Hidden Wealth

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Abstract

Sharp declines in wealth-concentration occurred across Europe and the US during the 20th century. But this stylized fact is based on declared wealth. It is possible that today the richest are not less rich but rather that they are hiding much of their wealth. This paper proposes a method to measure this hidden wealth, in any form. In England, 1920-1992, elites are concealing 20-32% of their wealth. Among dynasties, 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 one-third of the observed decline of top 10% wealth-share over the past century.

1 Introduction

The 20th century's 'Great Equalization' of wealth in Europe and the United States was the result of the decline of the top wealth-shares. In England the wealth-share of the top 1% transformed from over 75%, in 1900, to less than 20% by 1970. Figure 1.1 collects the principal candidate elements in explaining why this happened. In short, new wealth created by the post-war 'Golden Age' of economic growth grew faster than net-of-taxes returns on capital (Piketty (2014), p.362-3).

We base this stylized fact primarily upon *observed,* or *declared,* wealth. But the incentive to hide wealth exploded over the 20th century. In the 1950s, the top rate of estate tax was around 80%. Is the 'Great Equalization' of wealth an illusory characterization of the wealth distribution? A simple result of an increased tendency for elites to hide their riches?

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 presents 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. A portion of this 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 is a simple accounting exercise that exploits the nominal, individual level 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 incentives suggest that this is reasonable; taxes on wealth before 1920 were a tiny fraction of taxes 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 that should show up in those same dynasties after 1920. 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 dynasties, declared wealth is systematically below expected wealth from inheritance. This is hidden wealth.[2]

Let us take the Axxxxxxx family as a concrete case study to illustrate the method (I have anonomysed the name).[3] 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 capital in the economy, net of inheritance and capital income tax and also war-time destruction. All of these elements are separately calculated.

As figure 1.2 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

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

[2]Figures A.4c and A.4d report the declared wealth of 2 'hiding' dynasties over the sample period, 1892-1992. Figure A.4e on the other hand reports the declared wealth of a dynasty creating new wealth. One of these dynasties is that of a former primeminister.
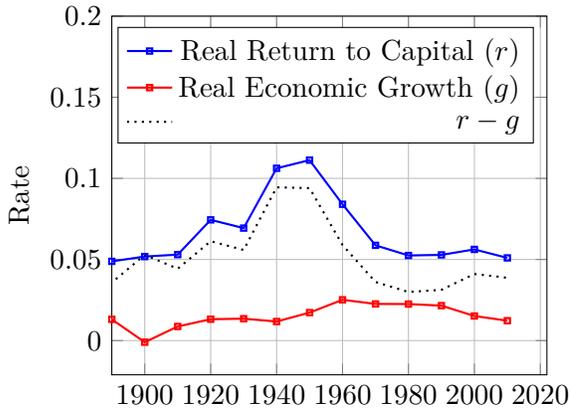
[3]The Axxxxxxxs are an English aristocratic family that traces its ancestors to the 10th century. A google search reveals connections to the Royal family and many MPs of that name.
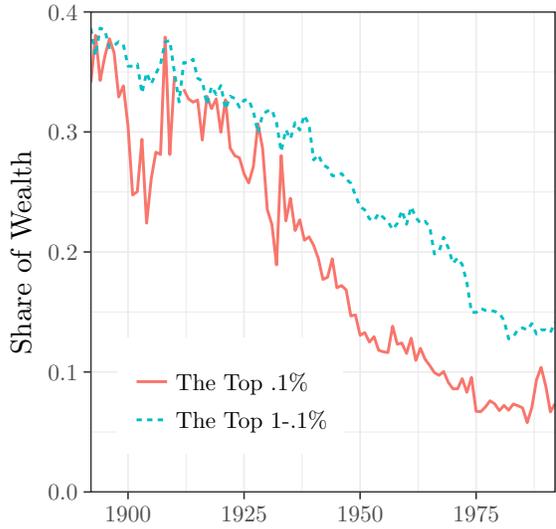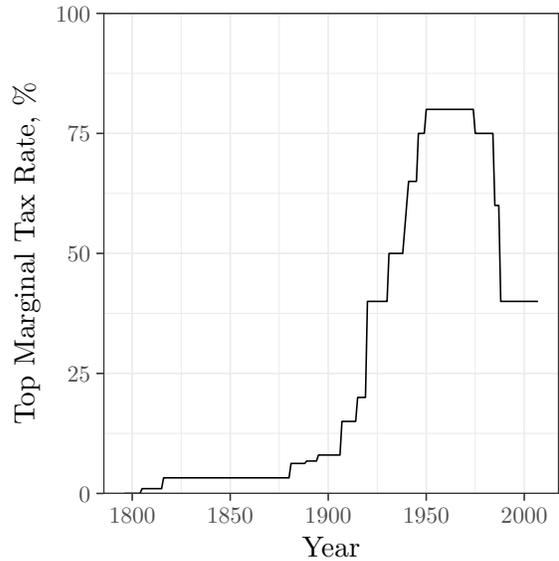
(a) The Decline of the top .1% and .1-1%
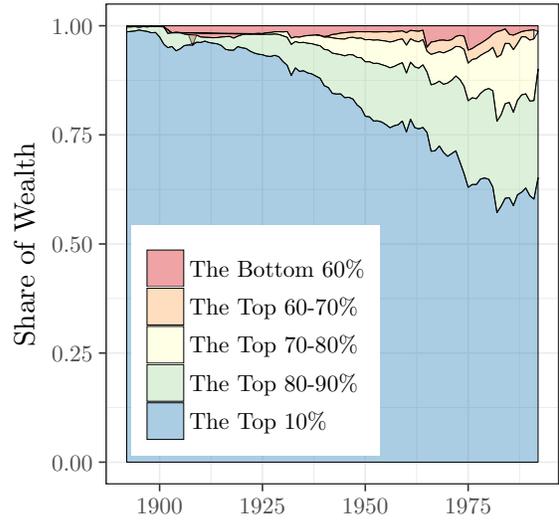
(b) The Growth of 'Popular Wealth'

