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HOUSEHOLD WEALTH AND ITS DISTRIBUTION IN THE NETHERLANDS, 1854–2019*

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Abstract

We analyze the evolution of aggregate household wealth, its composition, and top wealth shares since the mid-19th century for the Netherlands, a country which played a significant role in economic history. The main forces at play are the size and variation of colonial wealth up until WWII, and the introduction of a –particularly strong– pension system thereafter. We show that the wealth-income ratio followed the familiar U-shaped pattern over the 20th century. The Netherlands, however, had the largest wealth-income ratio on record, growing since the mid-1850s, driven by industrialization and booming private foreign investments, to a peak of 900% around 1880. In contrast to other countries, the wealth-income ratio remained high up until 1929. To better understand these trends, we construct the first series on colonial wealth and show that colonial and other foreign investment account for most of the gap with other countries in the pre-WWII period. The initial post-war decline in the ratio is driven by rapid income growth. The increase in the ratio since the 1970s has been mainly driven by the uniquely large capital-funded pension system. In contrast with other major countries, housing plays only a secondary role in net wealth accumulation due to significant mortgage debt. Methodologically, we are the first to compare historical national accounts, estate multiplier, and wealth tax data approaches to construct aggregate wealth. We find that the estate multiplier is a good alternative to the historical national accounts benchmark, while the use of wealth tax data results in unrealistically low estimates.

JEL Classification: D3 E2, G5

Keywords: Wealth inequality; wealth distribution; household wealth.

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1 Introduction

The Netherlands has historically been among the richest countries in the world, was once a colonial superpower, and played a major role in the development of modern capitalism (’t Hart, Jonker, and Van Zanden 1997). Despite of this, the Netherlands has been notably missing in studies which analyse the long-term evolution of household wealth (Piketty and Zucman 2014). This paper amends this shortcoming by providing the first series of historical household balance sheets, consistent with existing balance sheets in the System of National Accounts for the Netherlands, from 1854 until 2019. We decompose these balance sheets into wealth components from 1880, tracking the relative importance of asset classes such as real estate, equity, bonds, liabilities and pension wealth. We track top wealth shares from 1894 onward, arriving at a comprehensive picture of the dynamics of household wealth over more than 125 years. Finally, we discuss various interpretations of these trends, and contrast them to the available international evidence.

Our main conclusions are the following: First, we find that the wealth-income ratio in the Netherlands followed the familiar U-shaped pattern observed in earlier studies, with a peak in the early 20th century, a subsequent decline until the 1970s, and an increase in recent decades. However, we find that the magnitude of the peak is substantially larger than those identified in other countries (Waldenström 2021). Specifically, we document that the wealth-income ratio peaked in excess of 900% at the end of the 19th century; moreover, the wealth-income ratio remained high during and after World War I, only declining after the Great Depression of 1929. This is in contrast to other countries in this period for which we have data, which either had consistently lower wealth-income ratios or featured strong declines during World War I (Waldenström 2021). After World War II, the wealth-income ratio declined precipitously until the 1970s, when it reached a trough of approximately 300%. Since the 1980s, the wealth-income ratio has increased again to reach 600% in 2019.

Second, our findings for top wealth shares largely echo those for total household wealth, which are summarized by Figure 1, show a similar a clear U-shaped pattern. The figure depicts the wealth-income ratio and the top 1% wealth share from 1894 until 2019. We observe a peak in the top 1% share of household wealth peaked at close to 55% in the early 20th century, which was followed by a precipitous decline to as little as 10% in the 1970s and a subsequent increase to about 30% by the early 2010s.

Third, our historical National Accounts also allow for the decomposition of aggregate wealth into wealth components. Grouping assets and liabilities in broad classes to ensure comparability over the full period, we find a stark decline in the importance of agricultural land prior to World War II, with financial assets dominating wealth composition. After World War II, financial assets declined in importance, while the Dutch pension system – which we term semi-private wealth – rapidly became a dominant asset class for households, being worth 40% of the household portfolio in 2019. Moreover, housing also increased in importance from the 1980s onward. However, since the housing boom was financed by an enormous increase in mortgage debt, the net effect of housing accumulation on real wealth growth is modest. Instead, pension savings and capital gains are the most important drivers of wealth concentration since the 1980s.

Our contribution to the literature is threefold. First, we contribute to the small number of studies estimating the long-run evolution of household wealth and top wealth shares. The seminal work in this series is Piketty and Zucman (2014), who estimate historical wealth-income ratios for eight large economies. We introduce data for the Netherlands which has so far been absent. Historical estimates for Dutch household wealth do exist, including Boissevain (1891), and most notably Wilterdink (1984, 2015). Compared to these studies, we add a longer-run perspective,¹ as well as a decomposition of aggregate wealth, we provide an

1. Wilterdink’s series runs from 1894 until 1974

Figure 1: The Wealth-Income Ratio and the Top 1% Wealth Share, 1854–2019



(a) Wealth-Income Ratio



(b) Top 1% Share

Note: Figure depicts the ratio of aggregate household wealth to net national income (1854–2019), and the top 1% wealth share (1894–2019).

international comparison, and we operationalize all three main methods for household balance sheet reconstruction (Figure 1). Compared to existing studies focusing on top wealth shares in the Netherlands, (notably Wilterdink 1984 for 1894–1974 and Salverda 2019 for 1993–2000 and 2006–2014), we add a longer and uninterrupted timeframe (1894–2019), provide a consistent treatment of household wealth as corresponding to the National Accounts, and employ a more flexible estimation method than strict Pareto interpolation, namely generalized Pareto interpolation (Blanchet, Fournier, and Piketty 2021).

Second, our findings challenge the claim by Waldenström (2021) that wealth-income ratios pre-World War II were smaller than previously thought. We are the first to construct a series on colonial wealth, which demonstrates that colonial and other foreign wealth in particular played an important role in explaining the observed divergence – in particular the peak of 900% in the wealth-income ratio in the 1880s, as well as the persistent large ratios post-World War I – between the Netherlands and most other countries. In addition, we argue that denominator effects also matter for cross-country differences in wealth-income ratios, since persistent differences in income levels and growth rates also affect its evolution. More generally, our results show the importance of careful accounting for foreign investment, colonial wealth, and other major trends in the late 19th century to explain global patterns in wealth inequality.

Third, we are the first to compare historical national accounts, estate multiplier, and wealth tax data approaches to construct aggregate wealth. The first method, which we use as the benchmark, is the method used in most of the contemporary literature, including the seminal work by Piketty and Zucman (2014). The second method we employ is the well known estate multiplier approach (e.g. Kopczuk and Saez 2004) which estimates the aggregate stock of household wealth from tabulated inheritance tax records. This method was common for historical estimates of aggregate wealth and can be traced back to at least the late 19th century (e.g., Boissevain 1891). The third method builds upon available information from wealth tax data, and further assumes that wealth of those below the wealth tax threshold is reasonably approximated by a lognormal distribution. By comparing these two methods with our benchmark method, we improve our understanding concerning the accuracy of the levels and trends that these methods identify. In particular, we find that the estate multiplier method produces remarkably similar estimates to the benchmark historical national accounts pre-World War II; after the war, the two methods diverge. The lognormal extrapolation method underperforms relative to the two other methods throughout.

The rest of our paper is structured as follows: Section 2 discusses existing work on the dynamics of wealth in other countries and in the Netherlands. In Section 3, we discuss our definitions of household wealth, analyzing the distinct role of pension wealth in greater detail. Moreover, we introduce the three methods we use to reconstruct aggregate household wealth, as well as the mapping from aggregate wealth to wealth shares. Section 4 presents an overview of the results, for aggregates, wealth shares, and wealth composition. In addition, in this section we provide a brief international comparison for all results. In Section 5, we discuss the dynamics of the wealth-income ratio before World War II in international perspective. Here, we focus on the role played by international and colonial investment, as well as numerator effects (i.e., differences in national income). Finally, in 6, we explore socio-economic developments in the Netherlands after World War II and show how the large accumulation of capital-funded pensions was the major determinant of the rise in wealth concentration since the 1980s. Section 7 concludes.

2 Literature Review

Studies on long-term wealth dynamics, including the share of top wealth, are relatively new. At least in part, this is because this type of research relies heavily on national stock accounts, instead of flow accounts; these are data which national statistical institutes only began to compile from the early 1990s onward.

The past few years have seen a notable resurgence of interest in the long-term evolution of size, composition and distributional patterns of private wealth mostly across the Western world, along with India and China. Seminal studies include Davies, Sandström, and Wolff (2011) and the work by Piketty (2014) and Piketty and Zucman (2014). The latter work sparked a growing number of researchers to explore whether the U-shaped pattern observed by Piketty and Zucman (2014) also applied to countries with notable different institutional set-ups. Such studies include Waldenström (2017) for Sweden; Orthofer, Du Plessis, and Reid (2019) for South Africa; Piketty, Yang, and Zucman (2019) for China, Kumar (2019) for India; and most recently Artola Blanco, Bauluz, and Martínez-Toledano (2020) for Spain. In parallel, there is also a growing literature on top wealth shares. Key examples of this strand of research includes Saez and Zucman (2016) for the United States²; Garbinti, Goupille-Lebret, and Piketty (2020) for France; Alvaredo, Atkinson, and Morelli (2018) for the United Kingdom; Albers, Bartels, and Schularick (2020) for Germany; and Roine and Waldenström (2009) for Sweden.

For the Netherlands, studies on wealth dynamics are part of a once vibrant, but until relatively recently, almost entirely neglected scholarly tradition. The earliest studies on these matters can be traced back to at least the mid 19th century. Pareau (1864) for example was one of the first scholars which attempted to explore changing wealth patterns across several decades, comparing total private wealth in the 1830s and the 1860s to the respective size of the Dutch population. He argued that there has been a per capita decrease in national wealth throughout this period. Boissevain (1883, 1891, 1909, 1910) and Stuart (1888) were the first to provide somewhat reliable estimations of aggregate wealth for the 1880s and 1890s by relying on the estate multiplier method.

Following the events of the first World War, Bonger (1923) set out to measure total private wealth for the period between 1915 and 1920. His work criticizes the aforementioned method by Boissevain and Stuart, instead relying on an approach that is more akin to a reconstruction of the national accounts. His work was continued by Smeets (1932) and a few years later by Van der Wijk (1939).

In contrast to earlier decades, the period following the second World War until the 1980s was characterized by a notable absence of studies on long-term wealth dynamics. A major stimulus in increasing interest arose from the work by Wilterdink (1984) who documented and analysed long-term patterns of wealth dynamics based on wealth tax records from the 1890s until the 1970s, and provided a breakdown of top wealth shares. In his footsteps, the literature examining the Netherlands grew steadily, mostly focusing on periods that preceded Wilterdink's analysis. Verstegen (1996) for instance looked at national wealth and income in the Netherlands between 1805 and 1910, whereas Bos (1990) sketched the capital holdings and status of the wealthiest members of society in the 19th century Netherlands. Recent contributions include Wilterdink (2015) who reflect on the decades after the 1980s, which were not covered yet by his previous work. The most recent noteworthy contribution to the study of the top wealth shares in the Netherlands was made by Salverda (2019) covering many of the years after 1993.

Van Bavel and Frankema (2017) argue that Wilterdink's estimates for the 1970s only constitute roughly

2. However, see the discussion of their capitalization method and underlying assumptions (Kopczuk 2015; Smith, Zidar, and Zwick 2019; Saez and Zucman 2020).

85 percent of NNI, which based on our findings is an underestimation by a factor of two and a half; this is a point also reiterated more recently by Coenen (2017). Building on all these existing studies for the Netherlands, we set out to take the next step forward and provide the first comprehensive data set on Dutch wealth since the 1850s, which is –in addition– implemented within a framework consistent with recent international studies.

3 Concepts, Sources, and Methods

3.1 Definitions

Our aim is to reconstruct household wealth, W_t , following the definition spelled out in the System of National Accounts, which is the total market value of assets minus liabilities. Assets include all financial and non-financial assets over which ownership rights can be enforced and which provide economic benefits to their owners. This definition includes most major wealth components, including housing, real estate, savings accounts, stocks and bonds, which can be accessed and capitalized by their households.

It is useful at this point to clearly spell out the concepts which we will estimate and pursue throughout the paper. Denote national wealth by W_{nt} , government wealth by W_{gt} , corporate wealth by W_{ct} , household wealth by W_t , and foreign wealth by W_{ft} . We have the standard accounting identity that national wealth equals the sum of the wealth of the four main economic sectors:

$$W_{nt} = W_t + W_{gt} + W_{ct} + W_{ft}. \tag{1}$$

Various other decompositions of national wealth exist; for instance, national wealth equals the sum of the capital stock and the net foreign asset position $W_{nt} = K_t + NFA_t$. Moreover, if the book value of equity equals the market value of equity (i.e., Tobin’s q equals 1), corporate net worth is zero and national wealth equals private wealth plus government wealth. In general, corporate wealth need not be zero, as is discussed extensively in Piketty and Zucman (2014). Hence, we focus throughout on *household* wealth, with the understanding that clearly delineating between household and corporate wealth can be challenging in periods before official National Accounts balance sheets exist. In the Data Appendix, we provide an extensive discussion of the various steps we take to ensure consistency over the entire period.

Household wealth can be decomposed into financial assets A_t^f , nonfinancial assets A_t^{nf} , and liabilities D_t :

$$W_t = A_t^f + A_t^{nf} - D_t. \tag{2}$$

In this paper, we will often focus on several interesting subcomponents of these broad categories. We can decompose nonfinancial assets into housing – dwellings plus underlying land – as well as agricultural land and the remaining capital stock attributable to the household sector:

$$A_t^{nf} = A_t^h + A_t^l + A_t^k. \tag{3}$$

We can decompose financial assets into deposits, domestic securities (i.e., stocks and bonds), foreign securities – which includes claims to colonial investment before decolonization – and the value of life insurance and pension claims, which we term ‘semiprivate wealth’ following Wilterdink (1984):

$$A_t^f = A_t^d + A_t^{e,dom} + A_t^{e,for} + A_t^{sp}. \tag{4}$$

This final wealth component, which we refer to as semi-private wealth following Wilterdink (1984), deserves some attention because its inclusion in the household wealth statistics is not trivial. The Dutch pension system consists of three ‘pillars’: (i.) universal retirement payouts, funded as a PAYGO scheme (*Algemene Ouderdomswet* or *AOW*); (ii.) employer-based pension funds, which every employee is required to contribute to; and (iii.) personal pension accounts. Component (i.) is not considered wealth. The main discussion revolves around the inclusion of pillars (ii.) and (iii.). Standard DINA guidelines prescribe that the capitalized values of these pension contributions should be included as wealth, reasoning from a life-cycle perspective. All existing Dutch data sources, on the other hand, have so far excluded pension wealth from wealth distribution statistics. The commonly given reason is that these pension assets are not freely disposable, are not bequeathable and hence are more akin to claims on future income streams, like Social Security benefits (Van Bavel and Frankema 2017). Other authors disagree with this assessment, pointing to the important substitution effects pension wealth has with regular savings (Caminada, Goudswaard, and Knoef 2014). The inclusion of pension wealth is not a trivial matter: Dutch pension funds are among the best funded internationally, with total capitalized contributions in excess of 200% of national income in recent years. Since pension contributions tend to be distributed more equally than other financial assets, including pension wealth also has profound effects on estimates of wealth inequality. The size of employer-mandated pension wealth relative to other assets makes the Netherlands a unique case in this regard.

In this paper, we address the issue of pension wealth by defining it as semi-private wealth and by presenting two series of aggregate wealth, one with and one without pension wealth; our top wealth shares series will be defined net of pension wealth. In our view, this gives the most transparent treatment of capitalized pension wealth, is consistent with international practice, and makes long-run series more meaningful, since the distribution of pension wealth has failed to be documented for the virtual entirety of our time frame.

3.2 Household Wealth Methods

We now turn to the discussion of the three distinct methods we employ to reconstruct aggregate wealth: (i.) historical national accounts, (ii.) the estate multiplier method, and (iii.) lognormal extrapolation on wealth tax data. We describe each of these methods in turn, and briefly discuss the data sources we use for each method. We follow this with a discussion of our methods to construct top wealth shares. A full description of all data sources and methodological details can be found in the Appendix.

3.2.1 Historical National Accounts

Our benchmark series reconstructs household balance sheets, with the aim of producing a series that is as consistent as possible with the current System of National Accounts. For the post-1995 period, we can directly use the System of National Accounts’ household balance sheets. Pre-1995, no official balance sheets exist; but an estimate compiled by the Netherlands Bureau of Economic Analysis (CPB) provides balance sheets since 1970, which we augment with wealth components not covered in these estimates. Pre-1970, we manually reconstruct household balance sheets; from 1880 through 1938 we use a variety of sources to build full balance sheets, whilst for 1947 to 1969 we have to interpolate stocks of wealth based on observed saving flows and estimated capital gains. Hence, we break this series into four specific chunks: (i.) 1880–1938; (ii.) 1947–1969; (iii.) 1970–1994; and (iv.) 1995–2019. In Appendix A, we provide more detailed discussions for each wealth component separately.

For 1880–1938, we use a variety of sources to manually reconstruct household balance sheets. Here it

is important to distinguish between sources that were used to reconstruct the value of non-financial assets on the one hand and financial assets on the other hand. To estimate the value of non-financial assets in the Netherlands for this period we relied first and foremost on property tax assessments. For housing - the principal component of non-financial assets - total housing area was published in the Annual Statistics for the Netherlands (*Jaarcijfers voor Nederland*) published by the Central Bureau of Statistics (CBS 1880-1938), as well as total housing area. Moreover, we have an official Statistics Netherlands estimate of total housing for the year 1913. Hence, we obtain an estimate of the market value of housing per square meter for 1913. We index this price ratio for other years using the housing price index by Korevaar, Francke, and Eichholtz (2021), which is the most representative historical index for the Netherlands. In each year, the total value of housing then becomes the housing area multiplied by the indexed average housing price. We confirm in Appendix A that this method matches official balance sheets in 1938 remarkably well. For the other main component of nonfinancial assets – agricultural land – we employ a similar procedure. Here, we take the total volume of agricultural land from van der Bie (2001) based on Knibbe (1993), and then multiply these volumes by the agricultural land price estimates by Luijt and Voskuilen (2009). The final major component of nonfinancial assets – the fixed capital stock – is based on detailed estimates by Smits, Horlings, and van Zanden (2000) and Groote, Albers, and De Jong (1996), adjusted to capture the part of the capital stock attributable to the household sector.

Following the System of National Accounts, financial assets include deposits and currency, shares and mutual funds, bonds, individual pension, and insurance savings. The principal sources material used to estimate the value of these asset classes are (i.) the Statistical Publication by the Dutch Central Bank, which reported on the balance sheet information of commercial banking institutions as well as saving banks and cooperatives banks from 1900 onwards (De Nederlandsche Bank 1987, 2000); and (ii.) the previously mentioned Annual Statistics for the Netherlands. The total value of privately-held Dutch government bonds is directly observed in the Annual Statistics. For the value of domestic stocks, we start with the total Dutch stock market capitalization, available in van der Bie (2001). We then subtract the value held by foreigners and add the value of Dutch investments abroad using a capitalization of the net primary income from abroad, observed in Smits, Horlings, and van Zanden (2000) and den Bakker (2019); we capitalize these dividends using a “world average” dividend yield of the five financial markets most relevant for Dutch investors: Belgium, France, Germany, the UK, and the US; data for all dividend yields are from Jordà et al. (2019). Finally, funded occupational pension entitlements and private insurance savings are based on the technical reserves as recorded by the Dutch Central Bank. This gives us estimated household balance sheets from 1880 until 1937. For the year 1938, we have an official household balance sheet from Statistics Netherlands, which we use to calibrate the estimates for the years prior to 1938.

After 1938, the earliest reliable year we can recover is 1947, when Statistics Netherlands also published a balance sheet for the household sector in its National Accounts. From this year on through 1969, we do not have the sources to reconstruct stocks of wealth, which only begin again in 1970, with the exception of some intervening years. However, since we do observe savings flows of wealth for the entire period, as well as an estimate of total private wealth in 1947 and in 1970, we can interpolate stocks of wealth for the intervening years. Specifically, we can think of the accumulation equation of wealth W going from period t to period $t + 1$ as being determined by both savings s and capital gains q :

$$W_{t+1} = (1 + q_{t+1})(1 + s_t)W_t. \quad (5)$$

We observe the initial wealth stock, W_{1947} , annual saving flows s_t , and a final wealth stock W_{1970} .

Hence, we can residually estimate an average capital gains rate $q_t = q$ using a recursive estimation process (cf. Piketty and Zucman 2014, Online Appendix K). Once we have total stocks of wealth, we can estimate wealth composition for these years using available individual series on stocks of housing wealth, agricultural land, fixed capital stock, financial assets, and pension wealth to arrive at plausible estimates of the unavailable wealth components.³

From 1970, we have an estimate of household balance sheets by the Netherlands Bureau of Economic Analysis (CPB). In Appendix A.5, we compare all wealth components in these balance sheets with external sources, finding that they are remarkably similar for the most part. We augment the balance sheet with life insurance wealth, agricultural land, and the fixed capital stock.

