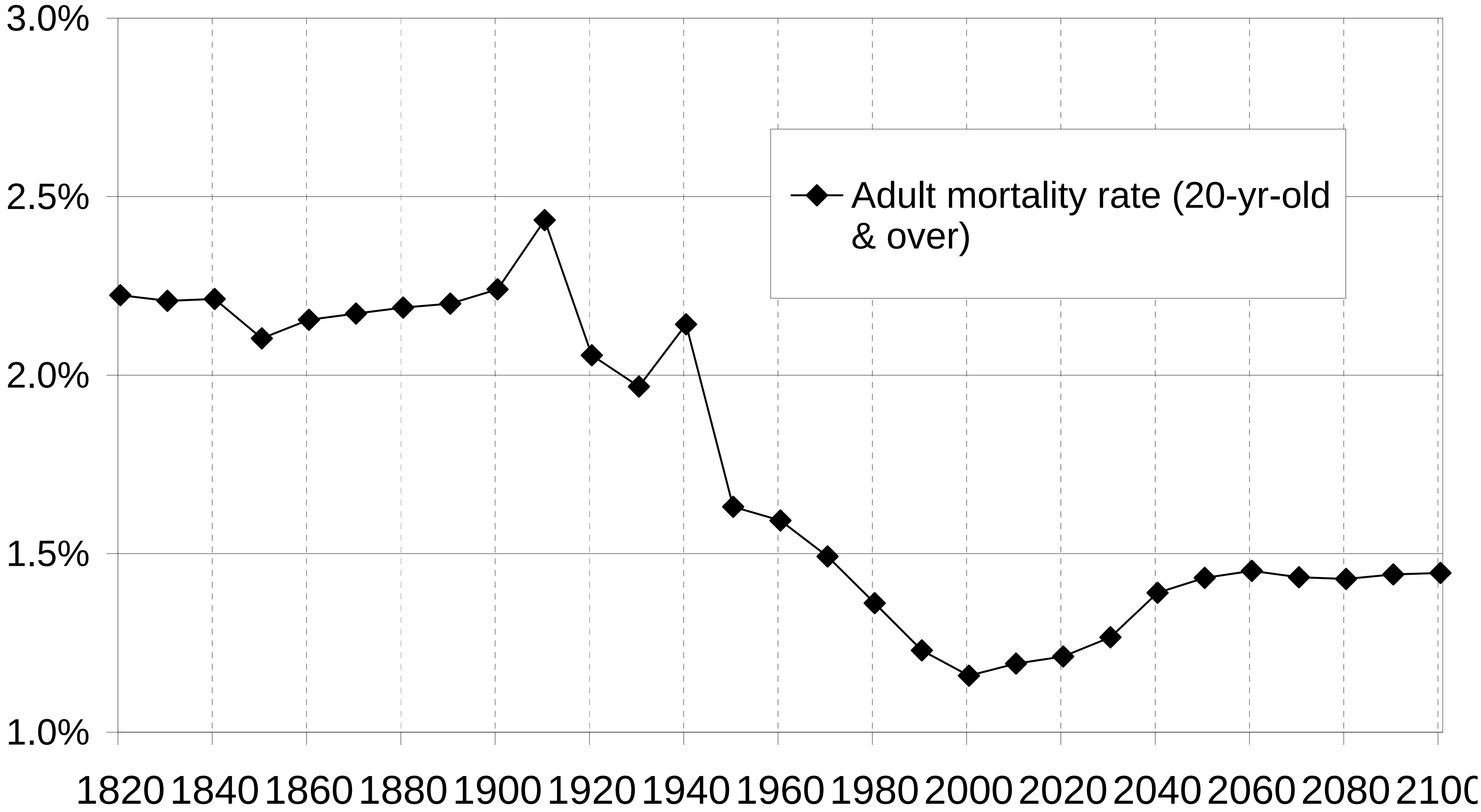


Figure 7: Age of decedents & heirs in France, 1820-2100

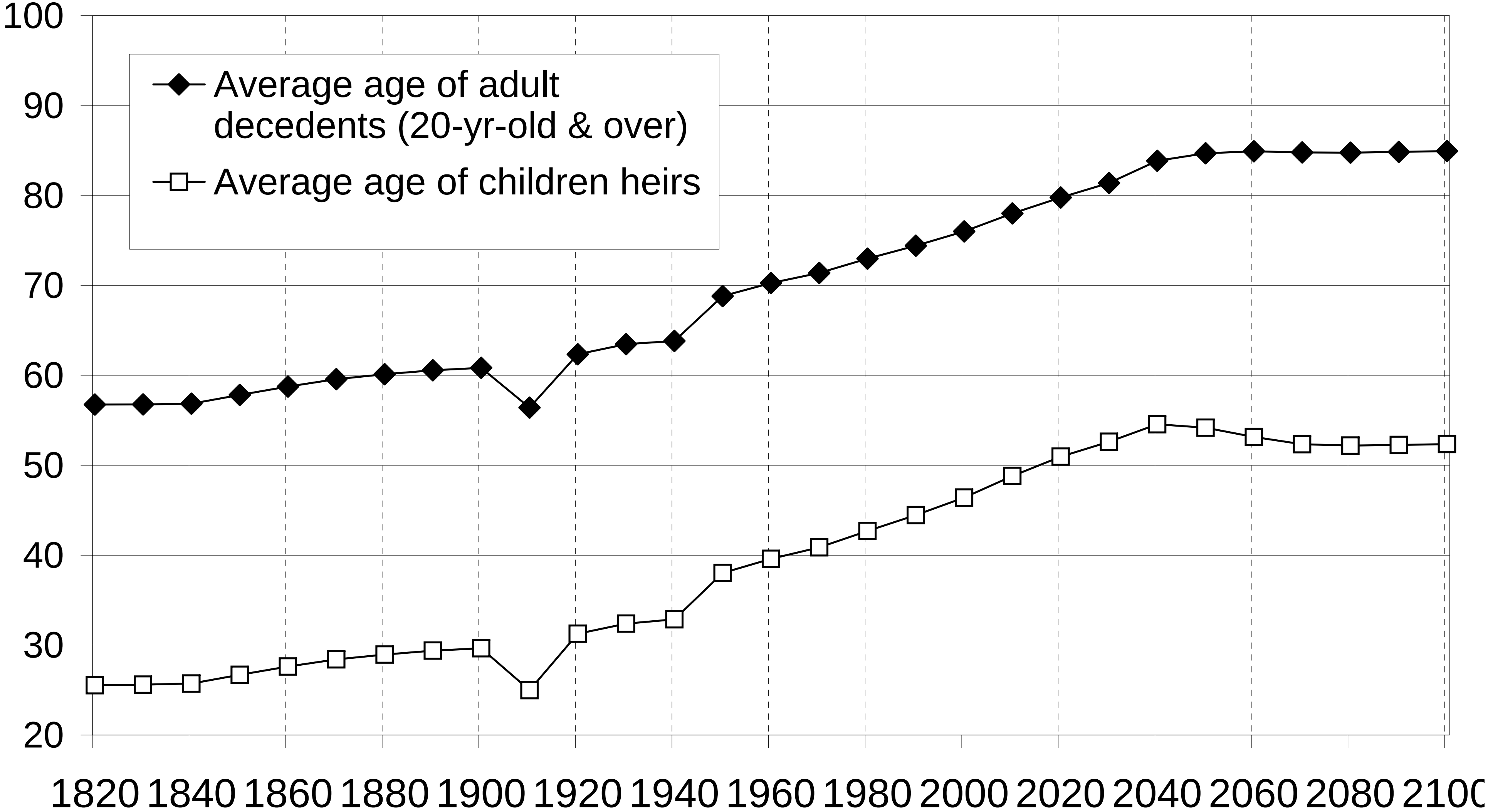


Figure 8: The ratio between average wealth of decedents and average wealth of the living in France 1820-2008

