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Hidden Wealth

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JEL Classification: N00, N33, N34, D31, H26

Keywords: hidden wealth, Inequality, economic history, Big Data, tax evasion

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Hidden Wealth

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Abstract

Using individual level records of all wealth-at-death in England, 1892-1992, together with new estimates of the wealth-specific rate-of-return on wealth, I estimate a plausible minimum level of the amount of inherited wealth that is hidden. Elites conceal around 20% of their inheritance. Among dynasties, this hidden wealth, independent of declared wealth, predicts appearance in the Offshore Leaks Database of 2013-6, house values in 1999, and Oxbridge attendance, 1990-2016. Accounting for hidden wealth eliminates at least 40% of the observed decline of the top 10% wealth-share over the past century. I find 8,549 dynasties that are hiding £7.7 Billion.

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1 Introduction

In England the wealth-share of the top 1% declined from over 75%, in 1900, to less than 20% by 1970, resulting in a 'Great Equalization'. This stylized fact is based entirely upon *observed* wealth-at-death. However, the incentive to hide wealth increased exponentially over the same period, peaking in the 1950s, when the top marginal rate of estate tax was around 80%. Is the 'Great Equalization' real? Or is it a misrepresentation based upon the changing character of elite wealth-at-death portfolios?

Declared wealth-at-death data is the primary source for our understanding of the 20th century wealth distribution in England (Atkinson and Harrison, 1978; Atkinson et al., 1989; Atkinson, 2013; Alvaredo et al., 2018). Since 1858, the individual details of wealth-at-death have been centrally recorded in the *Principal Probate Registry Calendars*. Using a 100% sample of this data, 1892-1992, this paper details a method to estimate hidden wealth.[1]

I define 'hidden' wealth as wealth missing from the perspective of the probate calendars, and therefore the tax authorities. This holistic definition of 'hidden' wealth does not necessarily correspond to wealth that is illegally concealed. However it is motivated by the fact that the empirical characterization of the English wealth distribution in the 20th century is in the main, based upon such declared wealth-at-death data.[2] The *Probate Registry Calendars* represent the most comprehensive, population-wide source of consistently collected wealth-at-death estimates. A portion of 'hidden' wealth will be legal portfolio re-arrangement to tax-exempt trusts, inter-vivos bequests, charitable donations, gifts to non-family members, and a portion will *potentially* be illegal tax evasion.

The method outlined here is a simple accounting exercise that exploits the nominal, individual level Calendar data. The key identifying assumption is that wealth declared before 1920 was a more accurate measure of the 'true' wealth of a dynasty, than declared wealth after 1920. The observed incentives suggest that this is reasonable; taxes on wealth before 1920 were a tiny fraction of what they were to become after 1920.

During the low tax era, 1892-1920, I sum declared wealth at death, by dynasty. I then calculate an expected flow of inherited wealth for these dynasties from 1920 to 1992 using new estimates of the rate of return for different wealth portfolios. These estimates incorporates war-time destruction, the specific amount of inheritance tax paid, capital income tax and the average asset composition of different wealth groups.

For most, wealth after 1920 is in excess of that predicted by the inheritance flow from 1892-1920. This is newly created wealth. However, for certain elite dynasties, declared wealth is systematically below expected wealth from inheritance. This is hidden wealth.[3]

Let us take the Axxxxxxx family as a concrete case study to illustrate the method (I have anonomysed the name).[4] In the 1881 census of England and Wales, there are 39 people with the surname Axxxxxxx. Between 1892 and 1920 I observe 4 probated deaths. The sum of the wealth of the Axxxxxxx's in this period is £12.4 Million (in £2015). Post 1920, I expect this amount of capital to generate a flow of wealth that should show up in the probate records of the Axxxxxxxs. This flow is calculated based on the rate-of-return of wealth in the economy, net of inheritance and capital income tax. All of these elements are separately calculated, as is wartime destruction of wealth.

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[1] For specific details on this wealth measure, which are valuations of a deceased's estate, see Cummins (2019b); Rubinstein (1974, 1981); Harbury (1962); Harbury and Hitchens (1979).

[2] If wealth is missing, or 'hidden', from the Probate calendars, it is also missing from analyses using related sources, for example from (Atkinson and Harrison, 1978; Atkinson et al., 1989; Atkinson, 2013; Alvaredo et al., 2018). These authors use aggregated summary data from the Inland Revenue for their estimates.

[3] Figures C.3c and C.3d report the declared wealth of 2 'hiding' dynasties over the sample period, 1892-1992. Figure C.3e on the other hand reports the declared wealth of a dynasty creating new wealth. One of these dynasties is that of a former primeminister.

[4] The Axxxxxxxs are an English aristocratic family that traces its ancestors to the 10th century. A google search reveals connections to the Royal family and many MPs of that name. I illustrate other surnames dynasties in this way in appendix figure C.3.

As figure 1.1 illustrates, the declared wealth of the Axxxxxxx dynasty is far below what we would expect from that observed before 1920. The difference between the expected flow of inherited wealth, and that actually declared is hidden wealth. In the period 1980-1992, this amounts to over £3m. The Axxxxxxxs *could* be hiding about 94% of their inherited wealth. Despite the fact that there are only 96 Axxxxxxxs in England in 2002, the name appears in the *Offshore Leaks database* (International Consortium of Investigative Journalists (2019)).

This paper finds thousands of dynasties that appear to be hiding wealth such as the Axxxxxxxs. Specifically I can name 8,549 dynasties hiding at least £7.7 Billion (£2015). I show that this hidden wealth estimate predicts a dynasty's appearance in the *Offshore Leaks Database.* I further show that hidden wealth is correlated with postcode house-value in 1999, and attendance at Oxford and Cambridge Universities, 1990-2016. These hidden wealth correlations are apparent even when controlling for observed wealth.

A crucial clarification is due: for any one dynasty, the categorization of the missing wealth as hidden is a *probability.* The random hazards of marriage choices, mad inheritors, disastrous investments, betrayal, theft, stupidity and chance can dilute and destroy even the grandest of fortunes. The method I apply here is not meant to be an accurate point estimate of the precise wealth for any one dynasty. Rather, it is designed to estimate a plausible minimum; at the group level, of the amount of inherited wealth that is hidden.

In this paper, I show that for Victorian elites, the richest 1,500 dynasties of the 1892-1920 period (of which the Axxxxxxx are members), wealth is systematically hidden.

For the analysis, I select only rare surnames of English origin, who have less than 100 people observed in the 1881 census, and track these rare surname dynasties in the Probate Calendars from 1892-1992. Formally, I compare *estimated* wealth with that later *actually observed* during the high-tax post war era. I incorporate wartime destruction and all death-taxes paid into this estimate of 'true' inherited-wealth.

To estimate this 'true' inherited wealth I apply a rate-of-return to the sum of observed wealth, pre-1920, that is based upon the portfolio composition of different wealth groups. I use the annual reports of the commissioners of *His Majesty's Inland Revenue* (after 1952, *Her Majesty's*) from ProQuest (2018) to reconstruct the average portfolio composition for six broad wealth classes, from '£10,0000 and under', to 'over £5,000,000 (£2015 prices). I then generate an expected rate of return on wealth for each class by matching the share of the asset in the portfolio to rates of return recently estimated by Jordà et al. (2019). The resulting estimates show that over the 20th century the rich have a higher rate of return on their wealth than the poor.

Figure 1.2 illustrates the concept for calculating hidden inherited wealth.

At the aggregate, estimated wealth is lower than observed wealth as new wealth is being created by non-inheriting surname dynasties. Figure C.1 reported in the appendix, illustrates how newly created wealth is captured. However, for the richest English dynasties, the Victorian Elite of 1892-1920, it is clear that at least 18-32% of all elite wealth is hidden by their descendants, 1950-1992.

At the individual surname level, this hidden wealth estimate, and the proportion of wealth hidden, strongly predict the appearance of a surname in the recent *Offshore Leaks Database* (Interna-

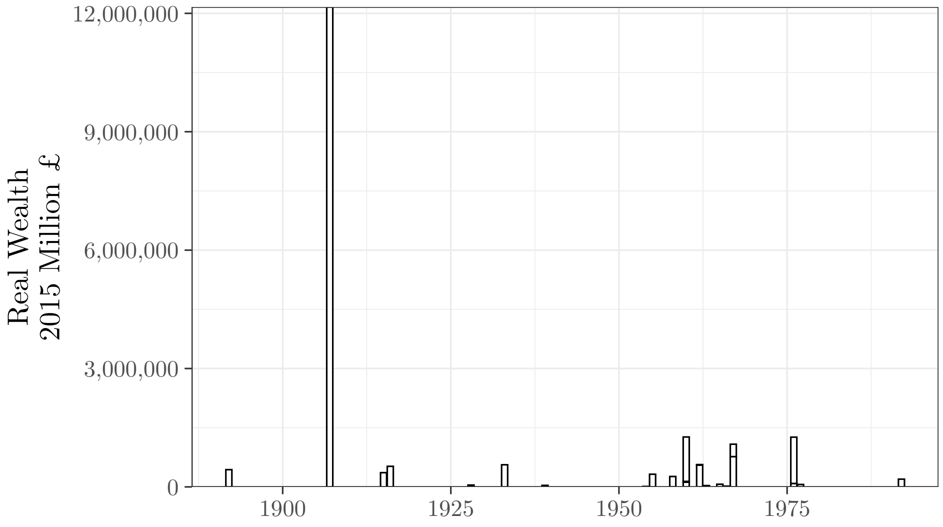

Figure 1.1: The Wealth at Death of Members of the Axxxxxxx Dynasty

Source: 100% PPR Calendar Sample.

tional Consortium of Investigative Journalists 2019). This suggests that a proportion of inheritance taxation is potentially being evaded. Further, the richer the dynasty, the greater is the proportion of wealth hidden.

Using the locations of 31 Million UK voters from the *electoral roll* of 1999, and the complete *price paid* data for house sales 2017-8, I show that hidden wealth is associated with more expensive postcodes. Hidden wealth appears to boost contemporary consumption and living standards of hiding dynasties. Further, I show that their children are more likely to attend the elite universities of Oxford and Cambridge, 1990-2016. Whilst the analysis cannot demonstrate that these relationships are causal, they do represent new descriptive patterns that demand an explanation via future research.

The fact that the estimates of dynastic hidden wealth correlate strongly with contemporary outcomes, are robust to different formulations (including different rates of return to wealth), and are highly statistically significant, is supportive of the validity of the method introduced by this paper.

Incorporating this elite hidden wealth into a recalculation of the top decile wealth share shows that the decline of the 'true' wealth share is significantly more muted than that for observed wealth. The richest decile hold an extra 15% of the 'true' wealth distribution, equivalent to a 40% reversal of the observed decline.[5]

This paper relates to existing work on the English wealth distribution Piketty (2014), Lindert (1986), Harbury (1962); Harbury and McMahon (1973); Harbury and Hitchens (1976, 1977); Atkinson and Harrison (1978); Harbury and Hitchens (1979); Lindert (1986); Atkinson et al. (1989); Atkinson (2013); Alvaredo et al. (2018); Scott (2021) and of course the titanic contributions of

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[5] This is based on figure 6.1.

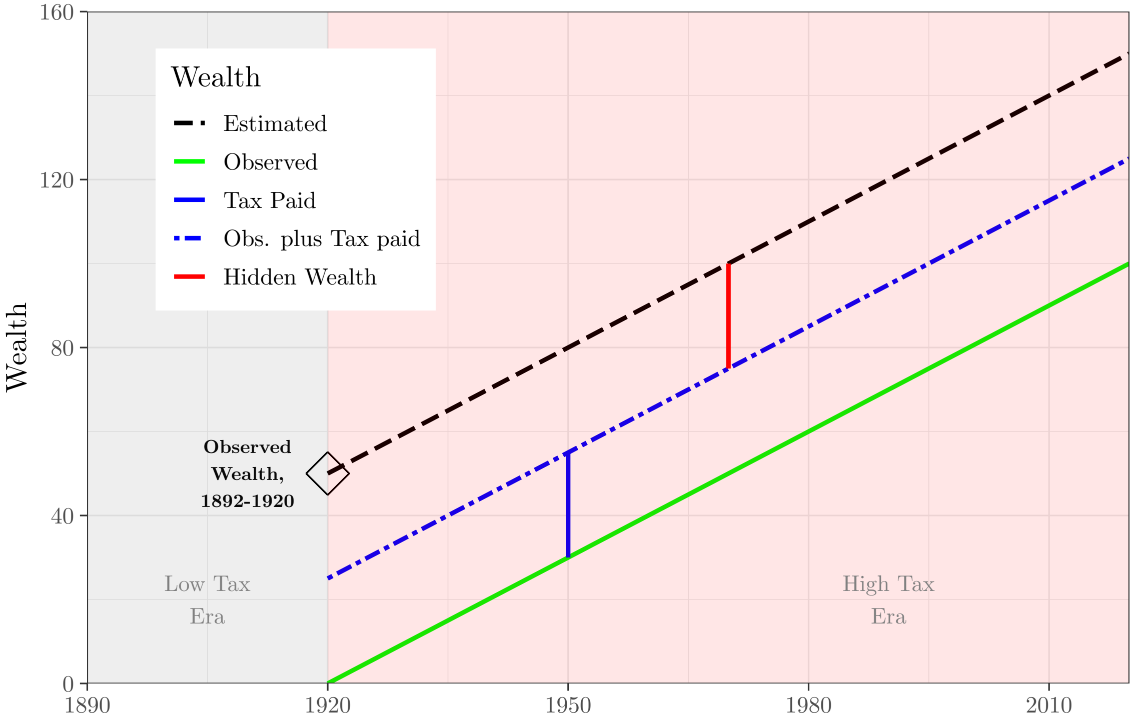

Figure 1.2: The Concept

Note: To estimate hidden inherited wealth, I project observed dynastic capital during the low-tax era forward using the net-of-taxes rate-of-return on wealth. I subtract inheritance tax paid. Hidden wealth is the difference between this expected wealth and that actually observed. I assume that wealth observed during the low-tax era is a much better approximation of true dynastic wealth than wealth observed during the high-tax era.

Piketty (summarized in Piketty (2014)). Of more immediate relevance to hidden wealth is the recent work of Gabriel Zucman: Zucman (2013), analyzing systematic anomalies in the foreign assets and liabilities of countries, estimates that 8% of household wealth is held unrecorded in offshore tax havens. Alstadsæter et al. (2019), also using off-shore banking leaks and micro-data, from Norway, Denmark and Sweden, claim that "the 0.01% richest households evade about 25% of their taxes".

The analysis in this paper also relates to the debates between Modigliani (1986, 1988) and Kotlikoff and Summers (1981); Kotlikoff (1988) on the share of inheritance in wealth (here I model a dynasties wealth flow as that from capitalized bequests). For 19th century Paris, Piketty et al. (2014) apply an analogous methodology to uniquely rich individual level data, to understand the relative importance of inherited and self-made wealth. They find that 10% of Parisians own about 70% of all wealth, and that 70% of the top 1% are rentiers, living off their inheritance (p.22). However, I focus here on estimating systematically hidden wealth.

This paper presents a simple method, combining historical and contemporary data, to estimate hidden wealth at the surname level. This method produces a set of surnames that are potentially hiding a large amount of wealth. Tax authorities could use this information to investigate potential evasion.

Internationally, the pattern of a low-tax pre-war era followed by a high-tax post-war period is almost universal; applying the method presented in this paper to other historical wealth data from other countries could lead to the uncovering of vast sums of hidden wealth.

The implications of incorporating hidden wealth into the top wealth shares are of profound importance. Changes in wealth inequality were the largest equalizing force in the 20th century (Piketty, 2014). This paper shows that the true top-wealth share did indeed decline but not by as much as that observed in the reported data. This finding is important for our empirical understanding of the true evolution of inequality over the last century and is crucial for attempts to understand the causal forces behind the 'Great Equalization'. It also highlights the need for further research on hidden wealth, both contemporary and historically, in the UK and elsewhere.

The data for analysis are presented in section 2, the methodology in section 3, results in section 4 (surname-group level) and section 5 (individual surname level). In appendix section B, I replicate the method and the empirical analysis using an alternative series for the rate of return to capital during the 20th century. Section 6 reports an adjusted top 10% wealth share that accounts for hidden wealth, 1920-1992, and section 7 concludes.

2 Data

This paper exploits several newly constructed and existing datasets.

2.1 The Principal Probate Registry Calendar entries, 1892-1992

All estates of the deceased in England and Wales, above a threshold, require an act of probate for inheritors to legally execute a will. I use the complete individual level wealth-at-death records from the the *Principal Probate Registry (PPR) Calendar* entries, 1892-1992, to track English dynastic wealth.[6] This source records all decedents in England and Wales with wealth above the threshold

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[6] Existing research directly using the individual probate valuations includes Wedgwood (1928), Harbury (1962), Perkin (1978), Rubinstein (1977a,b, 1981) Nicholas (1999), Rothery (2007), Turner (2010), Clark and Cummins (2015a) and (2015b).

Years	Valuation
1858-1898	Unsettled Personalty + Let Freeholds
1898-1925	" + Unsettled realty
1925→	" + Settled Land

Table 2.1: The Probate Valuations

Notes: Based on information from Rubinstein (1974, 1977a); Turner (2010). 'Unsettled refers to cash from the sale of an asset where as 'settled' refers to assets that are unsold but held in trust for successive beneficiaries (see `https://www.gov.uk/guidance/inheritance-tax-manual/section-8-settled-property` for more details on the legal definitions). This table is also reported in Cummins, 2019b.

(currently £5,000).[7] Name, address, date of death, the name of the executor and an estimate of estate value were consistently recorded. The original printed volumes were digitized and algorithmically parsed and formed into a database suitable for economic analysis, in a process described in Cummins (2019b), who investigates in depth the quality of the resulting data, 15 million individual level wealth-at-death observations.

As Wedgwood (1928) states: "generally speaking, the probate valuations are restricted to property within the free disposition of the deceased ... at the time of his death" (p.42). Table 2.1 reports the type of wealth included and the major changes 1858 to 1992. It should be noted that it is only after 1898 that unsettled realty is included, and only after 1925 when settled realty is part of the estate valuation. This will bias the hidden wealth estimates presented later downwards, as inherited realty is counted only after 1925 and not before. This supports the argument that the hidden wealth estimates of this paper are a lower-bound.

Estates were valued at market prices. The wealth information is imperfect; the biggest consistent omission is 'unsettled personalty' - for example trust funds (Rubinstein (1974)). p.70). Also, there is no information on inter-vivos gifts, nor on transfers to spouses, or to charity (these were never subject to inheritance tax). In addition, age at death is not reported.[8] Pension entitlements and annuities that end with death are completely omitted from the valuations, as is the cash value of joint bank accounts. There are more omissions and weaknesses, as detailed in Cummins (2019b). However, even considering these numerous, major flaws, the PPR Calendar valuations remain the best and most consistent, systematically collected estimates of individual English wealth-holding over the 20th century.

The wealth-share estimates of the top percentiles from the PPR Calendars match closely existing estimates from Atkinson and Harrison (1978); Atkinson et al. (1989); Atkinson (2013) and Alvaredo et al. (2018), who use aggregated returns reported by the Inland Revenue. Figure 2.1a compares the PPR percentile shares of the English wealth at death distribution with those from Alvaredo et al. (2018).[9] The PPR Calendar data also matches well with estimates of aggregate non-pension wealth, as reported by Blake and Orszag (1999), and illustrated in figure 2.1b. The empirical base for historical wealth estimates are limited so there are very few studies to compare with the PPR data. However, Lydall and Tipping (1961), who used the 1954 Oxford Savings Surveys to calculate a representative estimate of the individual wealth distribution below £2,000. Above £2,000, they used estate duty returns. In figure 2.1c I compare their estimates with those from the PPR Calendars. There is a striking correspondence.

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[7] The probate threshold during the period 1858-1900 was £10, 1901-1931: £50, 1932-1964: £100, 1965-1974: £500, 1965-1974: £500, 19754-1984: £1,500, 1984 onwards: £5,000 Cummins, 2019b, table 1.

[8] As the dead are not a random sample of the general population, this is a possible source of bias. However, Alvaredo et al. (2018), who use a related source, aggregated summary tables from the Inland Revenue, show in their figure 6 (p.18), that there is no substantive difference in the level or trend of wealth inequality when adjusting by age at death.

[9] I use the estimates reported in Table D1 of the working paper version, Alvaredo et al. (2017). See the appendix for a comparison of average wealth per adult.