Finally, from 1995 until 2019, we simply use the most recent version of the System of National Accounts (the 2015 revision), maintained by Statistics Netherlands. To preserve consistency throughout the time series, we report end-of-year values for all years.

3.2.2 Estate Multiplier Method

The second method we employ to estimate aggregate wealth is the estate multiplier method, which builds on succession tax data. The succession tax was introduced in the Netherlands in 1818, and until 1877 only indirect heirs with an estate value higher than 300 guilders were taxed. From 1879, the tax widened in scope to include all both direct and indirect heirs above the threshold. The tax threshold for direct accession was then set at 1,000 guilders, 300 for indirect accession.⁴

Dutch statistical agencies published inheritance tax returns records in an aggregate form since the mid-1850s, reporting wealth information that refers to the decedent population using market prices (Gelderblom, Jonker, Peeters, and de Vicq 2022). The exact level of detail in the wealth reports depends on the period (see below). In the literature, the usual caveat regarding this kind of data is that the threshold for including an estate in the inheritance tax returns records is typically relatively high. However, this does not hold in the case of the Netherlands since the threshold approximates the annual earnings of an unskilled worker, and it can be argued that it is covering a broader range of the full wealth distribution, instead of a high upper tail. Table 1 demonstrates this using data from 1880–1980, showing that the coverage is around 10-20% in the earlier period, and 30-40% in the more recent period. This can be contrasted with the low 1–3% coverage found in the US (e.g., Kopczuk and Saez 2004), although it is somewhat lower than the coverage of in modern day data for Italy that comes around 61% (Acciari, Alvaredo, and Morelli 2021).

During the early period of 1854–1878 it is only the indirect heirs that were subject to the estate tax in this period. However, we do not have data on how many filers are actually included in the reported aggregate wealth totals. The number of filers is important in making the conversion from the amount of wealth identified by the death duties tax to the aggregate wealth in the economy. But for the years 1878–1910 we do have the data split between direct and indirect heirs, so we can extrapolate backward and approximate the number of (indirect heir) filers for the 1854–1878 period, as shown in table 1. In this we are assuming that the ratio of indirect heir filers is equal to that from 1880 (and therefore the coverage remains fixed at 5.27%). The data from 1878 onward are available in tabulated form, with more granular thresholds, as shown in table B.2 (in the appendix).

The idea behind the estate multiplier method is to use the available wealth totals from the inheritance tax (i.e. the sample), to estimate the total wealth in the entire population. This method works by multiplying

3. The year 1969 is missing from the National Accounts, and is hence linearly interpolated from the values for 1968 and 1970.

4. More changes were introduced with later legislation, which are summarized in Table B.1.

Table 1: Coverage of the death duties tax in the Netherlands 1850-1980 from selected years (1850-1870 estimation, see text for details).

Year	Total Deceased	Filers	Coverage
1850	69,377	3,656	5.27%
1860	84,382	4,447	5.27%
1870	95,289	5,022	5.27%
1880	95,282	9,508	9.98%
1890	93,246	10,090	10.82%
1900	92,043	11,101	12.06%
1910	79,984	10,712	13.39%
1920	81,525	13,623	16.71%
1930	71,682	14,382	20.06%
1940	87,722	18,251	20.81%
1948	72,459	19,602	27.05%
1956	85,000	37,119	43.67%
1963	96,000	35,874	37.37%
1970	110,000	38,167	34.70%
1975	114,000	48,398	42.45%
1980	114,000	43,410	38.08%

the total wealth captured by the inheritance tax with the ratio of the deceased individuals covered by this tax over the surviving population in that particular year. Given that the sample in the annual inheritance tax returns, and the entire population, have different age-wise mortality rates (since age and size of the estate are positively associated and size of the estate is not orthogonal to age), a correction needs to be applied in the form of adjusted mortality rates. Typically, age-wise mortality rates for the entire population are available from the national statistical agencies. However, we additionally need data to estimate the mortality rates for the individuals present in the inheritance tax records. One solution is to turn to companies that keep records of life insurance holders, and their respective mortality rates (e.g. see Lampman (1962)). Other researchers have used social class mortality multipliers based on occupational classes (Alvaredo, Atkinson, and Morelli (2018) and Atkinson and Harrison (1978)), or use more sophisticated wealth mortality gradient using the relationship between mortality and housing wealth distribution (Acciari, Alvaredo, and Morelli 2021). In our approach we use mortality rates estimated based on the detailed individual level data from the Tafel V-bis annual ledger for 1921 (discussed further in the appendix), which has been made available by Gelderblom, Jonker, Peeters, and de Vicq (2022). This ledger contains all individuals that died in 1921, that had a wealth above the tax threshold, and also includes their demographic profile (age and gender), and their total wealth valuation. A limitation of this approach is that it is using the same multiplier for all the years, but this is not unique in the literature (e.g. Lampman (1962)).⁵ To address this issue we devise a method based on the ratio of the estimated estate multiplier for 1921 and the naive estate multiplier (which is the one obtaining by assuming that there is no mortality rate differential between the rich and the general population). Multiplying the 1921 multiplier with the series of the naive multipliers, we produce a dynamic series of alternative estate multipliers that considers the changes in the population dynamics. In Appendix B.1 we explain the details of how we apply this entire procedure. The last step in this procedure is to take

5. For the years before 1878, when only indirect heirs are taxed and registered, we work in two steps: first, we use one multiplier from the years 1878–1910 for which we have the data split between direct and indirect heirs, to bring the indirect-heir-only data to a comparable level with the post-1878 period; second, we multiply by the same mortality rate multiplier as we do for all other years.

the average of the fixed and the alternative series to obtain our final estate multiplier series. This step is based on the observation that the bias from the fixed multiplier and the bias introduced from the dynamic alternative series move in opposite directions (again see the appendix for the details).

3.2.3 Wealth Tax Method

The wealth tax was instituted in 1893. The first collections of statistics appeared for the fiscal year 1894, and the data series continues until 1993. These statistics appeared in the Annual Statistics for the Netherlands. Initially, the wealth tax only applied to fortunes with a value over 13,000 guilders, a threshold that was sporadically changed in the later years.⁶ Households above these thresholds typically comprised about 5-7% of the population. As a product of time, a decrease in tax morale also caused increases in tax avoidance and evasion, further weakening the informative value of the statistics, particularly for the very top wealth holders (Wilterdink 2015; Van Bavel and Frankema 2017). This led to the replacement of the wealth tax in 2001 by the current tax system, which taxes – at least ostensibly – capital income rather than net wealth. The historical wealth tax did not apply to households, but to natural persons, making direct comparisons with later tax statistics slightly difficult. Married couples were treated as a single natural person for tax purposes. The tax basis covered financial assets, deposits and cash, real estate, items of transport such as horse-carts and cars, claims to life insurance, and from 1918 onward also jewels and precious metals. It did not cover pension claims, artworks, or consumer durables.

We have tabulated wealth tax data from 1894–1993, with a few interruptions, particularly around the second World War. In the Dutch literature on national wealth the key reference is Wilterdink (1984), for which Potharst (2022) has developed a method for estimating μ and σ of lognormal distributions from censored datasets. The basic assumption they use is that the distribution does behave lognormally, $W_t \sim \log \mathcal{N}(\mu_t, \sigma_t^2)$. This assumption is relaxed when estimating total wealth by replacing the fitted values above the threshold with the actual value from the data. The issue is to estimate μ_t and σ_t^2 using the available information on the top brackets from the wealth tax. Each data point takes the form of a triple (k, n_k, μ_k) , where k is the lower threshold of the bracket (e.g., 1,000 guilders), n_k is the number of individuals in that bracket, and μ_k is the bracket average wealth. We obtain our estimate for μ and σ^2 by minimizing the distance between a lognormal distribution and the parameters of the low threshold of each bracket and the frequencies of observations per bracket (see Appendix C).

3.3 Wealth Shares

Once we have estimates for aggregate household wealth, we have a denominator for top wealth shares. For the numerator – i.e., total wealth per percentile – we rely on wealth tax statistics for 1894–1993, and for the wealth distribution statistics by Statistics Netherlands from 1993 onward. The wealth tax statistics were published in tabulated form in *Jaarcijfers voor Nederland*; we can therefore easily employ the semiparametric interpolation method developed by Blanchet, Fournier, and Piketty (2021) to estimate top wealth shares. This method, known as generalized Pareto interpolation, takes as inputs for each bracket k a bracket lower threshold q_k , its corresponding percentile p_k and the bracket average μ_k . It then interpolates the entire distribution based on the given inputs and the (known) mean population wealth $\bar{\mu}$. Since we do not possess information about the distribution below the lowest threshold of the wealth tax – usually the bottom 95%

6. This threshold was later set to 15,000 in 1915, then dropped to 10,000 in 1947, to subsequently be increased to 50,000 in 1957, 100,000 in 1970, and 200,000 guilders in 1983.

or so – we hesitate to report the interpolation results for anything but the upper 5% of the distribution⁷. To avoid wealth shares being mechanically biased downwards by our concept of aggregate wealth, we scale up the total wealth in each bracket by the average ratio between the historical national accounts method and the lognormal extrapolation. The lognormal extrapolation, which is based on the wealth tax statistics, may then be viewed as an estimate of aggregate taxable wealth; by scaling up wealth in each bracket, we implicitly assume that the wealth that is not captured in the wealth tax statistics is spread relatively uniformly across the distribution. Although this is not an entirely appealing assumption, it is the best possible solution to the fact that distributional statistics in historical data are scarcely available.

Post-1993, Statistics Netherlands starts reporting tabulated data for the full wealth distribution. These data are taken from a variety of fiscal sources, including the wealth tax, wealth surveys, and in recent years also mandatory disclosures of deposits by banks and other financial institutions. In this paper, we only report the upper percentiles of these Distributional Accounts, to preserve consistency with the historical series.

It is well-known that the post-1993 data, while significantly better than the wealth tax records that preceded it, significantly increase in quality from 2011 onward, when Statistics Netherlands started drawing on the universe of tax filers and received automatic disclosure of various wealth components. In this paper, we simply take wealth components as reported by Statistics Netherlands at face value; but doubtlessly, future research can and should critically adjust distributional statistics to produce fully time-consistent Distributional Financial Accounts.

4 Results

4.1 Aggregate Wealth

Figure 2 presents the ratio of household wealth to national income for the period 1854–2019.

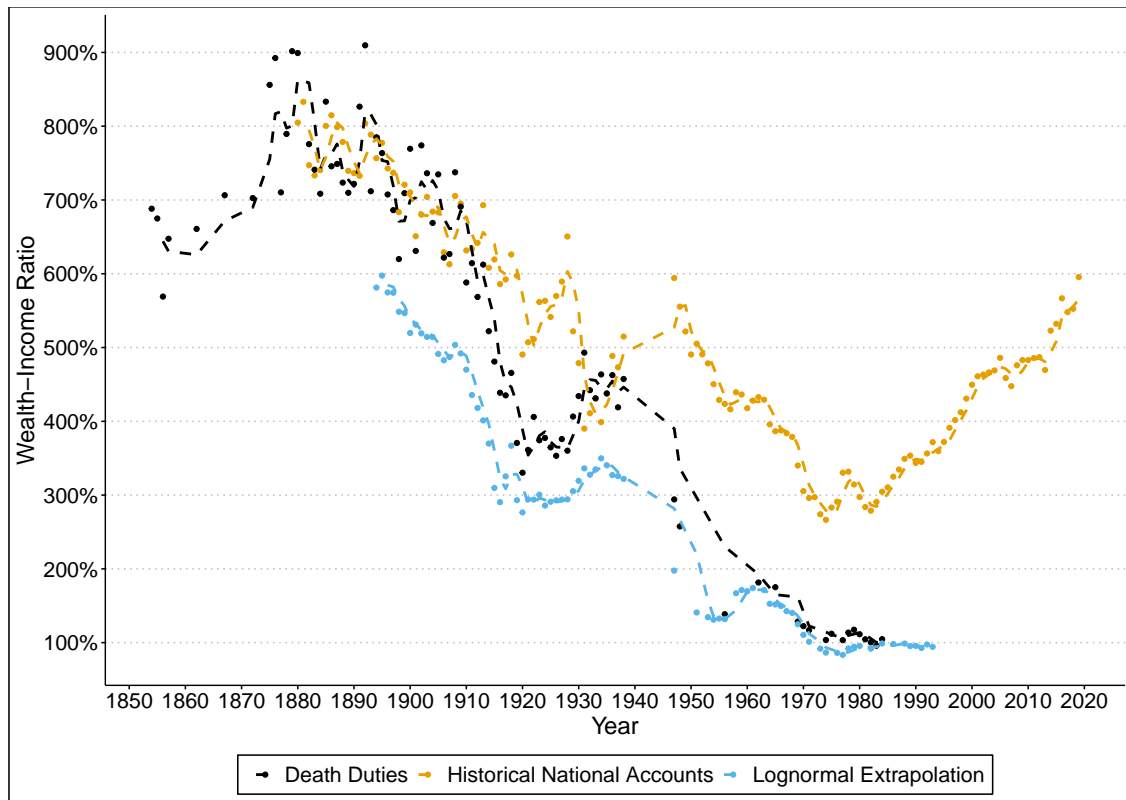
By contrasting the reconstructed national accounts with the two other methods, we find that, for the period where the three methods can be used concurrently – that is, from 1894 until the 1980s – there are significant differences between the outcome of the three methods. From the 1880s until the 1950s, the historical national account and estate multiplier methods are remarkably similar, and diverge afterwards. The wealth tax method results in lower wealth-income ratios in the same period, as noted before by Van Bavel and Frankema (2017). After the 1950s the estate multiplier and the wealth tax methods give very similar estimates which are well below the historical national account method. This is likely due to the increasing importance of pension claims, which are covered in the historical national accounts but not in the other two methods⁸. Another reason often identified is the increased unreliability of both wealth tax records and estate tax records (Wilterdink 1984; Van Bavel and Frankema 2017), which might bias results based on those sources downwards.

The first lesson we can draw from this comparison is that while the three methods differ in their estimated levels, they point toward the same direction overall. The important note here is that one has to correct for the lack of pensions in the estate multiplier and the wealth tax methods, in order for the trends to be in the same order of magnitude during the recent period as well.

7. This concern is noted by Blanchet, Fournier, and Piketty (2021) as well, who caution that the interpolation works best if at least some lower quantiles are also covered.

8. In Figure E.3, we add semiprivate wealth to the baseline series of Lognormal Extrpolation and Estate Tax Multiplier methods, and show that this does reduce the gap with the historical national accounts quite substantially from the 1980s onward.

Figure 2: Wealth-Income Ratios per Method



Note: Figure shows the ratio of household wealth to net national income, using our three main methods: (i) Historical National Accounts (the benchmark), (ii) Estate Multiplier methods using death duties, and (iii) Lognormal extrapolation from wealth tax data.

A second conclusion is that the estate multiplier method is highly similar to the historical national accounts prior to the 1920s, which makes it a useful substitute for countries or years where historical national accounts sources may be unavailable. After the 1920s, the historical national accounts are much larger than the estate tax multiplier. As we will discuss in more detail in Section 5.1, this was a period when capital gains on colonial wealth holdings skyrocketed; hence, it might be possible that death duties did not fully reflect these asset revaluation effects.

One interesting trend in the data is the increase in the wealth-income ratio between 1930 and 1950 across all three series. This trend is most prominent in the historical national accounts, and is unlikely to be driven by measurement error, since we have an official balance sheet both for 1938 and 1947, which indeed show that household wealth almost doubled in the intervening decade. The increase in the wealth-income ratio prior to 1938 is because national income declined in the aftermath of the Great Depression and World War II, whereas private wealth declined relatively less.

After World War II, aggregate wealth grew less rapidly than national income, resulting in the familiar decline in the wealth-income ratio observed elsewhere (Piketty and Zucman 2014). Similar to other countries, the trough occurs somewhere in the 1970s, at a depth of almost 300% of national income. Afterwards, private wealth grew in importance again relative to national income, speeding up in the 1990s and reaching a peak of 600% in 2019. In the next section (4.2), we decompose household wealth to analyze the underlying trends.

4.2 Wealth Composition

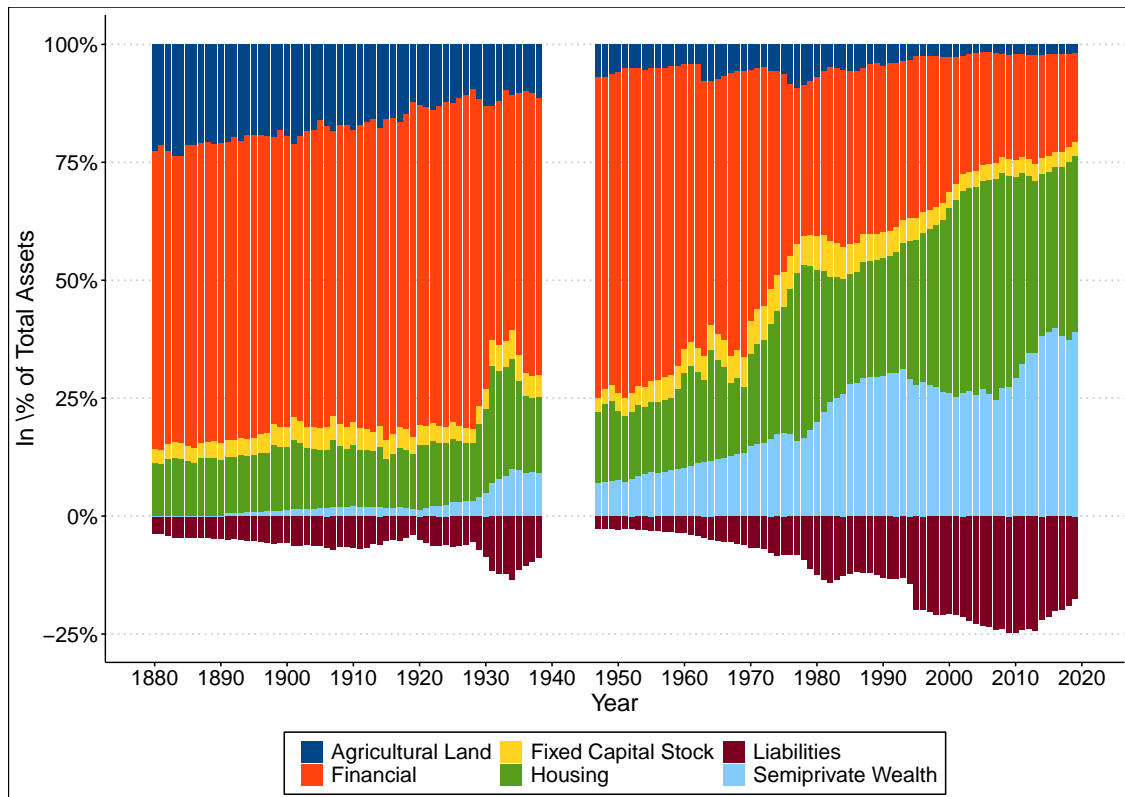
Figure 3 illustrates the decomposition of household wealth from 1880 until today, where all asset classes are expressed as percentage of total assets. We focus on the following broad categories: Financial assets, agricultural land, housing, other capital stock, liabilities, and semiprivate wealth. In Figure 4, we express the same series in percentage of net national income, to give an idea of the magnitudes of each wealth component.

The period between 1880 and 1938 is first and foremost characterised by a sharp decline in the relative value of agricultural land compared to net national income, declining from almost 200% in 1880 to 60% in 1938. This coincides with trends in several other countries (Piketty and Zucman 2014), and is driven to a large extent by falling agricultural prices as a result of global competition and technological improvement (Knibbe 2014). A second major finding is the strong importance of financial assets net of semiprivate wealth; this category dominates all others until the late 1970s. As we will explore in Section 5.1, this is mostly driven by securities, both domestic and foreign. The Netherlands developed a stock market in the 17th century, and this early financialization is likely to have persisted over time. Moreover, by the start of our series in 1880, the Industrial Revolution had taken off in the Netherlands, which led to a boom in industrial corporations seeking equity (van Zanden and van Riel 2000). Finally, and very significantly, foreign equity played an outsized role in the Dutch economy from the 1870s onward, with investments in American steel and railroad companies as well as Austrian and Russian bonds making up a major part of Dutch investors' portfolios; notably, the Dutch colony of Indonesia also opened up for private investment in the late 1870s, and would become a major source of household wealth by the early 1900s.

The other wealth components we identify play smaller roles prior to World War II. Housing is relatively constant at around 100% of national income, or 10-15% of household assets. Liabilities build up quite significantly before World War II; this is mostly due to an increase in mortgage debt (de Vries 1976).