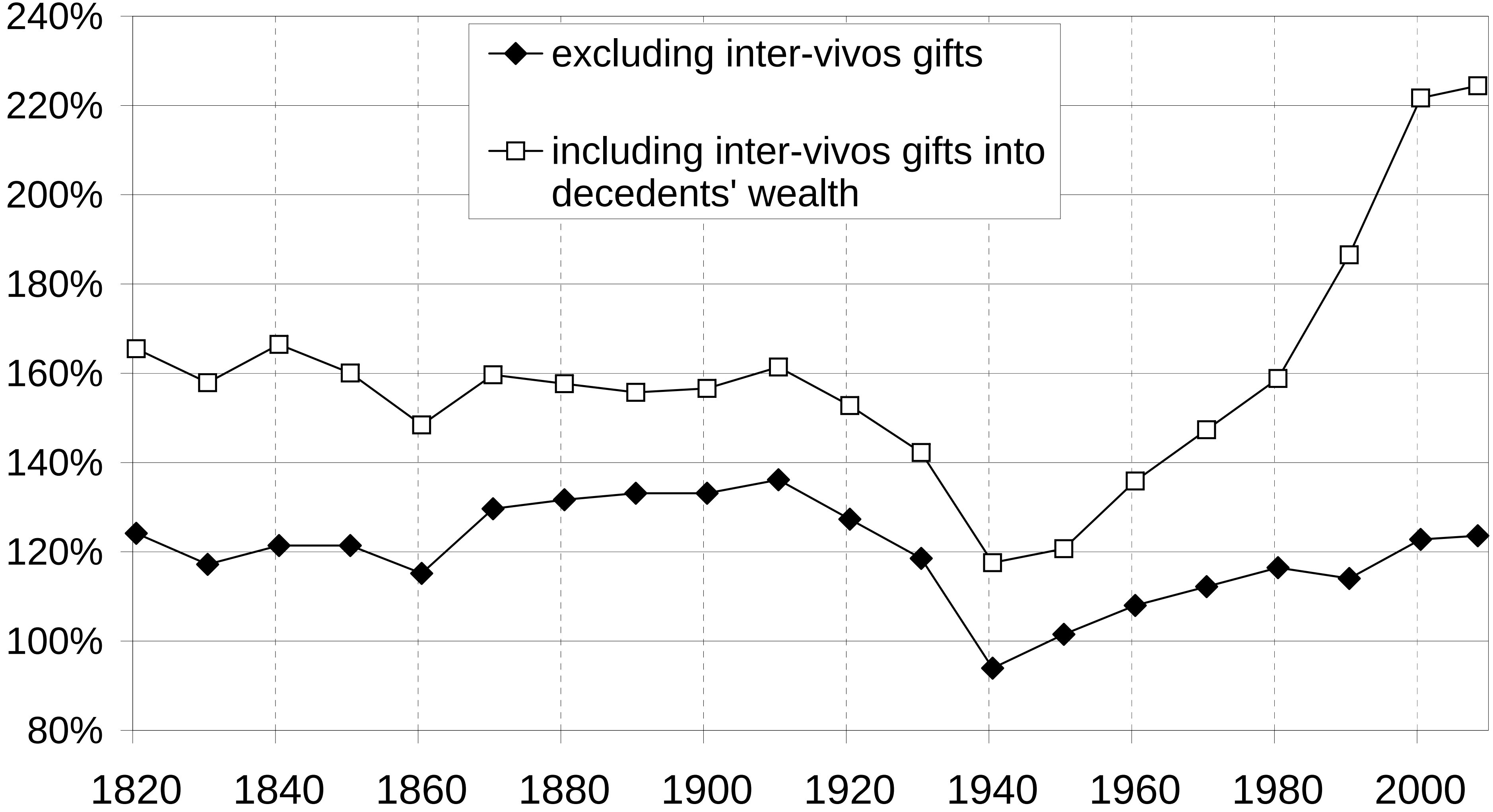


Table 2: Raw age-wealth-at-death profiles in France, 1820-2008

	20-29	30-39	40-49	50-59	60-69	70-79	80+
1827	50%	63%	73%	100%	113%	114%	122%
1857	57%	58%	86%	100%	141%	125%	154%
1887	45%	33%	63%	100%	152%	213%	225%
1902	26%	57%	78%	100%	172%	176%	233%
1912	23%	54%	74%	100%	158%	176%	237%
1931	22%	59%	77%	100%	123%	137%	143%
1947	23%	52%	77%	100%	99%	76%	62%
1960	28%	52%	74%	100%	110%	101%	87%
1984	19%	55%	83%	100%	118%	113%	105%
2000	19%	46%	66%	100%	122%	121%	118%
2006	25%	42%	74%	100%	111%	106%	134%

Figure 9: Steady-state cross-sectional age-wealth profile in the dynastic model ($r = \theta + \sigma g$, $s_L = 0$, $s_K = g/r$)

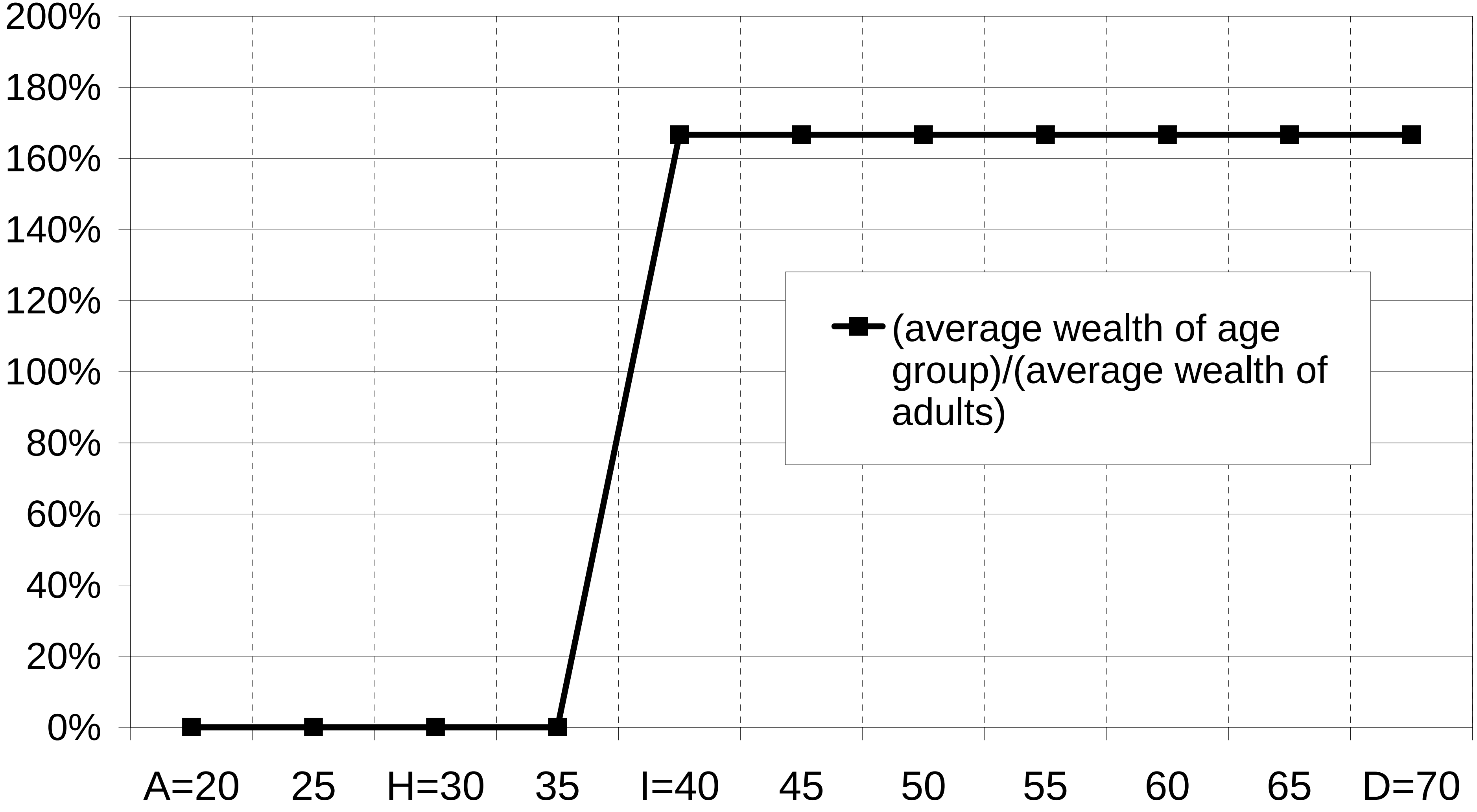


Figure 10: Steady-state cross-sectional age-wealth profile in the dynastic model with demographic noise