The evidence from existing studies support the credibility of the PPR Calendar wealth data.

2.2 Taxes Due at Death

Death duties are complicated taxes made up of different time-varying components. All death duties, composed of legacy, succession, estate duties (1892-1974), capital transfer tax (1974-1986), and inheritance tax (1986 and after) were collected: HM Revenue & Customs (2005) reports the schedules 1894 to 1974.[10] Capital transfer tax replaced estate duty in 1975 and was itself replaced by inheritance tax in 1986. Inheritance tax is a flat 40% above the nil-rate threshold (reported by HM Revenue and Customs). The Institute for Fiscal Studies (2007) collected the historical series for both inheritance tax and capital transfer tax (1986 to today; available at https://www.ifs.org.uk/uploads/publications/ff/iht.xls).

Figure 2.2 reports the total rate of death duties due by a set of estate values (in £2015), 1892-2015. By combining the tax and probate data it is simple to calculate tax paid. Table 2.2 reports the largest tax payers in England, 1892-1992.[11]

2.3 Variable Rates of Return based on the Composition of Wealth

To calculate the rate of return on inherited wealth I combine new data on the composition of wealth by estate value range, with existing estimates for the rate of return on different asset classes over the 20th century.[12]

The PPR Calendar's wealth summary is limited to an estimate of the value of a decedent's estate. To examine the composition of decedent's wealth I extracted breakdowns of wealth-at-death by asset type from the annual reports of the commissioners of *His Majesty's Inland Revenue* (after 1952, *Her Majesty's*) from ProQuest (2018). From 1908, detailed breakdowns of the composition of wealth-at-death by estate value ranges are reported, annually.[13] After 1968, the breakdown is reported in a new publication, entitled *Inland Revenue Statistics* Her Majesty's Stationery Office (1970–1992).

A sample photograph of the tables used, for the year 1920, is presented in appendix figure A.2. I digitized this set of tables for the years 1906, 1910, 1915, 1920, 1925, 1930, 1935, 1939, 1949, 1956, 1960, 1968, 1981 and 1990 (as close to every year ending in a 0 or a 5 that I could access).

I assign each reported category of wealth from these sources to one of five broad categories of wealth; equity, housing, government bonds and bills, cash and other.[14] Table A.1, in the appendix, details how this allocation between the Inland Revenue categories and the five broad categories

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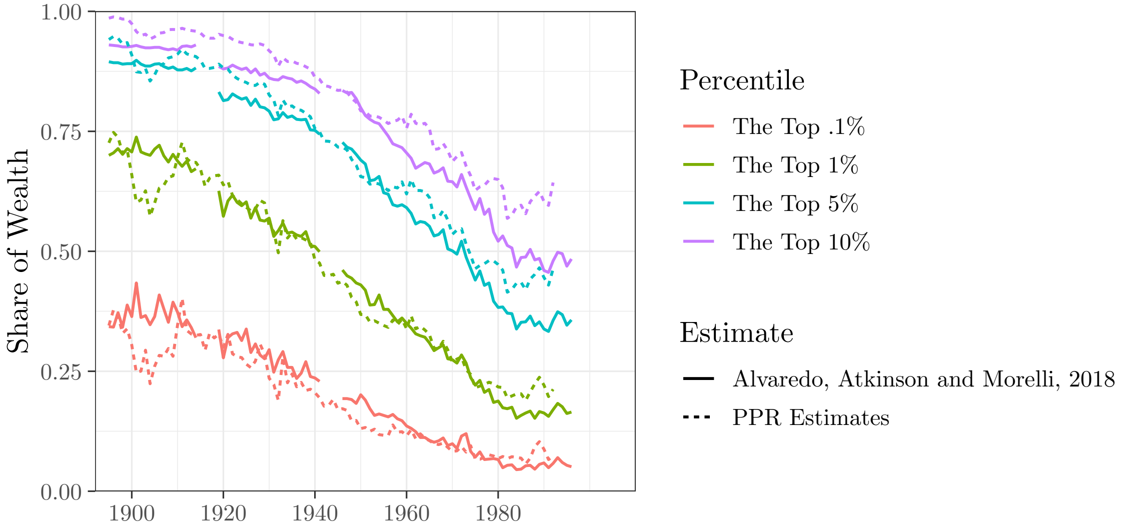
[10] Available at https://uk.practicallaw.thomsonreuters.com/.

[11] Note that the Grosvenor family famously invested the majority of their family fortune in a trust thus avoiding inheritance tax (See for example this story from *The Times*: link). The richest English women in the data, Eleanor Countess Peel, established a well endowed charitable trust with her estate (peeltrust.com). This will count as 'hidden' wealth in this analysis.

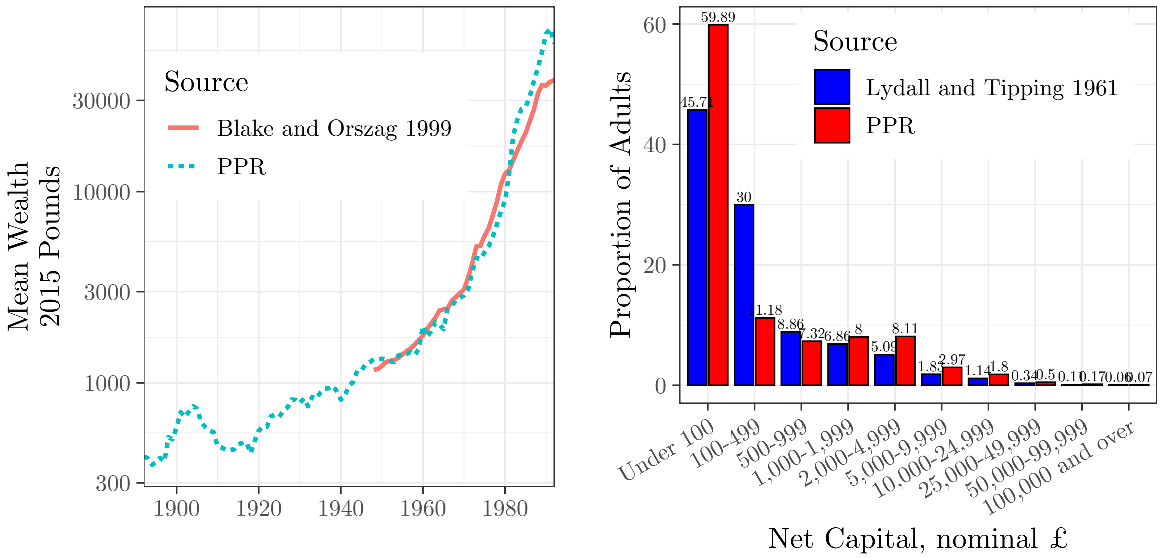
[12] A previous, working paper version of this analysis (Cummins (2019a)) used aggregate rates of return.

[13] Before 1908 only a simple aggregate breakdown for all estates is presented.

[14] Corresponding to available rates of return.



(a) Comparing Different Estimates of Top Wealth Shares, England 1892-1992



(b) Comparing Average Wealth with Blake and Orszag (1999)

(c) Comparison of Net Capital with Lydall and Tipping (1961), by Wealth Band, 1950s

Figure 2.1: The PPR Calendar Wealth Data, Compared with Existing Estimates

Notes: See Cummins (2019b) for a detailed account of the source, construction and validation of the PPR data. Sources: PPR wealth data, Alvaredo et al. (2017) table D1, Blake and Orszag (1999, Table 12) (sum of columns 'net financial wealth', 'housing wealth' and 'consumer durable assets'). These aggregate sums were converted to a per adult measure using population data from Office for National Statistics (2018). Source for figure c: Lydall and Tipping (1961, p.89). Note that the PPR covers England, the Lydall and Tipping (1961) estimates cover Great Britain. Both estimates exclude pension wealth. These figures are also reported in Cummins, 2019b.

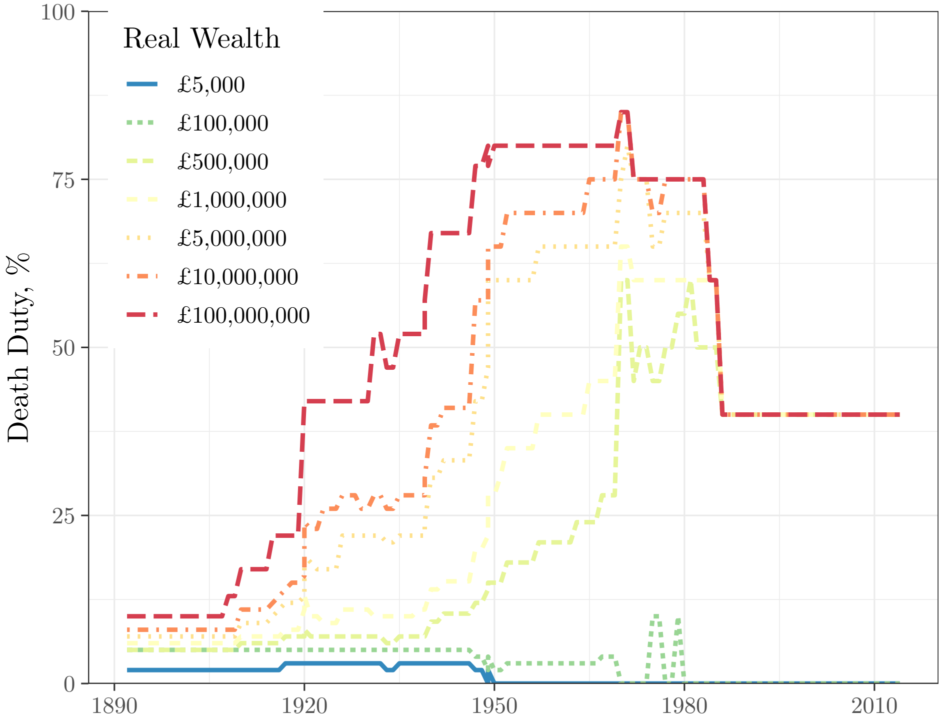


Figure 2.2: Death Duties, 1892-2015

Notes: £2015. Inspired by similar figure in Nicholas (1999). *Source*: HM Revenue & Customs (2005) and Institute for Fiscal Studies (2007).

	Year	Name	County	Real Wealth	Death Duties, %	Tax Paid
1	1933	Sir John Reeves Baronet Ellerman	London	1,257,371,575	52	653,833,219
2	1974	Charles Cross	Hampshire	288,513,883	75	216,385,412
3	1935	TRH James Woolavington	Cornwall	345,796,993	52	179,814,437
4	1957	James Armand De Rothschild	Buckinghamshire	183,395,206	80	146,716,165
5	1958	William Stone	London	147,904,760	80	118,323,808
6	1940	TRH Marmaduke Furness	Leicestershire	139,121,970	67	93,211,720
7	1940	Jack Bamato Joel	London	138,382,028	67	92,715,959
8	1929	Bernhard Baron	East Sussex	213,606,754	42	89,714,837
9	1974	James Henry Bryan	West Midlands	119,247,477	75	89,435,608
10	1935	Arthur Stanley-Wills	North Yorkshire	169,260,470	52	88,015,445
11	1946	William Johnston Yapp	Kent	128,326,006	67	85,978,424
12	1953	Hugh Richard Grosvenor*	Cambridgeshire	105,630,735	80	84,504,588
13	1921	TRH Sir Ernest Joseph Cassel	London	199,628,495	42	83,843,968
14	1949	TRH Eleanor Countess Peel	Scottish Borders	102,871,973	80	82,297,579
15	1948	TRH Gerald Berkeley	Lincolnshire	105,111,626	77	80,935,952

Notes: 2015 prices. “TRH” = “The Right Honourable”. * 2nd Duke of Westminster. *Source*: 100% PPR Calendar Sample.

Table 2.2: The 15 Largest Taxpayers, 1892-1992

employed in the analysis here. The ’other’ category generally comprised ‘policies of insurance’ and ‘trade assets’.

Figure 2.3 reports the composition of wealth-at-death, by broad asset category, for six ranges of estate value (in 2015 pounds). In general poorer decedent’s hold a greater proportion of their wealth in cash and housing with richer decedents holding significantly more equities. For these richer groups, equity and housing have increased their share over the second half of the 20th century.[15]

I then calculate rates of return for each of these wealth groups, based upon the different asset compositions, and rates of return from Jordà et al. (2019) and Bank of England (2020)[16] as

$$r^w = E^w_t * r^E_t + B^w_t * r^B_t + H^w_t * r^H_t + C^w_t * r^C_t + O^w_t * r \tag{1}$$

where r is the rate of return for year t for one of the wealth groups, w; £10,000 and Under, £10,000-£100,000, £100,000-£500,000, £500,000-£1,000,000, £1,000,000-£5,000,000, and Over £5,000,000. E is the share of equity in a wealth group’s overall wealth, B is the share of Govt. bonds, H is housing wealth, C is cash and O is other types of wealth (these shares sum to one). r is the rate of return for each broad class, as reported by Jordà et al. (2019).[17] I use the aggregate rate of return as the relevant return for the ‘Other’ wealth class. For the rate of return of cash, I use the Consumer Price Index (CPI) reported by Bank of England (2020) and apply the formula:

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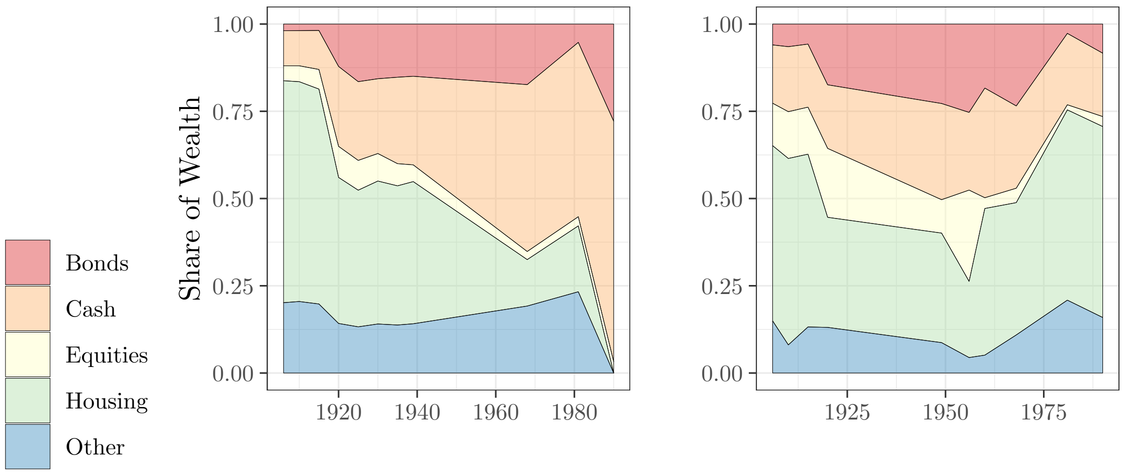
[15] Note that the proportion of wealth in housing of the ’£10,00 and under group’ in 1990 is set at zero. The actual proportion is negative (due to mortgage debt.)

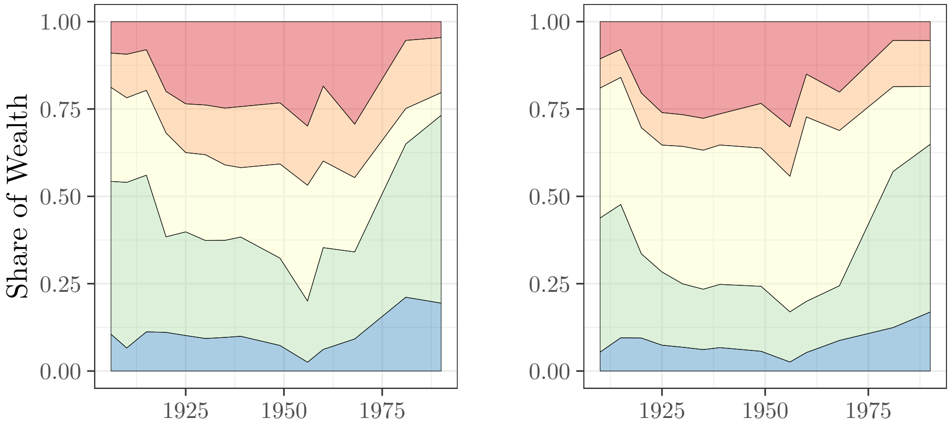
[16] Figure A.3, in the appendix, reports the rates of return for each of these five classes.

[17] The underlying data are described in the appendix to that paper, pages A82-84 (house price and rent data), A100 (equity and bond returns).



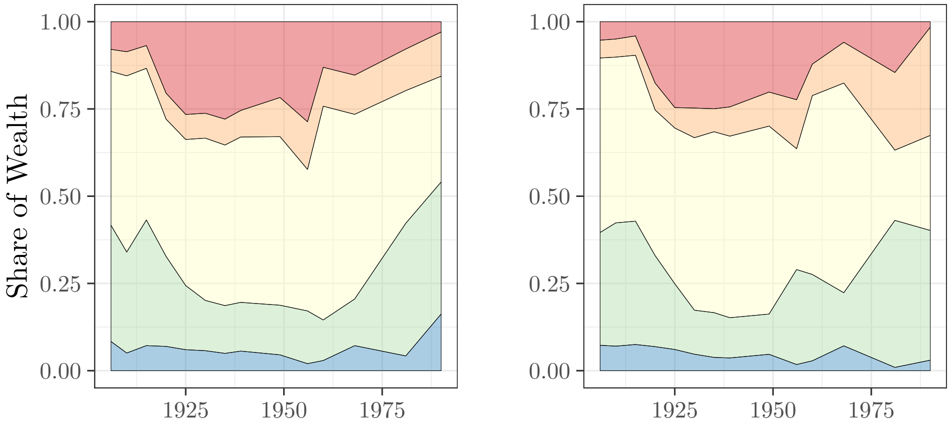
(a) £10,000 and Under

(b) £10,000-£100,000



(c) £100,000-£500,000

(d) £500,000-£1,000,000



(e) £1,000,000-£5,000,000

(f) Over £5,000,000

Figure 2.3: The Composition of Wealth at Death, by Broad Asset Category, and Range of Real Estate Value 1906-1990

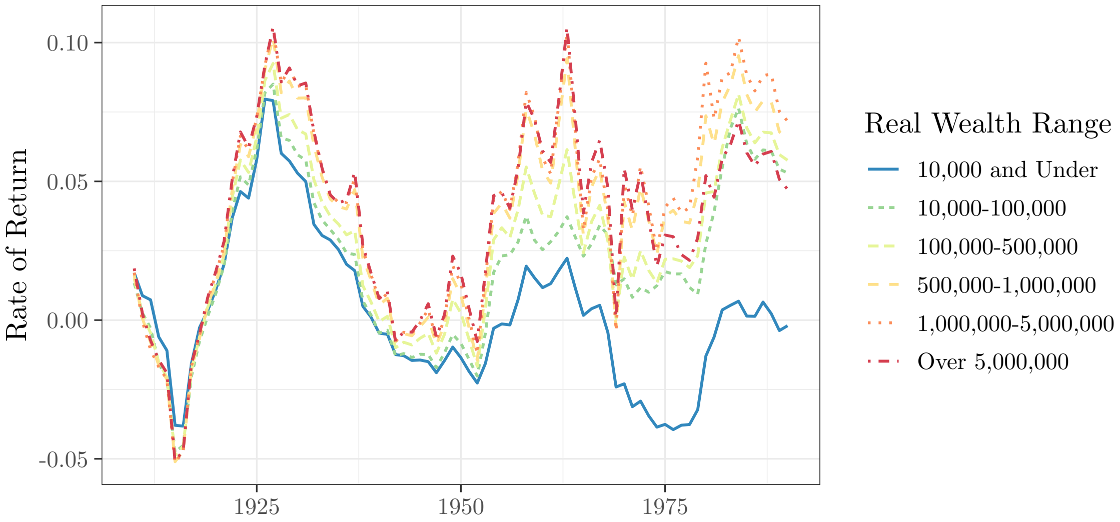


Figure 2.4: Rates of Return by Estate Value Range, 1910-1990

Notes: Rates of return are calculated using observed estate shares multiplied by rates of return from Jordà et al. (2019) (See figure 2.3 and equation 1. I apply a 11 year moving average to the data on returns. *Source*: Jordà et al. (2019) (website). I interpolate housing returns 1940-5, as Jordà et al. (2019). Estate value range is in real 2015 pounds.

$$r_t^C = \frac{CPI_{t-1}}{CPI_t} - 1 \tag{2}$$

I transform r to decadal moving averages, centered on the year of death of the decedent. The goal here is to use r to best-guess the rate of growth of inherited fortunes; an individual's financial assets are unlikely to be liquidated annually, so a decadal moving average gives a more realistic estimate of the likely gains or losses to the inheritance. The observed wealth shares by wealth range are interpolated to generate annual values that are matched to the annual moving-average rates of return.