(c) r and g

(d) Inheritance Taxes in England

Figure 1.1: Four Elements in The 'Great Equalization' of English Wealth

Source: a,b: Cummins (2019). 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 1.1a, declined because the rate of growth of the economy was greater than the real rate-of-return on capital (1.1c), net of war-time destruction and taxes (estate taxes are illustrated for example, 1.1d). In other words, new wealth created by economic growth ('popular wealth' reported in 1.1b) grew faster than *net* returns on capital (Piketty (2014), p.362-3).
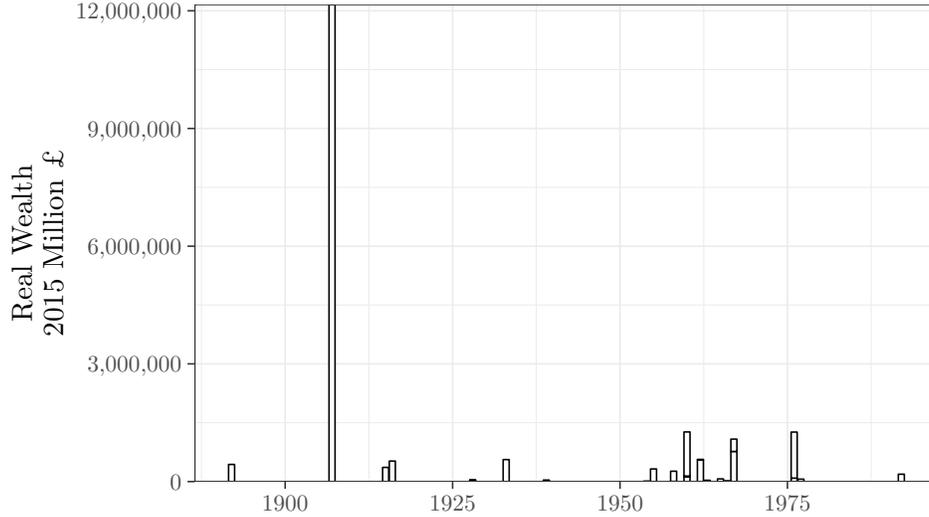
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Figure 1.2: The Wealth at Death of Members of the Axxxxxxx Dynasty

Source: 100% PPR Calendar Sample.

are only 96 Axxxxxxxs in England in 2002, the name appears as an account holder 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 3,311 dynasties hiding £3 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 effects are apparent even when controlling for observed wealth.

A crucial clarification is due at this point: 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 bad luck can dilute even the grandest fortunes. But I show that for Victorian elites as a whole, 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 calculated using the net-of-taxes rate-of-return on capital on observed dynastic capital during the low-tax prewar years with that later *actually observed* in the high-tax post war era. I incorporate wartime destruction and all death-taxes paid into this estimate of 'true' inherited-wealth. Figure 1.3 illustrates the concept for calculating hidden inherited wealth.

At the aggregate, this estimate is lower than observed wealth as new wealth is being created by non-inheriting surname dynasties. Figure A.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 20-32% of all elite wealth is hidden by their descendants, 1950-1992.