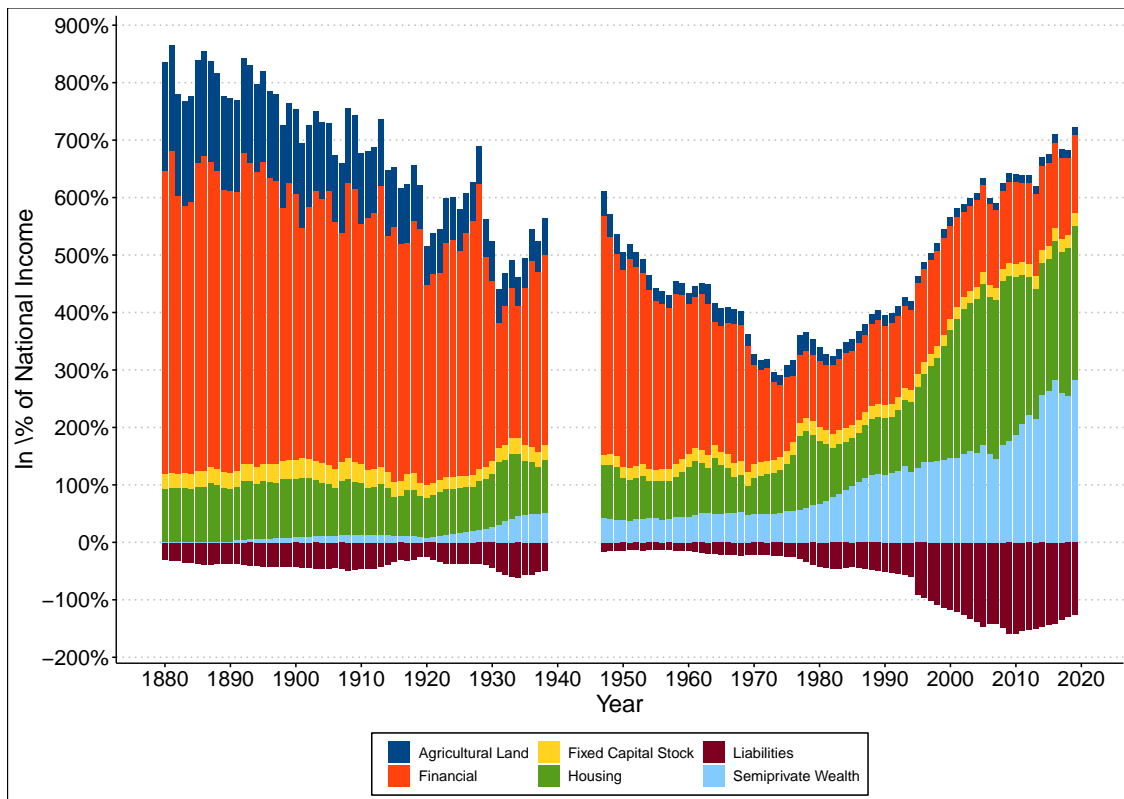
After World War II, we notice several similarities and other differences. Semiprivate wealth remains relatively constant, both as a share of wealth and as a share of national income. The same holds true for all

Figure 3: Wealth Composition, 1880–2019.



Note: Figure shows the composition of household wealth, with each asset expressed as a proportion of total assets. All wealth composition data are from the historical National Accounts method, with the sources described in the main text and Appendix A; data on net national income are described in Appendix D. Financial assets include both fixed-income securities and risky financial assets; semi-private wealth comprises pension claims and life insurance. Housing includes the capitalized value of land under dwellings.

Figure 4: Wealth Composition in Percent of National Income, 1880–2019



Note: Figure shows the composition of household wealth, with each asset expressed as a percentage of net national income. All wealth composition data are from the historical National Accounts method.

nonfinancial assets – housing, land and the capital stock. By contrast, the major reason for the decline in the wealth-income ratio in this period is due to a decline in the value of financial assets. The Bretton Woods system featured capital controls and other measures which limited the ability of equity to be freely traded. The Dutch stock market grows rather slowly from 1947 until 1980, only picking up afterwards; furthermore, foreign investment was much more limited in this period than before World War II. This is especially true for investments in Indonesia following Indonesian independence; we observe a sharp drop in the value of equity in the late 1950s, which corresponds precisely with the forced nationalization of all Dutch firms remaining in Indonesia at the time.

One of the most striking trends in the post-1970s period is the dynamic in the relative value of housing. Starting from a precipitous decline in relative value in the early 1980s, the value of housing then continued to grow almost uninterrupted until the mid-2010s. This increase in the value of private real estate was mirrored by a sharp increase in home mortgages; which, as a percentage of net national income, nearly quadrupled throughout this period, reflecting the growing financialization of the Dutch economy. A particular institution which contributed to the buildup in mortgage debt was the interest-only mortgage, which was enormously popular until the Great Financial Crisis of 2008 (Bernstein and Koudijs 2020). To a lesser extent this is also reflected in the stock market. While the holdings of both domestic and foreign securities decreased because of the subsequent oil crises in the 1970s, it started to increase substantially in the following years. This growth came to a standstill due to the Dot-com bubble in the early-2000s and more recently the Global Financial Crisis of 2007-2008. The relative value of other asset categories seem notably stagnant throughout this period, which is similar to most of the 1880–1938 period.

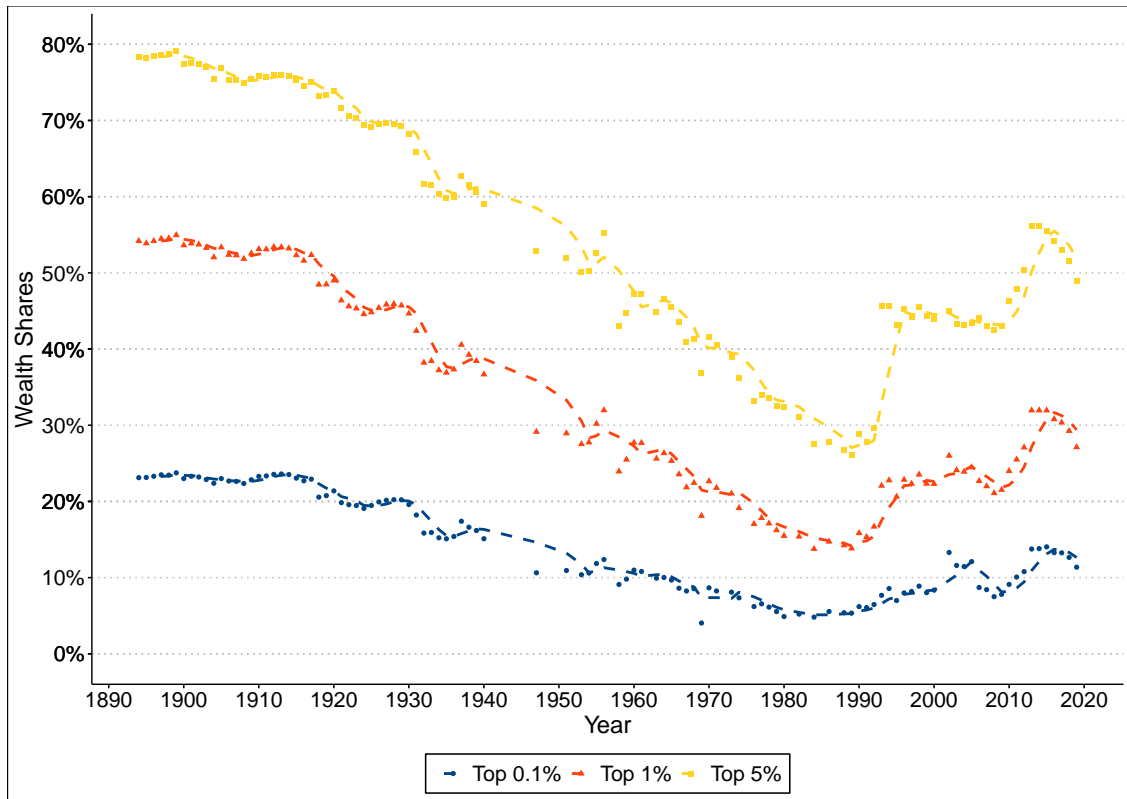
Notably for the Netherlands, it is important to point out the rapid growth of semi-private wealth after World War II. Pension wealth in particular expanded exponentially from the 1980s. Pension funds increasingly matured with a growing number of households that paid pension contributions for the full duration of their career. Falling discount rates play their role in more recent years by inflating the net present value of these household claims on pension funds. Whereas it was once all but a minor component of private wealth, it now slightly exceeds housing as the most important asset of households.

4.3 Wealth Shares

We now turn to our results for top wealth shares. Figure 5 shows the evolution of the top 5%, 1%, and 0.1% share from 1894–2019. As noted before, the data for this series are drawn from the wealth tax records and the results are estimated using generalized Pareto interpolation (Blanchet, Fournier, and Piketty 2021). The individual data points are connected by a three-year moving average trend line. Since the distribution of pension wealth is historically unavailable, this wealth component is excluded in these figures.

We observe a familiar U-shaped pattern in top wealth shares over the 20th century. The top 1% share peaked at close to 60% around 1900, before declining to as little as 15% by the end of the 1970s. From the late 1980s, the top shares start increasing again, peaking at a 1% share of around 35% in 2015. Several caveats about this trend should be noted. First, a lack of data availability of the full distribution before 1993 precludes robust conclusions about the evolving role of lower percentiles, which makes it difficult to verify the trends observed in these top wealth shares. Second, it is generally accepted that the wealth tax records become increasingly uninformative from the 1970s onward (Wilterdink 1984; Van Bavel and Frankema 2017). This is due to several factors, including increased thresholds (up to 200,000 guilders by the late 1970s), increased exemptions of business capital from the 1980s onward, as well as a weakening of tax morale. These factors are difficult to quantify precisely; however, the marked jump in top wealth shares

Figure 5: Evolution of Top Wealth Shares, 1894–2019



Note: Wealth shares calculated using generalized Pareto interpolation and the wealth tax records. Three-year moving average shown in dashed lines.

around 1993 – the first year for which Statistics Netherlands is able to recover the full distribution with some confidence – is striking, particularly for the 5% share. The unavailability of reliable sources before 1993 makes it difficult to determine which part of the decline in wealth shares prior to 1993 is due to worsening data quality and which part is a true decline in wealth concentration.

Data availability vastly improves after 1993, allowing us to reconstruct the full distribution of wealth with far higher confidence than before; as a result, the wealth shares series features a discontinuity between 1992 (the last year for which we base our results on the wealth tax) and 1993 (the first year that tabulated data for the full distribution are available). Nevertheless, despite this slight break in the series, the overall trajectory pre- and post-1993 is clear, with a clear upward trend that continues to this day, interrupted by a contraction in top wealth shares after the recessions in 2001 and 2008. After the peak in wealth concentration in 2015, the top 1% share fell somewhat until 2019. As we analyze in Section 6, this is likely explained by the strong increase in housing prices; as housing is the middle class’s most important asset, this increases their wealth relative to the wealthiest 1% whose wealth is mainly in closely held business equity and financial assets. This mechanical contraction in top wealth shares resembles the “race between the housing market and the stock market” analyzed in the United States by Kuhn, Schularick, and Steins (2020).

4.4 International Comparison

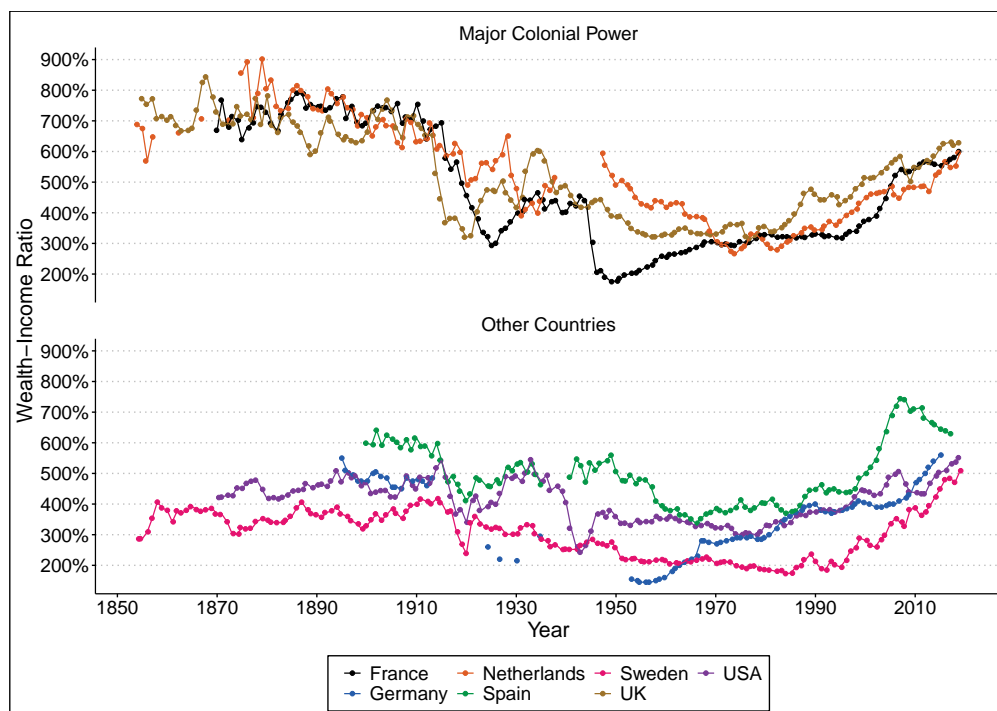
In this section we compare our findings with international estimates. Figure 6 looks at private wealth-income ratios for several western countries for which such long-run evidence exists: the United Kingdom, France, Germany, Sweden, Spain, and the United States. We use the series for Spain by Artola Blanco, Bauluz, and Martínez-Toledano (2020), as well as the estimates by Albers, Bartels, and Schularick (2020) for Germany and the series by Waldenström (2017) for Sweden; all other estimates are from Piketty and Zucman (2014). The Spanish, German, and Swedish series are all quite substantially lower before World War I than the series reported by Piketty and Zucman (2014); this fact has led Waldenström (2021) to state that wealth-income ratios were much lower pre-World War I than previously thought⁹.

Our evidence, however, provides important nuance to that claim. We notice that the Dutch series is among the highest observed, peaking in excess of 900% in the early 1880s, and generally being remarkably close to the French and British series until the late 1910s. By the 1920s, the Netherlands has by some distance the highest wealth-income ratio, only to converge to the other series after the 1929 crash. Hence, on the basis of these series, we can group pre-World War I countries into two groups: a high-wealth group, which consists of France, the Netherlands, and the United Kingdom; and the other countries. Not coincidentally, the first group consists of major colonial powers, whereas the other countries had no or relatively negligible colonies during this period. Understanding the differences between these groups, and between the Netherlands and these other countries in particular, will be at the centre of our analysis in Section 5.

For all countries, ratios continued to decrease after the second World War until the 1980s, when all countries experienced a sharp increase from about 300 percent in 1970 to about 400–600 percent today. This general trend obscures country-specific variation. In Europe, the trajectories for France and the United Kingdom are comparable: the private wealth – income ration rose from about 300 percent in 1970 to about 550 percent in recent times. In Germany and Sweden, the increase was more notable, but private wealth remained lower overall, never exceeding 400 percent up until the early 2000s. In the last decade, Sweden

9. Waldenström (2021) also uses the UK series by Madsen (2019), which arrives at substantially different estimates than Piketty and Zucman (2014) based on cumulated investments starting in the 1200s, as well as upward revisions of national income. In our view, the Piketty-Zucman series is closer to the modern benchmark of historical national accounts, and hence we will use this series in our comparisons.

Figure 6: Wealth-Income Ratio, International Comparison



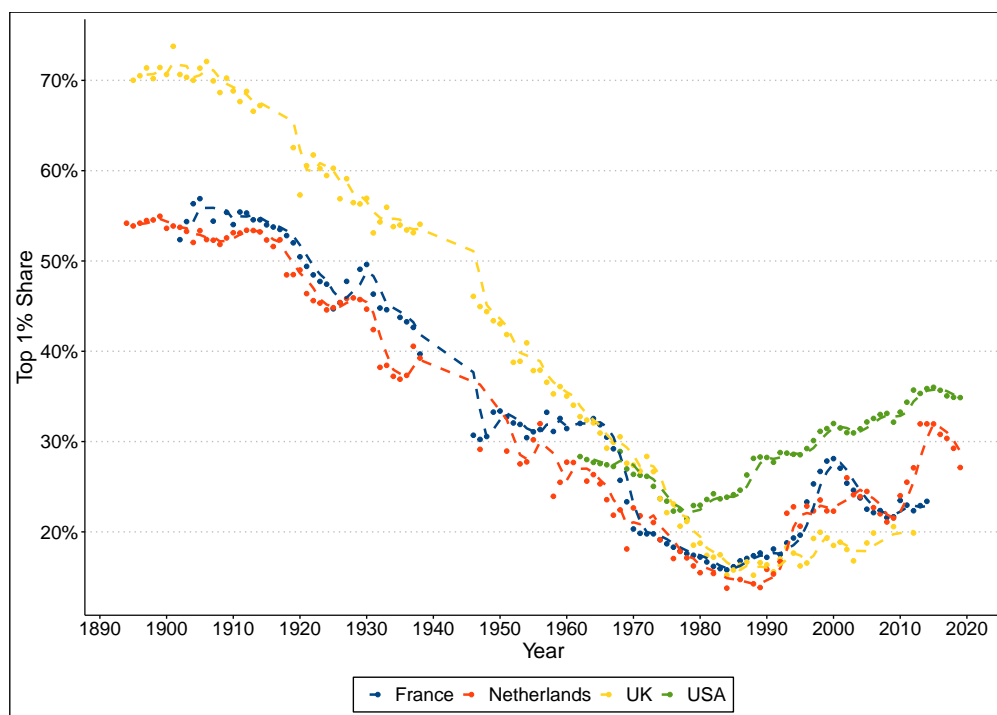
Note: Figure shows the evolution of the ratio of private wealth to net national income for the Netherlands, Germany (from Albers, Bartels, and Schularick (2020)), Spain (Artola Blanco, Bauluz, and Martínez-Toledano 2020), Sweden (Waldenström 2017); as well as the series for the UK, France, and the US from Piketty and Zucman (2014). The top panel shows France, the UK, and the Netherlands, which we have termed “major colonial powers”; all the other countries are shown in the bottom panel.

however was marked with a remarkable increase with the private wealth – income now exceeding 500 percent (Piketty and Zucman 2014: 1277-1279; Waldenström 2017: 291-293). Focusing on how the Netherlands fared compared with the other countries, two findings stand out. First, the Netherlands’ wealth-income ratios are low compared to all other countries from roughly the mid 1960s until the mid 1980s, always hovering around 300 percent. A second finding is that the Netherlands appears to follow a similar trend of a sharply increasing ratio in recent decades, most similar to the patterns observed for Germany and Sweden.

In sum, comparing the main trends for the Netherlands with other countries for which long-term series on private wealth-income ratios are available shows first and foremost that the patterns are relatively similar. Nevertheless, somewhat provocatively one could label the Netherlands as the land of the extremes. It is characterized by both the highest ratio from the mid 19th century until the early 20th century, as well as one of the lowest ratios from the mid 1960s until the mid 1980s.

Next, we turn to the international comparison of top wealth shares. Figure 7 shows the long-run evolution of the top 1% share in France, the Netherlands, the United Kingdom, and the United States. We observe that the trends for the top 1% share are much more similar across all countries. The United States notably diverges in recent decades, with higher top wealth shares than the other countries. Note, however, that the Netherlands approaches U.S. in recent years, both hovering between 30 and 40%, although the trends in recent years are diverging with Netherlands demonstrating a decrease.

Figure 7: Top 1% Wealth Share, International Comparison



Note: Figure shows the wealth share of the top 1% for France, the Netherlands, the UK, and the US. Data are from the World Inequality Database.

Since the underlying data for top wealth shares are more fragile than those for aggregate wealth, we view that conclusions from these long-run trends should be drawn sparingly. However, it is clear that top wealth shares have increased since the 1980s, reaching levels not previously seen since the 1950s.

5 The Rise and Decline of Wealth pre-World War II

In this Section, we dive deeper into the dynamics of the Dutch wealth-income ratio before World War II. Specifically, we are interested in two questions: Why was the wealth-income ratio so high in the Netherlands? And why was the wealth-income ratio lower almost everywhere else? We will argue that the historical context provides compelling answers to both questions. In our analysis, we focus on two aspects. First, we note that the extent of Dutch foreign and colonial investment was unprecedented, particularly from the 1910s onward, and this can account for a large part of the divergence with most other countries. Second, we also note that *denominator* effects matter: cross-country differences in the wealth-income ratio reflect not only differences in wealth levels but also in national income levels. We will argue that this explains, for instance, why the British wealth-income ratio was lower than the Netherlands prior to the 1930s, since its national income was significantly higher.