Figure 2.4 reports these rates of return that vary by wealth. There is a striking difference in the rate of return to wealth for the rich and the poor. This is because the rich have a greater share of their wealth in high yielding assets such as equities. The poor have a far greater share of their wealth in cash, which due to inflation, typically has a negative rate of return.

Finally, I calculate the net-of-taxes r, r^*, as $r^* = r - t$, where t is the highest rate of tax on capital income estimated by Atkinson for the UK, 1908-1992, and reported by Piketty (2014)[18]. This is of course unrealistic but is designed so that we are measuring a plausible minimum inherited wealth accumulation trajectory. Where the return on wealth is estimated as negative, $r < 0$, I set $t = 0$, as taxes are not due on negative capital income.

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[18] The original sources are Sabine (1966) and the Annual Reports of the Commissioners of the Inland Revenue.

2.4 Offshore Leaks

The *Offshore Leaks Database* by the International Consortium of Investigative Journalists (ICIJ) (2019) contains detailed information on indviduals connected to one or more of 785,000 offshore companies, foundations and trusts, from four recent data leaks; the Paradise Papers (2017 and 2018, principally from the law firm Appleby), the Panama Papers (2016, the law firm Mossack Fonseca), the Bahamas Leaks (2016, official corporate registry) and the Offshore Leaks (2013, Portcullis Trustnet and Commonwealth Trust Limited). Once cleaned and filtered, there are 298,015 names of individuals behind these Offshore entities and I utilize these names in my analysis.[19]

It is of course not illegal to be a director or owner of a foreign entity. However, the presence, or not, of elite inheritors in these lists is useful for our understanding of the destination of some of this hidden wealth.

2.5 Contemporary Outcomes: House Prices and Oxbridge Attendance

For contemporary outcomes by surname I collected individual nominal data on locations, house prices, and Oxford and Cambridge University attendance.

All voters in the UK are listed in the *electoral roll.* I extracted the records of the 1999 UK *electoral roll* from a CD-ROM entitled UK-Info Disk (2000). 1999 was the last year that the complete, pre opt-out, electoral roll was available. This resulted in 31,551,398 observations of forename, surname, specific address, and postcode.[20]

I then link the individual addresses from the electoral roll of 1999 to house price data by postcode in 2017 (from the land registry)[21]. There are 1,758,312 postcodes in the UK so this is a highly specific estimate of house values.

Attendance at Oxford and Cambridge Universities is sourced from official publications and email directories (see Clark and Cummins (2014); Clark et al. (2014); Clark and Cummins (2015a, 2018)).

In addition to the these data, this paper also uses the complete count of the 1881 Census of England and Wales, the Complete Death Register, 1892-2007 and multiple other 'Big' datasets summarized in Cummins (2018, 2019b).

3 Methodology

The data allow me to observe all declared probated wealth 1892-1992. From the sum of this wealth for surname 'dynasties', 1892-1914, I can estimate the flow of 'expected wealth', 1920-2018. By comparing estimated with observed wealth, and accounting for taxes; I can estimate how much of English wealth is 'hidden'.

This section details my methodology for defining surname 'dynasties', calculating wartime destruction, estimating expected wealth and measuring surname representation in the *ICIJ Offshore Leaks Database.*

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[19] I combined the "Officer" field in all 4 databases and manually cleaned out companies and organizations.

[20] Extracting the data from the 20 year-old CD-Rom interface was a technical challenge as only 250 records per individual search could be returned with a upper limit of 2,000 for any search criteria. Automation via jitbit Macro Recorder (`https://www.jitbit.com/macro-recorder/`) over several months resulted in apx. 31m duplicate free records. This represents a sample of apx. 70% (where 100% is 44m). The sample is complete for rarer names but incomplete for common names due to the 2,000 results per query hard limit.

[21] 'Price paid' data was downloaded from `http://prod.publicdata.landregistry.gov.uk.s3-website-eu-west-1.amazonaws.com/pp-complete.txt`(HM Land Registry, 2018).

3.1 Tracking Surname 'Dynasties'

I use rare surnames to track dynastic wealth over time. In England, surnames are hereditary and are typically passed down through the male line just as the non-recombining region of the Y-chromosome. Thus surnames generally mark clusters of genetically related men (and can be deduced from human genomes (Gymrek et al., 2013), finding current utility in modern forensics).

The probability of co-ancestry of two individual men sharing a surname is dependent on the number of founders of a surname, the incidence of non-paternities and genetic drift. Rare surnames are significantly more likely to indicate co-ancestry (surname counts under 5,000 (King et al., 2006; King and Jobling, 2009)). Here rare surnames, defined as a count of less than 100 people in the 1881 census, are employed under the assumption that the holders of that name are highly likely to not only share some co-ancestry but can be thought of as part of the same surname 'dynasty'. Under the assumption of positive assortative mating, I also include women.

The wealth-shares of the top-percentiles of the wealth distribution, 1892-1992, calculated at both the individual and rare-surname level are reported in figure 3.1. At the individual level, the top 10% have about 99% of all English wealth in 1900 - At the rare surname level the top decile have about 80% of all wealth. In 1992, the top 10% of individuals have over 60% of wealth whilst the top 10% of surname dynasties have just under 50%.

Despite these level differences, the time trends in the individual and rare surname series are remarkable similar (compare figure 3.1a with figure 3.1b and 2.1a). This suggests that the rare-surname level grouping captures the changing dynamics of the 20th century wealth distribution.

Harbury and McMahon (1973) note:

> some observers contend that the decline in the share of the richest percentiles in the wealth distribution may be quite misleading, and reflect merely a rearrangement of wealth within families, rather than a redistribution of wealth from rich to poor families (p.810)

Figure 3.1 indicates that the 'Great Equalization' of English wealth is reflected at the surname-dynasty level and not only the individual level. Therefore rearrangement of wealth within families cannot explain the decline in the wealth share of the top 10%. (If it were, this would show up as no change in the rare surname level wealth-shares 1900 to 1992.) Table 3.1 reports the distribution of English surnames, population in 1881 and population in 2002, by surname count ranges.[22] Rare surnames are both more likely to go extinct, or increase far more rapidly than common surnames. There are 34,928 surnames that are held by more than one and less than 100 people in 1881. I omit surnames that have only one holder as they are likely transcription errors. Of these 34,928 surnames, 18,921 appear at least once time in the PPR calendar between 1892 and 1920. I track these 18,921 names in the analysis. This set of surnames represent 758,755 individuals in 1881 and 1,503,669 in 2002.[23]

I define a 'Victorian rare elite' as the top 1,500 richest wealth-holding surnames from 1892 to 1920, for those surnames held by 2-100 people in the 1881 census (I drop surname counts of 1).[24]

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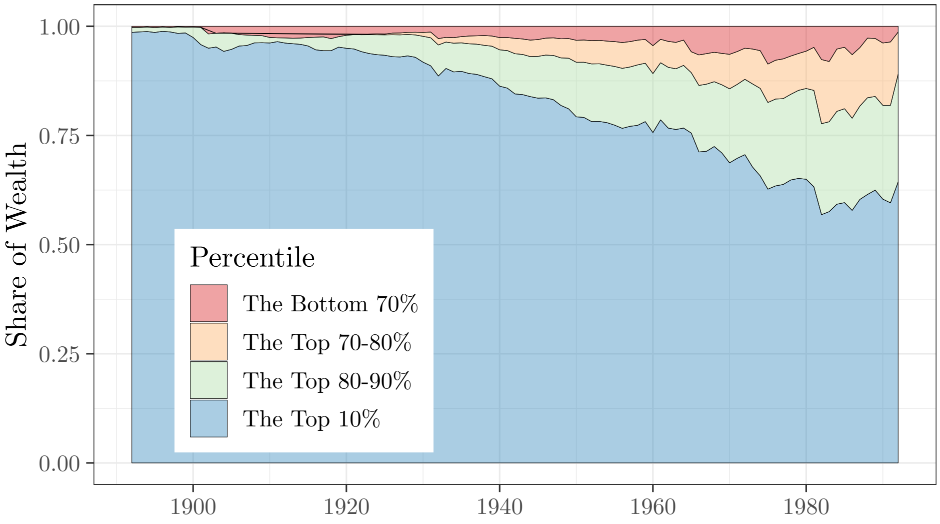
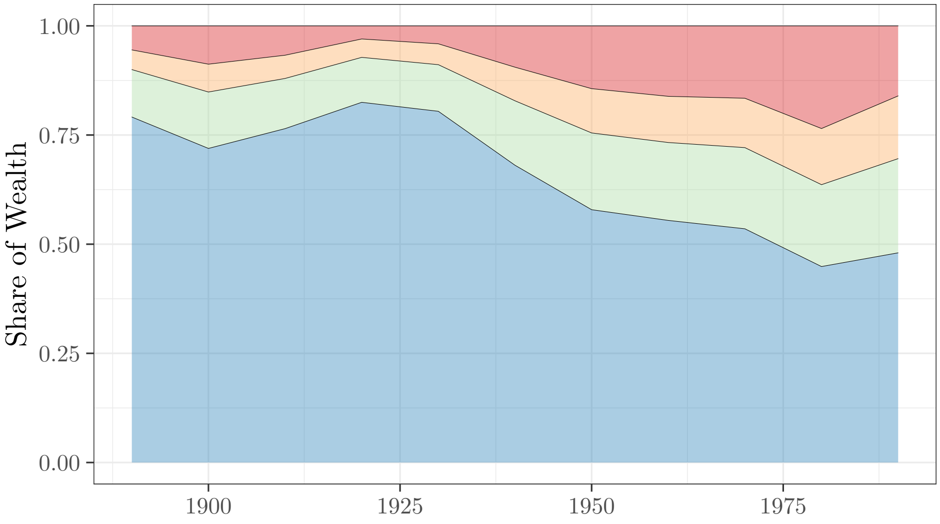
[22] Ethnicity was assigned to every observed surname using ONOMAP name classification software (http://www.onomap.org/) provided to me by Paul Longley and Oliver O'Brien (Both Department of Geography, University College London).

[23] The full population of all 34,928 surnames in 1881 is 1,047,459 and 2,095,463 in 2002, as table 3.1 reports (the smaller analytical sample is based upon those dynasties reporting some wealth, 1892-1920).

[24] Queen Victoria died on 22 January 1901, so consider the name a nominal convenience and not a iron-clad definition. (As an aside; the monarch is not subject to probate (Nash (2017) p.128)).



(a) Individual Level



(b) Rare Surname Level

Figure 3.1: Observed Wealth Shares, Individual and Rare Surname Level, 1892-1992

Source: 100% PPR Calendar Sample.

Table 3.1: English Surname Extinction, 1881-2001

N Range, 1881	N, Surnames	N, 1881	N, 2001	Prop. Extinct	Ratio
1	1,791	1,791	38,330	0.15	21.40
2-5	3,442	10,151	80,365	0.14	7.92
5-10	5,212	36,103	142,200	0.10	3.94
10-20	7,402	104,419	269,520	0.07	2.58
20-50	11,306	363,995	675,159	0.05	1.85
50-100	7,566	532,791	928,219	0.02	1.74
500-2,000	3,734	3,557,709	6,278,178	0.00	1.76
>2,000	1,680	13,607,051	24,335,967	0.00	1.79

Note: Calculated from the 1881 census (Schurer and Woollard (2000) and National Statistics (2002)

Table 3.2: English Surname Extinction, 1881-2001, Victorian Elite Dynasties

N Range, 1881	N, Surnames	N, 1881	N, 2001	Prop. Extinct	Ratio
2-5	26	93	539	0.08	5.80
5-10	68	458	2,054	0.12	4.48
10-20	173	2,525	5,866	0.07	2.32
20-50	542	18,547	32,733	0.03	1.76
50-100	691	50,295	84,922	0.00	1.69

Note: Calculated from the 1881 census (Schurer and Woollard (2000) and National Statistics (2002)

Individuals holding these surnames die on average 420% richer than the average person, 1892 to 1992. By following these rare surnames in the PPR data, I can observe dynastic wealth. Table 3.2 also details the distribution of English surnames, population in 1881 and population in 2002, by surname count ranges. for this Victorian rare elite.[25]

In addition a 'middling' Victorian wealth grouping, ranked 8,740-10,239 out of a rare lineage universe of 18,921 and a Victorian 'bottom' grouping, the bottom ranked 5,000 wealth holders, out of the same 18,921 surnames.

3.2 Wartime Destruction

To estimate the destruction of capital due to the World Wars I look at the sum of rare dynastic wealth in the 5 years before and after the wars. Wartime destruction, $_{wd}$ of wealth, W, for surname j is calculated as

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[25] The two tables we can immediately rule out differential fertility as a potential channel behind the dilution of elite wealth. By comparing the growth rate of rare names in the population, 1881-2002 to names in the Victorian top-one-percent, it can be seen that if anything elite fertility acted against wealth dilution. At every range, the growth rate of the 'Victorian Elite' is lower (or only marginally higher in the 5-10 count range) than that of the general population. Surname extinction rates of the Victorian elite are also lower (again apart from the 5-10 count range).

$$W_{wd} = \frac{\sum\limits_{t=WarStart-5}^{WarStart} w_{jt} - \sum\limits_{t=WarEnd}^{WarEnd+5} w_{jt}}{\sum\limits_{t=WarStart-5}^{WarStart} w_{jt}} \tag{3}$$

where $WarStart$ is the start year of the war (either 1918 or 1939) and $WarEnd$ is the end of the war (1918 or 1945). This will be an imperfect measure of the true wealth destruction of the war: Younger deaths during war will give the appearance of larger wealth destruction because of lost life-course wealth accumulation. Acting against this will be the reduced possibility to move wealth around to avoid the taxation of bequests. For simplicity, I take the simple ratio of equation 3.

3.3 Estimating 'Expected' Wealth, 1920-2018

Using the PPR calendar probate micro-data, I estimate *expected* wealth, W^* at year t of of rare surname j

$$W^*_{j,t} = \frac{\sum\limits_{1892}^{1920} W_j}{28} (1 + r^{net}_{1920})(1 + r^{net}_{1921}) \ldots (1 + r^{net}_{t-1}) \tag{4}$$

where W is observed real wealth (2015 pounds) in any year, 1892-1920, growing at the net-of-taxes, wealth specific, rate of return on wealth, r^{net}, where taxes are the maximum tax rate on capital income (T^K), estimated as

$$r^{net}_t = r^w_t - T^K_t \tag{5}$$

Every dynasty receives a specific r that is based upon their wealth (w) at time t, as described in section 2.3. [26] I divide the initial capital estimate by 28 to estimate the subsequent, expected annual flow of wealth ($1920 - 1892 = 28$).

The major weakness of my approach is that it cannot measure *new* wealth creation by elite inheritors (although new wealth creation by non-inheritors is observed, see equation 10 below). This is of course an unrealistic assumption. However, the purpose of the exercise is to estimate a *lower* bound for the amount of wealth hidden by the English elite. Any new elite-inheritor wealth creation will make W^* an underestimate of their 'true' dynastic wealth.

Acting against this will be the possible consumption of inherited wealth. If wealth is systematically spent on consumption and not invested, then my estimate of 'hidden' wealth is not truly concealed wealth but simply a measure of lost wealth due to consumption. At the dynastic level, I assume that the propensity to consume wealth and the propensity to add to dynastic wealth through income, result in a zero net gain or loss to the sum of inherited wealth. Supporting this assumption is the remarkable stability in the ranking of English dynasties, at the rare surname level, documented by Clark and Cummins (2015a). That study, using a subsample of the PPR calendar data used in this paper, estimate the intergenerational correlation of dynastic wealth at

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[26] The Jordà et al. (2019) estimates of r incorporate the negative returns to wealth during World War II. In section B I estimate expected wealth, W^*, using alternative aggregate rates of return on capital from Jordà et al. (2019) and Piketty (2014).

.7-.75. Over the sample period, Elite English dynasties regress towards the mean, but at a glacial pace. Further, there was no evidence for the very rich to regress to the mean faster than the not-so-rich, the average or the poor (Clark and Cummins (2015a), a finding that tends to get overlooked in the literature).

To estimate a lower bound on the amount of wealth hidden by the elite lineages, I apply the following logic: If death taxes, denoted as T^D, are close to zero, then there is no financial incentive for the rich to make arrangements to avoid paying taxes upon death. When $T^D > 0$, we can expect rational agents with bequest motives to avoid (legal) and perhaps evade (illegal) paying death taxes. This can be done by inter-vivos bequests and transferring assets between classes (for example trusts and offshore companies). Suppose family j has total wealth W

$$W_j = \alpha(W_j) + (1-\alpha)W_j \quad 0 \leq \alpha \leq 1 \tag{6}$$

where α is the propensity to avoid/evade, and is an increasing function of the tax rate and other factors that make it easier or harder to hide wealth $(Z)^{27}$:

$$\alpha = f(T^K, T^D, W, Z) \tag{7}$$

When taxes are 0, the observed estate at death is the true underlying wealth, W_j. This is the case in England before WWI. After WWI, observed wealth at death is the second component of equation 6. Death taxes (T^D) are substantially lower before WWI than after. For the super-wealthy, the maximum death duty is $\approx 10\%$, 1894-1910. From 1945-1958, the maximum $\approx 70-80\%$ (HM Revenue & Customs (2005), and plotted in appendix figure A.1d). Pre-War the PPR records reveal 'true' family wealth, W_j.[28] After they reveal $(1-\alpha)W_j = W_j^{obs}$. [29]

Cumulative tax paid (T^p) is calculated as

$$T^p = \sum_{1920}^{t} T_t^D * W_{j,t}^{obs} \tag{8}$$

where as before death taxes are T^D and W^{obs} $(= (1-\alpha)W)$ is observed wealth from the PPR calendars.

Where estimated wealth is greater than reported wealth inclusive of cumulative death-taxes paid, I calculate the difference as hidden wealth (HW). I divide cumulative taxes paid by 30 so that death taxes are effectively charged once per generation. Again this is to estimate the expected annual flow as equation 6.

$$HW_{j,t} = W_{j,t}^{*} - \left[W_{j,t}^{obs} + \frac{T^p}{30}\right] : W_{j,t}^{*} > W_{j,t}^{obs} + \frac{T^p}{30} \tag{9}$$

Note that by construction, HW must be greater than zero. Observed wealth that is in excess of that predicted by the level of inherited wealth, I calculate:

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[27] These may include legal changes, technology, culture and so on. See Alstadsæter et al. (2019) for recent evidence on the positive relationship between wealth and the propensity to evade tax.

[28] In the analysis I use 1920 as the cut-off for observing 'true' wealth. This is due to the structural break in the trend of the top 1% in apx. 1920 as revealed in figure A.1a.

[29] One could argue that privacy concerns might motivate some to conceal their true wealth. But that will still make wealth observed when tax = 0 a much more accurate estimate of family wealth than when tax is significantly greater than 0.

$$HW_{j,t} = \left[W_{j,t}^{obs} + \frac{T^p}{30} \right] - W_{j,t}^{*} : W_{j,t}^{*} < W_{j,t}^{obs} + \frac{T^p}{30} \tag{10}$$

which by construction gives negative HW, which is newly created wealth.

Next I estimate the 'true' wealth, W, of English dynasties, 1920-2018. This is done in 2 parts, for wealth inheritors and for those creating new wealth. Inheritors W is calculated as:

$$W_{j,t} = W_{j,t}^{*} - \left[\frac{T^p}{30} \right] \tag{11}$$

And for new wealth creation dynasties, wealth in excess of that predicted by inheritance, W is calculated by

$$W_{j,t} = \left(\frac{1}{1-\alpha}\right) W_{j,t}^{obs} \tag{12}$$

Newly created wealth is incorporated by adjusting upwards observed wealth (W^{obs}) by the implied population degree of tax avoidance, α.[30] This is initially given a value of $\alpha = .0$ for simplicity but is varied in section 6 when calculating wealth shares (see tables 4.3 and 5.2 for the empirical estimates).

Finally I calculate the proportion of wealth hidden, α, as

$$\alpha_{j,t} = \frac{HW_{j,t}}{W_{j,t}} \tag{13}$$

By construction, α ranges from -1 (all wealth observed is newly created wealth) to $+1$ (all wealth is hidden).