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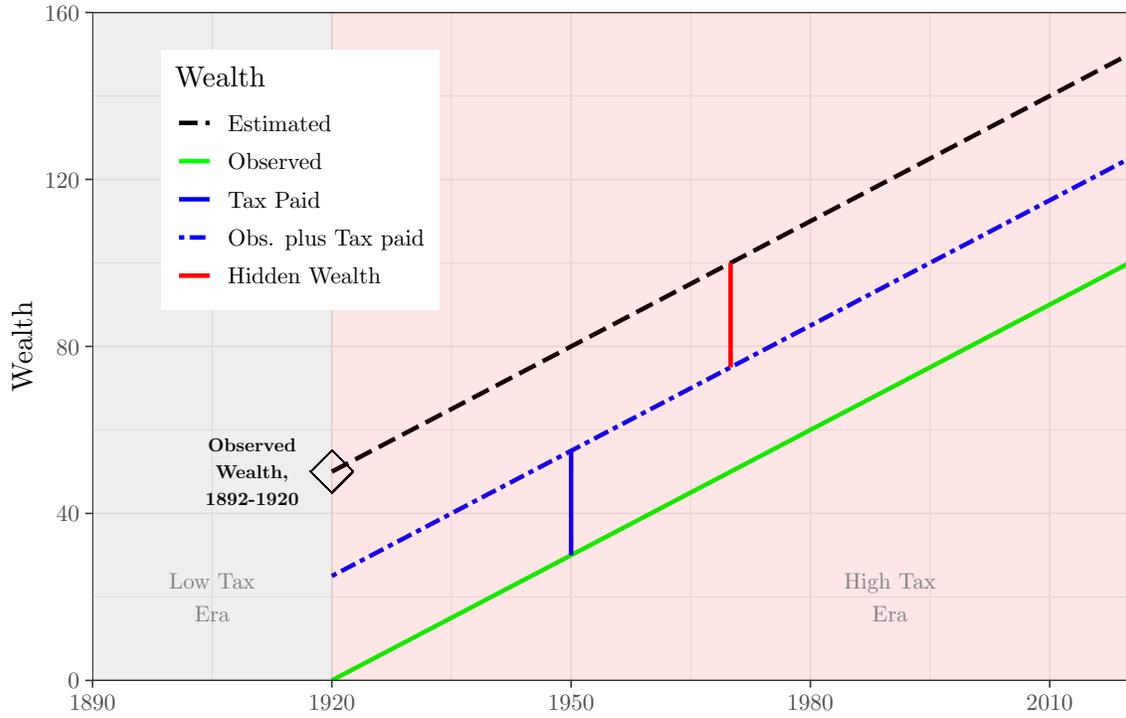
Figure 1.3: The Concept

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 capital. I subtract wartime destruction and 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.

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* (International Consortium of Investigative Journalists 2019). This suggest 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 boosts 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.

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 10% of the 'true' wealth distribution, equivalent to a 33% reversal of the observed decline.

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) and of course the titanic contributions of 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".

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). Section 6 concludes.

2   Data

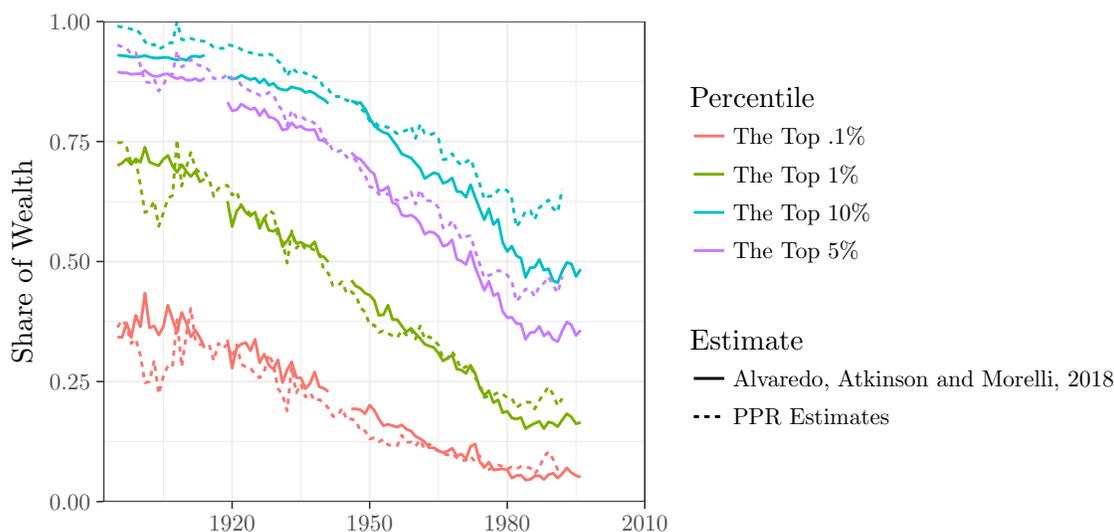This paper exploits several newly constructed and existing datasets.