5.1 Explaining the Trends: Foreign and Colonial Asset Holdings

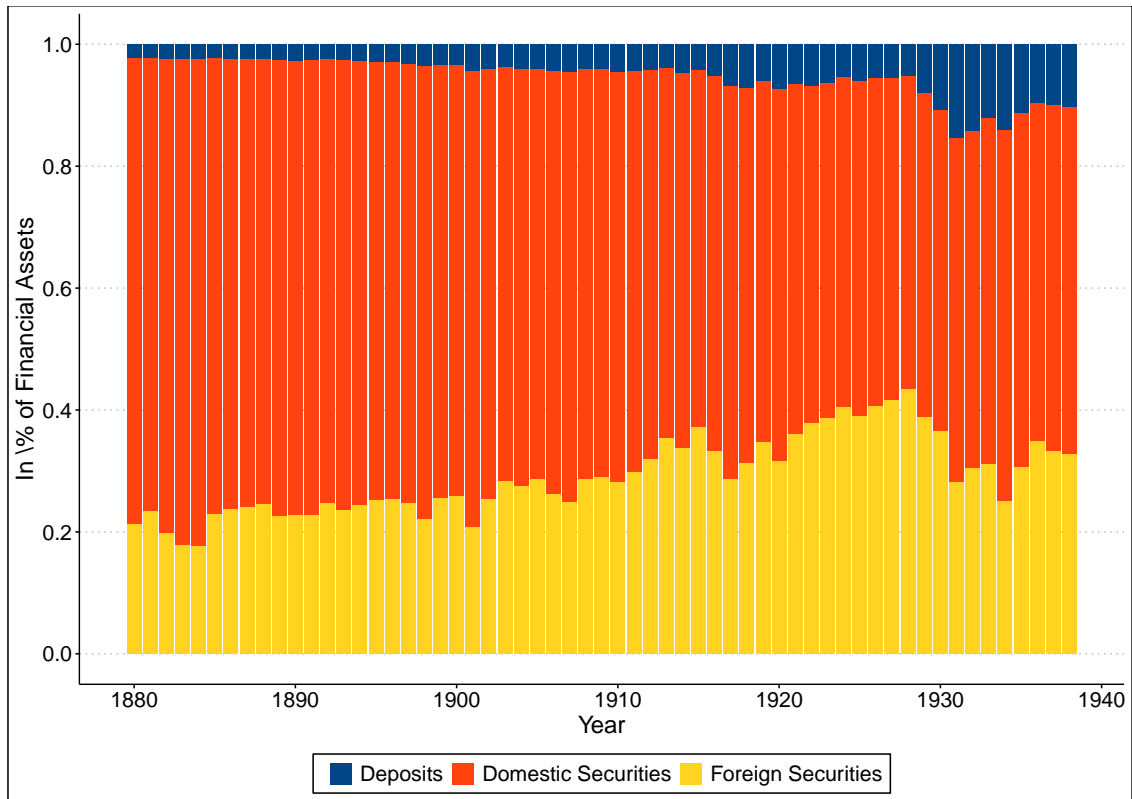
The upheavals of the late eighteenth century and the occupation of the French had inaugurated a period of economic stagnation in the Netherlands lasting some fifty years. Recovery after the restoration of independence in 1813 proved relatively slow, until the mid-1820s. The lack of an economic impetus meant that most companies did not need to raise substantial amounts of capital (Jonker 1995). At this time, colonial investment by private individuals was also limited. Indonesia had been administered by the Dutch East India Company until its dissolution, and had been contested by France and Britain in the Napoleonic era. By 1830, the Dutch had re-established control over the peninsula, and developed a new colonial policy to finance their mounting sovereign debt: the *Cultuurstelsel* (Cultivation System). This was a system of forced labor, mainly on the island of Java, where farmers were forced to grow cash crops like coffee and sugar. These cash crops were sold far below market prices to the *Nederlandsche Handelsmaatschappij*, which had a government-granted monopoly. As a result of the monopoly of the *Handelsmaatschappij*, private investment in Indonesia was absent in this period. Only when the Cultivation System was phased out in the 1870s did private colonial investment kick off. It is at the same time that investment in other foreign countries accelerates (van Zanden and van Riel 2000). Chief among these other foreign investments were industrial corporations in the United States, particularly steel and railroad companies. Bosch (1948) estimates the total value of Dutch investments in the United States in 1908 at 1.5 billion guilders, or close to 100% of national income.

The aforementioned trends are made visible by Figure 8 and Figure 9, which shows the composition of total financial assets (minus semiprivate wealth) from 1880 until 1938. Both series are based on observed dividends, which were carefully noted annually by Statistics Netherlands in various publications (Smits, Horlings, and van Zanden 2000; den Bakker 2019). We capitalize these dividends using information on dividend yields from Jordà et al. (2019), to arrive at total wealth invested abroad¹⁰.

We observe that foreign investment was substantial from the beginning of our series in 1880. Prior to the 1900s, most of foreign wealth was non-colonial, likely invested in American corporations (Bosch 1948) as well as Austrian and Russian bonds (de Vries 1976). Colonial dividends were small in this period, but increased dramatically during the long era of economic expansion which started in 1895 and ended in 1914

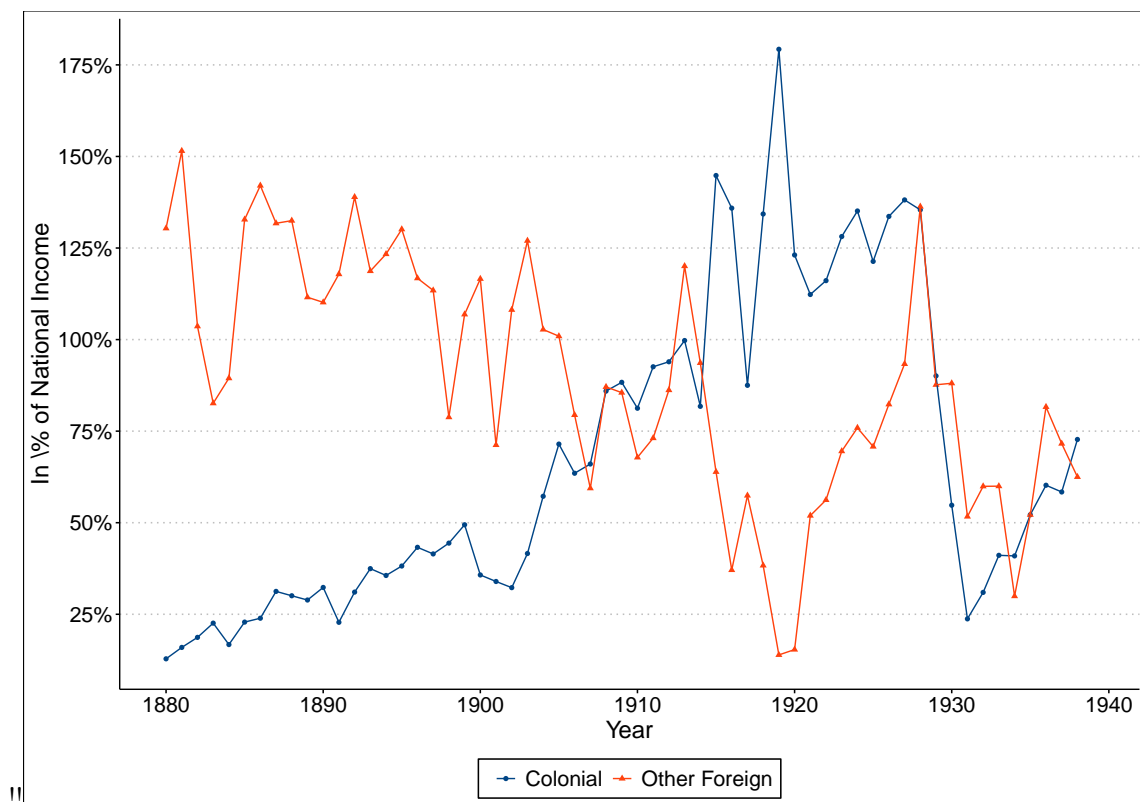
10. Note that, to the best of our knowledge, ours is the very first series on private colonial wealth. In Appendix A.3.4.2, we discuss this methodology and show how it is robust to other specifications; moreover, we show how our figures match various estimates in the historical literature remarkably closely.

Figure 8: Composition of Financial Assets, 1880–1938



Note: Figure shows the composition of financial directly held assets, from 1880 until 1938. All data are based on the Historical National Accounts method.

Figure 9: Foreign and Colonial Investment, in % of National Income



Note: Figure shows the evolution of (net) foreign and colonial investment from 1880 until 1938. Both series are expressed as percent of net national income.

(van Zanden and van Riel 2000). Although the Cultivation System had been abolished, cash crops still amounted for the majority of wealth generated in Indonesia; from the 1900s, oil and gas reserves were also found on the islands of Sumatra and Borneo, fueling the rise of the corporation now known as Shell. The expansion of colonial investment is clearly visible in Figure 9.

What is also striking is the collapse of non-colonial foreign investment during the 1910s. Clearly, the impacts of World War I, as well as the accompanying hyperinflation, played a major role here. What's interesting is that colonial investment only continued to expand during this period. After the end of World War I, both colonial and non-colonial investment crashed, reaching a nadir of 150%. Immediately afterwards, investment skyrocketed again. This is mainly driven by a boom in colonial commodity prices. The British had tried to introduce import restrictions on many cash crops to boost the post-war economy; the Netherlands ignored this plan and continued to export large amounts of cash crops and petroleum during the 1920s. The reduced supply by other producers resulted in high demand for Indonesian commodities, boosting profits and prices to unprecedented levels (Buelens and Frankema 2016). At its peak in 1928, colonial investment was worth approximately 140% of national income. A recovery in investment in the United States and other countries had also led to enormous growth in non-colonial foreign investment, resulting in a total foreign wealth peak of almost 300% of national income in 1928.

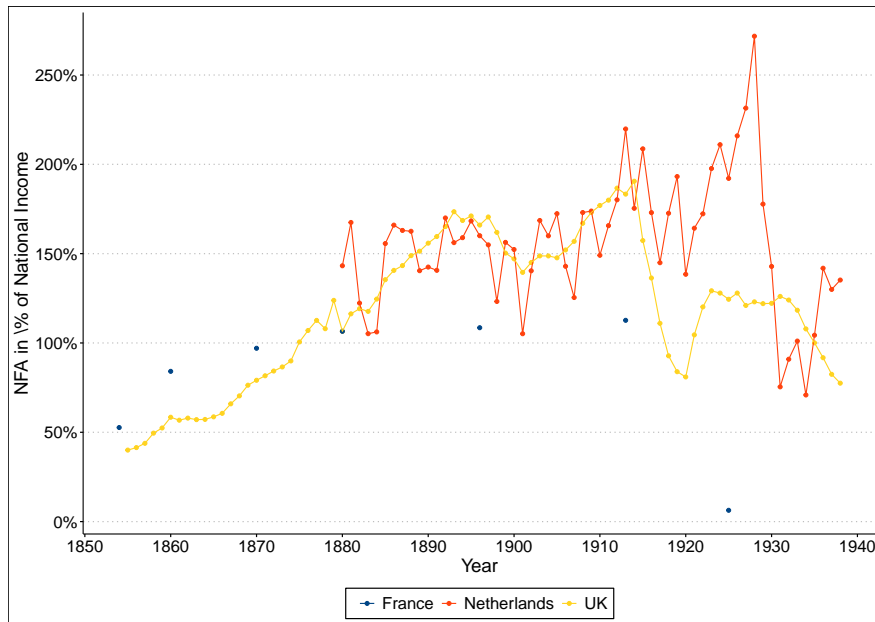
The Great Depression hit foreign investment hard; Indonesian corporations recorded losses of around 20% of their total value (van der Eng 1998), and investment in the United States also collapsed (Bosch 1948). By the late 1930s, some of these losses had been undone, with the final value of Dutch private foreign investment in 1938 being close to 140% of national income.

How does this compare to other countries? To the best of our knowledge, no direct estimates of colonial investment in total wealth are available for other major colonial powers. Instead, we will compare net private foreign asset positions of three major colonial powers for which these are available: the Netherlands, France, and the UK. The result is given in Figure 10. In panel 10a, we compare the net private foreign asset positions of these three countries. Note that for France, only isolated benchmark years exist, whereas for the UK and the Netherlands, a continuous series is available. We note that the Netherlands and the United Kingdom had comparable levels of foreign wealth until 1910, but started to diverge dramatically afterward, with the Netherlands increasing its foreign investment enormously, whereas the United Kingdom's foreign investment plummeted. France's foreign investment was much lower throughout this period.

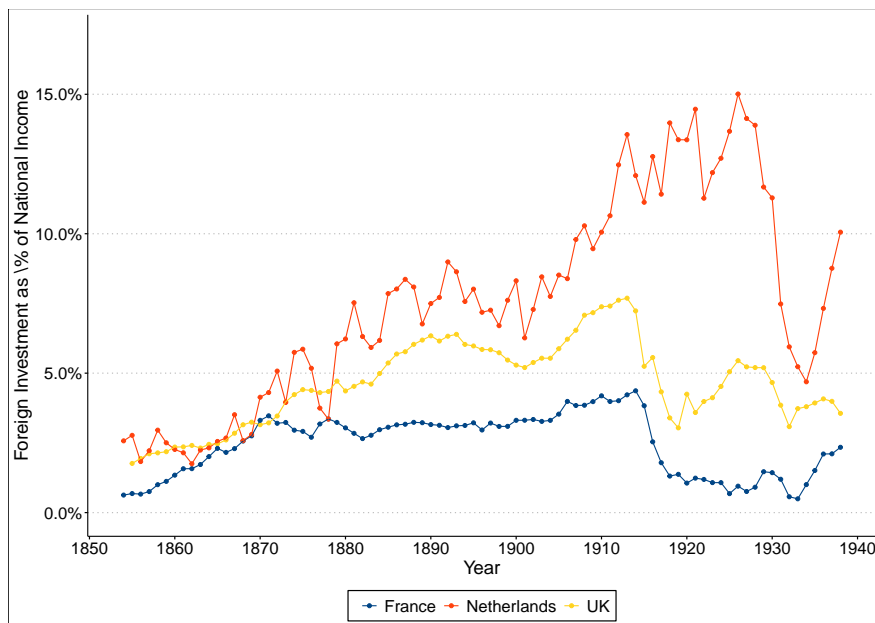
The Dutch series seems much more volatile than the other two series, which are estimated using different methods (see Piketty and Zucman (2014) for details); one might wonder how robust this feature is. Panel 10b shows that this is actually not driven by the estimation method, since the flows of foreign income are also much more volatile for the Netherlands than for the United Kingdom or France. It is an interesting open question why this should be the case; it is possible that the nature of colonial relations in the British and French empires resulted in more price stability, or that the Dutch investments were more tied to the world financial markets and hence more volatile. Also note that for foreign income, we can go back further than our starting point of 1880 for wealth; as a result, we see clear evidence that foreign investment in the Netherlands increased enormously in the second half of the 19th century, with foreign income growing from 2% of national income to almost 15% in the 1920s.

Hence, we can conclude that foreign investment, and especially colonial investment, was to a large extent responsible for the different trajectory of the Netherlands compared to other countries. Given that the British and French empires were vastly larger in size, it is remarkable that the value of investment relative to national income of the Netherlands is comparable to those two empires and even exceeds their value from the

Figure 10: Foreign Wealth and Income as % of National Income, International Comparison



(a) Foreign Wealth



(b) Foreign Income

Note: Figure shows the evolution of foreign wealth and foreign income for France, the Netherlands, and the United Kingdom. Data for France and the United Kingdom are from Piketty and Zucman (2014).

1910s onward. Although the extent of colonial exploitation in Indonesia is contested (Buelens and Frankema 2016; van der Eng 1998; Gordon 2010), it seems safe to say that it was exceedingly important for Dutch private wealth accumulation, particularly from 1900 onward.

5.2 Explaining the High Level: Income and Capital Income

While foreign investment may account for the trends pre-World War II, it does not entirely explain the differences in *levels* between countries. In Figure 6, we could see that by 1880, the Dutch wealth-income ratio already was at a high level, even though foreign investment would continue to grow in magnitude afterwards. How can we explain the differences in level between the Netherlands and other countries?

In this section, we advance two arguments. First, we note that denominator effects matter enormously when studying ratios such as the wealth-income ratio. Accounting for differences in income levels already accounts for a significant portion of the gap between the Netherlands and, say, Britain. Second, we argue that the long history of financial development in the Netherlands resulted in a uniquely financialized country, where therefore the value of financial investment was more significant than elsewhere.

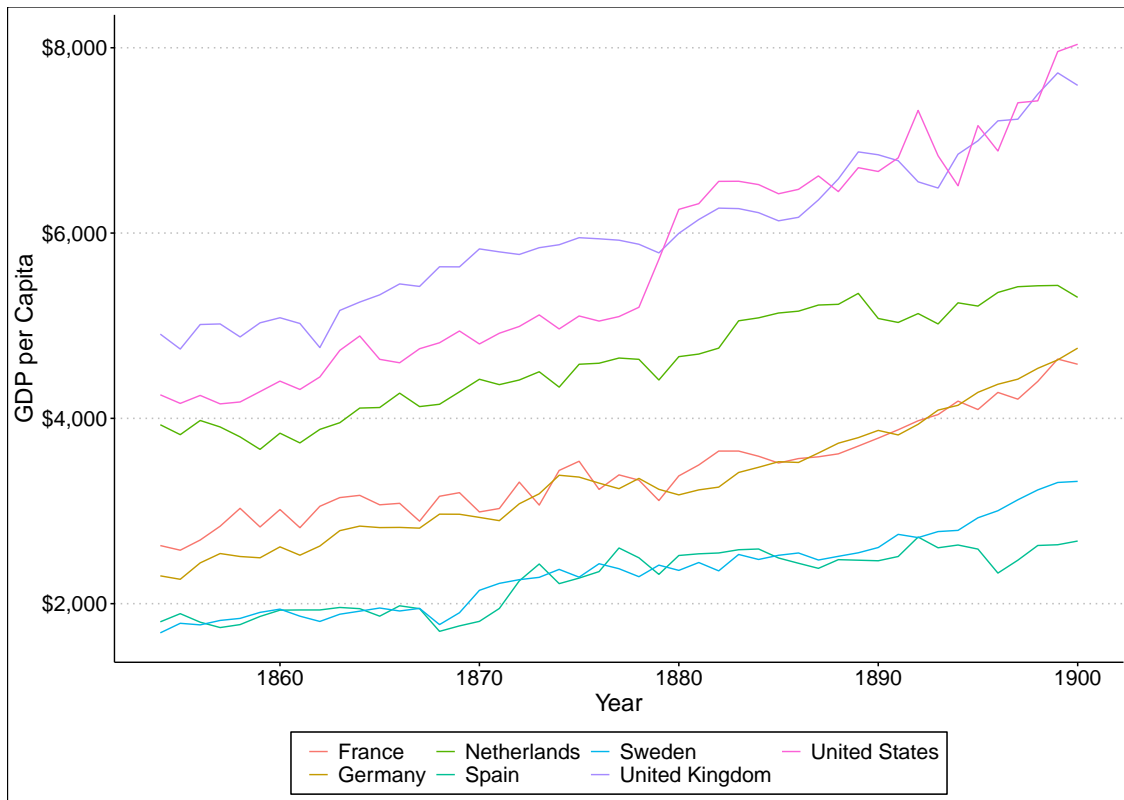
Start with cross-country income differences. This aspect of studying wealth-income ratios has so far been neglected in the literature, but it actually matters enormously for interpreting observed trends like Figure 6. One reason for using ratios as object of study is that they are independent of price levels, facilitating cross-country comparisons. When we start directly comparing income, we do have to take price differences into account. The most detailed and careful project doing so is the Maddison Project (Bolt and Van Zanden 2020), which collects detailed historical GDP estimates for many countries and presents them in a single database using the 1990 International Conference on Prices (ICP) weights to account for price level differences. We use their real GDP per capita figures for all countries covered in Figure 6 from 1850 until World War II; the result is presented in Figure 11.

It is immediately obvious that differences in real GDP per capita were substantial across countries for the entire period; in fact, the divergence increased significantly until World War I. The Netherlands lags behind the United Kingdom and the United States until the early 1920s, but is ahead of France, Spain, Germany, and Sweden. These findings have several implications for our interpretation of wealth-income ratio differences. First, denominator effects can explain a large part of the difference between the wealth-income ratio *levels*. The United Kingdom's GDP per capita in 1880 was almost 50% larger than the Dutch level; combine this with the fact that the UK population was about 10 times the Dutch population in 1880 (Bolt and Van Zanden 2020) and the conclusion becomes immediate that income differences play a major role. This is also the core of Madsen (2019)'s revisions of the original Piketty and Zucman (2014) series for the United Kingdom: most of his revisions deal with the fact that national income was underestimated in the Piketty-Zucman estimates; clearly, denominator effects matter.