Table 3.3 summarizes the sources for estimating the elements of equations 1 to 13.

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[30] For a proportion of the surname-generation level estimates (8,469/56,937), the estimate of newly created wealth is *greater* than that observed ($HW > W^{obs}$). This happens for dynasties where new wealth is being created that is in excess of that predicted by observed dynastic capital pre-1920. The case can be illustrated with a specific lineage (anonymized). The XXXXXX dynasty (97 people counted in the 1881 census, 129 in 2002) report $£1,052,781$ in wealth 1950-1980. Their estimated wealth, assuming no deaths taxes, for 1950-80 is $£595,229$, and when this is compared with that observed *plus* taxes-paid factored back in ($W^{obs} + £826,353 = £1,879,134$), their implied newly created wealth ($-HW$) is $£1,283,904$. (All in 2015 pounds.) The problem is that the method returns a value for newly created wealth that is *greater* than that observed. Their inheritance, accounting for tax paid is negative ($W^{*} - TP/30 = -£231,124$). Common sense would indicate that best estimate of their true wealth is their observed wealth. Therefore, for these cases, I assign all wealth observed as new wealth ($HW = -W^{obs}$) and the proportion of hidden wealth is assigned as -1 (all wealth is new).

Name	*Variable*	Source	Eq.
Directly Observed			
'True' Lineage Wealth	W	Probate Valuations 1892-1920	
Death Taxes	T^D	IR Tables, Figure 2.2	
Asset Portfolios, by Wealth†	E^w, B^w, H^w, C^w, O^w	Inland Revenue, 1908–1990	
Reported Wealth	$W^{obs} = (1-\alpha)W$	Probate Valuations 1920-92	
Taken from Other Studies			
Return on K, by Asset Classs†	r^E, r^B, r^H, r^C, r^O	Jordà et al. (2019)	
Tax on K income	T^K	Piketty (2014)	
Calculated			
Return on K,	r^w	$E^w * r^E + B^w * r^B +$	
by Wealth†		$H^w * r^H + C^w * r^C + O^w * r$	1
Net return on K	r^{net}	$r^w - T^K$	5
Taxes Paid	T^p	$T^D(1-\alpha)W$	8
Expected Wealth	W^*	$(1-\alpha)W(1+r^{net})$	4
Hidden Wealth	HW	$[W^* - (W^{obs} + T^p)] > 0$	9
New Wealth	$-HW$	$(W^{obs} + T^p) - W^* < 0$	10
'True' Wealth, Inheritors	W	$W^* - T^p$	11
'True' Wealth, Non-Inheritors	W	$\frac{1}{1-\alpha}W^{obs}$	12
Proportion Hidden	α	HW/W	13

Notes: Estimated for rare surname j and time t (subscripts omitted from table for simplicity). Summary terms for illustration, see text for detailed equations. $^\dagger E$ are equities, B are bonds, H is housing, C is cash and O is other.

Table 3.3: Summary Table of Sources, Identities and equations for Estimating Lineage Wealth

4 Results

4.1 Wartime Destruction of Dynastic Wealth

Tables 4.1 and 4.2 report the wartime destruction of English wealth, calculated as in equation 3 for all, and the dynasty groupings. Wartime wealth destruction is far greater in World War I than World War II, 38% versus 16% respectively. However, the lineage analysis reveals that this destruction is entirely limited to the pre-war elites. Nearly 60% of Victorian Elite dynastic wealth is wiped out during the Great War. The middling and bottom lineages get richer after the war.

World War II also sees more destruction of Victorian elite wealth but this time it is about half as damaging at 26%. Further, the Second World War was more egalitarian in its wealth destruction and thus less of an equalizing force than the Great War, at least as far as this dynastic evidence suggests.

Table 4.1: Wartime Destruction of Wealth, World War I

Victorian Wealth	Pre-War Wealth	Post-War Wealth	Prop. Destroyed	N	N, Lineages
All	63,987	39,532	0.382	342,614	34,259
Elites	2,148	891	0.585	2,395	990
Middling	35	56	-0.590	894	570
Bottom	13	109	-7.285	1,643	1,261

Note: Wealth is in Millions, £2015. *Source*: 100% PPR Calendar Sample.

Table 4.2: Wartime Destruction of Wealth, World War II

Victorian Wealth	Pre-War Wealth	Post-War Wealth	Prop. Destroyed	N	N, Lineages
All	90,516	76,019	0.160	623,136	53,181
Elites	1,501	1,111	0.259	4,521	1,153
Middling	213	187	0.123	2,639	996
Bottom	314	316	-0.007	5,285	2,514

Note: Wealth is in Millions, £2015. *Source*: 100% PPR Calendar Sample.

4.2 Estimated and Observed Lineage Wealth Accumulation

Figure 4.1 reports three series: estimated lineage wealth (equation 4), observed wealth ($(1-\alpha)W$) and observed wealth plus taxes paid (T^p), accumulating at r^{net}, for all wealth holders, 1920-1992. At this aggregate, the *positive* difference between the estimated and observed series is new wealth creation (see also figure C.2 in the appendix which compares estimated wealth with observed for the middling and bottom wealth holding groups). However, when the exercise is executed for the Victorian rare elite lineages, as in figure 4.1b, the pattern is different. The first observation to note is the close correspondence of estimated and observed wealth from 1920 to 1950.[31] This suggests

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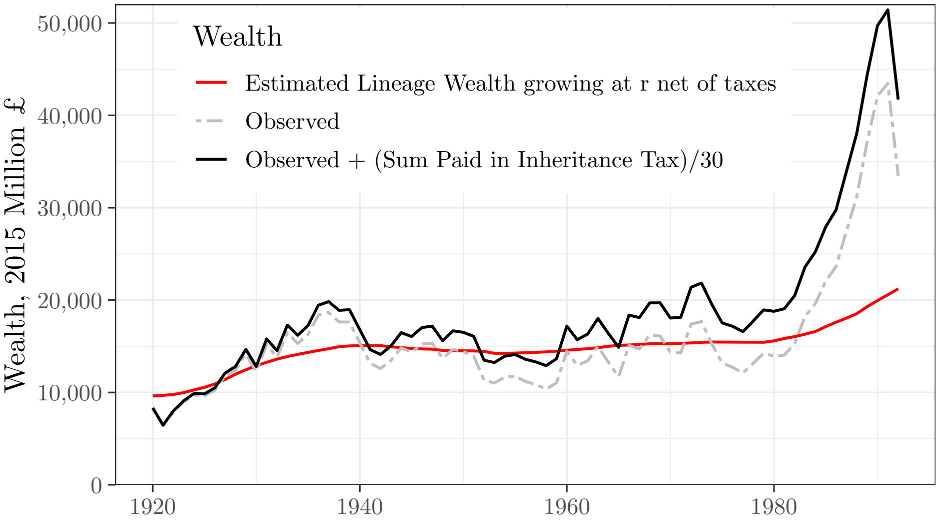
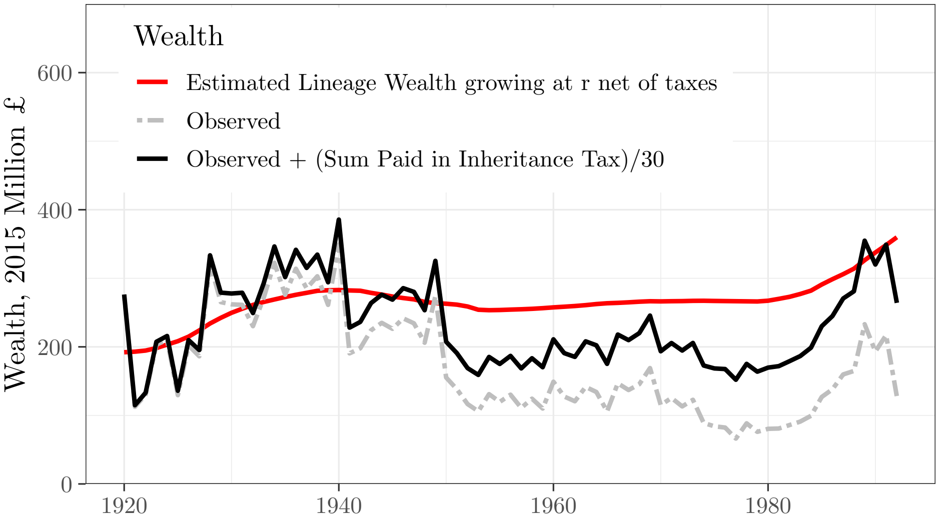
[31] Note also that reported wealth plus taxes paid is higher than expected wealth for most of the late 1940s. This may reflect a desire for the very rich to contribute to the financing of the war or a lag in adjusting their behavior to



(a) All



(b) Victorian Elite Lineages

Figure 4.1: Estimated and Observed Lineage Wealth, with taxes paid, all and Victorian top 1% Lineages

Source: 100% PPR Calendar Sample.

that using the methodology is plausible for tracking the wealth trajectory of this Victorian Elite. To formally assess this I run a simple regression with observed wealth (plus inheritance taxes paid) as a function of estimated wealth. Before 1950, the coefficient on estimated wealth as a predictor of observed wealth, plus inheritance tax paid, is 1.058 (with a standard error of .034).[32]

After 1950, reported wealth at death is consistently and systematically below the level of wealth we would expect. This is hidden wealth. From 1950 to 1985, this coefficient on estimated wealth as a predictor of observed wealth, plus inheritance tax paid, is .71 (.013). This implies that about 19% of wealth is hidden, on average, over this period.[33] The emergence of systematically hidden elite wealth is coincident with a large uptick in the levels of inheritance tax applied to estates of £5-10 Million (2015 prices), as reported in figure 2.2.

Precisely, how much wealth, as a lower bound, is being hidden by these Victorian elites?

4.3 What is the Propensity to Hide Wealth?

Table 4.3 reports the sum of hidden wealth by decade (as equation 9) and the mean value of α (the proportion of 'true' wealth hidden) for the Victorian elite lineages, 1920-1990. The results indicate that a *lower* bound of 18-32% of inherited wealth is hidden for this elite grouping, post 1950. The proportion hidden, α, falls after the 1970s, coincident with the reduction of the extremely high death duties of the earlier post-War era.

Table 4.3: Hidden Wealth and the Propensity to Hide, the Victorian Rare Elite, England 1920-1990

Decade	'True' Wealth	Observed Wealth	Observed + Paid in Inheritance Tax	Hidden Wealth	Prop. Hidden
1920	2,105	2,035	2,101	3	0.002
1930	2,693	2,787	3,032	-340	-0.126
1940	2,745	2,379	2,803	-58	-0.021
1950	2,566	1,242	1,796	770	0.300
1960	2,624	1,377	2,066	558	0.213
1970	2,667	962	1,799	868	0.325
1980-92	3,951	1,798	3,221	731	0.185

Note: Wealth is in Millions, £2015. *Source*: 100% PPR Calendar Sample.

5 Surname Level Analysis

As opposed to looking at lineage groups of 1,500 names, in this section I use all 18,921 rare surnames. I report the pattern of hidden wealth by decile and the predictive power of hidden wealth and the proportion of wealth hidden for appearance of a specific surname in the ICIJ *Offshore Leaks*

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the new high-tax regime. After 1950, this abruptly disappears. Note also the rise in reported wealth plus tax after 1980. This corresponds with the aggregate rise and the lowering of the extreme death tax levels to 40%. Figure C.2 in the appendix reports the same estimates for the Victorian mid and bottom Lineages.

[32] The details of this regression are reported in table C.2 in the appendix.

[33] As before, details are reported in appendix table C.2.

Database. The impact of hidden wealth on contemporary outcomes; housing and and elite education is estimated. Finally I recalculate the top 10% wealth-share, incorporating hidden wealth.

Table 5.1: Summary Statistics, Rare Surname Level

Statistic	N	Mean	St. Dev.	Min	Median	Max
Generation	56,763	2	.82	1	2	3
N, Probated	56,763	7.70	8.20	0	5	149
N, 2002	56,763	78.92	72.84	0	58	597
Inferred Wealth	56,763	.60	2.27	0	.10	135.88
Observed Wealth	56,763	.87	5.94	0	.35	1,269.79
Tax Paid	56,763	.18	3.13	0	.01	539.55
Hidden Wealth	56,763	−.38	6.10	−1,269.79	−.15	118.02
Hidden Wealth (>0)	56,763	.24	1.60	0	0	118
Proportion Hidden	56,763	−.38	.64	−1	−.7	1
Proportion Hidden (>0)	56,763	.14	.29	0	0	1
Hide Any Wealth	56,763	.24	.43	0	0	1
Victorian Elite	56,763	.08	.27	0	0	1
In Paradise Leaks	18,921	.12	.32	0	0	1
N, Paradise	18,921	.68	2.67	0	0	35
House Value, 1999	18,126	334.45	305.41	7.26	289.25	14,750.00
Oxbridge Rate	18,921	.01	.02	0	0	0

Note: Wealth is in Millions, £2015. House prices are thousands, £.

Source: 100% PPR Calendar Sample.

I aggregate all individual observations to the surname level by generation. The first generation is 1920-1950, the second is 1950-80 and the final generation is 1980-1992. Table 5.1 reports the summary statistics for the rare surname-level analysis.[34] The size of these dynasties varies from 0-149 people dying in a generation with a median of 5. The median living population of people with these rare surnames in 2002 is 58, with a 0-597 range. 23% of the sample report wealth below what we would expect from their pre-1920 inheritance. There are 8,549 dynasties hiding £7.7 Billion (£2015).[35]. 12% of the names show up in the paradise papers. A striking number in table 5.1 is the minimum reported hidden wealth, -1.27 Billion. This is the newly created wealth of the Ellerman dynasty (See table 2.2).[36]

5.1 The Proportion of Wealth Hidden and Newly Created Wealth, by Wealth Decile

How does the tendency to hide wealth vary across the wealth distribution? Figure 5.1 illustrates the

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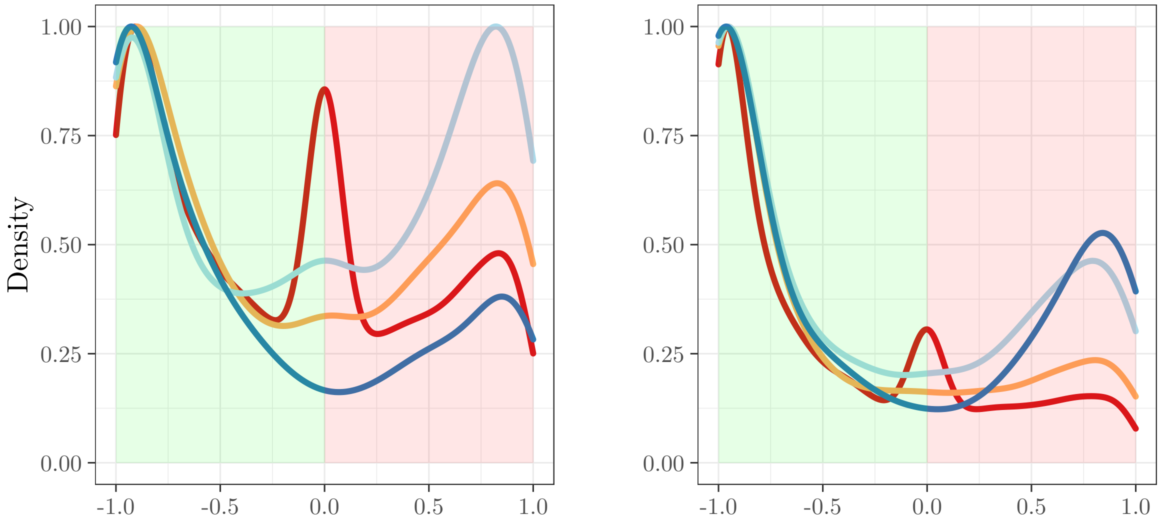
[34] Note that the paradise paper link is done for generation 3, 1980-92, only. In the 1999 electoral roll, not all rare surnames are found: 18,126 out of 18,921 names are present, 795 are not.

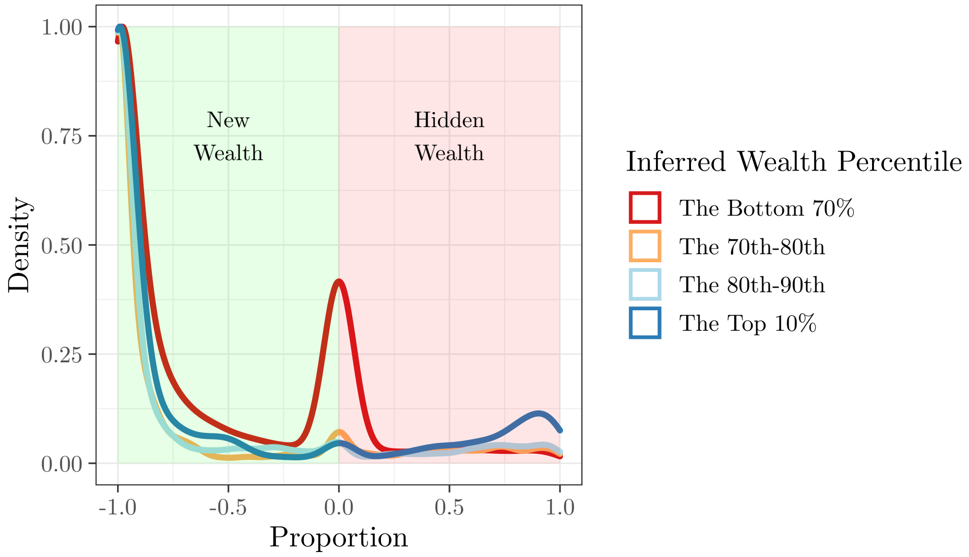
[35] This is the number of unique ‘hiding’ dynasties, where hidden wealth > 0, across all 3 generations, and the sum of their maximum observed hidden wealth, as summarized in table 5.1

[36] A portion of this estate was transformed in to a charitable trust and now funds the Scottish Ballet and Bumblebees (https://ellerman.org.uk/what-weve-funded/case-studies)



(a) 1920-50

(b) 1950-80



(c) 1980-92

Figure 5.1: The Proportion of Newly Created Wealth and Hidden Wealth, by Wealth Percentile
Source: 100% PPR Calendar Sample.

distribution of the proportion of newly created and hidden wealth, as calculated by equation 13, by inferred 'true' wealth decile and generation. The density distribution is scaled so that the maximum value is 1. This is for easy comparability across the percentile groups. Figure 5.1 illustrates that the distribution of newly created wealth and hidden wealth is bi-modal. In general, newly created wealth dominates (negative hidden wealth, as indicated by the left-side of the distribution). For the poorest group, the bottom 70%, there is also a tendency for there not to be any high proportion of either new or hidden wealth. This is because wealth itself is so low for this group. (Mechanically if wealth is estimated as zero, hidden wealth is set at zero.)

The right-side of the distribution illustrated in figure 5.1 shows the *relative* proportion of hidden wealth.

In the 1920-1950 period, the top 10% of the wealth distribution hide less wealth than everyone else. This reflects the relatively greater destruction of elite wealth during both World Wars (tables 4.1 and 4.2). For the post-War generations, there is a clear tendency for the higher wealth deciles, and in particular the top 10% to hide proportionally more wealth.

To get a minimum value for the proportion of wealth hidden, I calculate the proportion of hidden wealth again, this time setting all newly created wealth at zero. This can give us a lower bound on the tendency to hide inherited wealth. Table 5.2 reports these proportions. The top 10% hide 27% of their wealth, on average in 1950-80. This estimate is lower than the apx. 40% of wealth hidden by the top decile of Scandinavian wealth estimated by Alstadsæter et al. (2019) (see their figure 3 bottom panel).[37] The top 80-90th percentile are hiding a similar amount (24%), and the top 70th-80th, 16%.

From 1980-92 the percentage of 'hidden' wealth falls. But as this is a minimum, this should not be over-interpreted. This general tendency for my estimates of hidden wealth to fall over time may simply reflect the method: I calculate the share of inherited wealth from the 1892-1920 generation that is hidden. The share of newly created wealth hidden, 1920-1992, is not observed nor inferred. For this reason I consider the estimates from 1950-80 as the best guess estimate of the true hidden wealth share. The generation is not exposed to the capital destruction of a World War, economic growth is booming in Western Europe and death taxes are at their maximum. Inheritance from pre WWI is still a significant portion of all wealth. After 1980 new wealth creation means that my method loses power. In any case, at all times, my estimates are lower bounds.