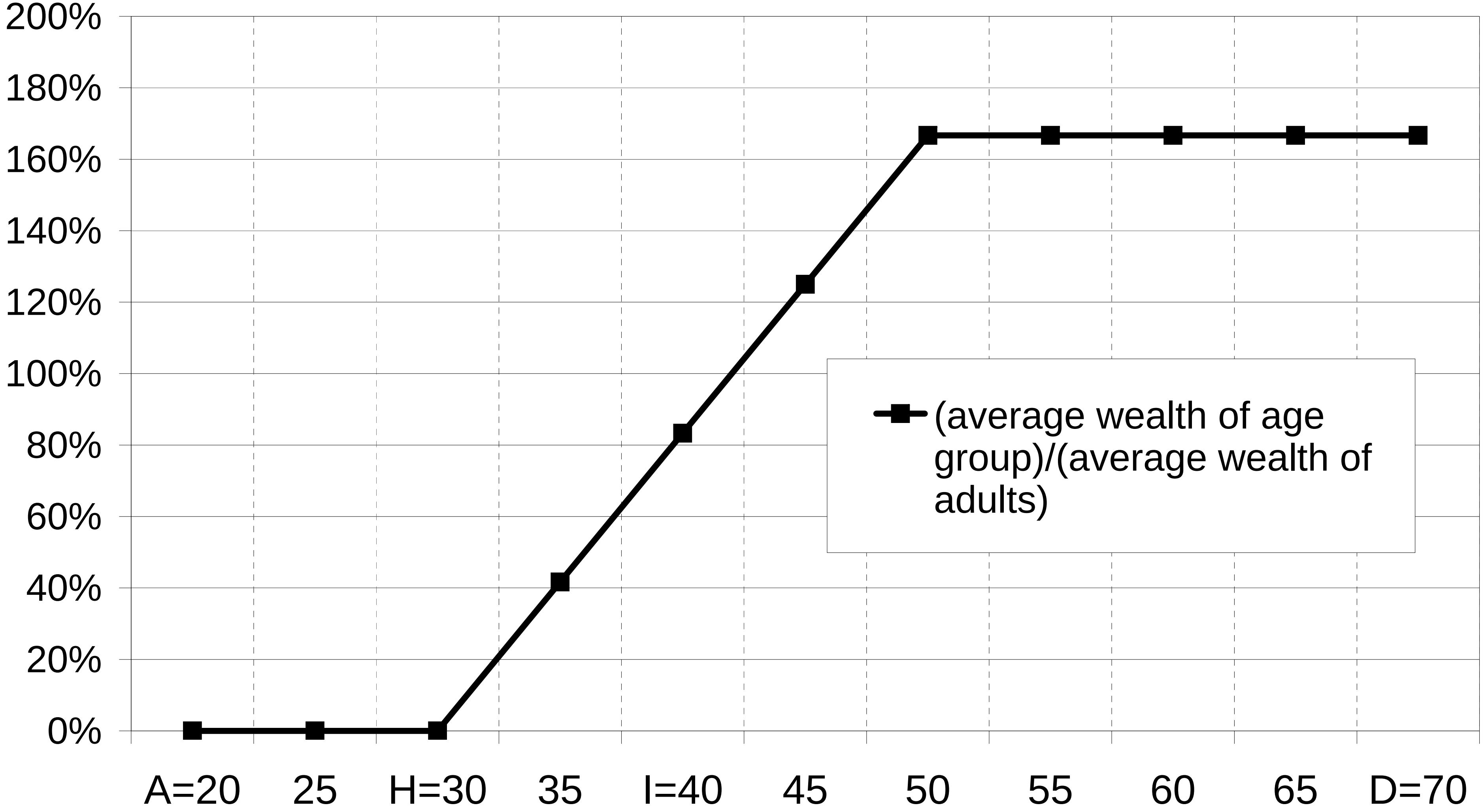


Figure 11: Private savings rate in France 1820-2008

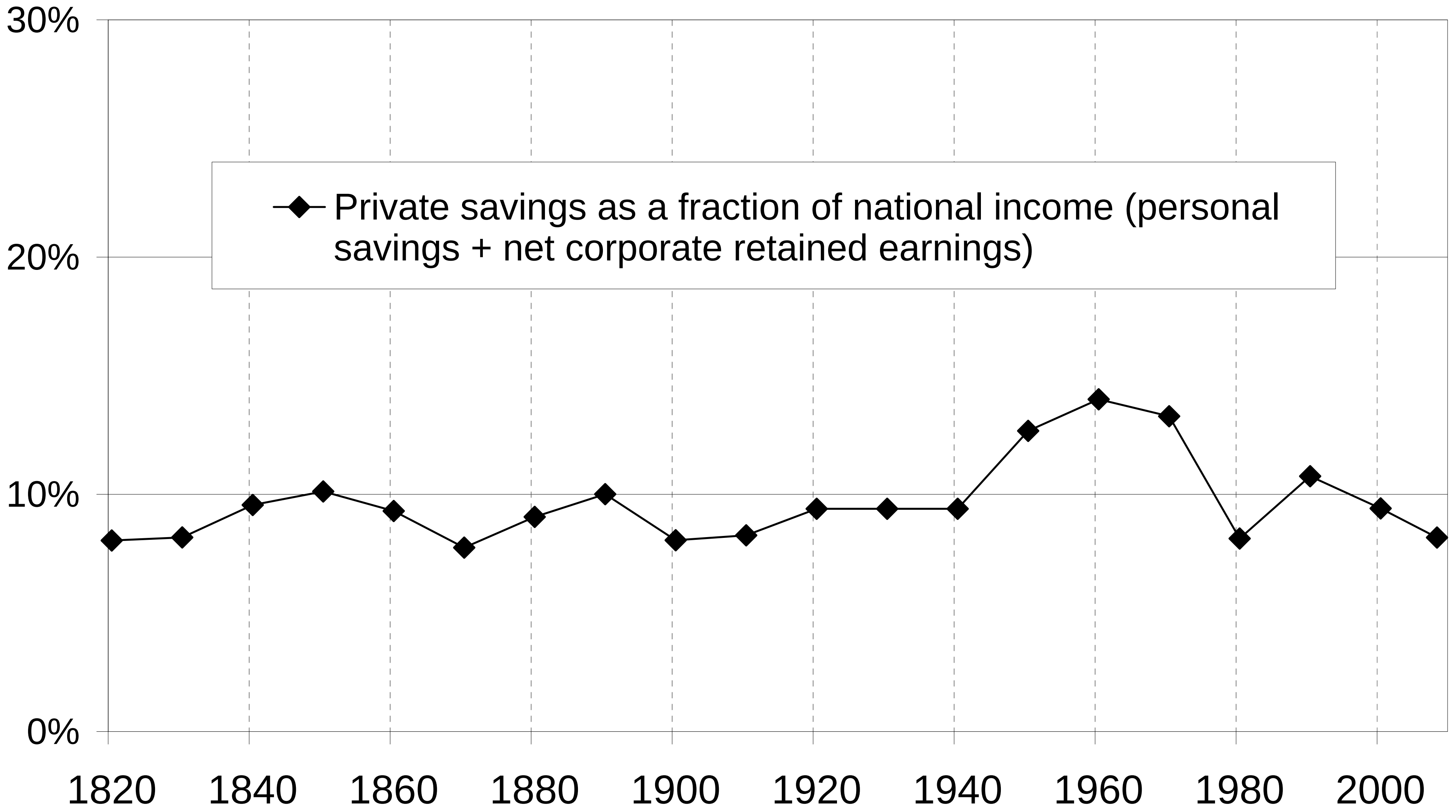


Figure 12: Observed vs simulated inheritance flow, France 1820-2050

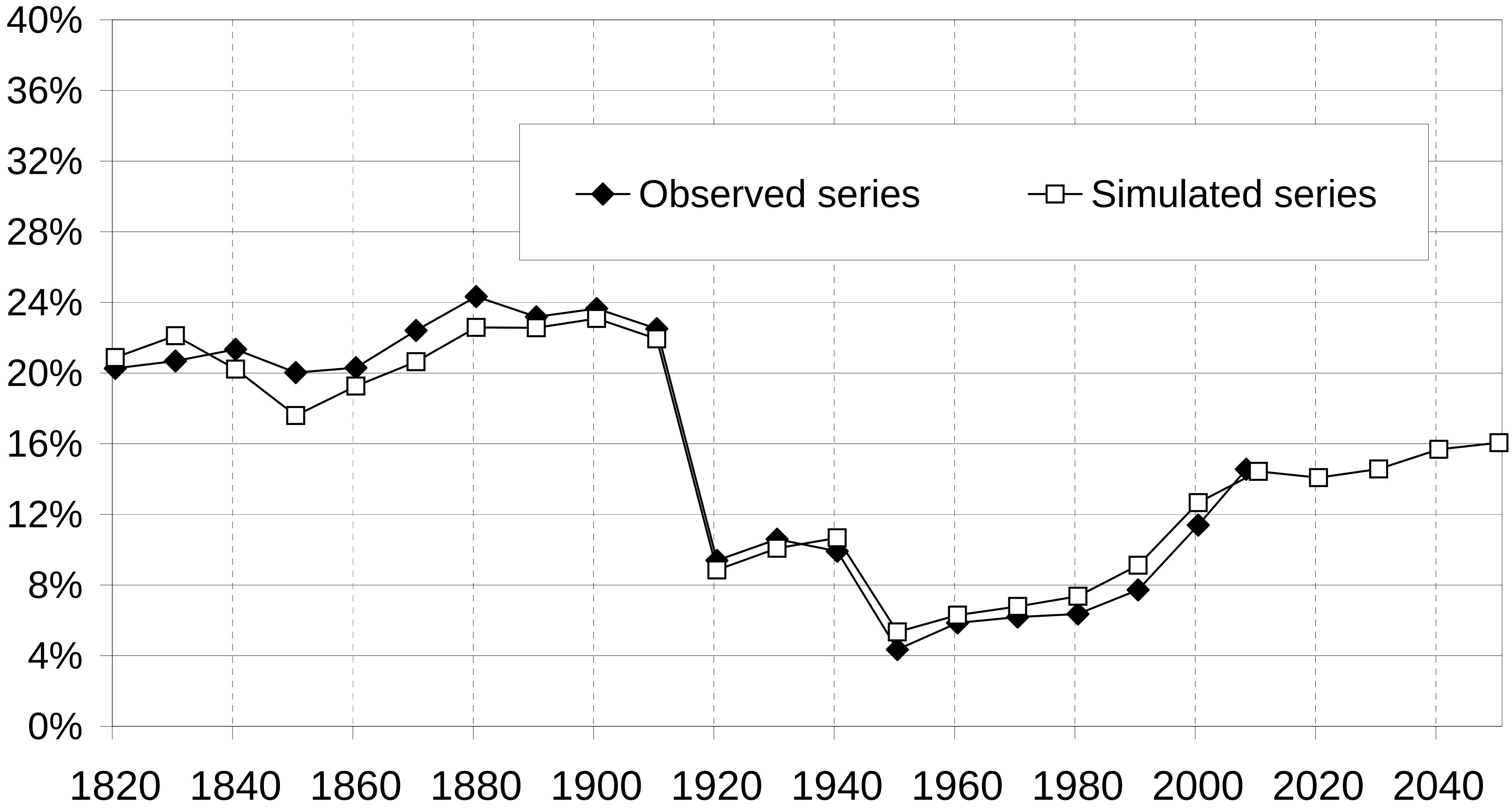


Figure 13: Labor & capital shares in (factor-price) national income, France 1820-2008