Conversely, the fact that France and the Netherlands had comparable wealth-income ratios for most of the late 19th century, despite the fact that France's GDP per capita is significantly lower than the Netherlands', suggests that wealth was much more important for the Netherlands relative to France. The same holds for the other countries in the series; however, since they both have lower wealth-income ratios and lower income levels than the Netherlands, the point is less relevant for those countries.

The reader might wonder at this stage how it could be possible that the Netherlands simultaneously had enormous wealth and relatively low income; wouldn't that imply an unrealistically low return to wealth? Figure 12 shows that this is not the case; the return to wealth was rather stable and sizable, hovering around 6% pre-World War I. After World War I, the return increases to almost 8% in the 1920s, before decreasing

Figure 11: Real GDP per Capita, 1854–1938



Note: Figure shows GDP per capita for the Netherlands, France, Germany, Sweden, Spain, the UK, and the US. Data are from the Maddison Project (Bolt and Van Zanden 2020), and all values are in international 1990 USD.

again to roughly 7% in the 1930s.

Figure 12: Return to Wealth, 1854–1938



Note: Figure plots the return to household wealth, using the Historical National Accounts. See Appendix D for details.

This indicates that capital played an outsized role in the Dutch economy. This striking pattern can best be explained by path-dependency and can be seen as a direct result of the country's past. Starting in the 15th century, the Netherlands – especially its Western regions – were already highly urbanized, with an economy focusing primarily on trade. Unlike most of its neighbouring countries, the most influential class at the time consisted of merchants, the so-called “Regents”, and not landowners. Trade allowed the merchant class to accumulate massive amounts of wealth, which they used to consolidate their political power (Wilterdink 2015).

Indeed, much of their wealth was allocated to foreign investment opportunities, facilitated due to Amsterdam's distinctive position as an international trade centre, but also in state obligations. Investing in government bonds linked Regent's private benefits to their public pursuits in a most direct way (Wilterdink 2015; 't Hart, Jonker, and Van Zanden 1997). This political-economic setup allowed for fiscal and financial structures, which further entrenched the beneficiary position of merchants: (i.) the customs rates were low; furthermore, (ii.) taxes were mostly levied on consumption and property rather than trade and direct investments ('t Hart, Jonker, and Van Zanden 1997).

Following the end of The Dutch Golden Age in the 18th century, the Netherlands increasingly started to play second fiddle compared to France and especially Great Britain, which had become the prime mercantile nation, supported by an ever-expanding colonial empire. By then, the initial advantages of the Dutch

Republic, most notable its urbanization and its well developed financial and commercial system, would no longer outweigh its inherent disadvantages such as its limited area, population, and relatively fragmented political system. Throughout the 18th century, national income tended to stagnate while national private wealth expanded steadily. These geopolitical developments did not prevent the further development of the city of Amsterdam into one of the leading financial markets of the time. Dutch capital penetrated far into European countries and their colonies (Dehing and ‘t Hart, 1997).

Due to the enormous reserve of accumulated funds, the Dutch elite managed to safeguard – or even strengthen - their privileges throughout the 19th century. Relying on their strong capital basis, they successfully responded to the geopolitical trends by shifting their business from merchants to bankers, commissioners in bills of exchange, insurers, and stockbrokers. Per these political-economic changes, a further shift was noted from mercantile finance to investments in foreign equity and bonds (Jonker, 1995). The climate for a thriving capital market remained highly profitable, and private wealth continued to grow faster than national income (Wilterdink 2015).

By the 1860s, the Netherlands started to industrialize, a few decades after its southern neighbour Belgium and most other surrounding countries. The reasons for this comparatively laggard development are still widely debated. So are the reasons why it took off by the middle of the 19th century. Even on the exact timing of the Dutch industrialization, there appears to be no real consensus (van Zanden and van Riel 2000; Philips 2020).

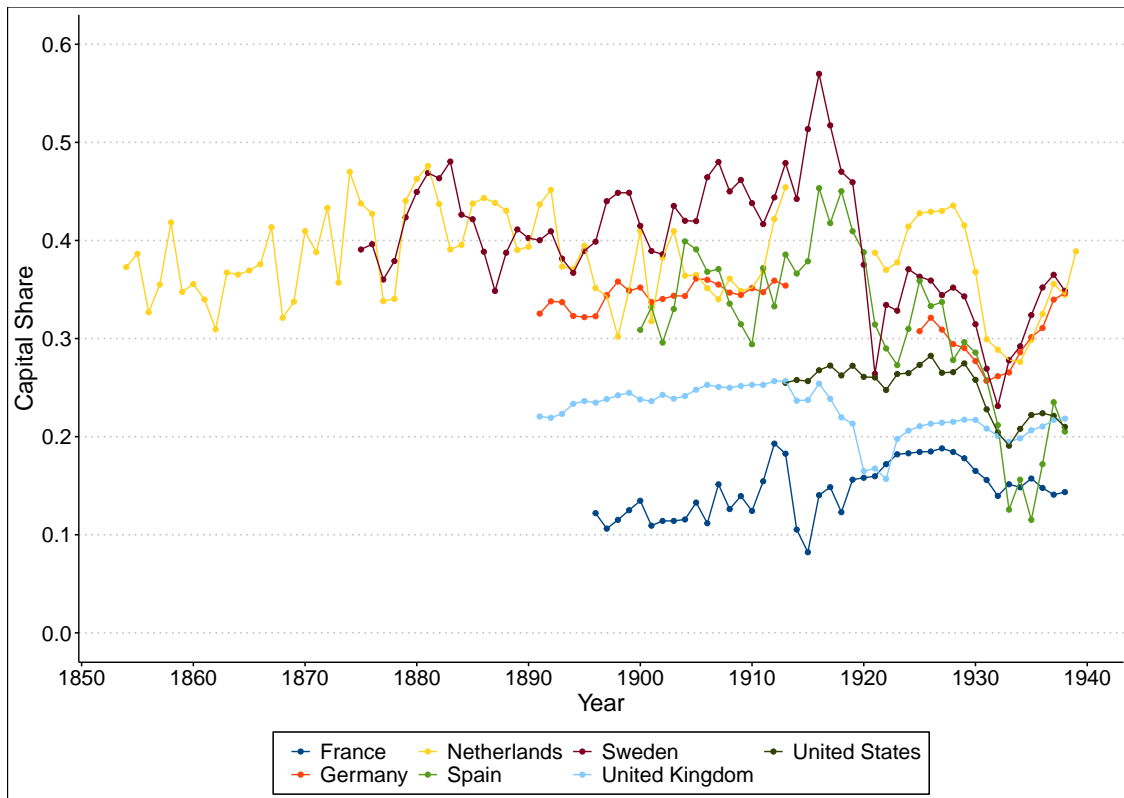
Sketching the outlines of this debate takes us far beyond the purpose of this article. However, what is of importance here is that the take-off of Dutch industrialization was fully underway by the late 18th and early 19th century. Simply looking at the nearly exponential rate in which the number of joint-stock companies (i.e., in 1850 there were only 137 joint-stock companies, by 1894 this had risen to over 1,700) rose throughout this period is exemplary for this trend.

The industrial expansion of the Dutch economy also allowed for new manners in which to accumulate riches. Consequently, a new class of industrialists joined the ranks of the Dutch elite, while the existing elite managed to preserve their wealth by expanding their mostly foreign investment portfolio with new domestic investment opportunities (Wilterdink 2015). The growing number of wealthy industrialists had a clear impact on the wealth-income ratio, which continued to grow in the decades following the 1860s; reaching an apex of more than 800 percent of national income by the dawn of the 20th century.

This importance of capital to the national economy is confirmed in Figure 13, which plots the capital share of national income for all seven countries in consideration. We have estimated the capital share for the Netherlands ourselves; data for all other series are from Bengtsson and Waldenström (2018).

We observe that the Dutch capital share was among the highest one record from the 1850s until the 1930s, only being outpaced by Sweden in some years. Significantly, the British and French capital shares were significantly lower. This corroborates our focus on the denominator as a major source of cross-country differences: These large countries both had a larger weight on labor in the economy than the Netherlands, whose labor share would remain low until the post-World War II era. The Dutch economy was dominated by capital to a far greater extent than most other countries, with the possible exception of Sweden. Sweden, however, had much smaller wealth-income ratios than any other country on record, suggesting that it was in effect a developing country for most of this period (Waldenström 2017).

Figure 13: Capital Share of National Income, 1854–1938



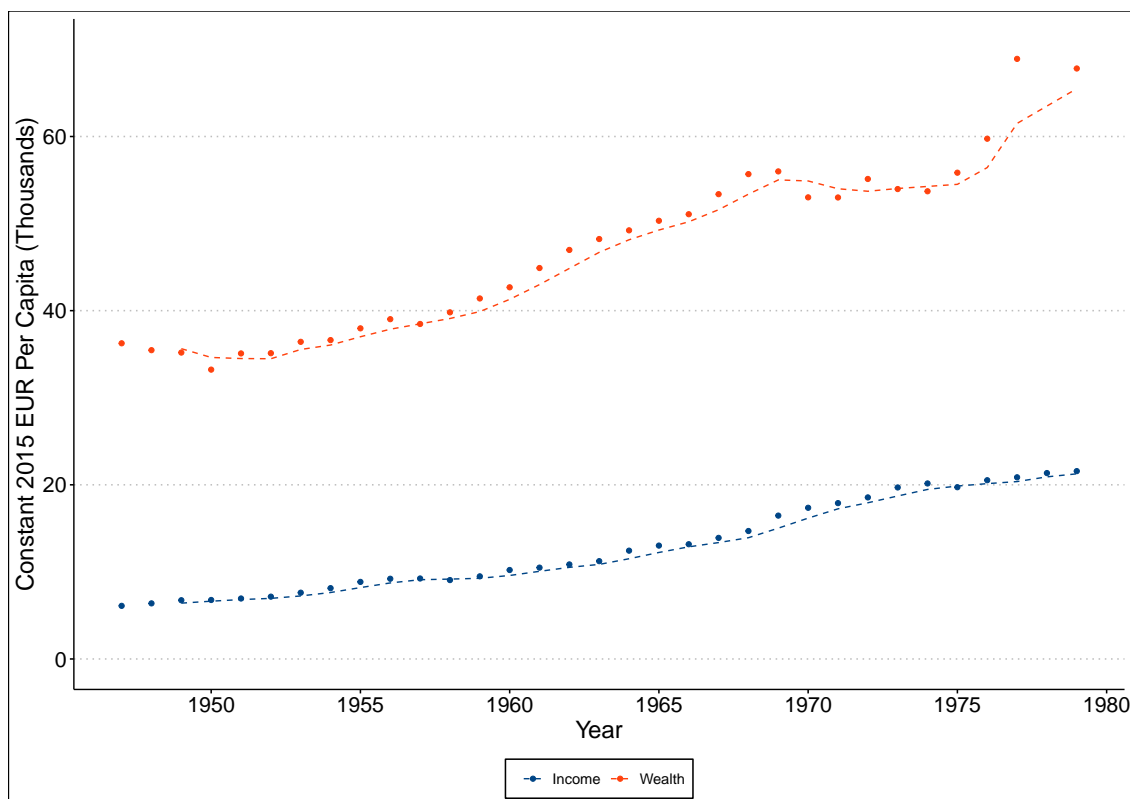
Note: Figure shows the capital share of national income, net of depreciation. Data for countries other than the Netherlands are from Bengtsson and Waldenström (2018). Details on the Dutch capital share can be found in Appendix D.

6 Post-World War II: Pension Savings, Corporate Savings, Housing Capital Gains

In this Section, we explore the decline and subsequent increase in the wealth-income ratio after 1947. Specifically, we will focus on the role played by savings and capital gains in the observed real growth rates, and we will argue that the dominance of capital gains in the Netherlands reflects the institutional design of its pension system and housing market.

After World War II, a large expansion of domestic investments contributed to the continuous growth of the Dutch economy, characterized by an average annual increase of nearly 3 to 4 percent in national income in the 1950s and 1960s. This is seen in Figure 14, which shows real wealth and income growth from 1947 until 1980. Comparing the increase of national income across this period to the nominal growth in wealth of the upper classes, it becomes apparent that the growth of the wealth has lagged considerably behind. Further contributing to this trend was the noteworthy shift from private wealth to so-called semi-private wealth detailed earlier (Wilterdink 2015). Because of all these reinforcing factors, the Netherlands experienced its equivalent of The Great Compression (Goldin and Margo 1992). Between the 1950s and the 1970s, the wealth-income ratio dropped to unprecedented levels, with an all-time low of approximately 300 percent in the early 1970s.

Figure 14: Real Wealth and Income Growth, 1947–1980

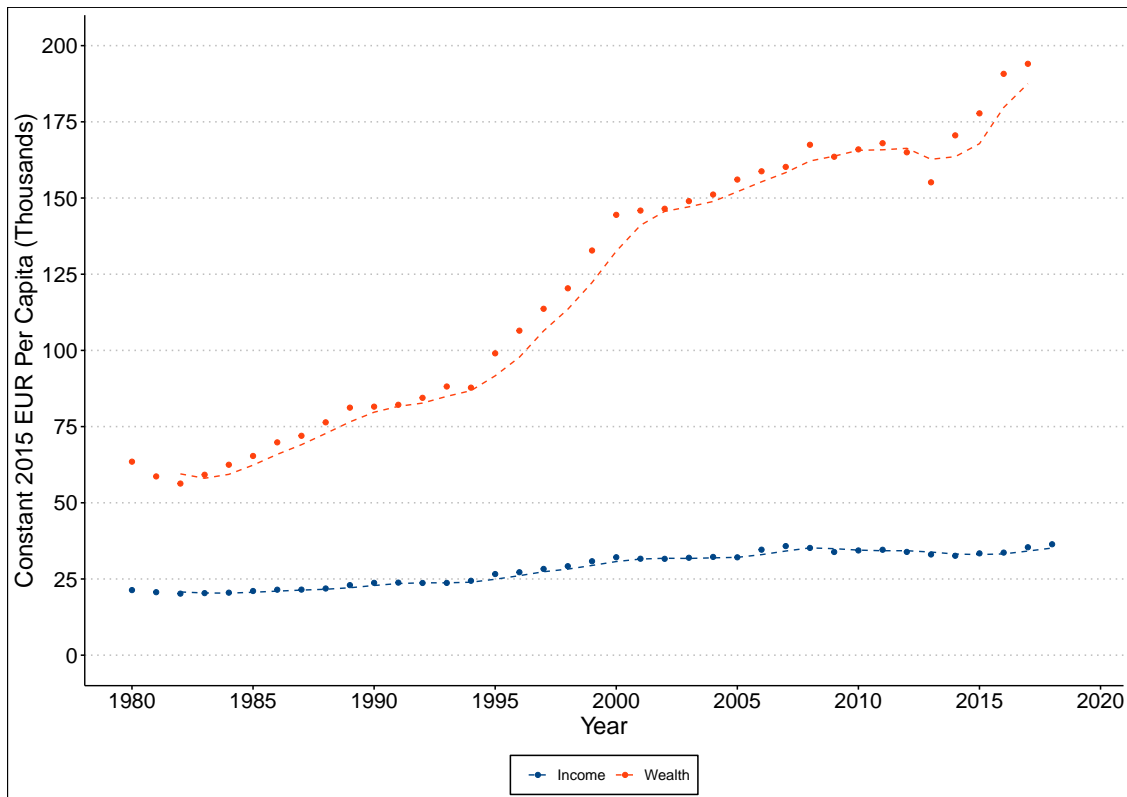


Note: Figure shows the evolution of household wealth and national income per capita, from 1947–1980. Both wealth and income are expressed in constant 2015 EUR.

While the effects of the World Wars as the great levellers lingered for several decades, things started to

change by the 1980s. This is clearly seen in Figure 15, where we observe that real wealth skyrockets, whereas real income grows at much slower rates and even seems to stagnate since the beginning of the 21st century. Section 4.2 already alluded to the import role played by pension assets in the rise of household wealth from the 1980s. Unlike other nations, housing wealth only plays a much more minor role in these developments as much of the increase in housing assets is matched by an equal increase in mortgages. The latter was supported by a liberal system of mortgage finance starting from the 1960s and the limited incentives for households to build up wealth given their already substantial pension claims (van der Valk 2019).

Figure 15: Real Wealth and Income Growth, 1980–2019



Note: Figure shows the evolution of household wealth and national income per capita, from 1980–2019. Both wealth and income are expressed in constant 2015 EUR.

6.1 Savings vs. Capital Gains

How can we make sense of these large upswings and downturns in the wealth-income ratio? A useful accounting decomposition is to split real wealth growth into a savings component and a capital gains component, using Equation 5. We observe real wealth growth $g_t := \Delta W_t/W_t - 1$, as well as savings rates out of wealth s_t ; hence, we can residually calculate real capital gains or losses as $q_t = (1 + g_t)/(1 + s_t) - 1$. Starting with Piketty and Zucman (2014), the subsequent literature has used this identity to identify an important role for capital gains in driving the recent boom in wealth-income ratios (e.g., Artola Blanco, Bauluz, and Martínez-Toledano 2020; Baselgia and Martínez 2020). When we try to do the same for the Netherlands, however, we first run into a conceptual difficulty: Which savings rate is the correct one to use?

Starting from national accounting identities, *national* saving is the sum of government and private saving;

private saving, moreover, can be decomposed into savings by households, financial institutions, and non-financial corporations. Most studies who have used accounting equation 5 so far have focused on *national* wealth. Then, the choice is clear: use the national savings rate. However, when we measure household wealth, it is not always clear which savings rate to use. Financial institution savings are mostly savings by pension funds; these conceptually are to the benefit of households. Likewise, corporate savings – retained earnings – can also be accrued to households to the extent that they own shares in the corporate sector. Obviously, the more expansive the savings concept, the lower the residually estimated capital gains will be, with the potential to radically alter conclusions about wealth accumulation. This point is acknowledged and discussed thoughtfully by Piketty and Zucman (2014) and Baselgia and Martínez (2020), but is especially important for the Dutch context, given the massive role that pension savings and retained earnings play. This point is illustrated in Table 2, which shows the decomposition of real wealth growth into its savings and capital gains components, using increasingly expansive definitions of savings for the period 1947–2019.

Table 2: Savings and Capital Gains by Savings Concept, 1947–2019

Period	Real Wealth Growth	Household		Household + Financial		Household + Financial + Corporate	
		Savings	Capital Gains	Savings	Capital Gains	Savings	Capital Gains
1947–2019	3.4%	1.6%	1.8%	2.3%	1.1%	3.8%	-0.4%
1947–1959	2.7%	0.6%	2.1%	1.4%	1.3%	2.5%	0.2%
1960–1969	4.9%	1.7%	3.2%	2.7%	2.1%	4.4%	0.4%
1970–1979	3.1%	3.2%	0.0%	3.5%	-0.4%	5.6%	-2.4%
1980–1989	2.7%	3.1%	-0.4%	3.8%	-1.1%	5.3%	-2.5%
1990–1999	6.4%	2.3%	4.0%	3.2%	3.0%	4.9%	1.4%
2000–2009	2.8%	0.6%	2.2%	1.1%	1.7%	3.3%	-0.4%
2010–2019	3.8%	1.2%	2.6%	1.9%	1.9%	3.5%	0.3%

Note: Table shows average real wealth growth rates for the respective periods in each row. This average growth rate is then decomposed into a savings and capital gains component using Equation 5. The savings concept used in each column is indicated at the top of the table.

Looking at the first row of Table 2, we observe that household wealth growth was sizable and positive, averaging 3.4% per year from 1947 until 2019. It is also clear that a sizable portion of this wealth growth is attributable to savings. This is true even when we use the narrowest savings concept, household savings; even with that conceptualization, savings accounted for $1.6/3.4 \approx 50\%$ of all household wealth growth. If we move to more expansive savings concepts, the role of capital gains mechanically declines even further. If we add savings by pension funds and other financial institutions, capital gains only contribute 1.1 percentage point on average to real wealth growth. Most interestingly, if we add retained earnings, capital gains turn *negative*, indicating that total private savings account for more than 100% of real wealth growth in the

Netherlands. Again, we do not take a stance on which savings concept to use; for one thing, if we want to include corporate and financial saving, we presumably also need to estimate the balance sheets of the corporate and financial sector. However, we stress that these issues are not clear-cut and have first-order impacts on the interpretations of wealth accumulation.

Even more interesting findings emerge once we move to the rows which show decadal averages. Here, it is clear that household savings really took off from the 1970s, with capital gains being 0 or negative even in the narrowest definition from 1970 until 1990. The 1990s witnessed an enormous boom in household wealth, which is mainly driven by capital gains. Again, using more expansive savings concepts decreases the role of capital gains even in these years. We can conclude that retained earnings and financial institution savings matter significantly for the development of private wealth.