Table 5.2: Mean Proportion of Wealth Hidden, Surname Level

Inferred Wealth Percentile	Generation 1920-50	1950-80	1980-92	N
The Top 10%	.20	.27	.13	5,547
The 80th-90th	.33	.24	.08	5,615
The 70th-80th	.27	.16	.08	5,630
The Bottom 70%	.19	.12	.04	39,480

Note: Negative hidden wealth is set at zero. *Source*: 100% PPR Calendar Sample.

In sum there is a positive relationship between the proportion of wealth hidden, and wealth. However the distribution of newly created wealth and hidden wealth is multi-modal. For the empirical analysis of dynastic outcomes in the next section, I code categorical variables to capture potential non-linear associations.

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[37] Both estimates are lower bounds. My estimates cannot capture newly created wealth, of elite inheritors. The estimates of Alstadsæter et al. (2019) are for wealth in HSBC accounts only.

5.2 Is Hidden Wealth in Offshore Tax Havens?

At the group and surname level there is evidence that a significant portion of wealth is hidden. Where is it? Offshore companies, foundations and trusts serve as potential destination for hidden wealth. Here I compare surname-level estimates of hidden wealth (HW), with the appearance of those same surnames in the *Offshore Leaks Database* (International Consortium of Investigative Journalists (2019)).

To measure presence in the *ICIJ* data, I code a simple 0/1 variable for a surnames presence ($D_{Paradise}$). As reported in table 5.1 about 12% of the sample surnames show up in the Paradise leaks (with a median equal to zero) and an average count of .7 (median also equal to zero). For the analysis only data from generation 3, 1980-1992, is used.

The general forms of the empirical models I apply to the surname level data are:

$$Y^j = c + \beta_1 \sum D^j_{OW} + \beta_2 X^j + \beta_3 ln(N^j_{2002}) \tag{14}$$

$$Y^j = c + \beta_1 \sum D^j_{OW} + \sum \beta_{2i} D_{X^j} + \beta_3 ln(N^j_{2002}) \tag{15}$$

$$X^j = \left\{ D^j_{Hider}, HW^j, \alpha^j \right\} \tag{16}$$

$$Y^j = \left\{ D^j_{Paradise}, H^j_{pcv} j, OXB^j \right\} \tag{17}$$

where D_{OW} are categorical indicators for the wealth percentile observed from the PPR calendars for surname j. This set of values are one of the bottom 70% and every decile to the top 10%. N_{2002} is the count of the surname in 2002 (ONS). X represents the set of hidden wealth calculations generated by this paper. I separately model D_{hider}, a categorical variable equal to 1 where hidden wealth is greater than zero and set to zero where no hidden wealth is estimated, α, as before, is the proportion of 'true' wealth hidden. D_X represents a set of categorical transformations of the hidden wealth calculations, designed to capture non-linear effects. In appendix table C.5 I present estimates using exact observed wealth as a control, entered as a cubic expression, in place of the observed wealth percentile. The results are almost exactly the same.

Y^j is the set of outcomes I observe at the surname level. In addition to $D_{Paradise}$, I estimate the same functional form for the outcomes H^j_{ppcv}, the average postal-code value observed in the 1999 electoral roll and OXB^j, the attendance rate of a surname at Oxford and Cambridge Universities, 1990-2016. I use logistic regression to model the categorical dependent variable, $D_{Paradise}$.

The estimates are executed at the surname level, for all rare surnames. Table 5.3 reports the results for presence in the *ICIJ* Paradise leaks database.[38] Logistic regression coefficients (log-odds) are exponentiated to odds ratios for ease of interpretation and the regression t-statistics are reported in place of standard errors[39]. (The results and signifciance levels are not dependent on the method used, an OLS version of table 5.3 is reported in the appendix as table C.4.)

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[38] All rare surnames appearing in the paradise papers were inspected by eye. Potentially misleading rare surnames that could also be confused with banking terms and jurisdictions (such as *Trust*, *Jersey* and *Pension)* were removed, as were names that were misclassified as English by Onomap. The regressions are run using the 15,975 surname

Table 5.3: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of Presence in the Paradise Papers

	Paradise Dummy				
	(1)	(2)	(3)	(4)	(5)
Wealth Percentile: 70-80	1.077	1.059	1.071	1.083	1.079
	[.950]	[.730]	[.878]	[1.015]	[.964]
80-90	1.112	1.084	1.107	1.113	1.112
	[1.352]	[1.043]	[1.296]	[1.365]	[1.361]
The Top 10%	1.371	1.333	1.363	1.371	1.372
	[4.124]***	[3.777]***	[4.044]***	[4.121]***	[4.127]***
D_{Hider}	1.287				
	[3.334]***				
Hidden Wealth		1.035			
		[2.086]*			
HW: 0-.2m			1.087		
			[.682]		
HW: .2m-1m			1.387		
			[2.855]**		
HW:>1m			1.464		
			[2.739]**		
Prop. Hidden, α				1.453	
				[3.217]**	
α: 0-.5					1.237
					[1.874]
α .5-.75					1.275
					[1.750]
α. 75-.9					1.514
					[2.621]**
α>.90					1.182
					[.885]
N_{2002}	1.004	1.004	1.004	1.004	1.004
	[13.122]***	[12.987]***	[13.123]***	[13.099]***	[13.126]***
Observations	15,975	15,975	15,975	15,975	15,975
Log Likelihood	-5,706.900	-5,710.239	-5,705.178	-5,707.324	-5,706.196
Akaike Inf. Crit.	11,425.800	11,432.480	11,426.360	11,426.650	11,430.390

Note: *p<.05; **p<.01; ***p<.001
Wealth is in 2015 Pounds, Per Annum flow
No hidden wealth and $\alpha = 0$ are the omitted categories
Hidden wealth is calculated 1980-92, estimated via logistic regression
Odds Ratios are reported with t-stats in parantheses

Appearance of a surname in the Paradise papers leaks is related to the number of people with that surname counted in England and Wales by the ONS in 2002. As well as an essential control variable, this also serves as a sanity check on the empirical exercise. In every specification, the top wealth decile have an odds ratio of about 1.3 relative to the odds of the bottom 70%. The simple hider dummy also indicates a higher odds of appearing (1.29 times the odds of non-hiders) as does the level of hidden wealth. The effects of hidden wealth are non-linear as indicated by column 3. There, using categorical wealth groups, we see the odds of appearing in the paradise papers are 1.5 times higher for those who have an estimated lineage hidden wealth of £1m and up. All of these coefficients are statistically significant the 1% level with the top 10% dummy, the proportion of hidden wealth (column 4), and the simple hider dummy all being significant at the $p = .001$ level.

In every column, the set of hidden wealth measures is informative of the probability of a surnames' appearance in the Paradise papers leaks. Hidden wealth matters even when controlling for observed wealth. The correlation for those with an annual hidden wealth amounting to over £1m is approximately equal to the effect of being in the top 10% of the observed wealth distribution.[40]

By cross-referencing the hidden wealth estimates with the ICIJ *Offshore Leaks Database* there is evidence that certain surname dynasties may be evading their taxes. Both hidden wealth and the propensity to hide wealth are statistically significant predictors of appearance in the *Offshore Leaks Database*, all the while controlling for total 'true' wealth. Figure 5.2 reports the top 50 dynasties, ordered by the amount of hidden wealth.[41] I have anonomyzed the names. While the method employed here can claim that the Victorian Elite *as a group* are 'hiding' wealth, for any one lineage it is only a *probability.* The hazards of bad investments, mad inheritors, bad marriage choices, preferences for consumption over preservation of wealth and simple bad luck can easily destroy even the largest family's wealth. At the surname-dynastic level, figure 5.2 and table C.1 lists the hiders as well as the unlucky. Without specific research into these families, we cannot say which category they belong to, hence I do not report their names.

5.3 Hidden Wealth and Contemporary Outcomes: Housing Value and Oxbridge Attendance

What is the impact of hidden wealth on contemporary outcomes? Tables 5.4 reports the correlations of hidden wealth, as equations 14 and 15, with average postcode house-value of a surname, observed in the 1999 electoral roll.

The top *observed* wealth percentiles live in more expensive postcodes than the bottom 70%. The top 10% live in houses that, are on average, almost £92,000 more expensive than the bottom 70%. However, even controlling for observed wealth, hidden wealth matters. Knowing that a surname has *any* hidden wealth is associated with them living, on average, in a postcode with house prices that are almost £50,000 more expensive (col. 1). Knowing that a dynasty has over £1m in hidden

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observations that record at least one death 1980-92.

[39] I choose to report t-statistics because the confidence intervals around odds ratios are non-symmetric so therefore the approximated standard error (for example the one reported in Stata) cannot be used to calculate them.

[40] Investigations of the empirical models of the form in equations 14 and 15 on the count of a rare surname as dependent variable in the Paradise papers failed to generate any large or statistically significant results. Considering that hidden wealth predicts the probability of appearance, the count results imply that hidden wealth is negative associated with the count of a name in the paradise papers, once we examine varaition above 0. This is confirmed by zero-inflated negative binomial models and censored OLS models (results available upon request).

[41] Table C.1, in the appendix, lists the top 50 dynasties, their hidden wealth, their propensity to hide, the number of them living in the UK in 2002, whether presence is recorded in the *Offshore Leaks Database* and whether they were members of the Victorian Elite.

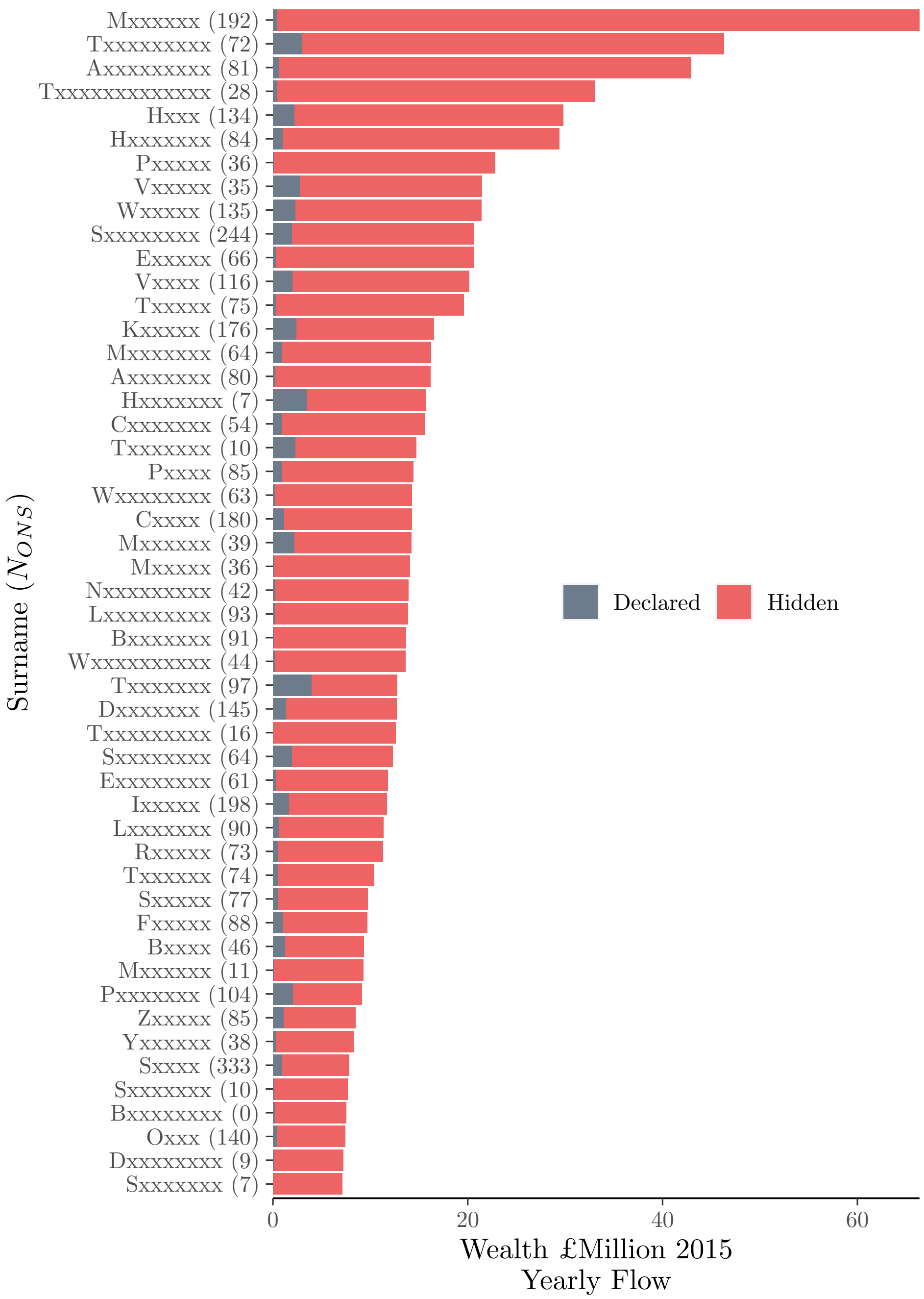

Figure 5.2: The Top 50 Hiding Dynasties, Hidden and Declared Wealth

Source: 100% PPR Calendar Sample.

Table 5.4: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of House Price in 1999

	House Price				
	(1)	(2)	(3)	(4)	(5)
Wealth Percentile: 70-80	15.9^{*}	13.9	14.7	16.8^{*}	15.7^{*}
	(7.6)	(7.6)	(7.6)	(7.6)	(7.6)
80-90	46.8^{***}	43.5^{***}	45.7^{***}	46.9^{***}	46.6^{***}
	(7.8)	(7.8)	(7.8)	(7.8)	(7.8)
The Top 10%	92.6^{***}	88.2^{***}	91.1^{***}	92.6^{***}	92.5^{***}
	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)
D_{Hider}	50.0^{***}				
	(7.5)				
Hidden Wealth		10.8^{***}			
		(2.1)			
HW: 0-.2m			16.5		
			(11.5)		
HW: .2m-1m			54.4^{***}		
			(11.8)		
HW:>1m			101.2^{***}		
			(15.1)		
Prop. Hidden, α				71.1^{***}	
				(11.7)	
α: 0-.5					53.6^{***}
					(11.5)
α .5-.75					45.9^{***}
					(13.9)
α. 75-.9					57.7^{***}
					(16.9)
α>.90					38.8^{*}
					(18.4)
N_{2002}	$-.6^{***}$	$-.6^{***}$	$-.6^{***}$	$-.6^{***}$	$-.6^{***}$
	(.03)	(.03)	(.03)	(.03)	(.03)
Observations	18,126	18,126	18,126	18,126	18,126
R^{2}	.02	.02	.02	.02	.02

Note: *p<0.05; **p<0.01; ***p<0.001
Wealth is in 2015 Pounds, Per Annum flow
House Prices are in Thousands of 2018 Pounds
No hidden wealth, $\alpha = 0$ are the
omitted categories, OLS

wealth is associated with them, again on average, living in a postcode with nearly £101,000 more expensive homes (col. 3). The effect of hidden wealth is substantial and in most cases statistically significant at the one-tenth of one-percent level.

Table 5.5 reports the same empirical formulation as before (equations 14 and 15) for wealth and attendance at the elite universities of Oxford and Cambridge, 1990-2016. Wealth has a strong effect on attending these institutions. In Z score units, where the mean is 0 and the standard deviation is 1, being a member of the top 10% of dynasties boosts Oxbridge attendance by .26 units ($p < 0.001$). For Oxbridge, hidden wealth predicts attendance, even when controlling for observed wealth. The effect is large; hidden wealth over £1m boosts attendance by .2 standardized units. For the hiding dummy, the amount of hidden wealth, wealth over £1m and the proportion of hidden wealth, the coefficients are significant at the one-tenth of one-percent level.

All of these 'outcome' results are insensitive to the type of wealth control used. In the appendix I substitute a cubic expression for wealth in place of the wealth deciles of equations 14 and 15. This is to capture any *within* decile wealth effects missed by the simple wealth decile dummy. Tables C.5 (paradise appearance), C.6 (post-code house price in 1999), C.7 (Oxbridge attendance) show that the results for all the variables of interest are almost exactly the same as those reported in this section. The correlations of hidden wealth and contemporary outcomes are not a product of incorrectly specified wealth controls.

5.4 Interpretation

The surname level analysis reveals 8,549 dynasties hiding at least £7.7 Billion. The amount of this dynastic hidden wealth correlates strongly and positively with appearance in the *Offshore Leaks Database,* the post-code value of where people are living in 1999 and the rate of attendance at Oxford and Cambridge Universities. It is robust to different formulations, highly statistically significant, and thus supports the validity of the measure of hidden wealth proposed in this paper. If this missing wealth was not hidden, it would be an estimate of the failure of great dynastic fortunes to accumulate over time. Therefore the 'hidden' wealth would simply represent the gap between what's left of the family fortune, and what should be there, had the estate being managed competently. If this was the case, we would *not* expect to find the positive correlations with the contemporary outcome variables.

However, this is not conclusive evidence that hidden wealth is *causal* in the determination of these contemporary outcomes. Alternative explanations are possible. This paper defined 'hidden' wealth as being that part of capitalized inheritance that does show up in probate records. These results could simply reflect the legal portfolio arrangement of elites[42]; and the observed outcomes are to be expected, as we are simply adding another measure that correlates with underlying wealth.

More generally, it is not necessarily hidden wealth that transforms mediocre offspring into Oxbridge high flyers. Social networks, preferences for elite education and even Oxbridge admission procedures themselves could benefit the English elite, irrespective of their wealth. Wealth itself, whether observed or 'hidden', and that part which manifests itself in someones house, will be a product of underlying family abilities and cultures.

One way to think about this is the causal schema drawn in figure 5.3. An unobserved latent factor, perhaps a vector of the characteristics discussed in the paragraph above, determines both observed and 'hidden' wealth, and also contemporary outcomes. This paper provides evidence that the conditional correlations, β_1 and β_2 are together both quantitatively and statistically significant.

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[42] Further, it is not illegal for an individual to be listed as a beneficiary or otherwise connected to an offshore entity.

Table 5.5: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of Oxbridge Attendance Rate 1990-2016

	Oxbridge Attendance Rate (Z)				
	(1)	(2)	(3)	(4)	(5)
Wealth Percentile: 70-80	.089***	.085***	.087***	.091***	.089***
	(.022)	(.022)	(.022)	(.022)	(.022)
80-90	.113***	.106***	.111***	.114***	.113***
	(.023)	(.023)	(.023)	(.023)	(.023)
The Top 10%	.262***	.252***	.259***	.262***	.262***
	(.024)	(.024)	(.024)	(.024)	(.024)
D_{Hider}	.103***				
	(.022)				
Hidden Wealth		.031***			
		(.006)			
HW: 0-.2m			.024		
			(.033)		
HW: .2m-1m			.131***		
			(.034)		
HW:>1m			.196***		
			(.043)		
Prop. Hidden, α				.153***	
				(.033)	
α: 0-.5					.098**
					(.033)
α .5-.75					.088*
					(.040)
α. 75-.9					.159***
					(.048)
α>.90					.077
					(.052)
N_{2002}	.002***	.002***	.002***	.002***	.002***
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Observations	18,921	18,921	18,921	18,921	18,921
R^2	.042	.042	.042	.042	.042

Note: *p<0.05; **p<0.01; ***p<0.001
Wealth is in 2015 Pounds, Per Annum flow.
No hidden wealth, $\alpha = 0$ are the
omitted categories, OLS

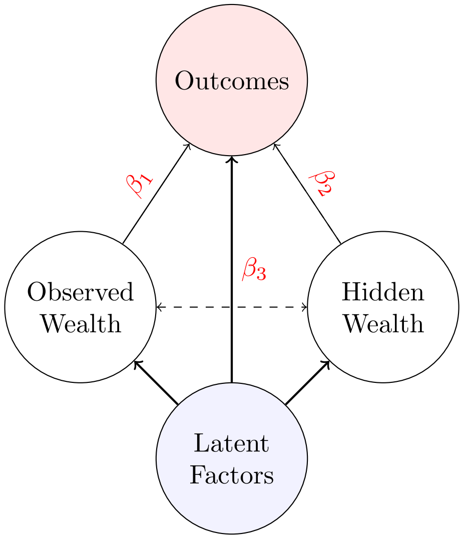

Figure 5.3: The Joint Determination of Observed Wealth, Hidden Wealth and Contemporary Outcomes

However both could be just an artifact of the channel driven by the unobserved latent factor, β_3. In order to identify β_2, the causal effect of 'hidden' wealth on outcomes, we need some historical shock that quasi-randomizes our measure of hidden wealth. Such a shock could perhaps be an abrupt legal change in the treatment of offshore wealth, where we could compare dynasties who experience the death of a major wealth-holder dying just before the change, with those who have a major wealth-holder die just after.[43] Alternatively, a micro-level analysis that conducts a detailed accounting of the wealth holdings of individual dynasties could demonstrate the importance, or not, of hidden wealth in the distribution of contemporary outcomes. Given the societal importance of this, future research should examine this.