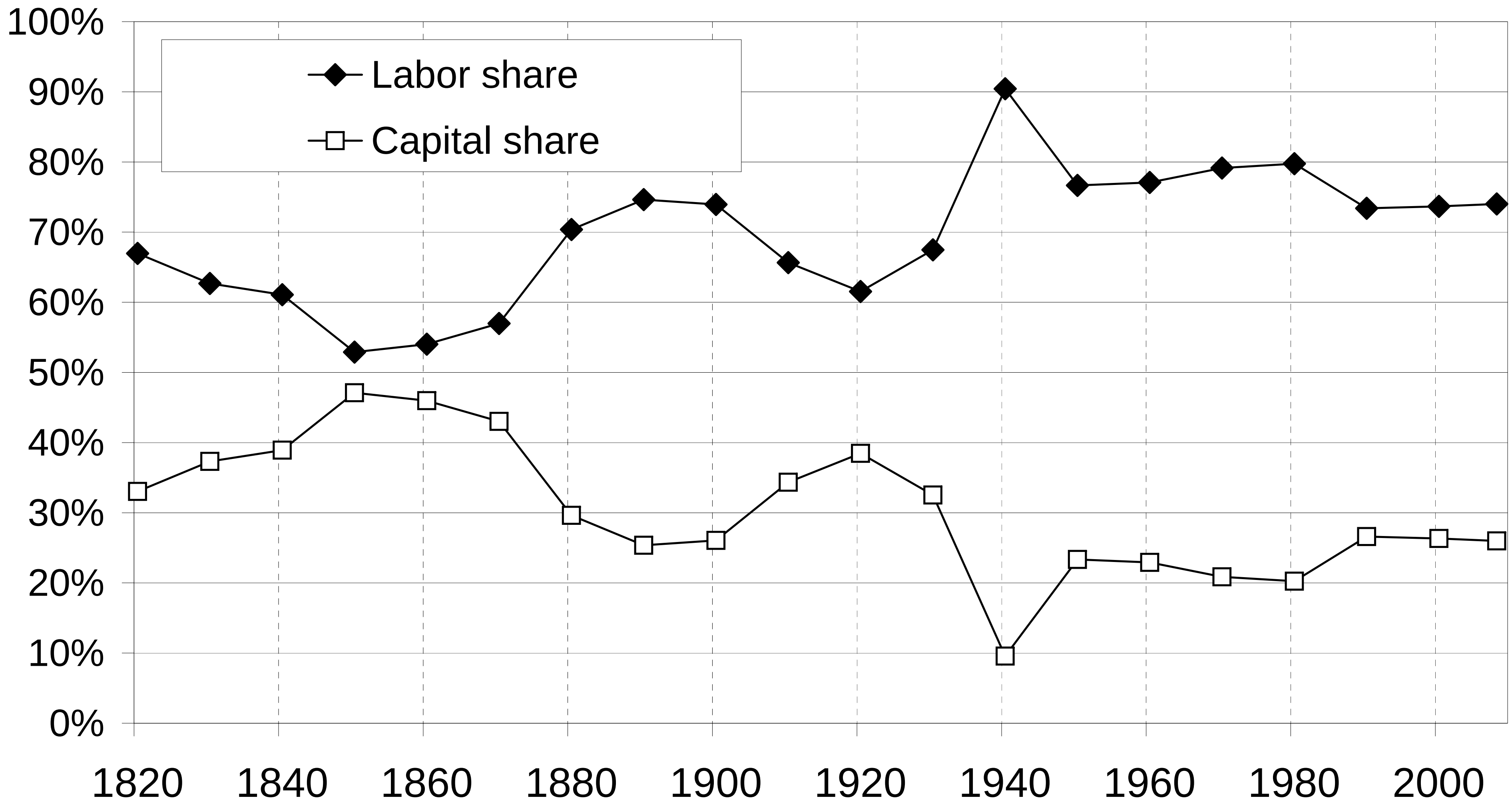


Figure 14: Rate of return vs growth rate France 1820-1910

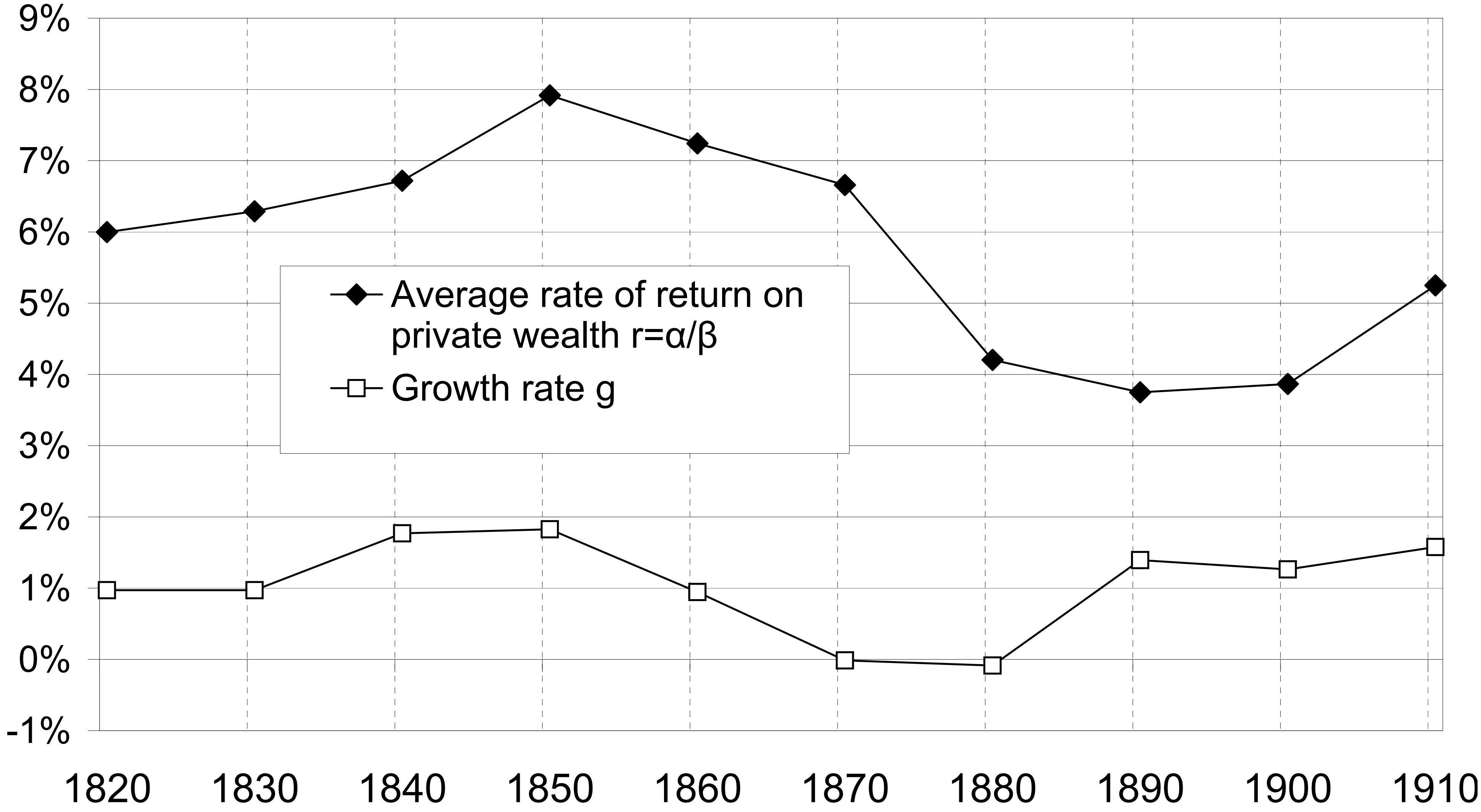