From 1995, we can get a grasp on the sources underlying these savings and capital gains components. From that year on, Statistics Netherlands publishes modern household balance sheets that include all wealth components, as well as volume and price mutations happening during each year to these components. Hence, we can decompose the household wealth growth rate into savings and capital gains components per major wealth component. We do so in Table 3, where we focus on four major categories: financial wealth (net of financial debt), semiprivate wealth (pensions and life insurance), housing wealth (net of mortgage debt), and nonfinancial wealth.

Table 3: Decomposition of Household Wealth Growth by Wealth Component, 1995–2019

	1995–2019	1995–1999	2000–2004	2005–2009	2010–2014	2015–2019
Real Wealth Growth	3.8%	8.4%	4.0%	2.7%	1.2%	7.1%
- <i>Financial</i>	0.5%	2.5%	-0.3%	0.2%	0.0%	0.6%
- <i>Semiprivate</i>	2.0%	2.3%	1.3%	1.6%	3.9%	3.0%
- <i>Housing</i>	1.2%	3.0%	3.0%	0.5%	-2.6%	3.3%
- <i>Nonfinancial</i>	0.2%	0.5%	0.1%	0.4%	0.0%	0.2%
Due to Savings	1.3%	2.3%	1.4%	1.2%	1.4%	1.6%
- <i>Financial</i>	0.6%	1.7%	1.0%	0.6%	0.1%	0.4%
- <i>Semiprivate</i>	1.1%	2.0%	1.5%	1.1%	1.0%	0.8%
- <i>Housing</i>	-0.5%	-1.5%	-1.2%	-0.7%	0.2%	0.3%
- <i>Nonfinancial</i>	0.1%	0.1%	0.2%	0.2%	0.1%	0.1%
Due to Capital Gains	2.5%	5.9%	2.6%	1.5%	-0.2%	5.4%
- <i>Financial</i>	-0.1%	0.8%	-1.3%	-0.4%	-0.1%	0.2%
- <i>Semiprivate</i>	0.9%	0.3%	-0.1%	0.5%	2.8%	2.2%
- <i>Housing</i>	1.7%	4.6%	4.3%	1.1%	-2.7%	3.0%
- <i>Nonfinancial</i>	0.1%	0.4%	-0.1%	0.2%	-0.1%	0.1%

Note: Table shows the decomposition of average real wealth growth per five-year period from 1995 until 2019, split into savings and capital gains components per major wealth component. All wealth components are measured net of debt.

By focusing on five-year intervals, we can shed further light on dynamics happening in the last 25 years. We notice that the positive real wealth growth since 1995 has been extremely heterogeneous over time, with the years following the Great Financial Crisis seeing little more than a percentage point of growth per year; by contrast, the late 1990s were characterized by growth rates of over 8% annually. By decomposing these

growth trends across savings and capital gains and across wealth components, we observe various patterns. First, the major contributor to wealth growth since 1995 has been semiprivate wealth – pensions and life insurance. This component accounted for slightly more than half of all real wealth growth, with housing playing a secondary role. Other financial and nonfinancial assets matter far less for wealth growth in general, with the exception of the late 1990s, when financial assets were the most important contributor to wealth growth leading up to the Dot-Com bubble.

Semiprivate wealth added to wealth growth both via savings and via capital gains, with those channels being roughly equal in magnitude across the whole period but showing significant fluctuations in between. By contrast, housing actually dominates semiprivate wealth in most five-year intervals; however, housing experienced a stark slowdown in growth from 2005 onward, turning negative in the 2010-2014 interval. This period, associated with the collapse of housing prices following the Great Recession, clearly significantly repressed real wealth growth of households. It is also interesting to note that even in the other periods, housing’s contribution to wealth growth almost exclusively originates from capital gains, with housing savings being negative or very weakly positive throughout. This is due to the enormous accumulation of mortgage debt by households; the value of mortgages, in excess of 100% of national income in 2019, was stimulated by various government policies from the 1980s onward. One of those policies was the internationally unique institution of the interest-only mortgage, which did not require any amortization, and was only regulated following the Great Financial Crisis (Bernstein and Koudijs 2020). Another contributing feature of the Dutch institutional design was that households could until recently borrow in excess of the value of their home, up to 130% in the 1990s (van der Valk 2019). We can conclude from this exercise that pension wealth is the dominant factor explaining the real wealth growth of Dutch households. Note that if we were to use more expansive savings concepts, this conclusion would be even strengthened further.

7 Conclusion

Following the seminal work by Piketty and Zucman (2014), this study analysed the historical development of aggregate wealth-income ratios for the Netherlands from 1854 until 2019; a country that was notably missing in their analysis. In addition, we decompose total private wealth into various components, tracking the relative value of financial and non-financial asset categories for 140 years (from 1880 until 2019). Furthermore, we track top wealth shares from 1894 onward. Finally, we discuss various interpretations of these trends, and contrast them to the available international evidence.

We find that while the private wealth-income ratio in the Netherlands followed the familiar U-shaped pattern observed in earlier studies, the highs and low were more outspoken compared to most other countries for which such long-term evidence is available. In comparison with other industrialised countries, the Netherlands, experienced periods with some of the highest as well as one of the lowest private wealth-income ratio: from a ratio in excess of 900% at the turn of the 20th century, to a ratio as low as 300% in the 1970s. Likewise, the top 1% share of household wealth peaked at about 55% in the early 20th century, which was followed by a precipitous decline to about 10% in the 1970s and a subsequent increase to about 30% by the early 2010s.

The main empirical contribution of this paper is to expand the existing evidence on long-term wealth dynamics for large, at times closed, economies with evidence on a small and very open economy. A novelty of this paper is that it provides empirical evidence that the enormous wealth-income ratio was at least in large part due to a significant proportion of private wealth invested in foreign equity, which was predominantly

held at the top of the wealth distribution. This finding further highlights the significance of colonial empires in explaining (global) wealth dynamics and thus makes an important contribution to this ongoing debate (Chancel and Piketty 2021).

Methodologically, we exploit the rich availability of data sources for the Netherlands: (i) historical national accounts; (ii) estate multiplier methods; (iii) lognormal extrapolation from wealth tax data. We find that historical balance sheets and the estate multiplier produce remarkably similar results, particularly for the 19th century and early 20th century. Hence, the estate multiplier, if one is not too far from the benchmark year, is likely to be a reasonable method to employ in cases where the necessary data to reconstruct historical balance sheets are unavailable. The wealth tax extrapolation method performs less satisfactorily, and is sensitive to the quality of the underlying wealth tax data.

Our findings can inform policymakers about the level of wealth concentration, by placing recent figures in a historical perspective. Moreover, our decomposition of aggregate wealth highlights the important institutional determinants of household portfolio choice. Policy choices since the 1980s aimed at stimulating homeownership, like the mortgage interest deduction, are likely to have contributed to the rise in mortgage debt and housing prices; likewise, the tax-exempt treatment of pension wealth will have contributed to its increase in relative importance in household portfolios. These results show the importance of careful policy design to stimulate household private savings while also not encouraging overreliance on debt. Policy choices on the composition and distribution of household wealth also matter for macroeconomic stability, the level of the interest rate, and other key macroeconomic variables, and therefore the findings presented here are relevant regardless of preferences for wealth redistribution.

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A Historical National Accounts

A.1 Concepts and Preliminaries

This section details the construction of our benchmark series on aggregate household wealth, using the historical national accounts method. As detailed in the main text, we work with standard accounting definitions of household wealth, W_t . In the following subsections, we will focus on the following decompositions of household wealth. Household wealth is the sum of financial and nonfinancial assets minus liabilities:

$$W_t := A_t^f + A_t^{nf} - D_t.$$

Financial assets can be divided into deposits, securities, and semiprivate wealth (pension + life insurance):

$$A_t^f := A_t^d + A_t^s + A_t^{sp}.$$

Nonfinancial assets can be divided into land, housing, and the fixed capital stock (including small remainder items):

$$A_t^{nf} := A_t^l + A_t^h + A_t^k.$$

Liabilities, finally, can be defined as the sum of housing debt (mortgages) and financial debt:

$$D_t := D_t^h + D_t^f.$$

We start with non-financial assets, before moving to financial assets, and we conclude with liabilities. At the end of this section, we also discuss the comparisons of the CPB balance sheets since 1970 to alternative sources

A.2 Non-financial Assets

A.2.1 Housing

The value of housing is the sum of the value of dwellings and the land underlying dwellings. For the construction value of dwellings, we have perpetual inventory method (PIM) estimates from Smits, Horlings, and van Zanden (2000) for 1807–1913 and from Groote, Albers, and De Jong (1996) for 1900–1994. Although the assumptions differ a bit between these two sources, they are broadly comparable and yield almost identical estimates.

Unfortunately, no estimates exist of the value of land underlying dwellings. Hence, we do not use the PIM estimates until the official National Accounts start in 1995. Before 1995, we construct a series on the market value of housing. Before 1947, we use a series on the total volume of housing available, which was published in the Annual Statistics for the Netherlands (Jaarcijfers voor Nederland) in various editions. Moreover, in Centraal Bureau voor de Statistiek (1947) there is an estimate of the total value of housing wealth in 1913 of 2.2 billion guilders; this gives us an estimate of housing wealth per square meter. We index this estimate to the housing price index of Korevaar, Francke, and Eichholtz (2021).

This series produces estimates of housing which correspond exactly to the value of housing recorded on the National Accounts balance sheet in 1938, namely 5 billion guilders. The value of housing for 1947, which

also recorded in the same balance sheet, seems implausibly high, by contrast, at 16 billion guilders, whereas our estimates give it approximately half that value. Although World War 2 plausibly caused many changes in the structure of the economy, it seems implausible that the value of the housing stock would triple in nominal terms, especially when taking into account wartime destructions. Hence, while we think that the 1938 figure is plausible and a nice match with our series, we do not use the 1947 figure.

From 1947 until 1969, we construct housing wealth in the following way. We define housing assets in year t , HW_t , as the product of the average housing price P_t , the housing stock HS_t and the share of owner-occupied housing DS_t . The average housing price is equal to

$$P_t = PI_t \cdot \left(\frac{HW_{2011}}{HS_{2011}} \cdot \frac{1}{DS_{2011}} \right), \quad (6)$$

where PI_t is a price index equalling 1 in 2011 and the expression in brackets is the average house price in 2011. Data on the housing stock comes from Statistics Netherlands, the share of owner occupied housing from Haffner, Hoekstra, Oxley, and van der Heijden (2009), and the housing price index from Korevaar, Francke, and Eichholtz (2021)¹¹. The market value of housing assets in 2011 is taken from the wealth distribution statistics of Statistics Netherlands.

From 1970 until 1994, we use the value of housing recorded in the CPB balance sheets. Our own estimates prior to 1970 match very closely with the CPB balance sheets.

From 1995, we use the value of dwellings and land underlying dwellings recorded in the National Accounts. The difference between the market-value series before 1995 and the PIM series after 1995 results in a slight jump of around 20% of national income.

A.2.2 Agricultural Land

For non-residential land (which is predominantly farmland), we obtain a total value by multiplying estimated total area with estimated average prices. We use volume data on the area of agricultural land from van der Bie (2001), which is based on the work of Knibbe (1993). For land prices, we rely on work by Luijt and Voskuilen (2009). Their data series gives estimations of the price of farms and farmland from 1952. For the period before 1952, it only provides estimations of the value of farms. We calculate the ratio between farms and farmland throughout the 1950s and take the average for this period. This ratio (of 1.4) is then applied to estimate the value of farmland for the period 1880 and 1938. We interpolate some of the missing years. The resulting series for the value of agricultural land is very comparable to that of Knibbe (2014), who basically uses the same data and methods as we do, but does not adjust the pre-1952 series as we do. As a result, his series show higher values of land pre-1952, but these values also capture implicitly the value of the farm buildings, capital stock and other attributes that would be reflected in the farm price. Since these aspects are better attributed to other wealth components, we feel our adjustment is closer to the likely value of land.

After 1995, we use the value recorded in the Nonfinancial Accounts by Statistics Netherlands.

11. This housing price index is based on the entire Amsterdam housing market; hence, while not perfectly representative of the aggregate housing index, it is more representative than the narrow *Herengracht-index* that forms the basis for the housing index in Jordà et al. (2019).

A.2.3 Livestock

The number and total value of cattle is readily available in the Annual Statistics for the Netherlands. We interpolated some of the missing years between 1880–1897; between 1908–1913; between 1922–1925; and between 1925–1930. Having the total value of cattle and the number of cattle at our disposal for most year, we were able to calculate the value of a single cattle. We took the average of this individual price (172 guilders) and assumed a horse would be approximately 5 times more expensive (862 guilders). Since we were able to retrieve the number of horses held by individuals based on their tax record, we were thus able to estimate the total value of all horses.

After World War 2, we rely on the total number of cattle presented in van der Bie (2001). The total value of livestock is put at 3 billion guilders in 1958; hence, we obtain an estimate of the average value of cattle for that year. For the remaining years, we assume that this value follows the development of agricultural land prices, so we index the average value in 1958 to our agricultural land price series. After 1995, we use the National Accounts, which do not explicitly include a post for livestock; hence, it appears in our series in the residual capital stock (i.e., the part of the nonfinancial accounts that isn't one of the main items mentioned in the rest of this section).

A.2.4 Other Fixed Capital Stock

This remainder item mainly includes nonresidential dwellings, roads and public buildings, machinery and equipment, as well as smaller components. We start by estimating the total capital stock. From 1854 until 1900, we use the capital stock estimates from Smits, Horlings, and van Zanden (2000). From 1900 until 1969, we use the estimates by Groote, Albers, and De Jong (1996). Inspection of the two series in the overlapping years (1900–1913) reveals that they track each other very closely, despite differing in the underlying assumptions made on the lifecycle of the components.

From 1969, we can use official National Accounts balance sheets. It is also in this year that we therefore can allocate the total capital stock into the different sectors. This exercise reveals that households consistently owned about 40% of the private capital stock, with the remaining 60% being allocated to the corporate sector. Moreover, the series from Groote, Albers, and De Jong (1996) – which runs until 1994 – is almost identical to the National Accounts series on the private capital stock. Hence, we assume that in all years prior to 1969, the historical estimates also correspond to the private capital stock, and we allocate 40% of these estimates to the household sector.

For the years 1938, 1947, and 1948, we also have National Accounts estimates of the total capital stock. However, these are not easy to interpret. For instance, the total capital stock (including housing and land) is put at 20 billion guilders in 1938, but the total 'freely disposable' capital stock attributable to households is put at 11.5 billion, with 2.9 billion belonging to the government and the remainder being 'covered' by mortgages, shares and other claims. Since we would nowadays place mortgages on the liabilities side – which isn't done in the balance sheet – we increase the private capital stock that is 'disposable' for households by the amount of mortgages. The adjusted National Accounts totals are almost identical to the series by Groote, Albers, and De Jong (1996) (after inclusion of land and livestock). The difference between our capital stock and the adjusted National Accounts total is assumed to be the part of the capital stock that belongs on the corporate balance sheet.

A.2.5 Inventories

We have an estimate in the 1938 National Accounts of 2.6 billion guilders for total inventories. This number seems implausibly high, implying that almost 10% of private wealth was in inventories; it is more likely that this figure also includes part of the capital stock. No direct sources exist before this year; only indirect estimates of changes in inventories by Smits, Horlings, and van Zanden (2000) and den Bakker (2019), who both estimate this change as the residual between national savings and gross fixed capital formation. This imprecision leads to implausibly high values of inventories if taken at face value (values well over 200% of national income before 1900), meaning these numbers cannot be used.

Instead, we opt for an indirect approach. The first balance sheet of nonfinancial assets, in 1969, puts the value of inventories at around 8% of the capital stock. We use this percentage and apply it to our estimates of the capital stock before 1969. This adjustment works fairly well, with a smooth series of inventories from 1880 until 1994. After 1995, we use the National Accounts.

A.3 Financial Assets

Following the System of National Accounts, financial assets include deposits and currency, shares and mutual funds, bonds, individual pension, and insurance savings.

A.3.1 Deposits

We begin by reconstructing the total amount of deposits from 1880 until 1970. The principal sources material used to estimate the value of these asset classes are (i.) the Statistical Publication by the Dutch Central Bank, which reported on the balance sheet information of commercial banking institutions as well as saving banks and cooperatives banks from 1900 onwards (DNB 1987, 2000); and (ii.) the previously mentioned Annual Statistics for the Netherlands. For **Saving Banks**, the data on the total value of deposits held by these institutions was readily available in the Annual Statistics for the Netherland from 1885 onward. Thus, leaving a gap in the period between 1880–1885. For these years we however knew the amount of saving banks there were active; so we looked at the average deposits held by saving banks in 1880 and 1885 and interpolated this data based on the number of banks between 1881 and 1884. For **Farmers' Cooperatives**, we relied on Westrate (1948: 374-376). This memorial book, published to celebrate the 50-years jubilee of Cooperative Banks reported the value of deposits held by this type of banks from 1899 onward. For **Postal Savings Banks**, we relied on the Annual Statistics for the Netherlands. This data was readily available from 1885 onward. The data for **Commercial Banks**, was retrieved from the Statistical Publication by the Dutch Central Bank. This data was however only estimated for the entire commercial banking sector for the years 1903, 1908, 1913, 1918, 1923, 1928, 1933, and 1938. We therefore collected the deposits from the 3 largest banks from 1880 to 1900 and interpolated this data to calculate the deposits held by all commercial banks. We did the same to fill in the gaps between 1900 and 1908, but in this case, we relied on the data for the 5 largest banks as published in the Statistical Publication by the Dutch Central Bank. We then cross-referenced this estimation of all deposits held by commercial banks by comparing it to a newly collected dataset of approximately 140 individual commercial banks (De Vicq and Peeters 2022). This results in a series for aggregate deposits from 1880 until 1938. In 1938, we cross-check the amount in deposits with the official National Accounts balance sheets. The numbers align reasonably well; our stock of deposits is 3.3 billion guilders, whereas the official balance sheet gives a sum total of 4.4 billion. However, only 1.9 billion of these deposits should be ascribed to the household sector; the rest shows up on the balance sheet

of corporations, the government, the insurance sector, and the foreign sector. Hence, for 1938, we take the official number for households as given, and for all years prior to 1938, we divide our series by the ratio of the series in 1938 to the official number ($3.3/1.9 \approx 1.7$).

On the website of Statistics Netherlands¹², we also find a series for total deposits, starting in 1900 and with continuous values from 1935. Inspection of this series yields that it is a bit higher than the official National Accounts total, 2.9 billion instead of 1.9. The same holds for the values of the balance sheets for 1947 and 1948. Hence, we downweight this series by the ratio of the series in 1938 ($2.9/1.9 \approx 1.5$).

After 1970, we use the deposits total noted in the CPB balance sheet. This amount is quite a bit higher than the adjusted deposits series, with a jump of about 17 billion guilders. However, if we adjust the previous series using the CPB balance sheet (or take it at face value), we lose consistency with the balance sheets in 1938, 1947 and 1948. Hence, we decided to preserve consistency with the earlier official balance sheets, and accept the (small) trend break that occurs in 1970. The scale of the discontinuity is very small, around 20% of national income.

After 1995, we use the National Accounts.

A.3.2 Currency

The value of coins and printed money was consistently published in the Annual Statistics for the Netherlands. We only had to interpolate some missing data points in the years between 1881 and 1884. We cross-referenced our figures with similar estimations made by Kymmel (1996: 457).

As with deposits, we use the value recorded in the 1938 balance sheet to adjust this series, to obtain the amount of currency held by households. We also use the same sources and procedures for currencies after 1947 as with deposits, outlined above. However, the trend break is much less severe in 1970, only 1.7 billion guilders. After 1970, we use the CPB balance sheet, and after 1995 the National Accounts.

A.3.3 Pension and insurance funds

The value of funded occupational pension entitlements and private insurance savings are based on the technical reserves as recorded in the Statistical publication by the Dutch Central Bank. We simply transcribed the results from this publication, as this data was readily available. This data can be found in table A.11.

A.3.4 Securities

A.3.4.1 Domestic Government Bonds

The value held by privately owned **treasury bonds** was listed in the Annual Statistics for the Netherlands from 1891 onward; similar series appear before 1891 as well. There seems to be no trend-break in 1891, hence we use the full series from 1880 until 1938. We confirm that the value of privately held bonds corresponds almost identically to the value listed in the 1938 official balance sheets: 3.2 billion guilders.