The empirical analysis of outcomes and hidden wealth conducted here can only be claim that the hidden wealth-outcome correlations as descriptive. The correlations are consistent with hidden wealth being a significant factor in the distribution of contemporary social outcomes but the research design cannot claim causality. Rather they describe important empirical patterns that demand explanation, and signpost directions for future research.

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[43] One such case is that of *Egyptian Delta Land and Investment Co. Ltd v. Todd* (1929), decided on by the House of Lords which "created a loophole which in a sense made Britain a tax haven" Picciotto (1992, p.8). Picciotto states on the same page: "later, tax planners could set up foreign resident companies to ensure that individuals resident in the UK could escape tax."

6 'True' Inherited Wealth and the Decline of Elite Wealth. Accounting for the 'Great Equalization'

Finally, what are the implications of hidden elite wealth for our understanding of the historical evolution of the wealth distribution? As figure A.1a reports, the standard interpretation is built upon the massive decline in the *observed* relative wealth-share of the top decile, the top percentile and the top .1% (Atkinson and Harrison (1978); Piketty (2014); Alvaredo et al. (2018)). This narrative places Wartime destruction, taxes and economic growth as the causal forces behind the 'Great Equalization.

Figure 6.1 reports a recalculated top decile wealth-share based on true wealth, incorporating hidden wealth, and compares it with the observed series. This is calculated as before over rare surnames, which, as discussed earlier, capture the secular decline in inequality over the 20th century. For this calculation I assume that true, underling wealth is 1.3 times observed wealth. This is done on the basis of the observed proportion of hidden inherited wealth reported in tables 4.3 and 5.2.

The decline of the top wealth share is still evident but it has different characteristics. By 1980, the richest decile of dynasties hold an extra 15% of the 'true' wealth distribution (63% v. 48%), equivalent to a 40% reversal of the observed decline.[44] Given the methodology employed on the paper, this effect must be interpreted as a minimum reversal.

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[44] This finding is similar to Alstadsæter et al. (2019) who find that "accounting for hidden assets erases almost half of the decline in the top 0.1% wealth share observed".

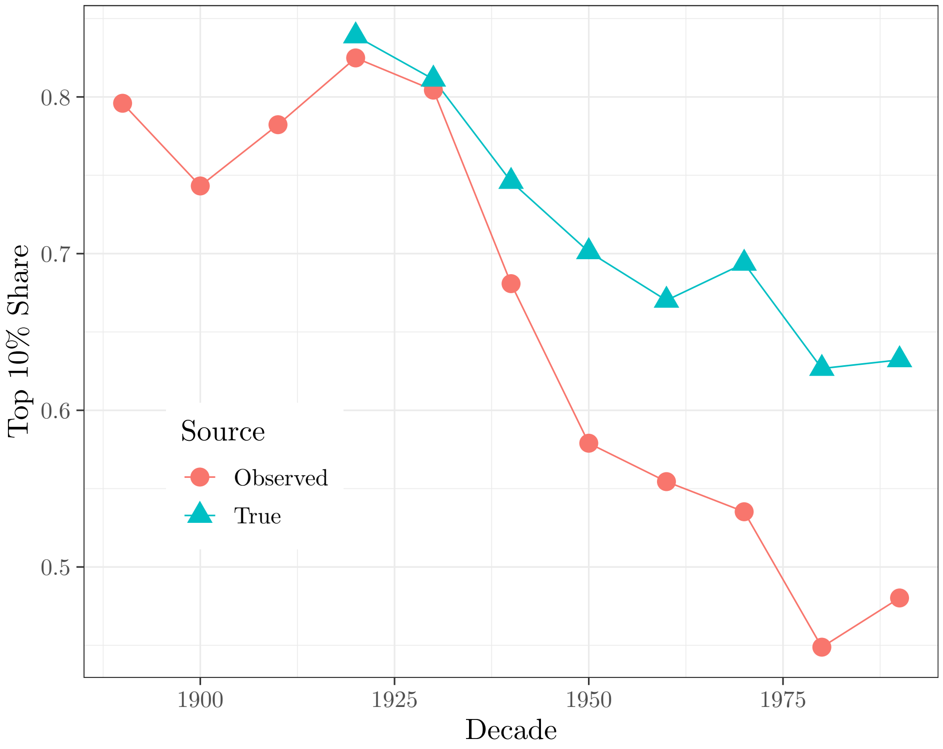

Figure 6.1: Top 10% Shares, Observed and 'True'

Notes: Calculated at the Rare Surname Level. *Source*: 100% PPR Calendar Sample.

7 Conclusion

This paper introduces a method using historical data to detect hidden wealth at the surname level. Tax authorities could use this method to investigate tax-evasion in England. Further, the method could be applied to other sources in other countries, with the potential to uncover vast amounts of hidden wealth.

In England, 1920-92, I find 8,549 dynasties that are potentially hiding at least £7.7 Billion.

The post-war era introduced wealth and death taxes sufficient to confiscate all elite wealth. Elites responded rationally. The analysis revealed that the English elites are hiding at least 18-32% of their true inherited wealth. Hidden wealth, calculated from the pre-WWI era, strongly correlates with the probability of a surname appearing in the *Offshore Leaks Database* of 2013-6. Hidden wealth appears to boost the value of hiding dynasties homes in 1999, and their children's chances of attending Oxbridge, 1990-2016.

Analyses of wealth-at-death reveal a secular observed decline in wealth inequality, driven by the top 1%. However when I calculate the 'true' inherited wealth of English dynasties I find that 40% of the decline of the top 10% wealth-share can attributed to hidden wealth. This is a lower-bound estimate. Future detailed research of individual dynasties could more precisely estimate the scale of hidden wealth and, perhaps, reverse one of the great stylized facts of the 20th century.

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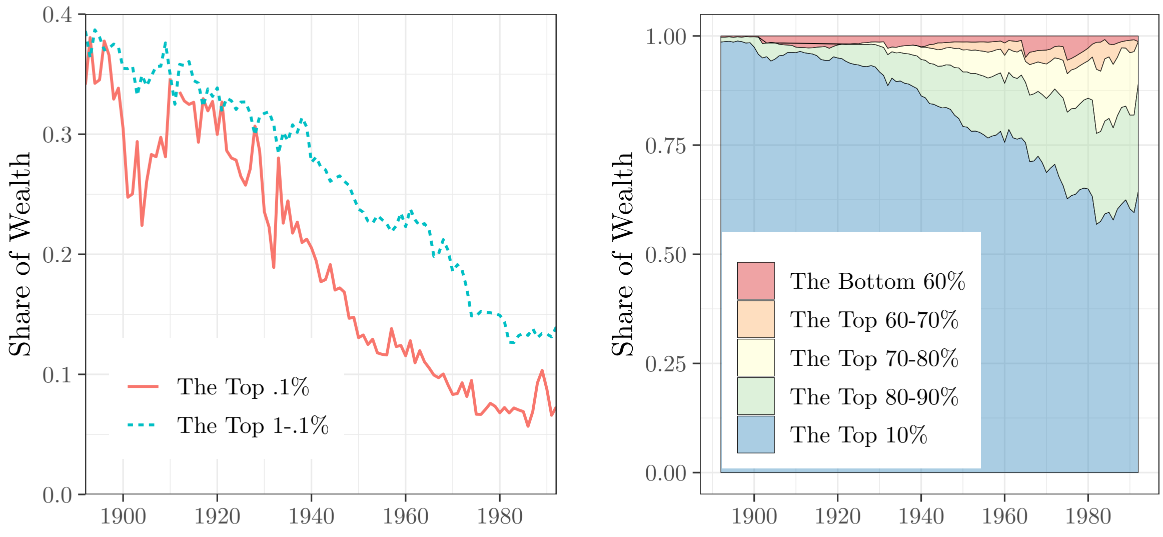
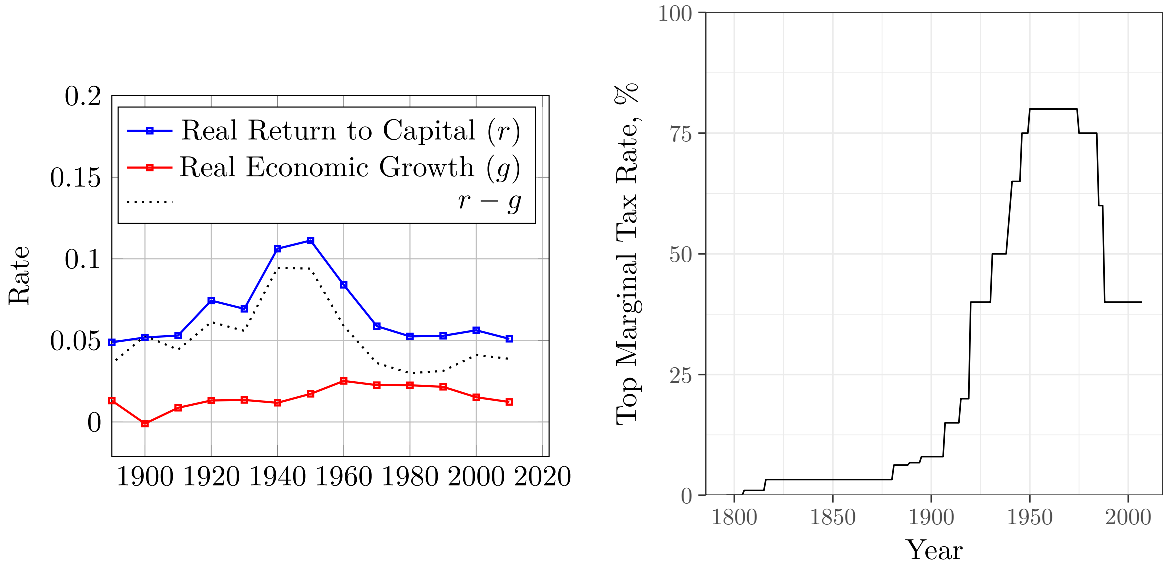
A Supplementary Material

A.1 Background and Source Material



(a) The Decline of the top .1% and .1-1%

(b) The Growth of 'Popular Wealth'



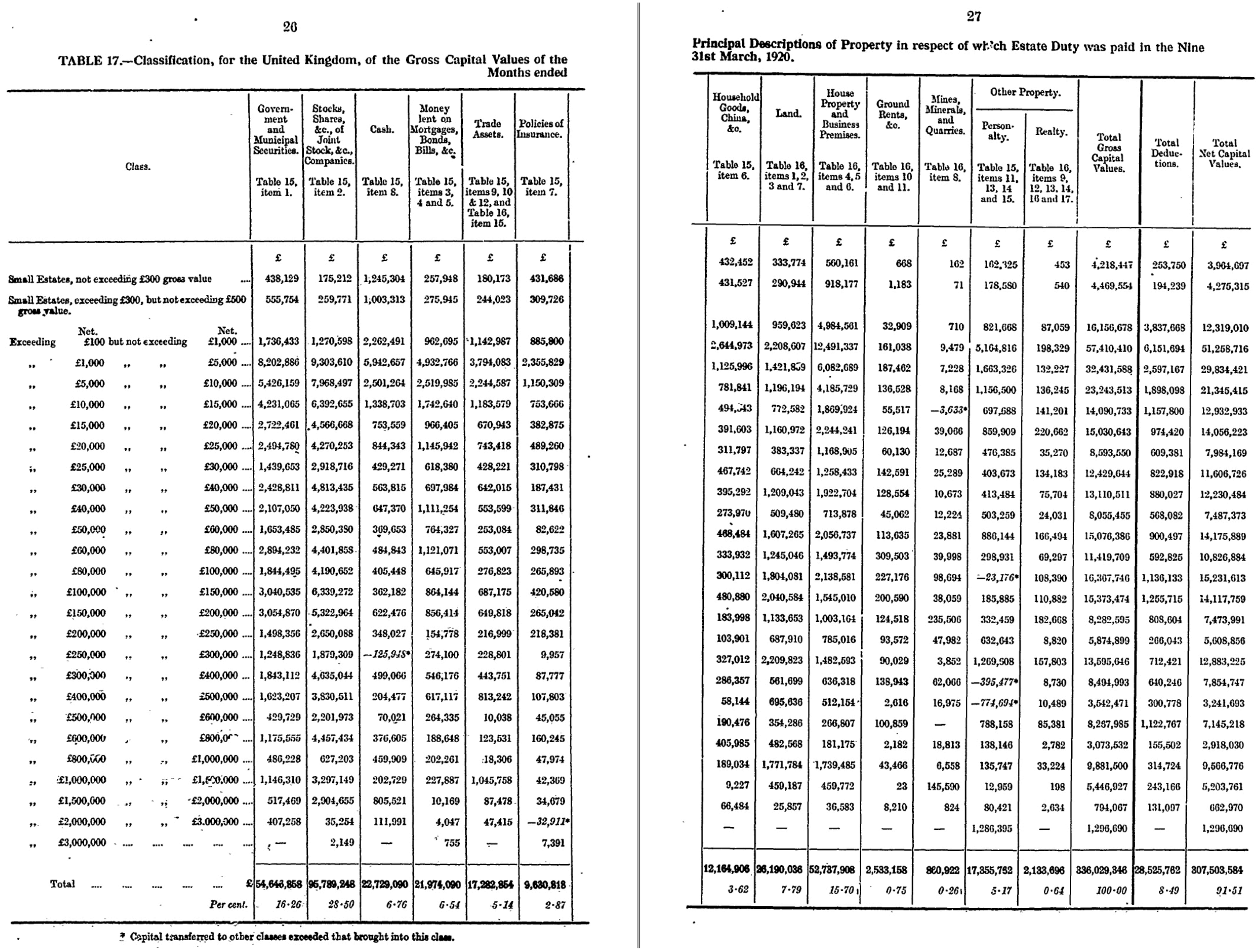
(c) r and g

(d) Inheritance Taxes in England

Figure A.1: Four Elements in The 'Great Equalization' of English Wealth

Source: a,b: Cummins (2019b). c: Piketty Figure 6.3 (Data on the rate of return to capital available from `http://piketty.pse.ens.fr/en/capital21c2`), and GDP per capita from the Maddison Project (`http://www.ggdc.net/maddison/maddison-project/home.htm`). Both rates are 'Real' (see Piketty p.209-11 on this point). d: Maximum inheritance tax plotted (HM Revenue & Customs (2005)).

The current narrative: The wealth share of the top 1%, reported in figure A.1a, declined because the rate of growth of the economy was greater than the real rate-of-return on capital (A.1c), net of war-time and taxes (estate taxes are illustrated for example, A.1d). In other words, new wealth created by economic growth ('popular wealth' reported in A.1b) grew faster than *net* returns on capital (Piketty (2014), p.362-3).



26 27

TABLE 17.—Classification, for the United Kingdom, of the Gross Capital Values of the Principal Descriptions of Property in respect of which Estate Duty was paid in the Nine Months ended 31st March, 1920.

Class.	Government and Municipal Securities.	Stocks, Shares, &c., of Joint Stock, &c., Companies.	Cash.	Money lent on Mortgages, Bonds, Bills, &c.	Trade Assets.	Policies of Insurance.	Household Goods, China, &c.	Land.	House Property and Business Premises.	Ground Rents, &c.	Mines, Minerals, and Quarries.	Other Property. Personalty.	Other Property. Realty.	Total Gross Capital Values.	Total Deductions.	Total Net Capital Values.
	Table 15, item 1.	Table 15, item 2.	Table 15, item 8.	Table 15, items 3, 4 and 5.	Table 15, items 9, 10 & 12, and Table 16, item 15.	Table 15, item 7.	Table 15, item 6.	Table 16, items 1, 2, 3 and 7.	Table 16, items 4, 5 and 6.	Table 16, items 10 and 11.	Table 16, item 8.	Table 15, items 11, 13, 14 and 15.	Table 16, items 9, 12, 13, 14, 16 and 17.			
	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£
Small Estates, not exceeding £300 gross value	438,129	175,212	1,245,304	257,948	180,173	431,686	432,452	333,774	560,161	668	162	162,325	453	4,218,447	253,750	3,964,697
Small Estates, exceeding £300, but not exceeding £500 gross value.	555,754	259,771	1,003,313	275,945	244,023	309,726	431,527	290,944	918,177	1,183	71	178,580	540	4,469,554	194,239	4,275,315
Exceeding Net. £100 but not exceeding Net. £1,000	1,736,433	1,270,598	2,262,491	962,695	1,142,987	885,800	1,009,144	959,623	4,984,561	32,909	710	821,668	87,059	16,156,678	3,837,668	12,319,010
„ £1,000 „ „ £5,000	8,202,886	9,303,610	5,942,657	4,932,766	3,794,083	2,355,829	2,644,973	2,208,607	12,491,337	161,038	9,479	5,164,816	198,329	57,410,410	6,151,694	51,258,716
„ £5,000 „ „ £10,000	5,426,159	7,968,497	2,501,264	2,519,985	2,244,587	1,150,309	1,125,996	1,421,859	6,082,689	187,462	7,228	1,663,326	132,227	32,431,588	2,597,167	29,834,421
„ £10,000 „ „ £15,000	4,231,065	6,392,655	1,338,703	1,742,640	1,183,579	753,666	781,841	1,196,194	4,185,729	136,528	8,168	1,156,500	136,245	23,243,513	1,898,098	21,345,415
„ £15,000 „ „ £20,000	2,722,461	4,566,668	753,559	966,405	670,943	382,875	494,543	772,582	1,869,924	55,517	−3,633*	697,688	141,201	14,090,733	1,157,800	12,932,933
„ £20,000 „ „ £25,000	2,494,780	4,270,253	844,343	1,145,942	743,418	489,260	391,603	1,160,972	2,244,241	126,194	39,066	859,909	220,662	15,030,643	974,420	14,056,223
„ £25,000 „ „ £30,000	1,439,653	2,918,716	429,271	618,380	428,221	310,798	311,797	383,337	1,168,905	60,130	12,687	476,385	35,270	8,593,550	609,381	7,984,169
„ £30,000 „ „ £40,000	2,428,811	4,813,435	563,815	697,984	642,015	187,431	467,742	664,242	1,258,433	142,591	25,289	403,673	134,183	12,429,644	822,918	11,606,726
„ £40,000 „ „ £50,000	2,107,050	4,223,938	647,370	1,111,254	553,599	311,846	395,292	1,209,043	1,922,704	128,554	10,673	413,484	75,704	13,110,511	880,027	12,230,484
„ £50,000 „ „ £60,000	1,653,485	2,850,380	369,653	764,327	253,084	82,622	273,970	509,480	713,878	45,062	12,224	503,259	24,031	8,055,455	568,082	7,487,373
„ £60,000 „ „ £80,000	2,894,232	4,401,858	484,843	1,121,071	553,007	298,735	468,484	1,607,265	2,056,737	113,635	23,881	886,144	166,494	15,076,386	900,497	14,175,889
„ £80,000 „ „ £100,000	1,844,495	4,190,652	405,448	645,917	276,823	265,893	333,932	1,245,046	1,493,774	309,503	39,998	298,931	69,297	11,419,709	592,825	10,826,884
„ £100,000 „ „ £150,000	3,040,535	6,339,272	362,182	864,144	687,175	420,580	300,112	1,804,081	2,138,581	227,176	98,694	−23,176*	108,390	16,367,746	1,136,133	15,231,613
„ £150,000 „ „ £200,000	3,054,870	5,322,964	622,476	856,414	649,818	265,042	480,880	2,040,584	1,545,010	200,590	38,059	185,885	110,882	15,373,474	1,255,715	14,117,759
„ £200,000 „ „ £250,000	1,498,356	2,650,088	348,027	154,778	216,999	218,381	183,998	1,133,653	1,003,164	124,518	235,506	332,459	182,668	8,282,595	808,604	7,473,991
„ £250,000 „ „ £300,000	1,248,836	1,879,309	−125,948*	274,100	228,801	9,957	103,901	687,910	785,016	93,572	47,982	632,643	8,820	5,874,899	266,043	5,608,856
„ £300,000 „ „ £400,000	1,843,112	4,635,044	499,066	546,176	443,751	87,777	327,012	2,209,823	1,482,593	90,029	3,852	1,269,508	157,803	13,595,646	712,421	12,883,225
„ £400,000 „ „ £500,000	1,623,207	3,830,511	204,477	617,117	813,242	107,803	286,357	561,699	636,318	138,943	62,066	−395,477*	8,730	8,494,993	640,246	7,854,747
„ £500,000 „ „ £600,000	429,729	2,201,973	70,021	264,335	10,038	45,055	58,144	695,636	512,154	2,616	16,975	−774,694*	10,489	3,542,471	300,778	3,241,693
„ £600,000 „ „ £800,000	1,175,555	4,457,434	376,605	188,648	123,531	160,245	190,476	354,286	266,807	100,859	—	788,158	85,381	8,267,985	1,122,767	7,145,218
„ £800,000 „ „ £1,000,000	486,228	627,203	459,909	202,261	18,306	47,974	405,985	482,568	181,175	2,182	18,813	138,146	2,782	3,073,532	155,502	2,918,030
„ £1,000,000 „ „ £1,500,000	1,146,310	3,297,149	202,729	227,887	1,045,758	42,369	189,034	1,771,784	1,739,485	43,466	6,558	135,747	33,224	9,881,500	314,724	9,566,776
„ £1,500,000 „ „ £2,000,000	517,469	2,904,655	805,521	10,169	87,478	34,679	9,227	459,187	459,772	23	145,590	12,959	198	5,446,927	243,166	5,203,761
„ £2,000,000 „ „ £3,000,000	407,258	35,254	111,991	4,047	47,415	−32,911*	66,484	25,857	36,583	8,210	824	80,421	2,634	794,067	131,097	662,970
„ £3,000,000	—	2,149	—	755	—	7,391	—	—	—	—	—	1,286,395	—	1,296,690	—	1,296,690
Total	£54,646,858	95,789,248	22,729,090	21,974,090	17,282,854	9,630,818	12,164,906	26,190,036	52,737,908	2,533,158	860,922	17,855,782	2,133,696	336,029,346	28,525,782	307,503,584
Per cent.	16·26	28·50	6·76	6·54	5·14	2·87	3·62	7·79	15·70	0·75	0·26	5·17	0·64	100·00	8·49	91·51

* Capital transferred to other classes exceeded that brought into this class.