Figure 15: Capital share vs savings rate France 1820-1910

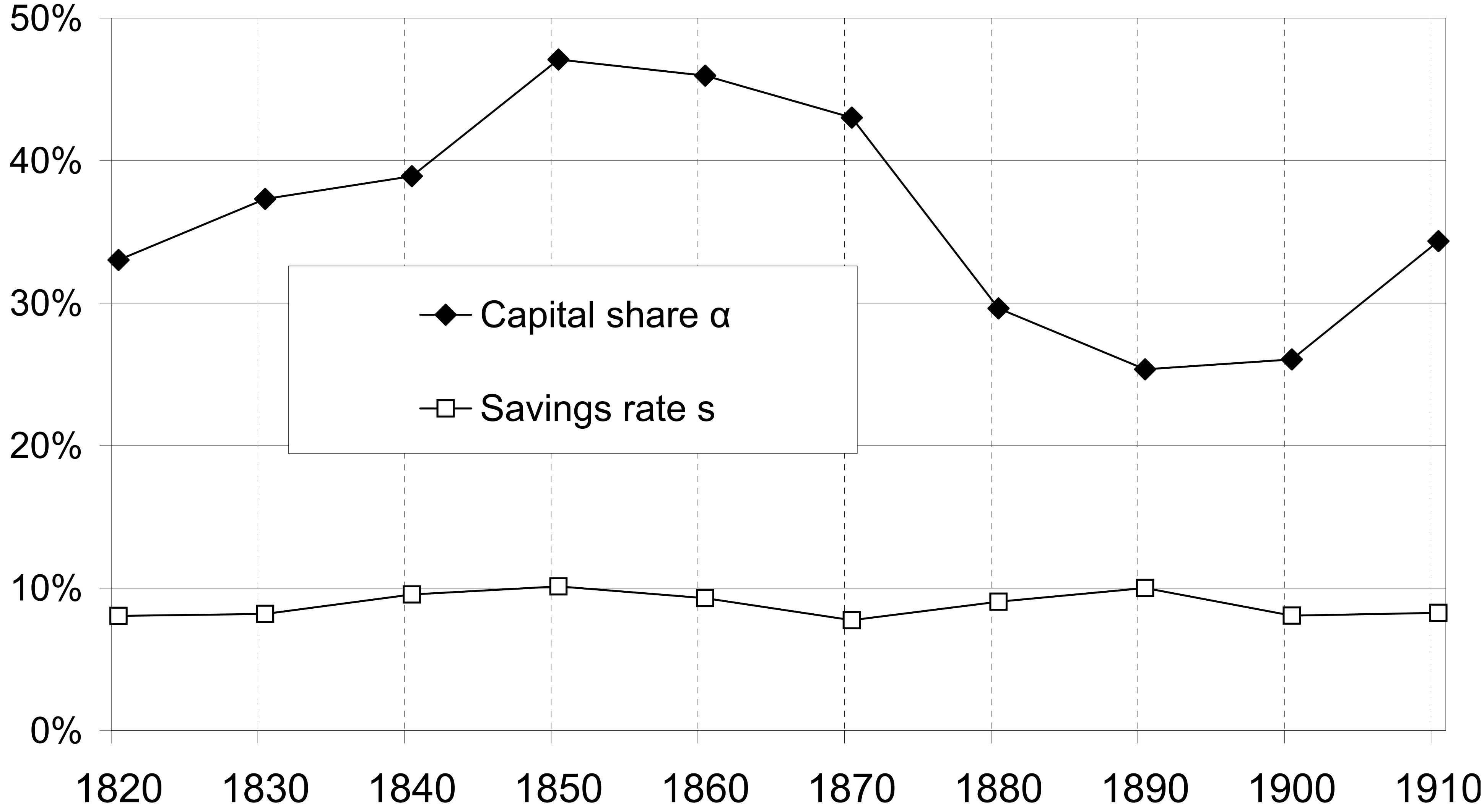
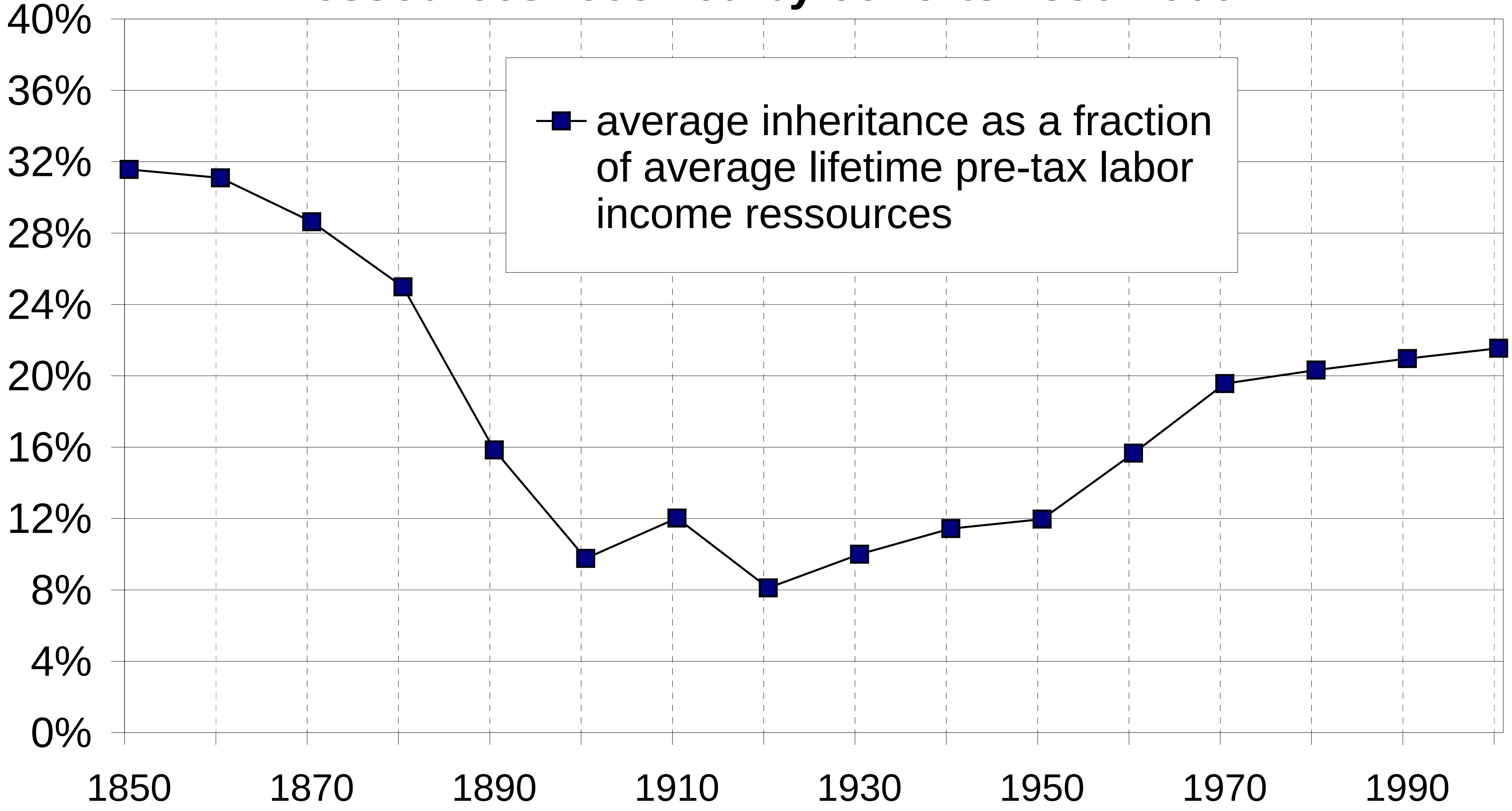