Figure 2.1: Comparing Different Estimates of Top Wealth Shares, England 1892-1992
Notes: See Cummins (2019) for a detailed account of the source, construction and validation of the PPR data.

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. This source records all decedents in England and Wales with wealth above the threshold (currently £5,000). 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 (2019) (and summarized in figure A.2 in the appendix).

Cummins (2019) investigates in depth the quality of the resulting data, 15 million individual level wealth-at-death observations. The wealth-share estimates of the top percentiles match closely 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 2.1 compares the PPR percentile shares of the English wealth at death distribution with those from Alvaredo et al. (2018).[4]

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

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[4]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.
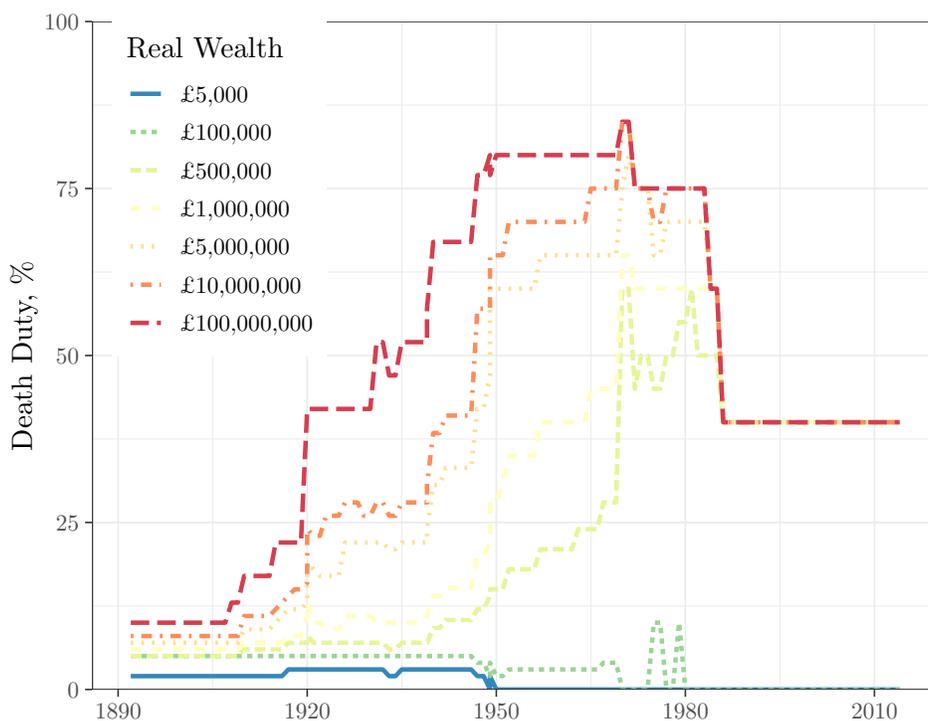
Figure 2.2: Death Duties, 1892-2015

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

the schedules 1894 to 1974. [5] 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 2.1 reports the largest tax payers in England, 1892-1992.[6]

2.3 The Return on Capital and Capital Income Tax

The rate of return on capital (r) is taken from Piketty (Piketty (2014), website. 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

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

[6]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.

	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 2.1: The 15 Largest Taxpayers, 1892-1992

Atkinson for the UK, 1908-1992, and also reported by Piketty (2014)[7]. Before 1908 I use a value of 2.9%. Piketty's estimates of r, g (the growth rate of the economy and my calculation of r^*(using his numbers)) are plotted in figure 2.3.

2.4 Offshore Leaks

The *Offshore Leaks Database* by the International Consortium of Investigative Journalists (ICIJ) (International Consortium of Investigative Journalists (2019)) contains detailed account level information on 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.[8]

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.