Figure A.2: Table 17 from the 1920 report of the *Commissioners of His Majesty's Inland Revenue* showing the Composition of Wealth-at-Death by Asset Type

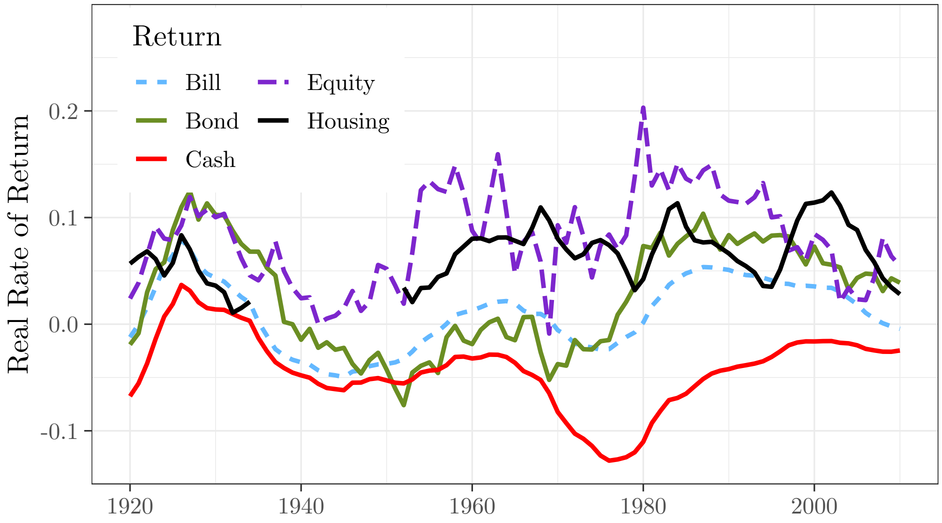


Figure A.3: The Real Rate of Return on Equity, Housing, Bonds, Bills and Capital

Notes: I apply a 11 year moving average to the annual data. *Source*: Jordà et al. (2019) (website). I interpolate housing returns 1940-5, as Jordà et al. (2019).

A.2 The Composition of Wealth

As detailed in section 2.3, I extracted breakdowns of wealth-at-death by asset type from the annual reports of the commissioners of *His Majesty's Inland Revenue* (after 1952, *Her Majesty's*), from ProQuest (2018). After 1968 in *Inland Revenue Statistics* Her Majesty's Stationery Office (1970–1992). Table A.1 reports the details of which specific asset class was assigned to broad class, for use in the analysis.

Year	Broad Class	Inland Revenue Description			
1906	Equity	Stocks, Funds, Shares, and other like Securities			
	Govt Bonds and Bills	Money lent on Mortgages, Bonds, Bills, etc.			
	Cash	Cash in the House and in Bank	Household Goods, Apparel, etc.		
	Housing	Agricultural Land	House Property and Business Premises		
	Other	Trade Assets, le.,Book Debts, Stock, Goodwill, etc.	Policies of Insurance		
1910-5	Equity	Stocks, Funds, Shares, and other like Securities			
	Govt Bonds and Bills	Money lent on Mortgages, Bonds, Bills, See			
	Cash	Cash in the House and in Bank			
	Housing	Agricultural Land	House Property and Business Premises	Ground Rents and other similar Burdens	Other Property
	Other	Trade Assets, Book Debts, Stock, Goodwill etc.			
1915-20	Equity	Stocks, Funds, Shares, and other like Securities			
	Govt Bonds and Bills	Money Lent on Mortgages, Bonds, Bills, etc.			
	Cash	Cash in the House and in Bank	Household Goods, Apparel, etc.		
	Housing	Agricultural Land	House Property and-Business Premises.	Ground Bents and other similar Charges	Other Property
	Other	Trade Assets, i.e., Book Debts, Stock, Goodwill, etc.	Policies of Insurance	Mines, Minerals, and Quarries	
1925-49	Equity	Stocks, Shares, Ac., of Joint Stock., Companies			
	Govt Bonds and Bills	Government and Municipal Securities: British Government Securities issued since 1914	Other Securities		
	Cash	Cash in the House and in Bank	Household Goods, Apparel, etc.		
	Housing	Land	House Property and Business Premises	Ground Rents, etc.	
	Other	Trade Assets	Policies of insusurance	Mines, Minerals, and Quarries	
1956	Equity	Stocks, shares, etc. Private British companies			
	Govt Bonds and Bills	Government and municipal securities British government	Other securities		
	Cash	Cash			
	Housing	Land	House property and business premises		
	Other	Trade assets	Policies of insurance		
1956-1960	Equity	Stocks, shares, etc. Private British companies	Stocks, shares, etc. Other companies		
	Govt Bonds and Bills	Government and municipal securities British government	Other securities		
	Cash	Cash	Household goods, china, etc.		
	Housing	Land	House property and business premises		
	Other	Trade assets	Policies of insurance		
1968	Equity	Shares : British, unquoted Ordinary	Shares : Preference, debentures	Shares: and debentures in companies British, quoted Ordinary shares, investment trusts	Shares : Ordinary shares, Others
	Govt Bonds and Bills	National Savings Certs. and Premium Bonds	Defence and Development Bonds and Tax Reserve Certs	British Government securities	Municipal and other government securities|Money on mortgage|Shares and deposits in building societies of real estate and on bonds and securities
	Cash	Household goods etc.	Cash in the house	Cash at the Post Office and Trustee Savings Banks	
	Housing	Land	Residential buildings	Other realty	
	Other	Policies of insurance	Trade assets and share of partnership	Other personalty	
1981-1990	Equity	Ovrerseas and Foreign Securitis	Unlisted UK company secutitiers	Listed UK company securities	
	Govt Bonds and Bills	UK Govt and Municipal Securities	Loans mortgaes etc		
	Cash	Household goods			
	Housing	UK residential buildings	Other UK buildings	UK land	Mortgages
	Other	Superannuation benefits	Policies of insurance	Trade assets and shares in partnerships	Other Personalty|Foreign immovables

Table A.1: Allocation of Asset Types to Broad Categories

Notes: This table reports the assignment of specific asset classes, listed in *His Majesty's Inland Revenue* (after 1952, *Her Majesty's*), from ProQuest (2018) and *Inland Revenue Statistics* Her Majesty's Stationery Office (1970–1992), 1906-1990, to broad asset classes.

B Alternative Estimates using Alternative Rates of Return on Capital

The main analysis uses estimates of the rate of return from Jordà et al. (2019) for different wealth groups. Here I present alternative results using different rates of return on capital. In place of variable rates of return calculated using the observed composition of wealth matched to asset classes from Jordà et al. (2019) (see section 2.3), I substitute the aggregate rate of return on wealth from Jordà et al. (2019) and separately, an alternative aggregate rate of return on capital from Piketty (2014). The different time-trends of r are plotted in figure B.1. Firstly I use the aggregate rate of return on wealth (r) for the UK 1896-2015 from Jordà et al. (2019) (website). They calculate r as a weighted average of bonds, bills, equity, and housing returns. For 1892-5, I use the average r 1896-1899. As in the main analysis, this annual return on wealth reflects both capital gains and yields, so I transform r to decadal moving averages, centered on the year of death of the decedent. The goal here is to use r to best-guess the rate of growth of inherited fortunes; an individual's financial assets are unlikely to be liquidated annually, so a decadal moving average gives a more realistic estimate of the likely gains or losses to the inheritance. Piketty (2014) reports decadal values from 1770 to 2010 for the 'Pure rate of return (estimate)' to capital. These values are calculated from the capital share in national income accounts divided by an estimate for national capital stock. Piketty adjusts these numbers downwards to account for the cost of managing wealth to obtain a 'pure' return on capital, plotted in figure B.1 (2014, p.205). (The underlying data for these estimates reported in Piketty comes from Piketty and Zucman, 2014 and Allen, 2007.)

As plotted in figure B.1, the estimates for the 'pure' rate of return on capital by Piketty (2014) report positive returns for the war years and significantly lower returns after 1975 or so, than the series used in the paper by Jordà et al. (2019). The expected wealth of dynasties is calculated exactly as before (as described in section 3), apart from the explicit adjustment for the wealth destruction of World War II. As figure B.1 illustrates, the Piketty series does not incorporate wartime capital losses. I therefore apply the observed destruction of wealth, by dynastic wealth grouping, to the expected wealth of dynasties, as reported in in table 4.2.

Here I replicate table 4.3 which reports the estimated amount of hidden wealth for the Victorian Elite lineages for the two alternative r series. Table B.1 reports this alternative set of estimates for the aggregate Jordà et al. (2019) series. Estimates using Piketty's series for the return on capital are reported in table B.2.

The substitution of aggregate rates of return in place of variable (by wealth group) rates of returns results in significantly lower estimates of hidden wealth. The Piketty series generates lower estimates of hidden wealth but there are some interesting differences. Similar to the estimates using Jordà et al. (2019), the alternative r estimates a proportion of hidden wealth close to zero in the 1920s, negative hidden wealth in the 1930s and 40s, broadly similar but lower levels for the 1950s, 60s and 70s and estimates zero wealth for 1980-92. Recall, that the estimate of hidden wealth proposed by this paper is a cautious minimum, not a precise spot estimate. As the Jordà et al. (2019) directly estimate the rate of return on wealth, they are preferred.

Table B.3 presents the regression results from tables 5.3, 5.4 and 5.5 with those using the alternative estimates of r. Despite the fact that the three series produce very different estimated levels of aggregate hidden wealth, the choice of r does not materially affect the significance nor magnitude of any of the contemporary outcome correlations, at the surname level.

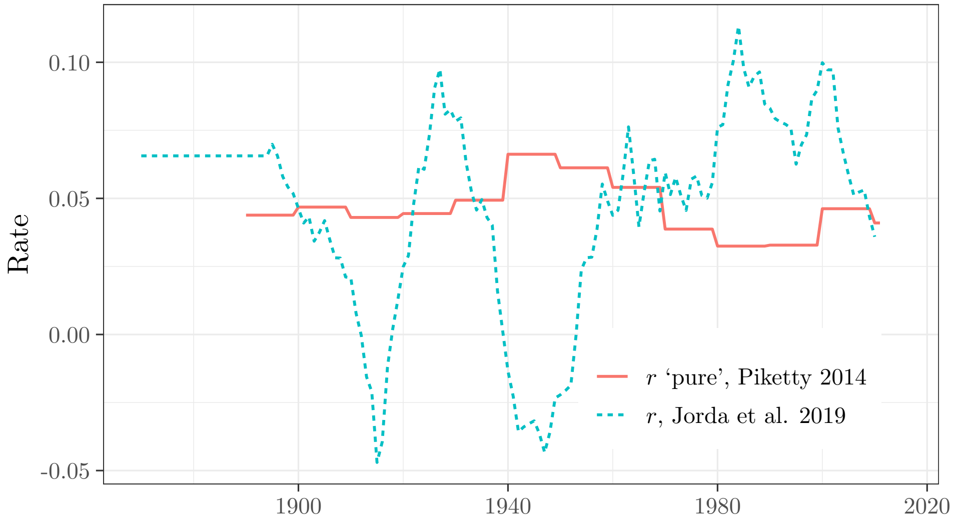


Figure B.1: Estimates of Rate of Return to Wealth or Capital, Jorda et al. 2019 and Piketty 2014
Source: Jordà et al. (2019), website. (For 1892 to 1895, I use the 1896 value.) Piketty (2014): http://piketty.pse.ens.fr/files/capital21c/en/xls/, spreadsheet Chapter6TablesFigures.xlsx. sheet "TS6.1".

Table B.1: Hidden Wealth and the Propensity to Hide, the Victorian Rare Elite, England 1920-1990, using Jorda (2019) aggregate rate of return on capital

Decade	'True' Wealth	Observed Wealth	Observed + Paid in Inheritance Tax	Hidden Wealth	Prop. Hidden
1920	2,203	2,035	2,102	100	0.046
1930	2,894	2,787	3,040	-147	-0.051
1940	2,597	2,379	2,771	-174	-0.067
1950	2,106	1,242	1,714	392	0.186
1960	2,189	1,377	1,990	199	0.091
1970	2,292	962	1,748	544	0.237
1980-92	3,845	1,798	3,298	547	0.142

Note: Wealth is in Millions, £2015. *Source*: 100% PPR Calendar Sample.

Table B.2: Hidden Wealth and the Propensity to Hide, the Victorian Rare Elite, England 1920-1990, Using Piketty (2014) rate of return on capital

Decade	'True' Wealth	Observed Wealth	Observed + Paid in Inheritance Tax	Hidden Wealth	Prop. Hidden
1920	2,222	2,045	2,110	112	0.050
1930	2,675	2,801	3,043	-368	-0.138
1940	2,055	2,380	2,831	-776	-0.378
1950	2,102	1,242	1,867	235	0.112
1960	2,214	1,377	2,158	56	0.025
1970	2,301	962	1,917	384	0.167
1980-92	3,292	1,796	3,323	-31	-0.009

Note: Wealth is in Millions, £2015. *Source*: 100% PPR Calendar Sample.

Table B.3: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of Presence in the Paradise Papers and Contemporary Outcomes, comparison using alternative r

	logistic		*OLS*		*OLS*	
	Paradise Dummy		House Price		Oxbridge Rate	
	Odds Ratio		000s of Pounds		Z-Score	
	(1)	(2)	(3)	(4)	(5)	(6)
	J	P	J	P	J	P
Wealth Percentile: 70-80	1.065^{***}	1.054^{***}	21.364^{**}	16.144^{*}	$.089^{***}$	$.108^{***}$
	(.079)	(.080)	(7.645)	(7.646)	(.022)	(.022)
80-90	1.128^{***}	1.117^{***}	43.498^{***}	47.630^{***}	$.119^{***}$	$.125^{***}$
	(.079)	(.079)	(7.859)	(7.856)	(.023)	(.023)
The Top 10%	1.412^{***}	1.383^{***}	94.087^{***}	93.928^{***}	$.255^{***}$	$.265^{***}$
	(.077)	(.077)	(8.241)	(8.240)	(.024)	(.024)
D_{Hider}	1.235^{***}	1.250^{***}	40.104^{***}	37.704^{***}	$.065^{***}$	$.076^{***}$
	(.068)	(.070)	(6.580)	(6.780)	(.019)	(.019)
N_{2002}	1.004^{***}	1.004^{***}	$-.565^{***}$	$-.566^{***}$	$.002^{***}$	$.002^{***}$
	(.0003)	(.0003)	(.035)	(.035)	(.0001)	(.0001)
Observations	15,975	15,975	18,126	18,126	18,921	18,921
R^2			.018	.018	.041	.042

Note: $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$
J uses Jorda et al. (2019) r series
P uses Piketty et al. (2014) r series
No hidden wealth is the omitted category
Oxbridge Rate is Z-Score
House Prices are in Thousands of 2018 Pounds

C Extra Results

Figure C.1 illustrates how newly created wealth is captured. Table C.1 lists the top 50 dynasties, their hidden wealth, their propensity to hide, the number of them living in the UK in 2002, whether presence is recorded in the *Offshore Leaks Database* and whether they were members of the Victorian Elite, as defined in the paper. Figure C.2 reports three series: estimated lineage wealth (equation 4), observed wealth ($(1-\alpha)W$) and observed wealth plus taxes paid (T^p), accumulating at r^{net}, for the middle ranking Victorian Lineages, 1920-1992. Table C.2 reports the correlation of estimated wealth and observed wealth for the Victorian Elite lineages, 1920-1992. Figure C.3 reports the cumulative wealth of a set of random illustrative rare surnames from the PPR Calendar data. Table C.3 reports a sample of names found in the *ICIJ Offshore leak database* that have surnames that are designated as possessing significant amounts of hidden wealth by this analysis. Table C.4 reports an OLS estimation of the probability of appearance in the *ICIJ Offshore leak database,* as reported in logistic form in table 5.3.

C.0.1 Contemporary Outcome Regressions: Alternative Wealth Controls

The wealth decile dummies used in the regressions in sections 5.2 and 5.3, allow for the wealth effect on the probability of a surname's appearance in the paradise papers, it's average post code house price in 1999 and it's Oxbridge attendance, to be non-linear. However, it is possible that this formulation could miss the effect of wealth *within* these deciles. To address this I rerun the regressions using a cubic formulation for wealth as opposed to the decile dummy as detailed in equations 14 and 15. Tables C.5 (paradise appearance), C.6 (post-code house price in 1999), C.7 (Oxbridge attendance), reported here, replicate the regressions reported previously but this time using cubic wealth as opposed to wealth decile dummy variables. The results for all the variables of interest are almost identical.