Figure 16: The share of inheritance in lifetime ressources received by cohorts 1850-2000



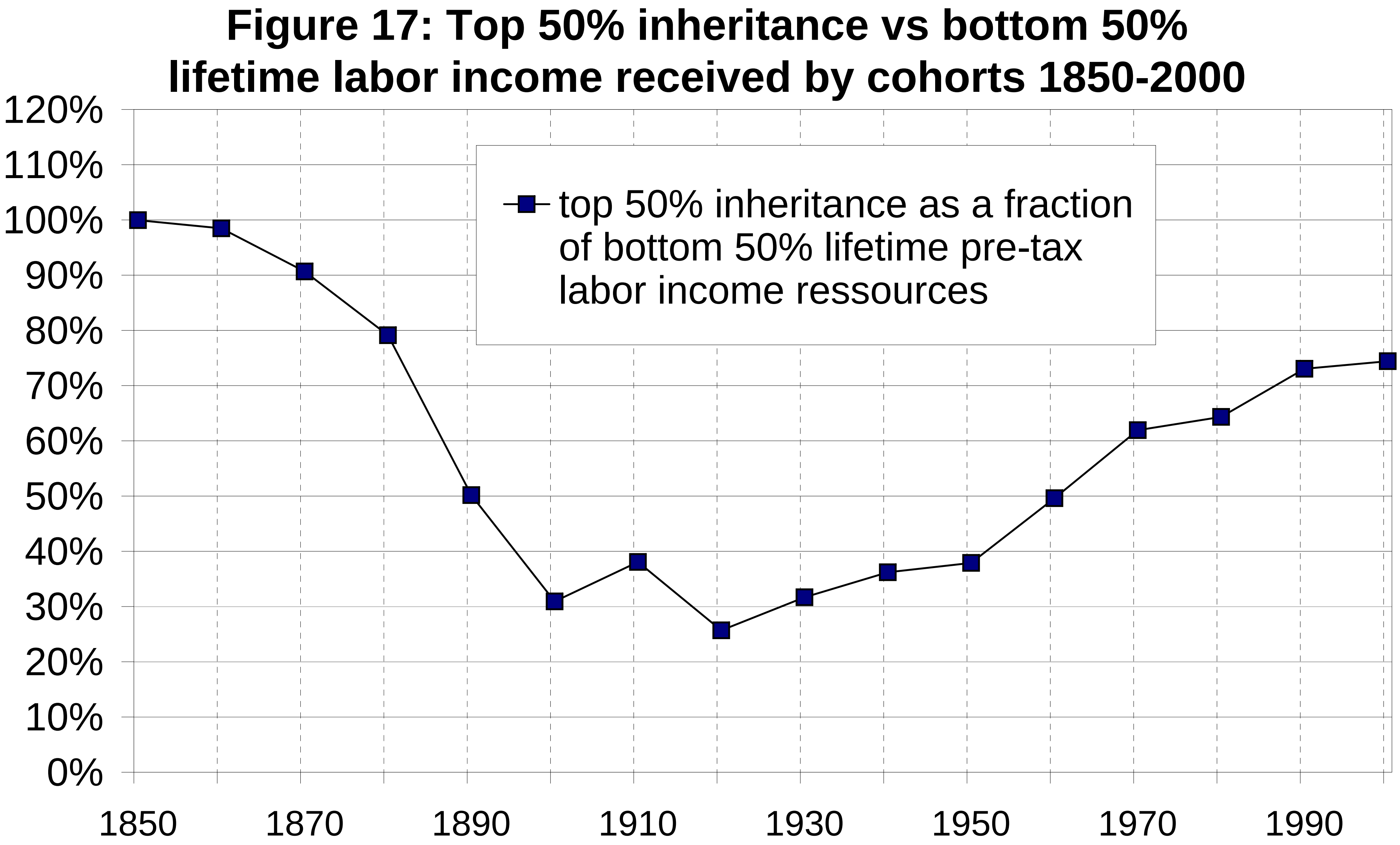


Figure 17: Top 50% inheritance vs bottom 50%
lifetime labor income received by cohorts 1850-2000
top 50% inheritance as a fraction of bottom 50% lifetime pre-tax labor income ressources
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1850
1870
1890
1910
1930
1950
1970
1990

Figure 18: Top 10% inheritance vs average lifetime labor income received by cohorts 1850-2000

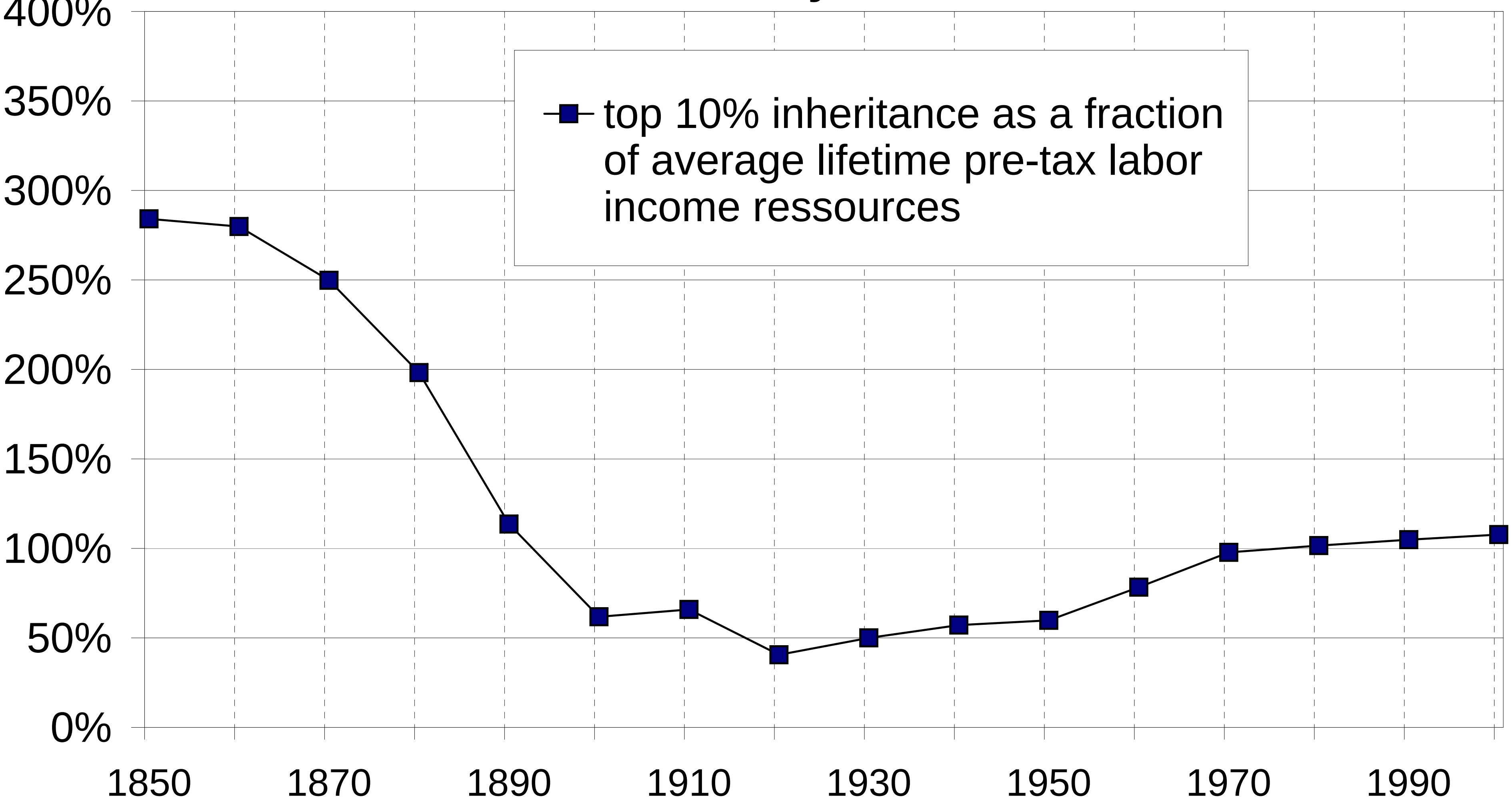


Figure 19: Top 1% inheritance vs average lifetime labor income received by cohorts 1850-2000