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

[8]I combined the "Officer" field in all 4 databases and manually cleaned out companies and organizations.
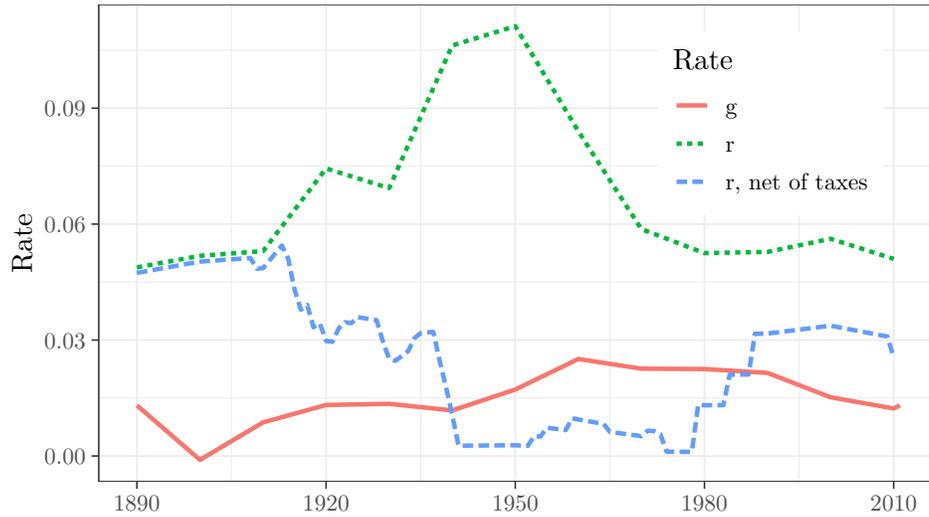
Figure 2.3: The Net-of-Taxes Rate of Return to Capital

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.[9]

I then link the individual addresses from the electoral roll of 1999 to house price data by postcode in 2017 (from the land registry)[10]. 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 (2015, 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, 2019).

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[9]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.

[10]'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 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. I am then able to assess the relative contribution of wartime wealth destruction, the rate of return on capital, the rate of growth of the economy, capital income tax and inheritance tax to the decline of elite English wealth share (figure 1.1a). 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*.

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 the 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 aggregate series are remarkable similar (compare figure 3.1 with figures 1.1a and 2.1). 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.[11] Rare

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[11]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).
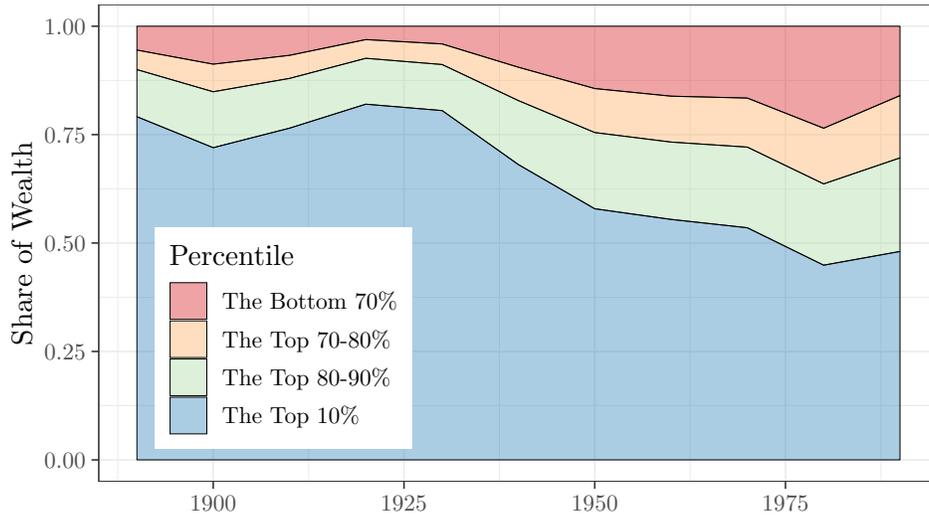
Figure 3.1: Observed Wealth Shares, Rare Surname Level, 1892-1992

Source: 100% PPR Calendar Sample.

surnames are both more likely to go extinct, or increase far more rapidly than common surnames. There are 36,719 surnames that are held by less than 100 people in 1881. I define this group as the universe of English rare names.[12] It represents 1,049,250 individuals in 1881 and 2,133,793 in 2002.

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)

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).[13]

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[12]Of these 37,719 names, 18,979 appear at one time in the PPR calendar between 1892 and 1920. I track these 18,979 names in the analysis.

[13]Queen Victoria died on 22 January 1901, so consider the name a nominal convenience and not a iron-clad

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	543	18,581	32,774	0.03	1.76
50-100	690	50,213	85,232	0.00	1.70

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.[14]

In addition a 'middling' Victorian wealth grouping, ranked 8,740-10,239 out of a rare lineage universe of 18,979 and a Victorian 'bottom' grouping, the bottom ranked 5,000 wealth holders, out of the same 18,979 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

$$
W_{wd} = \frac{\sum\limits_{t=WarStart-5}^{WarStart} w_{jt} - \sum\limits_{t=WarEnd}^{WarEnd+5} w_{jt}}{\sum\limits_{t=WarStart-5}^{WarStart} w_{jt}}
\tag{1}
$$

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 1.

definition. (As an aside; the monarch is not subject to probate (Nash (2017) p.128)).