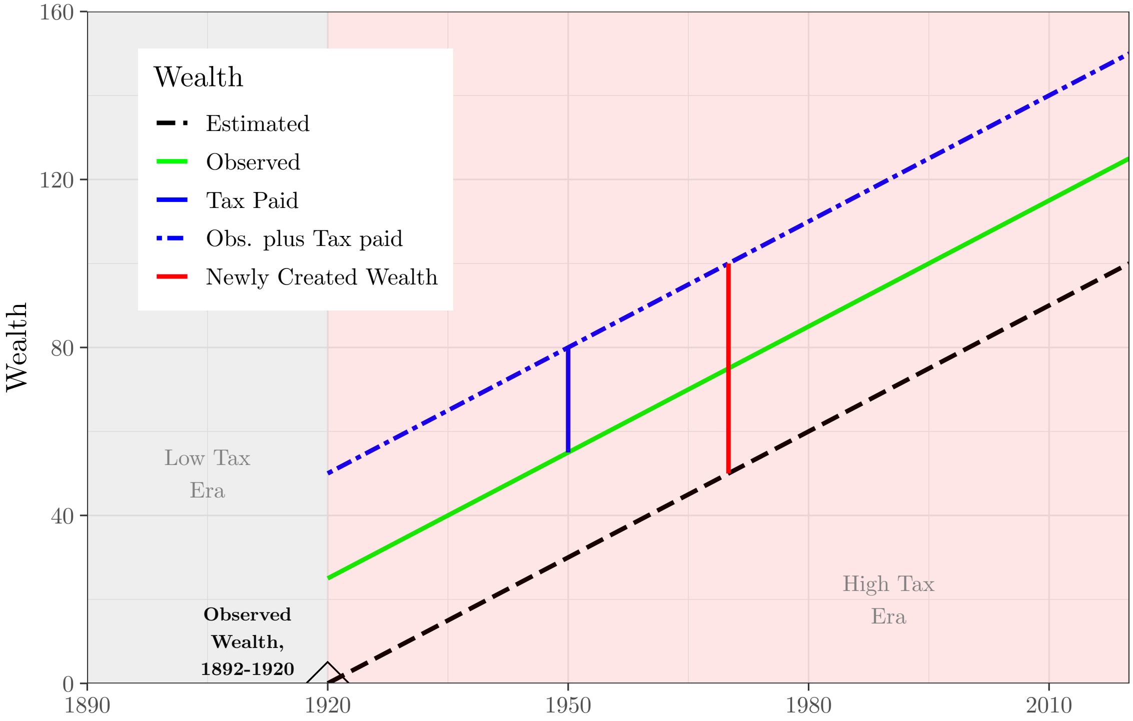


Figure C.1: The Concept for Net Wealth Creating Dynasties

Table C.1: Hidden Wealth by Lineage, the top 50

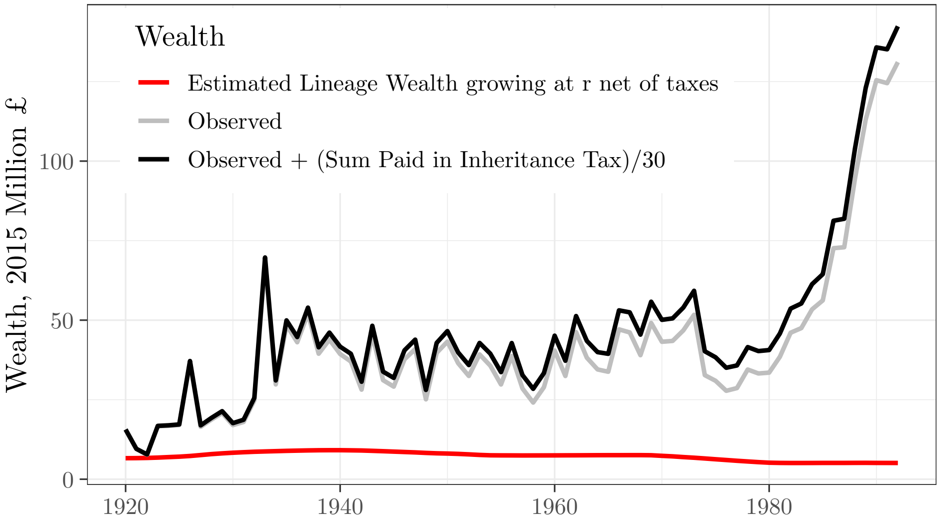
Surname	Hidden Wealth	α	N_{2002}	$D_{Paradise}$	Victorian Elite
Mxxxxxx	65,923,932	0.993	192	0	1
Txxxxxxxxx	43,350,670	0.936	72	0	1
Axxxxxxxxx	42,332,417	0.986	81	0	1
Txxxxxxxxxxxxx	32,624,264	0.987	28	0	1
Hxxxxxxx	28,450,143	0.967	84	0	1
Hxxx	27,646,518	0.927	134	1	1
Pxxxxx	22,707,561	0.996	36	1	1
Exxxxx	20,321,616	0.987	66	0	1
Txxxxx	19,304,711	0.986	75	0	1
Wxxxxx	19,130,575	0.894	135	0	1
Vxxxxx	18,702,416	0.872	35	0	1
Sxxxxxxxx	18,681,330	0.907	244	1	1
Vxxxx	18,179,483	0.902	116	0	1
Axxxxxxx	15,950,506	0.987	80	0	1
Mxxxxxxx	15,355,281	0.947	64	0	1
Cxxxxxxx	14,709,259	0.942	54	0	1
Kxxxxx	14,133,302	0.856	176	1	1
Wxxxxxxxx	14,098,695	0.988	63	0	1
Mxxxxx	13,948,960	0.991	36	0	1
Nxxxxxxxxx	13,707,769	0.985	42	1	1
Lxxxxxxxxx	13,686,703	0.987	93	1	1
Bxxxxxxx	13,607,744	0.996	91	0	1
Pxxxx	13,545,627	0.940	85	0	1
Wxxxxxxxxxx	13,415,295	0.986	44	0	1
Cxxxx	13,138,200	0.922	180	0	1
Txxxxxxxxx	12,598,740	0.999	16	0	1
Txxxxxxx	12,423,616	0.844	10	1	1
Hxxxxxxx	12,213,711	0.778	7	0	1
Mxxxxxx	12,010,727	0.845	39	0	1
Exxxxxxxx	11,524,548	0.977	61	0	1
Dxxxxxxx	11,377,363	0.894	145	0	1
Rxxxxx	10,855,304	0.958	73	0	1
Lxxxxxxx	10,809,117	0.950	90	0	1
Sxxxxxxxx	10,397,906	0.845	64	0	1
Ixxxxx	10,092,022	0.861	198	0	1
Txxxxxx	9,882,457	0.951	74	0	1
Sxxxxx	9,291,299	0.951	77	1	1
Mxxxxxx	9,184,817	0.991	11	1	1
Txxxxxxx	8,846,034	0.692	97	0	1
Fxxxxx	8,677,633	0.894	88	0	1
Bxxxx	8,090,784	0.866	46	0	1
Yxxxxxx	7,911,995	0.958	38	1	1
Sxxxxxxx	7,568,581	0.983	10	0	1
Zxxxxx	7,416,921	0.874	85	1	1
Bxxxxxxxx	7,380,714	0.978	0	0	1
Dxxxxxxxx	7,126,978	0.984	9	0	1
Sxxxxxxx	7,125,969	0.996	7	0	1
Pxxxxxxx	7,086,222	0.776	104	0	1
Oxxx	7,071,051	0.950	140	0	1
Sxxxx	6,944,444	0.886	333	0	1

Wealth is in £2015. Names are withheld. Annual flow of £.

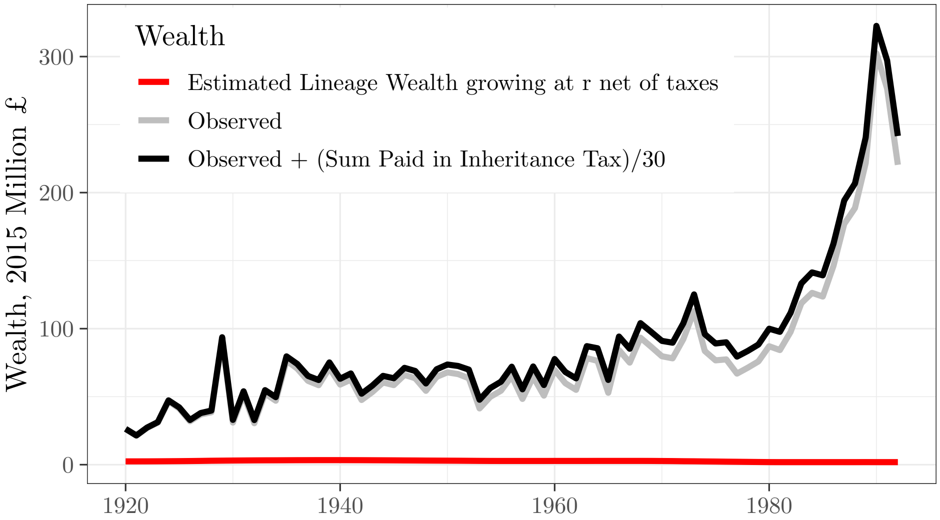
Table C.2: Observed Wealth as a function of Estimated Wealth, Victorian Elite Lineages

	Observed Wealth 1920-49 (1)	 1950-1984 (2)	 1985-92 (3)
Estimated Wealth	1.058^{***}	$.712^{***}$	$.927^{***}$
	(.034)	(.013)	(.039)
Observations	30	35	7
R^2	.970	.989	.990

Note: *p<0.05; **p<0.01; ***p<0.001
No Constant, OLS
Observed Wealth is inclusive
of inheritance tax paid

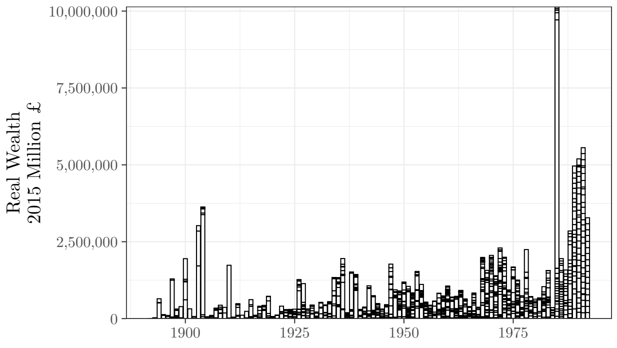


(a) Victorian 'Middling' Lineages

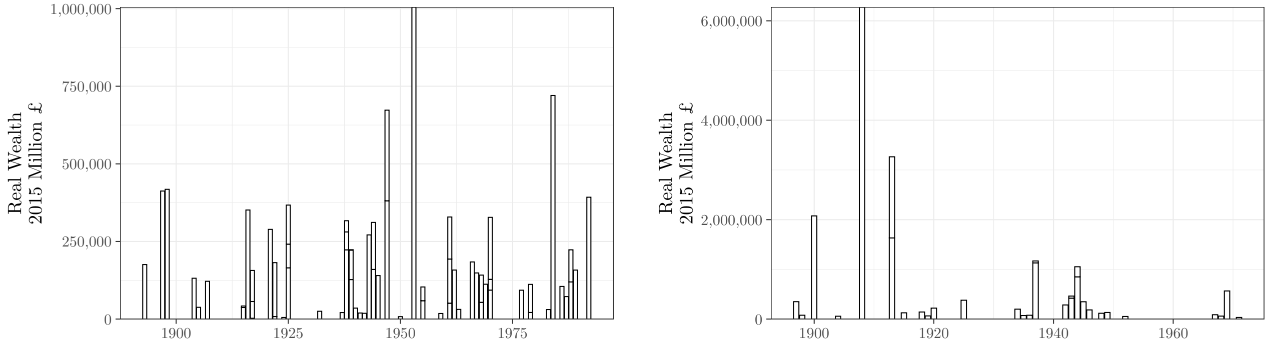


(b) Victorian Bottom Lineages

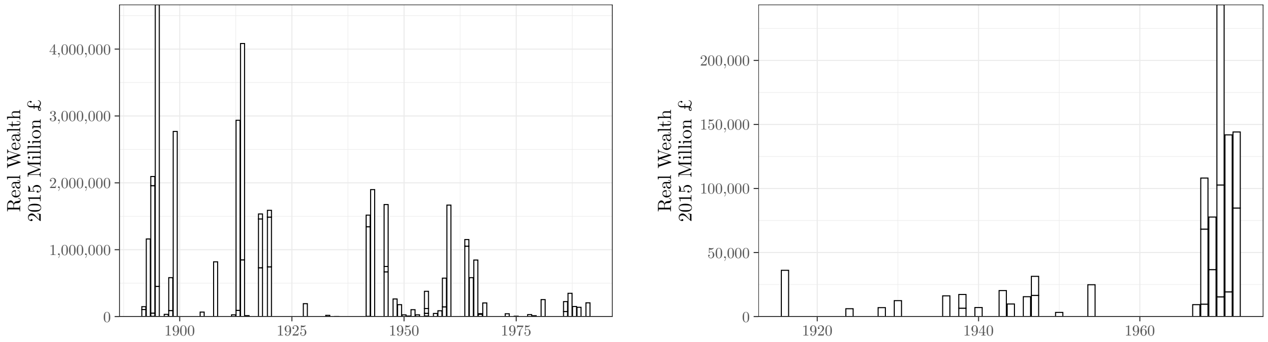
Figure C.2: Estimated and Observed Lineage Wealth, with taxes paid, Victorian mid and bottom Lineages
Source: 100% PPR Calendar Sample.



(a) Cummins's



(b) Comyns's (c) Xxxxxx's



(d) Axxxx's (e) Dxxxxxxxx's

Figure C.3: Example of Lineage Wealth by Rare Surname

Source: 100% PPR Calendar Sample.

Table C.3: Examples of English Lineage Names Found in Paradise Papers

Name	Source	Hidden Lineage Wealth	α	N, 2003	N, Paradise	Victorian Elite
XXXXXX XXXXXXXXX	Paradise Papers - Samoa corporate registry	1,817,835	0.58	209	11	1
XXXXXXX XXXX X.	Paradise Papers - Barbados corporate registry	17,366	0.16	26	1	0
XXXXXX XXXXX-XXXX	Paradise Papers - Barbados corporate registry	43,661	0.10	202	6	0
XXXX XXXXXX	Panama Papers	2,323,661	0.70	171	3	1
XXXXXXXXX XXXXXX XXXXX XXXXX	Panama Papers	90,745	0.08	172	11	0
XXXXXXXXX XXXX XXXXXXXXX	Paradise Papers - Malta corporate registry	188,947	0.74	32	2	0
XX. XXXXXX XXXXX	Panama Papers	71,170	0.92	34	1	0
XXXXXXX XXXXXX	Paradise Papers - Barbados corporate registry	258,964	0.36	224	3	0
XXXXXXX XXXXXX XXXXXXX	Paradise Papers - Barbados corporate registry	258,964	0.36	224	3	0
XXXXX, XXXXX XXXXX	Paradise Papers - Aruba corporate registry	131,995	0.08	110	10	0

Hidden Wealth is Annual Flow, in 2015 pounds

Table C.4: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of Presence in the Paradise Papers

	Paradise Dummy				
	(1)	(2)	(3)	(4)	(5)
Wealth Percentile: 70-80	.003	.002	.003	.004	.003
	(.008)	(.008)	(.008)	(.008)	(.008)
80-90	.007	.004	.006	.007	.007
	(.008)	(.008)	(.008)	(.008)	(.008)
The Top 10%	.037***	.034***	.036***	.037***	.037***
	(.009)	(.009)	(.009)	(.009)	(.009)
D_{Hider}	.026***				
	(.008)				
Hidden Wealth		.005*			
		(.002)			
HW: 0-.2m			.010		
			(.012)		
HW: .2m-1m			.035**		
			(.012)		
HW:>1m			.042**		
			(.016)		
Prop. Hidden, α				.039**	
				(.012)	
α: 0-.5					.022
					(.012)
α .5-.75					.026
					(.015)
α. 75-.9					.044*
					(.018)
α>.90					.017
					(.019)
N_{2002}	.001***	.001***	.001***	.001***	.001***
	(.00004)	(.00004)	(.00004)	(.00004)	(.00004)
Constant	.064***	.068***	.065***	.065***	.064***
	(.004)	(.004)	(.004)	(.004)	(.004)
Observations	15,975	15,975	15,975	15,975	15,975
R^2	.020	.019	.020	.020	.020

Note: $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$
Wealth is in 2015 Pounds, Per Annum flow
No hidden wealth and $\alpha = 0$ are the omitted categories
Hidden wealth is calculated 1980-92, estimated via OLS
Standard Errors in parantheses

Table C.5: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of Presence in the Paradise Papers, Alternative Wealth Controls

	Paradise Dummy				
	(1)	(2)	(3)	(4)	(5)
Observed Wealth	1.122	1.107	1.119	1.124	1.123
	[3.722]***	[3.297]***	[3.601]***	[3.748]***	[3.730]***
Observed Wealth Squared	.998	.999	.998	.998	.998
	[$-$1.278]	[$-$.959]	[$-$1.189]	[$-$1.305]	[$-$1.288]
Observed Wealth Cubed	1.000	1.000	1.000	1.000	1.000
	[.570]	[.309]	[.497]	[.595]	[.580]
D_{Hider}	1.296				
	[3.435]***				
Hidden Wealth		1.036			
		[2.127]*			
HW: 0-.2m			1.103		
			[.798]		
HW: .2m-1m			1.386		
			[2.856]**		
HW:>1m			1.476		
			[2.795]**		
Prop. Hidden, α				1.475	
				[3.352]***	
α: 0-.5					1.240
					[1.893]
α .5-.75					1.280
					[1.779]
α. 75-.9					1.533
					[2.700]**
α>.90					1.209
					[1.007]
N_{2002}	1.004	1.004	1.004	1.004	1.004
	[13.794]***	[13.621]***	[13.796]***	[13.772]***	[13.800]***
Observations	15,975	15,975	15,975	15,975	15,975
Log Likelihood	-5,704.479	-5,708.051	-5,702.887	-5,704.818	-5,703.759
Akaike Inf. Crit.	11,420.960	11,428.100	11,421.770	11,421.640	11,425.520

Note: *p<.05; **p<.01; ***p<.001
Wealth is in 2015 Pounds, Per Annum flow
No hidden wealth and $\alpha = 0$ are the omitted categories
Hidden wealth is calculated 1980-92, estimated via logistic regression
Odds Ratios are reported with t-stats in parantheses

Table C.6: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of House Price in 1999, Alternative Wealth Controls

	House Price				
	(1)	(2)	(3)	(4)	(5)
Observed Wealth	39.5^{***}	37.4^{***}	38.6^{***}	39.8^{***}	39.4^{***}
	(3.4)	(3.4)	(3.4)	(3.4)	(3.4)
Observed Wealth Squared	-1.1^{***}	-1.1^{***}	-1.1^{***}	-1.1^{***}	-1.1^{***}
	(.2)	(.2)	(.2)	(.2)	(.2)
Observed Wealth Cubed	$.01^{***}$	$.01^{***}$	$.01^{***}$	$.01^{***}$	$.01^{***}$
	(.002)	(.002)	(.002)	(.002)	(.002)
D_{Hider}	50.5^{***}				
	(7.5)				
Hidden Wealth		10.8^{***}			
		(2.1)			
HW: 0-.2m			19.7		
			(11.5)		
HW: .2m-1m			52.2^{***}		
			(11.8)		
HW:>1m			101.0^{***}		
			(15.1)		
Prop. Hidden, α				73.5^{***}	
				(11.7)	
α: 0-.5					52.0^{***}
					(11.4)
α .5-.75					45.1^{**}
					(13.9)
α. 75-.9					59.8^{***}
					(16.9)
α>.90					44.7^{*}
					(18.4)
N_{2002}	$-.6^{***}$	$-.6^{***}$	$-.6^{***}$	$-.6^{***}$	$-.6^{***}$
	(.03)	(.03)	(.03)	(.03)	(.03)
Observations	18,126	18,126	18,126	18,126	18,126
R^2	.02	.02	.02	.02	.02

Note: *p<0.05; **p<0.01; ***p<0.001
Wealth is in 2015 Pounds, Per Annum flow
House Prices are in Thousands of 2018 Pounds
No hidden wealth, $\alpha = 0$ are the
omitted categories, OLS

Table C.7: Wealth, Hidden Wealth and the Proportion of Hidden Wealth as Predictors of Oxbridge Attendance Rate 1990-2016, Alternative Wealth Controls

	Oxbridge Attendance Rate (Z)				
	(1)	(2)	(3)	(4)	(5)
Observed Wealth	.136***	.131***	.134***	.137***	.136***
	(.010)	(.010)	(.010)	(.010)	(.010)
Observed Wealth Squared	$-$.005***	$-$.005***	$-$.005***	$-$.005***	$-$.005***
	(.001)	(.001)	(.001)	(.001)	(.001)
Observed Wealth Cubed	.00003***	.00003***	.00003***	.00003***	.00003***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
D_{Hider}	.107***				
	(.021)				
Hidden Wealth		.030***			
		(.006)			
HW: 0-.2m			.039		
			(.033)		
HW: .2m-1m			.127***		
			(.034)		
HW:>1m			.195***		
			(.043)		
Prop. Hidden, α				.165***	
				(.033)	
α: 0-.5					.095**
					(.033)
α .5-.75					.088*
					(.040)
α. 75-.9					.169***
					(.048)
α>.90					.100
					(.052)
N_{2002}	.002***	.002***	.002***	.002***	.002***
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Observations	18,921	18,921	18,921	18,921	18,921
R^2	.045	.045	.045	.045	.045
Note:	*p<0.05; **p<0.01; ***p<0.001 Wealth is in 2015 Pounds, Per Annum flow. No hidden wealth, $\alpha = 0$ are the omitted categories, OLS				

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