After World War 2, we no longer possess direct information on the value of privately-held bonds, hence we take the entire value of Dutch bonds until 1970. From 1970, we use the bond holdings listed in the CPB balance sheets. Remarkably, despite using the full value of bonds from 1947 onward, we find no trend break when we switch to the CPB balance sheets in 1970, with only a slight jump from 29 to 38 billion guilders. Of course, the bondholdings recorded in the CPB balance sheets would plausibly also include corporate bonds and bonds from other countries; yet for our purposes this does not matter, since we are only interested

12. Link: <https://opendata.cbs.nl/#/CBS/nl/dataset/37758/table?dl=6E2C5>.

in reconstructing total securities holdings by households, which thus seem to be captured quite accurately, especially when combined with the other components, which are detailed in the next sections. From 1995, we use the official National Accounts.

A.3.4.2 Listed Domestic and Foreign Stocks

We take as benchmark the nominal value of the Amsterdam Stock Exchange, for which an index can be found in van der Bie (2001). This index gives us the value of all Dutch firms listed on the exchange, taking into account dividend issuance and other factors which mechanically depress the share price. The index is available from 1890 until the present; since the index appears to be remarkably stable (around an index value of 21, where the 1983 stock market capitalization is set to 100) for the 1890s and 1900s, we assume it is also stable in the 1880s and extrapolate the 1890s average backwards to get a stock market index from the 1880s until the present. The total stock market value of Dutch firms as a percentage of national income aligns reasonably with the estimates presented by Kuvshinov and Zimmermann (2022), who use a different source for their Dutch pre-World War 2 series, namely Moore (2012) for the period 1900-1913; they do use the official index by Statistics Netherlands for the post-war period and seem unaware of the pre-war index estimates presented in van der Bie (2001). Comparing Moore’s data with the official index reveals that Moore’s estimates align reasonably well with the index until about 1910, after which Moore’s series vastly outpaces the index. Retaining the index preserves both consistency throughout the period, and is a more conservative estimate of household equity holdings.

To arrive at the total value of listed stocks held by Dutch households, we need to (a) add the value of foreign stocks held by Dutch households, and (b) subtract the value of domestic stocks owned by foreigners. While direct information on asset holdings is not available, we can arrive at a reasonable figure in the following way. We know the net primary income received, which is calculated by Smits, Horlings, and van Zanden (2000) until 1913 and by Statistics Netherlands for most years afterwards¹³. Then, we capitalize these dividend streams $y_t^{f,div}$ using an average dividend yield $r_t^{f,div}$, using

$$y_t^{f,div} := r_t^{f,div} \cdot W_t^f.$$

Note that for our purposes, the dividend yield is the correct variable by which to capitalize the dividend streams and not the total return, i.e., dividends plus capital gains. This is because we are interested in the nominal value of equity at time t , and not in its real value, corrected for price revaluations.

For each year, we take the average of the dividend yields of Berlin, Brussels, London, New York, and Paris; the stock exchanges which were by far the most important for Dutch non-colonial foreign investment in terms of cross-listed equities and bonds (Moore 2012). Data on dividend yields for those exchanges are taken from Jordà et al. (2019). The five series are generally quite close to each other, with an average standard deviation over the 1880–1938 period of slightly more than 1%. During crisis years, such as 1917, the standard deviation increases; nevertheless, we feel that the average dividend yield gives a reasonable capitalization factor even in volatile years, particularly when considering that the resulting series is quite smooth; sticking with only one series would likely result in much more artificial volatility in the equity series.

When capitalizing net dividends from abroad, we implicitly capitalize Dutch dividends paid to foreigners with the same yield as foreign dividends paid to Dutch households. Unfortunately, no systematic information

13. The years 1918-1920 are missing and are linearly interpolated from the values of 1917 and 1921, which reasonably captures the decline in foreign capital income due to the upheavals of the war, the Russian Revolution, and other large international shocks.

exists on Dutch dividend yields for the entire pre-war period; the only available series covers 1900–1917, and is included in Jordà et al. (2019). Inspection of dividend yields in this series reveals that Dutch dividends did obtain higher yields than the average yield we have chosen for this period. This outperformance is on average 1.6 percentage points. However, the volatility is large, with a standard deviation of 1 percentage point. In short, we are not certain that Dutch dividends systematically performed better than foreign dividends even in this limited sample. This conclusion also holds for each of the five different series individually: none of them seem systematically over- or underperformed by the Dutch series, and the Dutch series does not track any of them particularly closely. Hence, we stick with the averaged series throughout, noting that this likely represents an *underestimation* of Dutch equity holdings, since we capitalize dividends paid to foreigners by a too large factor.

Our series on colonial dividends, covered in Smits, Horlings, and van Zanden (2000) and den Bakker (2019), is mainly based on the work of Korthals Altes (1986), who carefully reconstructs the Indonesian balance of payments from 1822 until 1939¹⁴. Unfortunately, neither Korthals Altes nor anyone else has provided consistent estimates of the dividend *yield* of Indonesian stocks. Bosch (1948) presents estimates based on a sample of firms on the Batavia stock exchange, but his series are problematic since he does not weight stocks by market capitalization, nor does he compute geometric averages of monthly yields, but only simple averages. As a result, his series of returns are much too high. van der Eng (1998) presents several estimates, but notes that these are mostly unweighted as well, and agrees with our assessment that this likely results in upward-biased dividend yields; his critical conclusion is that dividend yields were probably only 2 percentage points higher than bond yields on average, which would put Indonesian dividend yields closely in line with our calculated world average. Buelens and Frankema (2016) present average rates of return and dividend yields for 1919–1958, for a sample of 17 firms which were listed on the Belgian stock exchange. They find geometric average dividend yields of 2.7% for the 1919–1928 period, and 1.3% for the 1929–1938 period. These averages are *lower* than our estimates of the world dividend yield by several percentage points. Since it is unclear how representative their sample is of the whole, we stick with capitalizing Indonesian dividend yields with the world dividend yield; this results in a more conservative series of colonial wealth, if anything.

The resulting series of colonial and other foreign asset holdings align quite well with existing estimates. The colonial holdings in 1938 are estimated at approximately 4 billion guilders (70% of national income), which is exactly Tinbergen’s estimate and very close to a number of other estimates covered in Bosch (1948). Moreover, we estimate the total amount of listed equity in 1914 at 6.5 billion guilders, which is very close to the 6 billion given by de Vries (1976); moreover, his estimates of domestic shares in that year, at 1.7 billion, are almost identical to ours; his figures for foreign equity – which do not include colonies – is given at around 3 billion, which is close to our 3.5 billion estimate.

Bosch (1948), meanwhile, critically analyzes several estimates of Dutch investments in the United States, one of the major destinations of foreign investment. He suggests a total investment in the U.S. of 1.5 billion guilders in 1908, 1.5–1.7 billion in 1914, 1 billion in 1919, 600 million in 1924, 1.1 billion in 1929, 1.2 billion in 1935, and 1.5–1.75 billion in 1939. All these numbers are well within the range of possibility in our series, consistently suggesting an American share in total non-colonial investment of around 50%, which is very plausible. The only year where this doesn’t align well is 1908, where Bosch’s estimate is almost our entire estimate for foreign wealth. Since it would be implausible in our view for U.S. investment to remain stagnant

14. As noted in Smits, Horlings, and van Zanden (2000), no sources exist on equity holdings in the other Dutch colonies, which were the Dutch Antilles and Surinam. Particularly the inclusion of Surinam would be interesting, since the abolition of slavery in 1863 and the subsequent compensation of Surinamese slaveholders would be an important aspect of the Dutch private wealth distribution to cover; we hope that future research uncovers methods to estimate these colonial holdings.

for the entire 1908-1914 period, this suggests to us that his 1908 figure might be an overestimate.

Ideally, we would also need to subtract ownership by financial institutions such as banks and insurance corporations. Unfortunately, information on asset holdings of these institutions is very limited in nature, but appears not to be quantitatively significant; a 1942 census of the 42 major mortgage banks, for example, only found equity holdings equalling 14 million guilders in 1938, which is a tiny fraction of the total size of equity (Amsterdamsch Effectenblad 1942). This view is confirmed by the 1938 balance sheet, which shows combined equity holdings of the financial sector of around 300 million guilders, which is less than 1% of the total estimated value of the corporate sector. A final confirmation for a slightly earlier year comes from de Vries (1976), who mentions that equity holdings by institutions accounted for only 0.3% of the total value in 1935. All these facts combined give us confidence that our total equity series is quite robust.

Comparing this series with the 1938 National Accounts is not trivial, since the National Accounts list several items on the household balance sheet which added together resemble our measure of total equity. If we add up all these items – which include shares, bonds, and mortgages of corporations held by households as assets, shares and bonds of banks and other financial corporations, and investments in the rest of the world – we arrive at a figure of 14.2 billion guilders, which corresponds very closely to our aggregate figure for all equity excluding government bonds of 14.5 billion guilders. As mentioned in the previous section, government bonds also align very closely with the National Accounts figure. Our estimate of 14.5 billion includes the residually estimated nonlisted stocks, to which we turn next.

After 1947 until 1970, we continue with our basic approach as outlined above; however, since we already know total wealth for all these years (whether directly or by our interpolation), we are less concerned with precise estimations of each wealth component, but rather to get the relative magnitudes right. Nevertheless, our series aligns remarkably closely to the CPB balance sheet, which we start using in 1970. The balance sheet lists a total value of listed equity of 29 billion guilders in 1970, which is a bit lower than the 1969 combined value of domestic and foreign equity of 43 billion; however, when combined with the slightly higher estimate of household-owned bonds, the total value of equity – excluding non-listed stocks – remains remarkably stable, going from 70% of national income in 1969 to 60% in 1970.

After 1995, we use the official National Accounts.

A.3.4.3 Nonlisted Stocks and other Financial Wealth

Nonlisted stocks are the most difficult item to estimate, since there are no official sources for them until 1970. Dutch corporate law did not make a distinction between corporate forms until the early 1970s, when a ‘closed’ corporation with limited liability was established, the *besloten vennootschap*. Until the 1970s, the main corporate form was the “nameless” corporation, *naamloze vennootschap*, which could be either listed or non-listed. Remarkably, there exist no official figures on the total number of corporations until 1930, shortly after the first official law on this corporate form was established. Hence, for the vast majority of our period, we do not possess any additional information about even the number of corporations, let alone their balance sheets. Hence, we resort to estimating this wealth component residually until 1970. All other wealth components are accounted for, as described in this appendix. Hence, any remaining difference between an official balance sheet and our series must be attributable to non-listed equity. We use the 1938 balance sheet as our benchmark for total wealth, where we add to the household balance sheet our series of semiprivate wealth, which were noted in the 1938 balance sheet as “potential private wealth” on the balance sheet of the insurance sector; we also subtract the residual part of nonfinancial assets that we attribute to the corporate sector, as explained in section A.2.4. The residual between our series in 1938 and the official balance sheet

is approximately 6.3 billion guilders, or 120% of national income. This strikes us as a reasonable figure, especially when considering that this figure will also include smaller financial items which we also do not estimate separately, such as corporate bonds and shares in non-listed financial institutions. Remarkably, our figure for nonlisted stocks aligns very well with the figures in Bosch Kemper (1950), who mentions a total paid-up capital by all corporations – listed and unlisted – which is very close to our series.

Since there is no additional information before 1938 on non-listed firms that we might use, we simply peg the value of non-listed firms to the total value of equity, and extrapolate this ratio backwards until 1880. This is the least intrusive assumption we could think of to measure non-listed equity before 1938.

After 1947 until 1970, we continue with this residual approach, until 1970, when we use the information in the CPB balance sheet for households, which notes ‘aanmerkelijk belang’ (significant ownership), i.e., whether a household owns more than 5% of shares in a firm. Almost always, significant ownership pertains to non-listed firms; nowadays, the majority of significant ownerships are in closed limited liability corporations (*besloten vennootschappen*). Our residually estimated series aligns quite well with the 1970 balance sheet, being a bit higher (88 billion guilders in 1969 versus 65 billion in 1970). This difference – amounting to 20% of national income – is unlikely to significantly affect our results.

After 1995, we use the total value of equity holdings, which include non-listed corporations.

A.4 Liabilities

The total value of private liabilities was based on the total value of private mortgages (loop der hypotheeken/openstaande inschrijvingen), which are made available in the Annual Statistics for the Netherlands. Not all mortgages can be ascribed to the household sector; a large fraction is attributable to the corporate sector instead. We have a first breakdown of mortgage debt in 1970, when we both have the historical sources described above and the balance sheet compiled by the CPB. We take the average ratio of household mortgages to total mortgages and apply this pre-1970. The result is a consistent series of mortgage debt; while we might miss some fluctuations by taking this ratio, we have no indication that there were dramatic trends in mortgage debt prior to the 1970s that would qualitatively challenge our results.

We added the number of loans issued by cooperative banks, help banks and credit unions. Unlike commercial banks, these banks were known to issue private, consumer loans. We retrieved this data from Weststrate (1948: 374-376), de Vicq and van Bochove (2022) and de Vicq (2022) respectively.

After 1970, we use the CPB balance sheets for both mortgage debt and other liabilities, until 1995, when we switch to the National Accounts. There is a small trend break in 1995, as the Financial Accounts record more liabilities for the household sector than the CPB estimates, on the order of 30% of national income.

A.5 Total Household Wealth, 1947–1969

We have balance sheets for the years 1946–1952, available in the National Accounts of 1954, which we show in Figure . These balance sheets also show the single estimate for 1938, which we use to calibrate our manual reconstruction of the national accounts from 1880–1938, detailed in the previous section. These balance sheets, although they do not decompose total wealth into components, do include estimates for total household wealth.

After 1952, the National Accounts no longer feature balance sheets regularly. Two exceptions exist: For 1958, we have a breakdown of national wealth, from which we can subtract the value of government assets to arrive at private wealth; and 1960, where the total size of national wealth is mentioned. We assume that

Figure A.1: Household Wealth Estimates in National Accounts, 1938 and 1946-1952

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P. NATIONALE REKENINGEN

159. Nationale Balans, 31 December 1)

	1938	1946	1947	1948	1949	1950	1951	1952
	× mld gld.							
Activa								
Bedrijven en banken:								
Kapitaalgoederen	20,5	44,9	48,3	52,3	57,6	62,8	77,9	78,6
Buitenland:								
Buitenlands saldo	8,5	8,1	5,9	5,5	4,2	4,8	6,6	8,9
Nationaal vermogen	29,0	53,0	54,2	57,8	61,8	67,6	84,5	87,5
	× mld gld.							
Passiva								
Verzekeringsfondsen:								
Potentiëel privaatvermogen	3,5	6,1	6,5	7,0	7,6	8,3	9,1	10,0
Verbruikers:								
Particulier vermogen	29,9	63,7	65,2	66,9	71,6	74,6	88,3	88,6
Overheid:								
Overheidsvermogen 2)	- 4,4	- 16,8	- 17,5	- 16,1	- 17,4	- 15,3	- 12,9	- 11,1
Nationaal vermogen	29,0	53,0	54,2	57,8	61,8	67,6	84,5	87,5

1) Zie voor toelichting „Statistische en econometrische onderzoeken” jrg. 9, no. 1 en de daarin genoemde publicaties. 2) Deze negatieve bedragen representeren het verschil tussen activa en passiva van de Overheid.

160. Nationaal vermogen per 31 December 1)

	1938	1946	1947	1948	1949	1950	1951	1952
	× mld gld.							
Grond	4,6	11,0	11,5	12,0	12,7	13,5	16,0	16,1
Vorraden	2,6	0,7	1,4	2,1	2,8	4,5	6,8	5,5
Overige kapitaalgoederen	13,3	33,2	35,4	38,2	42,1	44,8	55,1	57,0
Buitenlands saldo	8,5	8,1	5,9	5,5	4,2	4,8	6,6	8,9
Nationaal vermogen	29,0	53,0	54,2	57,8	61,8	67,6	84,5	87,5

1) Zie noot 1 bij tabel 159.

government wealth is the same proportion of national wealth in 1960 as in 1958, and subtract this estimated government wealth to arrive at household wealth for 1960. In sum, we have estimates from National Accounts for household wealth for 1946–1952, 1958, and 1960. As discussed in the main text and in the next section, we also have estimates of balance sheets from 1970 onward. We then interpolate all missing years using the multiplicative decomposition (5), where we residually estimate an average capital gains rate q such that the known endpoints (1958, 1960, and 1970, respectively) are reached. We define private savings as the sum of household, corporation, and financial institution saving. After having estimated the endpoints of each year using this method, we average W_{t-1} and W_t to reach middle-of-year estimates, as is consistent with DINA practice. This means that we have to disregard the data point for 1946, as its value is subsumed in the averaged value for 1947.

The main source for our balance sheets are the balance sheets constructed by the CPB Netherlands Bureau of Economics Analysis, which they published as an appendix to their 2013 *Macro Economische Verkenningen* (Macroeconomic Explorations, MEV). These balance sheets include financial assets, deposits, housing, other real estate, business wealth, and pension claims. We verify that all estimates of these wealth components correspond closely with estimates from other sources, such as various series by Statistics Netherlands and De Nederlandsche Bank. All series mentioned so far match very closely with National Accounts totals. Stocks and bonds are a bit noisier, but the results are still very comparable.

The largest difficulty with the 1970–1994 balance sheets lies in life insurance, which is not included in the MEV balance sheets. There are three sources: Long-run data from DNB on life insurers’ technical reserves, data from Statistics Netherlands on life insurers’ technical reserves, and the data from the National Accounts. The first source is the only one available for the entire period, but is also one that diverges widely from the other two. Hence, we opt for the following approach: For 1970–1974, we adjust the DNB series such that it merges perfectly with the Statistics Netherlands series in 1975, which we use until 1994. This adjustment ensures that the life insurance series do not counterfactually exceed the values reported by Statistics Netherlands or the National Accounts, which ensures consistency.

B Estate Multiplier Methods

B.1 Death Duties Data

Table B.1: Exemptions for the succession tax in the Netherlands since 1818

Period	Direct accession line	Indirect accession line
<1878	Exempt	Exempt when below 300 guilders
1878–1896	Exempt when below 1,000 guilders	Exempt when below 300 guilders
1897–1910	Exempt when below 1,500 guilders	Exempt when below 500 guilders
>1911	Exempt when below 1,000 guilders	Exempt when below 300 guilders

Note: Table shows the exemptions that applied to the inheritance tax in various years. ‘Direct accession line’ refers to direct family of the decedent; ‘indirect accession line’ refers to other family.

The procedure that the authorities went through to identify the amount of tax to be paid has as follows: If after a formal application by the successors of an estate, it was found that the estate’s net worth was likely higher than the appropriate threshold, then a detailed evaluation called “Memorie van Successie” was drawn

up. The net worth of those estates – along with the all other deceased individuals with net worth lower than the threshold – were listed alphabetically in Tafel V-bis, which functioned as an annual ledger for the more detailed "Memorie van Successie". To ensure a high tax morale the authorities maintained "[p]enalties for fraud and evasion were about twice the due tax plus any costs" (Gelderblom, Jonker, Peeters, and de Vicq (2022)). Several crosschecks where in the disposal of the tax inspectors. The actual value of the estate's land, deposits, and other investments where relatively easy to be verified. In contrast, various types of debt where significantly more difficult to validate (Gelderblom, Jonker, Peeters, and de Vicq (2022)).

Table B.2: Succession tax data thresholds for different periods (for 1900-1910 the data are available in two publications with different brackets/threshold).

Period	# Brackets	Thresholds
1882–1910	20	300; 500; 1,000; 1,500; 2,000; 3,000; 5,000; 7,500; 10,000; 15,000; 20,000; 25,000; 30,000; 40,000; 50,000; 75,000; 100,000; 150,000; 200,000; 300,000; 500,000; >500,000
1900–1955	8	100; 1,000; 2,000; 5,000; 10,000; 25,000; 50,000; 200,000; >200,000
1956–1984	10 (12)	(<0; 0;) 100; 1,000; 2,000; 5,000; 10,000; 25,000; 50,000; 100,000; 200,000; 500,000; >500,000

Given the availability of detailed wealth and age data on the individual level for 1921 from Gelderblom, Jonker, Peeters, and de Vicq 2022, we will use them to estimate the aggregate estate multiplier for 1921. Our problem, however, is that for 1921, although we have the population that died at various wealth and age groupings, we do not know what is the corresponding size of each of those groupings in the general population. For example, we do know that in 1921, there are say 3275 50-60 year old with wealth more than 15K who died, but we do not know in 1920 how many were the living 50-60 years old with wealth more than 15K. Therefore, we do not have a proper denominator to estimate the mortality rates for each wealth group. In the solution described in the next paragraph we are able to estimate an average mortality rate for the rich as a whole, and through that arrive at an aggregate estate multiplier.