[14]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).

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

$$W_{j,t}^* = \frac{\sum\limits_{1892}^{1920} W_j}{28}(1 + r_{1920}^{net})(1 + r_{1921}^{net})\ldots(1 + r_{t-1}^{net}) \tag{2}$$

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

$$r^{net} = r - T^K \tag{3}$$

Observed Wartime destruction of wealth, by wealth grouping, is applied to W^* in 1945 to account for World War II (See table 4.2). 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 8 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.[15]

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

$$W_j = \alpha(W_j) + (1 - \alpha)W_j \quad 0 \le \alpha \le 1 \tag{4}$$

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)[16]:

$$\alpha = f(T^K, T^D, W, Z) \tag{5}$$

---

[15]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 (2015). That study, using a subsample of the PPR calendar data used in this paper, estimate the intergenerational correlation of dynastic wealth at .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 (2015), a finding that tends to get overlooked in the literature).

[16]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.

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 4. According to figure 1.1d, 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 $\approx 70 - 80\%$. Pre-War the PPR records reveal 'true' family wealth, W_j.[17] After they reveal $(1 - \alpha)W_j = W_j^{obs}$. [18]

Cumulative tax paid (T^p) is calculated as

$$T^p = \sum_{1920}^{t} T_t^D * W_{j,t}^{obs} \tag{6}$$

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 4.

$$HW_{j,t} = W_{j,t}^* - \left[W_{j,t}^{obs} + \frac{T^p}{30} \right] : W_{j,t}^* > W_{j,t}^{obs} + \frac{T^p}{30} \tag{7}$$

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:

$$HW_{j,t} = \left[W_{j,t}^{obs} + \frac{T^p}{30} \right] - W_{j,t}^* : W_{j,t}^* < W_{j,t}^{obs} + \frac{T^p}{30} \tag{8}$$

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:

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

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

$$W_{j,t} = (\frac{1}{1 - \alpha})W_{j,t}^{obs} \tag{10}$$

Newly created wealth is incorporated by adjusting upwards observed wealth (W^{obs}) by the implied population degree of tax avoidance, α.[19] This is initially given a value of $\alpha = .0$ for

[17]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 1.1a.

[18]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.

[19]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

Name	$Variable$	Source	Eq.
Directly Observed			
'True' Lineage Wealth	W	Probate Valuations 1892-1920	
Death Taxes	T^D	IR Tables, Figure 2.2	
Reported Wealth	$W^{obs} = (1-\alpha)W$	Probate Valuations 1920-92	
Taken from Other Studies			
Return on K	r	Piketty (2014)	
Tax on K income	T^K	Piketty (2014)	
Calculated			
Taxes Paid	T^p	$T^D(1-\alpha)W$	6
Net return on K	r^{net}	$r - T^K$	3
Expected Wealth	W^*	$(1-\alpha)W(1+r^{net})$	2
Hidden Wealth	HW	$[W^* - (W^{obs} + T^p)] > 0$	7
New Wealth	$-HW$	$(W^{obs} + T^p) - W^* < 0$	8
'True' Wealth, Inheritors	W	$W^* - T^p$	9
'True' Wealth, Non-Inheritors	W	$\frac{1}{1-\alpha}W^{obs}$	10
Proportion Hidden	α	HW/W	11

Notes: Estimated for rare surname j and time t. Summary terms for illustration, see text for detailed equations.

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

simplicity but is varied in section 5.4 when calculating wealth shares (see tables 4.4 and 5.2 for the empirical estimates).

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

$$\alpha_{j,t} = \frac{HW_{j,t}}{W_{j,t}} \tag{11}$$

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 11.

(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).

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 1 for all, and the dynasty groupings. Wartime wealth destruction is far greater in World War I than World War II, 35% versus 17% 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 29%. 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	64,250	41,994	0.346	396,343	34,259
Elites	2,145	919	0.572	2,761	990
Middling	35	62	-0.755	1,029	570
Bottom	13	117	-7.832	1,863	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	91,390	76,026	0.168	623,413	53,181
Elites	1,507	1,112	0.262	4,553	1,153
Middling	219	187	0.149	2,647	996
Bottom	327	316	0.033	5,308	2,514

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

4.2 The Relative Contribution of Wartime Destruction and Taxes to Wealth Accumulation: A Simple Simulation

What is the expected *cumulative* effect on elite inherited wealth of the calculated wartime destruction, return on capital and tax regime after 1920?