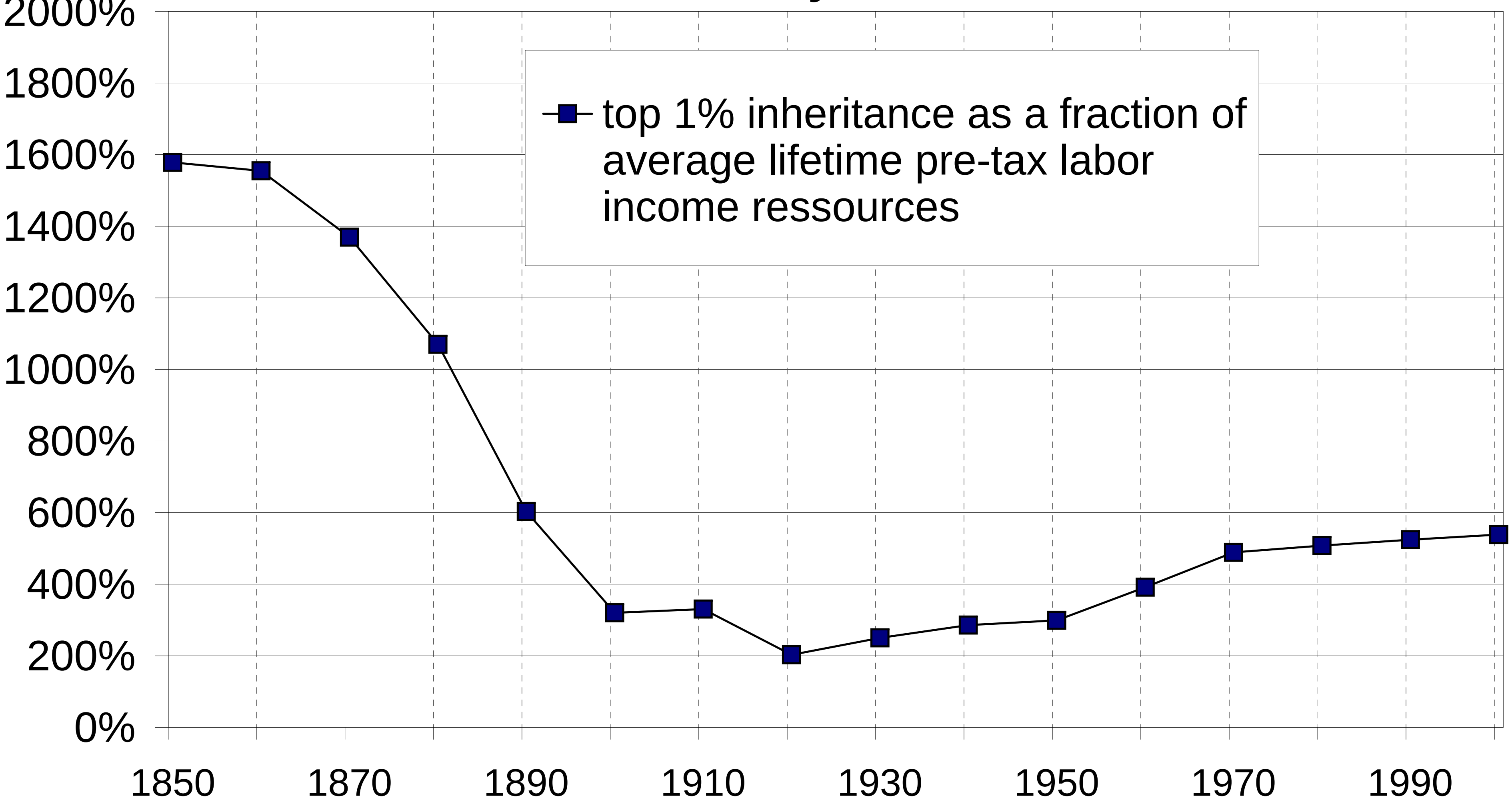


Figure 20: The share of inheritance in aggregate wealth accumulation , France 1900-2050

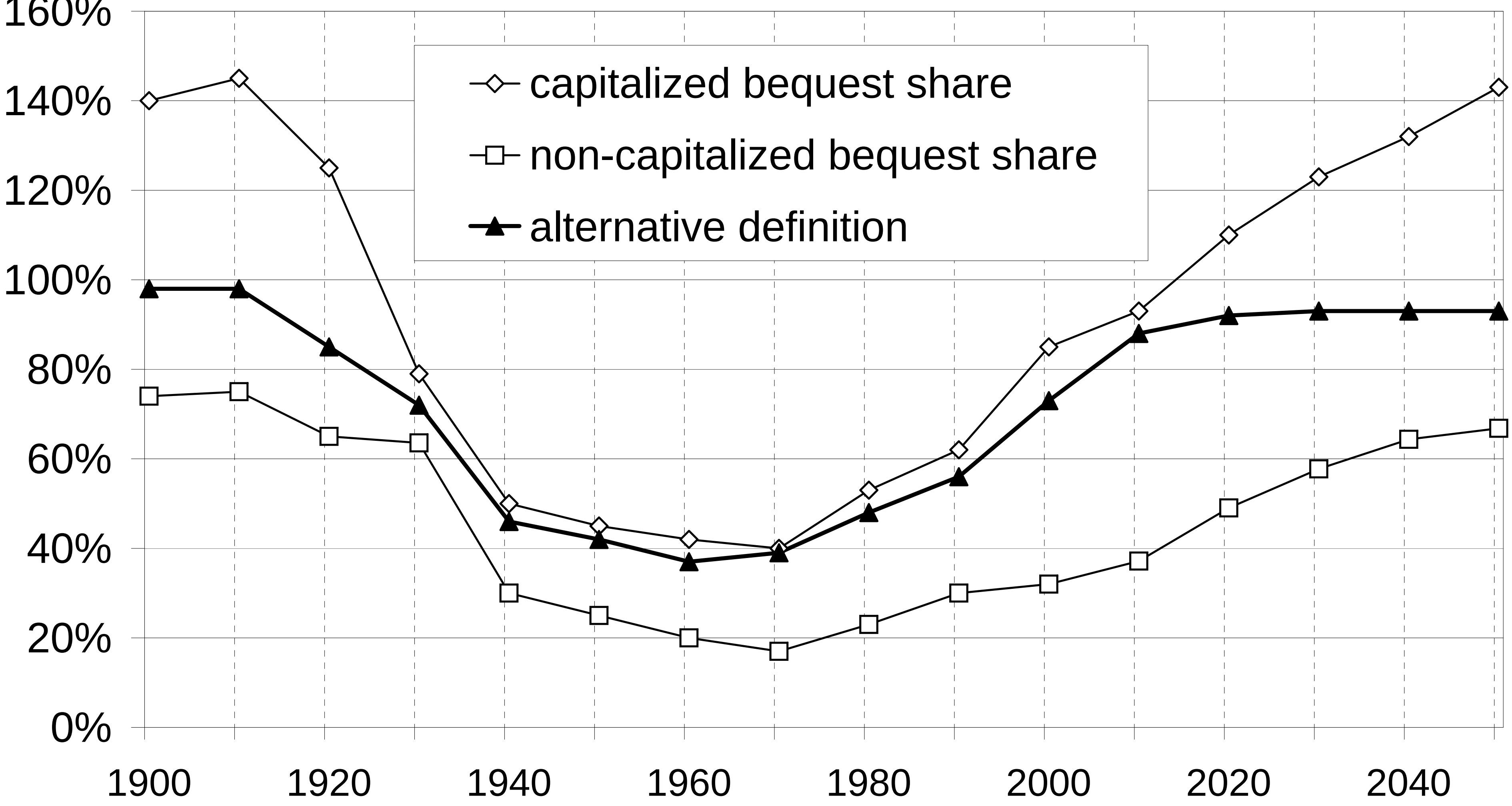


Figure A1: Annual inheritance flow as a fraction of national income, France 1900-2008 (annual series)