To overcome the lack of proper denominator problem, we work as follows: from a different source (see next section) we have the wealth tax data from 1920 (which is the reference year for the death rates of 1921). We have these wealth tax data for the population as a whole distributed in various wealth buckets. But, we have no information with respect to their age distribution per bucket. To address this we combine the wealth tax data buckets with the 1921 data in the following way: for each of the wealth buckets we get the age distribution from the 1921 Tafel-V bis data, by splitting our complete 1921 inheritance tax data into the same buckets that the wealth tax data are provided with. Doing so for all buckets in 1921 we obtain an estimate for the age-wealth distribution. We then re-combine the 1921 data using the wealth buckets used in 1920 in order to get an estimate of the 1920 age structure of the wealth tax data. In this we assume that the individual sample in the death duties for 1921 is not substantially different compared to 1920. Unfortunately thought we do not have enough data to populate all the age-wealth groups required from the wealth tax data buckets. We therefore gather all the rich in one group (>15000 guilders),¹⁵ and we thus obtain the mortality rate of the rich in general, as we are not able to distinguish the age wise distribution of the death rate of the rich.

Our end goal here is to estimate an aggregate estate multiplier that can be applied upon the total death duties wealth, since we do not have the inheritance data spit across age groups. To estimate this aggregate

15. The aggregate from the official data is 451,912,000 but in the Tafel V-bis data for 1921 we have 412,440,216. We therefore multiply all inheritance entries with this ratio.

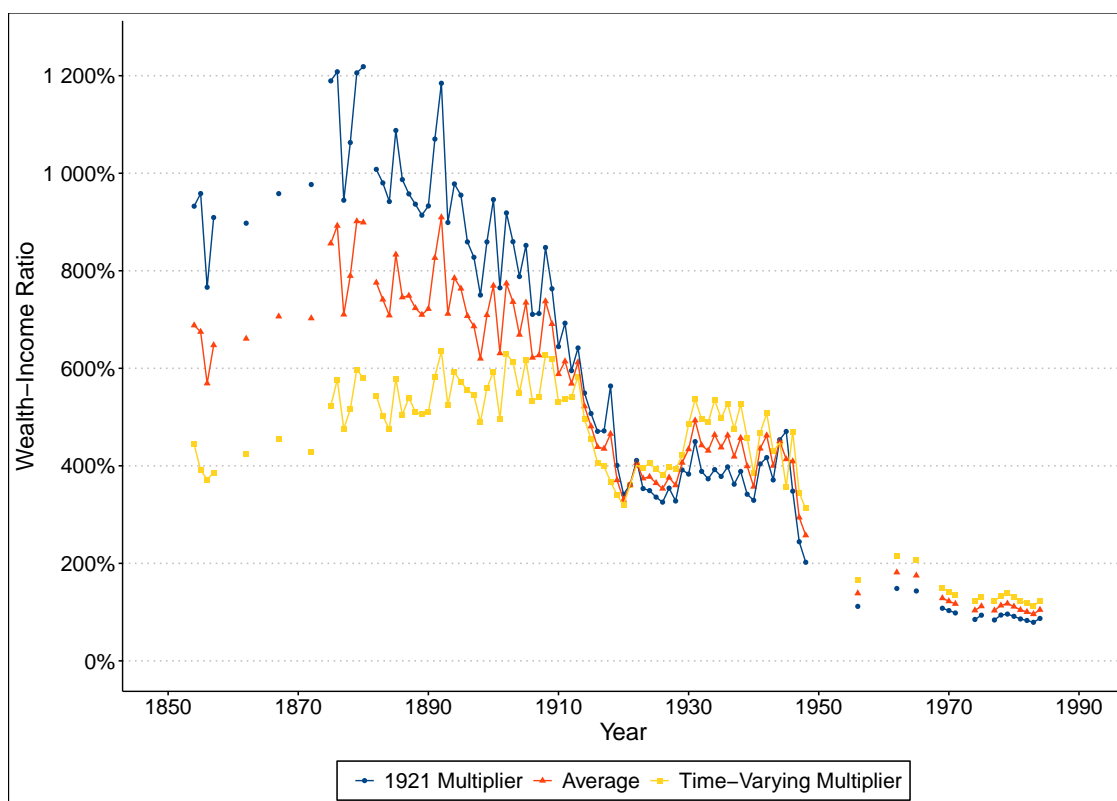
estate multiplier for 1921 we will exploit the mortality rate for the rich that is estimated based on the procedure in the previous paragraph. A byproduct of the procedure is the age distribution of the rich (we already have the total number of rich we have for 1920 based on the wealth tax). We then multiply each age group in that distribution with the mortality rate of the general population, to get the number of the rich that would exist should the rich and the general population have the same mortality rates (R_t). The ratio of the actual number of rich over R_t is the ratio of the average mortality rate differential between the rich and the general population (M_d). We now divide the mortality rates from 1921 with this ratio M_d to create the adjusted mortality rate table. We populate the adjusted mortality rates table with the expected wealth for each age group based on the data from Tafel V-bis, which gives us the average wealth per age group. Dividing each average wealth per age group cell with the adjusted mortality rate for each age group, gives us the total wealth in the population for each age group. Summing all these total wealth estimates produces our estimate for total wealth in the population for 1921. Finally, taking the ratio of the estimated total wealth in the population over the total wealth captured by the estate tax gives us the estimate for the aggregate estate multiplier for 1921.

If this estate multiplier estimated for 1921 is applied for all years, we will be assuming that the age differential between the rich and the entire population is constant across all years, and that the coverage of the tax also remains constant. This second bit, however, is ignoring the fact that as a product of time the coverage of this inheritance tax increases substantially (from about 17% in 1920 to about 30 to 44% after the 1950s), and thereby the multiplier should be decreasing (since we are anchoring our multiplier to the wealth tax data; see above). To counter-balance this bias we can make an alternative assumption; to do so we introduce the concept of the naive estate multiplier. The naive estate multiplier for year t is the ratio of all the living in the year $t-1$ over all that died in year t . The naive estate multiplier assumes that there is no differential in terms of mortality rates between the rich and the general population. Taking the ratio of the naive estate multiplier over the estimated multiplier for 1921, we isolate the differential between the two in one year of reference. We apply this differential on every naive estate multiplier that we estimate for all the years separately. This way we have another series of estate multipliers that are built using the assumption that the ratio between the actual multiplier and the naive multiplier is constant across the years. This implies that the mortality rate differential between the rich and the rest of the population is constant across the years. But we know from other sources, that there are evidence that do not support this claim, and indicate that the reverse is probably the case (Kopczuk and Saez (2004)). Therefore this alternative estate multiplier series is positively biased, because since as a product of time the differential between the rich and the general population is decreasing, other things equal, this would make multiplier to move up (moving closer to the naive multiplier). Given that the effects of the two estate multiplier series, that our data permit us to estimate, have opposing biases, we take their average as our final estate multiplier series. Figure B.2 shows the series using each of those two multipliers and their average series which is the series used throughout the paper.

C Wealth Tax and Wealth Distribution

In this appendix, we describe the wealth tax data and associated methods. First, we describe the lognormal extrapolation method, as developed by Wilterdink (1984) and Potharst (2022). Then, we discuss our methods and sources for the wealth distribution.

Figure B.2: Estate Multiplier Estimates per Method



Note: Figure shows total wealth estimates based on the estate multiplier method, using three alternatives: (a) the fixed aggregate estate multiplier for 1921, (b) the dynamic aggregate estate multiplier, and (c) the average of (a) and (b).

C.1 Lognormal Extrapolation Method

We use the tabulated figures produced in *Jaarcijfers voor Nederland*, which became its English equivalent *Statistical Yearbook* in the 1970s and which provide values from 1894–1993. The following Table C.3 reports the structure of brackets over the years.

Table C.3: Wealth tax data thresholds for different periods.

Period	# Brackets	Thresholds (in 1,000 NLG)
1894–1914	18	13; 15; 20; 30; 40; 50; 75; 100; 150; 200; 300; 500; 750; 1,000; 1,500; 2,000; 5,000; 10,000; >10,000
1915–1924	17	15; 20; 30; 40; 50; 75; 100; 150; 200; 300; 500; 750; 1,000; 1,500; 2,000; 5,000; 10,000; >10,000
1925–1941	9	16; 30; 50; 100; 200; 300; 500; 1,000; >1,000
1942–1956	11	<10; 10; 15; 20; 30; 50; 100; 200; 300; 500; 1,000; >1,000
1957–1969	7	<50; 100; 200; 300; 500; 1,000; >1,000
1970–1973	16	100; 150; 200; 300; 400; 500; 600; 700; 800; 900; 1,000; 1,500; 2,000; 3,000; 5,000; 10,000; >10,000
1974–1975	10	100; 150; 200; 300; 500; 1,000; 1,500; 2,000; 5,000; 10,000; >10,000
1976–1982	6	100; 150; 200; 300; 500; 1,000; >1,000
1983–1993	6	200; 300; 400; 500; 750; 1,000; >1,000

The method applied by Wilterdink (1984) and developed by Potharst (2022) uses information on the thresholds of each wealth bracket to estimate a lognormal distribution. Essentially, the method estimates the overall mean μ and variance σ^2 by minimizing the squared distance between the observed percentile-bracket average pairs of each bracket, and the theoretical lognormal distribution. Once we have an estimated mean and variance, we can integrate over the density to arrive at an estimate of total wealth. Then the estimated total wealth above the lowest wealth threshold that it is captured by the wealth tax data is substituted by the actual total wealth contained in the wealth tax tabulations (although the difference between the estimated and the data is relatively small with the theoretical being on average 0.5% –and a standard deviation of 4%– lower than the data across the entire period). We refer the reader to Potharst (2022) for further details.

C.2 Wealth Distribution

Our series on top wealth shares can be split in two parts: the pre-1993 and post-1993 period. Pre-1993, we use the wealth tax tabulations extensively discussed in the previous section. Using total wealth derived in the lognormal distribution method as denominator, we then calculate top wealth shares using generalized Pareto interpolation (Blanchet, Fournier, and Piketty 2021); we use the `gpinter` interface on `www.wid.world` for our interpolations. The `gpinter` algorithm takes as inputs for each bracket k a bracket lower threshold q_k , its corresponding percentile p_k and the bracket average μ_k . It then interpolates the entire distribution based on the given inputs and the (known) mean population wealth $\bar{\mu}$, using the fact that at each bracket threshold we can exactly calculate a local inverted Pareto coefficient $b(p) = \mathbb{E}[w|w > q_k]$. The points of the distribution between the known thresholds are then interpolated using quintic splines.

Blanchet, Fournier, and Piketty (2021) caution that the algorithm works best when one or more of the thresholds is placed at the bottom of the distribution. For the pre-1993 data, this is not possible, since the wealth tax returns only cover the upper tail. Hence, our results might be sensitive to the exact functional form of the wealth distribution, which is not known.

After 1993, Statistics Netherlands publishes full wealth distributions of taxable wealth (i.e., excluding semiprivate wealth). These tabulations cover the entire distribution for every year from 1993 until 2019, with the exception of 2001; we interpolate the 2001 values linearly using the values in 2000 and 2002. We should note that the distributional statistics generally improve in quality over time; in particular, data quality increases drastically in 2006, when Statistics Netherlands starts to cover the universe of households instead of a representative sample; and in 2011, when many difficult-to-measure wealth components like unsecured credit and small deposits become integrally measured. Hence, data from 2006 (and especially 2011) are considered to be close to error-free, subject to the usual caveats about tax avoidance and evasion. One particular concern about the Dutch wealth distribution is the importance of private business equity for the top of the distribution (Toussaint, van Bavel, Salverda, and Teulings 2020). This wealth component is taxed preferentially, and is difficult to assess at market-value due to the closely-held nature of the businesses. Since only realized capital gains are taxed, fluctuations in flows are also difficult to measure. Although Statistics Netherlands has recently improved its measurement of private business equity, concerns about the potential underestimation of this wealth component remain. In this paper, we simply take the distributional statistics published by Statistics Netherlands as given, and do not adjust them to account for increasing quality over time or potential underreporting of some components. Future work will doubtlessly improve upon these decisions.

D Population, Income, Prices, and Savings

D.1 Population

We use population figures from van der Bie (2001).

D.2 Prices

Throughout, we use the Statistics Netherlands Consumer Price Index, as it appears in van der Bie (2001), which is based on the work of Smits, Horlings, and van Zanden (2000) before 1913 and Statistics Netherlands and den Bakker (2019) thereafter. We normalize the index such that 2015 equals 100.

D.3 Income and Factor Shares

We measure net national income at market prices. Data are from van der Bie (2001), which are based on Smits, Horlings, and van Zanden (2000) for the period up to 1913, and Statistics Netherlands and den Bakker (2019) thereafter.

For the labor and capital shares of income pre-World War 2, we also rely on Smits, Horlings, and van Zanden (2000) and den Bakker (2019). Smits, Horlings, and van Zanden (2000) carefully present separate series for wages, capital income, mixed income, and indirect taxes, which sum up to national income; but they do not calculate the share of mixed income (called ‘profits’ in their series) that is attributable to labor. den Bakker (2019) does do this, by presenting both wage shares and labor income shares for the period 1921–1939; however, his denominator is GDP, not national income. Hence, we opt for the following approach. Before 1913, we use the data by Smits, Horlings, and van Zanden (2000), allocating 30% of mixed income to labor. This is the average of the allocation in the den Bakker (2019) series, and seems reasonable, given that we know that labor only started to obtain importance at the turn of the 20th century. For 1921–1939,

we use the series by den Bakker (2019), but add net primary income from abroad, also from the same source, to add up to national income. All primary income from abroad is allocated to capital, as Den Bakker mentions that labor remittances were negligible in this period and hence also considers all primary income to be capital income. This results in a consistent labor and capital share out of national income for the entire 1854–1939 period, with the exception of the years 1914–1920. The obtained labor and capital share are broadly comparable to those estimated in Bengtsson and Waldenström (2018), who do not use the novel estimates by den Bakker (2019) and do not attempt to estimate factor shares in the pre-1913 data.

Once we have factor shares, we can also estimate the return to wealth r_t , using

$$r_t := \frac{\alpha Y_t}{W_t}, \quad (7)$$

where α is the capital share of national income.

D.4 Savings

For 1854–1913, we use Smits, Horlings, and van Zanden (2000). National saving is defined as gross fixed capital accumulation minus depreciation plus exports minus imports. Helpfully, Smits et al. also construct estimates of government investment, which we take as a measure of government saving. Hence, private saving equals national saving minus government saving. No further decomposition of the private saving rate is possible for this period.

For 1921–1939, we have data on savings from den Bakker (2019), who constructs estimates of national saving, government saving, and corporate retained earnings, and obtains household saving as a residual.

From 1947 onward, we use savings rates reported by Statistics Netherlands, in various editions of *Jaarcijfers voor Nederland*. We define private savings as the sum of household, corporate and financial institution savings, but we also report these estimates separately. From 1969, we use the official National Accounts.

For table 3, we use the volume and price changes recorded in the Financial and Nonfinancial Accounts of the household sector (+ NPISH) from 1995.

E Robustness Checks

E.1 Historical Wealth Estimates

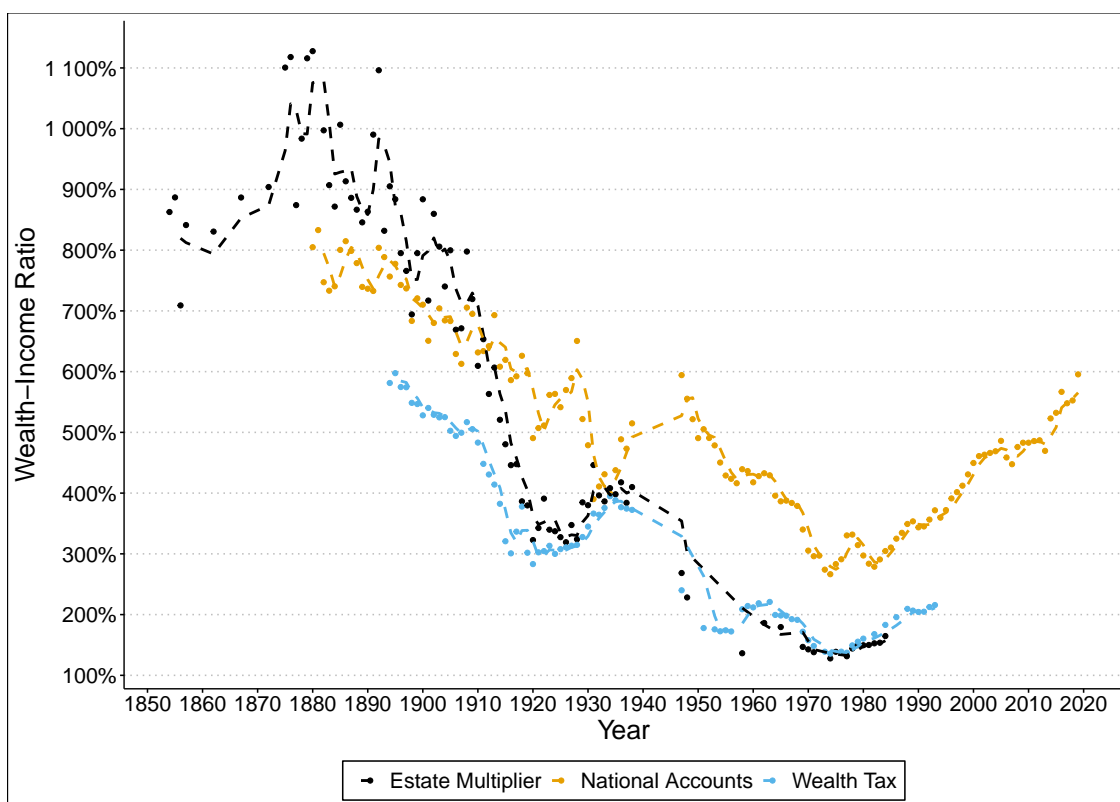
E.2 Household Wealth with Pensions

Table E.4: Comparisons with Historical Estimates of Household Wealth

Year	HNA	Estate	Wealth Tax	Historical	Source
1854-1857		4,894		5,723	Stuart, <i>Ons Maatschappelijk Vermogen</i> , 1888
1855		4,894		3,800	Verstegen, <i>National Wealth and Income</i>
1865		6,138		5,150	Verstegen, <i>National Wealth and Income</i>
1872		7,877		5,260	<i>Ons Nationaal Vermogen, 1875</i>
1875 - 1877		10,069		3,021	Gleichman, <i>Memorie van Toelichting</i> , 1879
1879		9,460		11,166	Vissering, <i>Memorie van Toelichting</i> , 1879
1880	9,113	10,181		10,280	Boissevain, <i>De Omvang</i> , 1883
1879-1883	9,674			9,822	Boissevain, <i>De Omvang</i> , 1884
1879-1882	9,113	10,181		8,397	Fabricant & Maarschalk, <i>International capital</i> , 1952
1879-1882	9,113	10,181		8,262	Van Zanden, <i>Income and wealth inequality</i> , 1995
1879-1882	9,113	10,181		8,702	Verstegen, <i>National Wealth and Income</i> , 1996
1879-1882	9,113	10,181		11,318	Stuart, <i>Ons Maatschappelijk Vermogen</i> , 1888
1883-1886	8,633	8,261		10,992	Stuart, <i>Ons Maatschappelijk Vermogen</i> , 1888
1888-1890	9,227	8,855		11,902	Boissevain, <i>De Omvang</i> , 1891
1908-1912	12,711	11,837	9,460	12,120	Derksen, <i>Berekening van het nationaal vermogen</i> , 1934
1908-1912	12,711	11,837	9,460	11,558	Fabricant & Maarschalk, <i>International capital</i> , 1952
1908-1912	12,711	11,837	9,460	11,240	Van Zanden, <i>Income and wealth inequality</i> , 1995
1908-1912	12,711	11,837	9,460	12,860	Verstegen, <i>National Wealth and Income</i> , 1996
1915	19,987	15,520	9,995	7,453	Bonger, <i>Vermogen en Inkomen</i> , 1923
1916	21,635	16,197	10,721	7,995	Bonger, <i>Vermogen en Inkomen</i> , 1923
1917	21,713	15,952	11,927	9,058	Bonger, <i>Vermogen en Inkomen</i> , 1923
1918	25,670	19,091	15,043	11,602	Bonger, <i>Vermogen en Inkomen</i> , 1923
1919	33,036	20,499	16,205	12,711	Bonger, <i>Vermogen en Inkomen</i> , 1923
1920	30,831	20,763	17,379	13,855	Bonger, <i>Vermogen en Inkomen</i> , 1923
1927	36,825	23,490	18,357	14,073	Subcommissie, 1927

Note: All values in millions of nominal NLG. Columns 2–4 give our estimates, respectively using Historical National Accounts, the Estate Tax multiplier, and the Wealth Tax extrapolation. Column 5 notes historical estimates, and column 6 gives their source. For historical estimates that cover a range, we use our midpoint estimate for that year (e.g., the year 1881 for 1879–1883).

Figure E.3: Wealth-Income Ratios per Method, with Semiprivate Wealth



Note: Figure shows all three main methods to reconstruct aggregate household wealth, but with semiprivate wealth added to the estimates from the death duties and the lognormal extrapolation.