Figure 4.1 reports the growth rate of £1 billion (2015 pounds) in 1920, to 1992, under a set of varying assumptions. (Note that the y-axis scale is log(10)). The first estimated path is that the fortune grows at the average rate of the return to capital in the economy. This results in a sum of £222 billion in 1992. Applying the observed wealth destruction of elite fortunes from tables 4.1
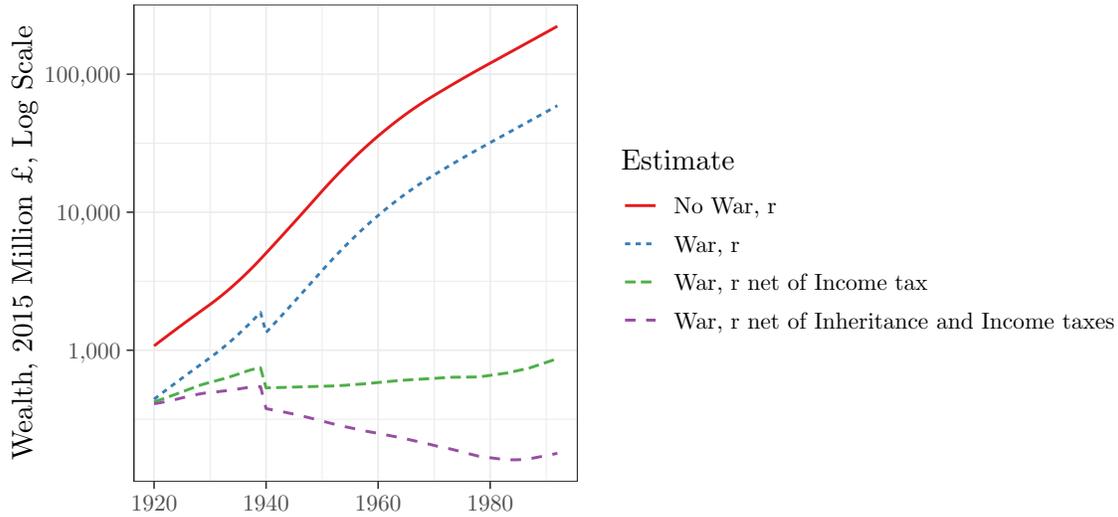
Figure 4.1: The effect of Wartime Destruction, r, and r net of income and inheritance taxes on Capital Accumulation
Source: Simulation.

and 4.2 during the wars reduces the terminal wealth in 1992 to £60 billion (a proportionate drop of 73%, compared to no War). Income taxes on capital during the 20th century reduced this 'No-War' potential wealth by 98%. Finally, Inheritance taxes (paid once per generation, the maximum rate is applied) reduced wealth proportionally by 80%. Together these forces left a 1920's fortune of 1 billion pounds worth .17 billion in 1992.

This suggests that capital income tax had the most *potential* effect on diluting elite wealth with a marginal proportionate effect of 99%. War (73% marginal effect) and inheritance tax (79%) were eclipsed by the annual compounding of capital income tax.

Of course this simple exercise assumes no avoidance or evasion by elite wealth holders. At minimum, it serves to illustrate that a strong incentive existed to hide wealth from taxation in England post 1920.

Table 4.3: The effect of War and Taxes on a fortune of £1 Billion in 1920 accumulating to 1992

Growth Path	Wealth, £bn. 1992	Lost Wealth	Prop. Loss	Marginal Prop. Loss
No War, r	222.73	0.00	0.000	0.00
War, r	59.17	163.56	0.734	0.73
War, r net of income tax	0.87	58.30	0.262	0.99
War, r net of inheritance an income tax	0.18	0.69	0.003	0.79

Note: Wealth is in Millions, £1920. *Source*: Simulation.

What do we observe about *actual* family fortunes, as revealed by rare surname dynasties, in England, 1892 to 1992?

4.3 Estimated and Observed Lineage Wealth Accumulation

The observed wealth shocks (tables 4.1 and 4.2) are applied to the estimated growth path of dynastic wealth, as described in equation 2. Figure 4.2 reports three series: estimated lineage wealth (equation 2), observed wealth $((1 - \alpha)W)$ and observed wealth plus taxes paid (T^p), accumulating at r^{net}, for all wealth holders, 1892-1992. At this aggregate, the *positive* difference between the estimated and observed series is new wealth creation (see also figure A.3 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 4.2b, the pattern is different. The first observation to note is the close correspondence of estimated and observed wealth from 1920 to 1940.[20]

After 1950, reported wealth at death is consistently and systematically below the level of wealth we would expect. This is hidden wealth. Its emergence is coincident with a large uptick in the levels of inheritance tax applied to estates of £5-10 Million (2015 prices) (see figure 2.2).