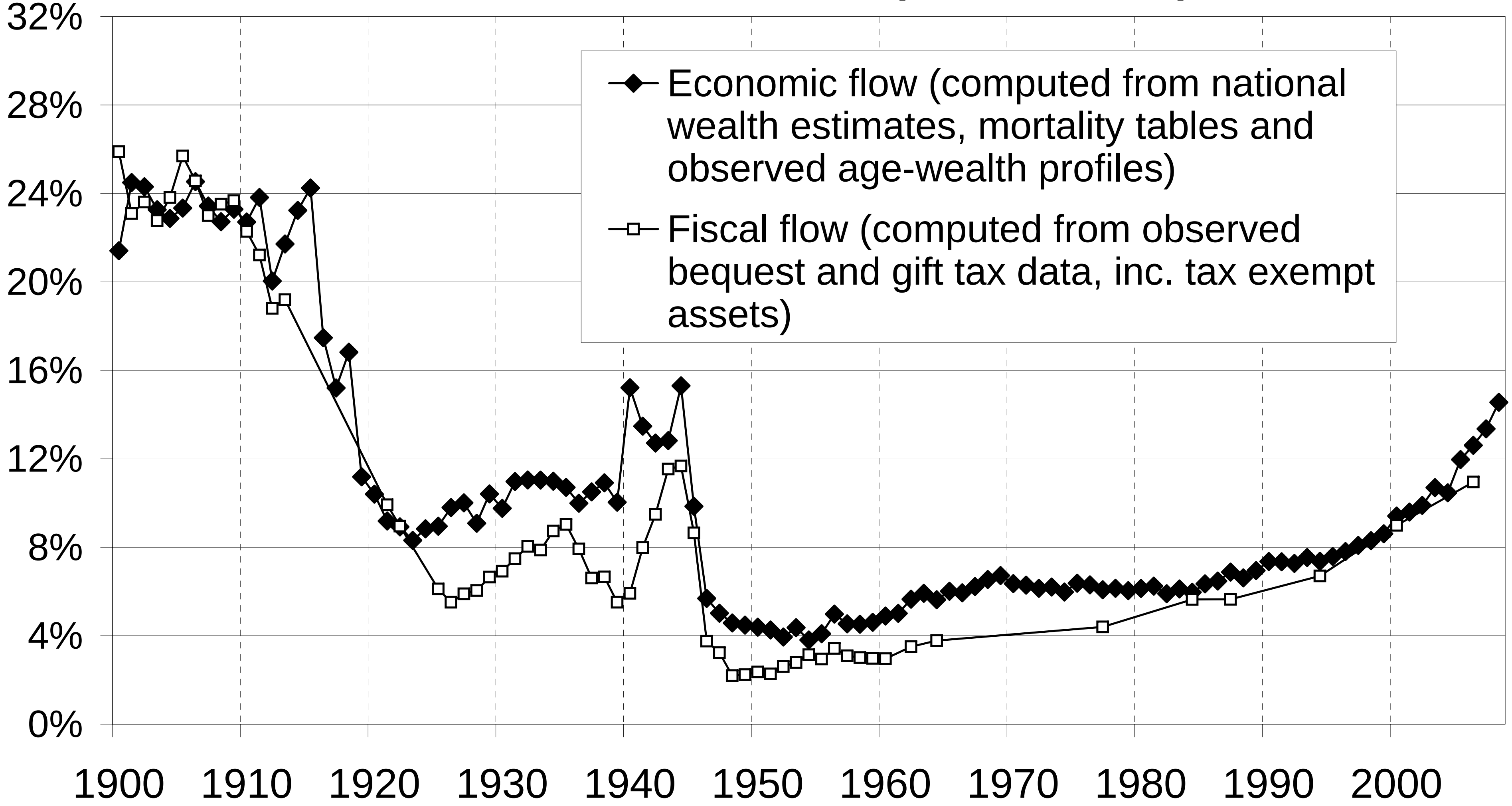


Figure A2: Wealth-income ratio in France 1896-2009 (annual series)

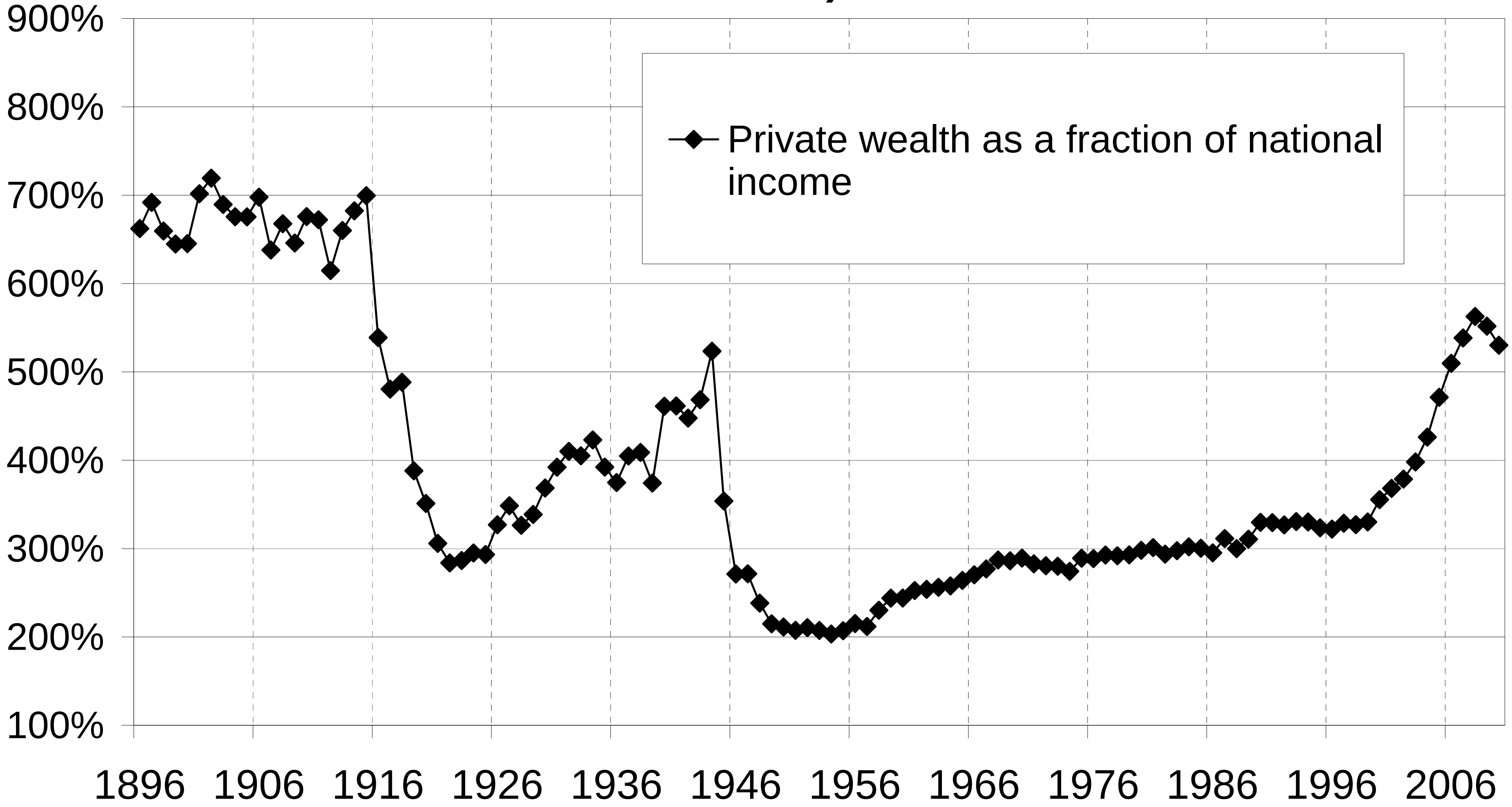


Figure A3: Wealth-disposable income ratio in France 1896-2009 (annual series)