How much wealth is being hidden by these Victorian elites?

4.4 What is the Propensity to Hide Wealth?

Table 4.4 reports the sum of hidden wealth by decade (as equation 7) and the mean value of α (the proportion of 'true wealth' hidden) for the Victorian rare elite lineages, 1920-1990. The results indicate that a *lower* bound of 20-32% of 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 4.4: 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	2,300	2,099	2,169	131	0.057
1930	3,095	2,802	3,071	24	0.008
1940	2,517	2,380	2,879	-363	-0.144
1950	2,612	1,243	1,926	686	0.263
1960	2,817	1,378	2,238	579	0.206
1970	2,968	964	2,015	953	0.321
1980-92	4,497	1,798	3,557	939	0.209

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

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[20]Note also that reported wealth plus taxes paid is higher than expected wealth in the 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 the new high-tax regime. After 1950, this 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 A.3 in the appendix reports the same estimates for the Victorian mid and bottom Lineages.
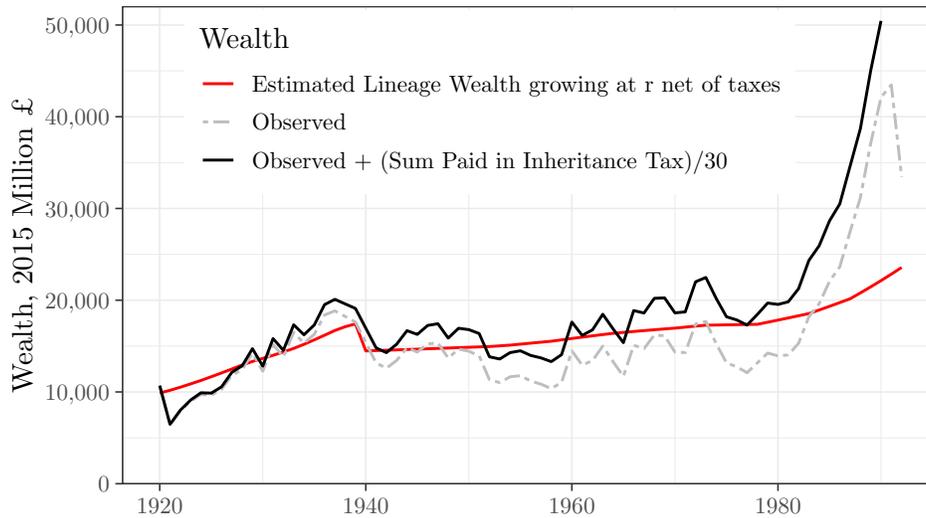
(a) All
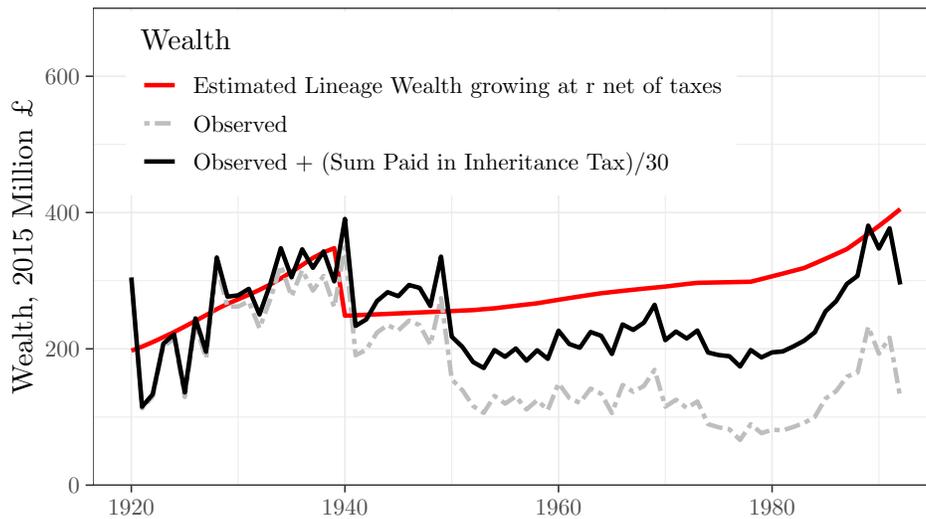
(b) Victorian Elite Lineages

Figure 4.2: Estimated and Observed Lineage Wealth, with taxes paid, all and Victorian top 1% Lineages

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 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	7.73	8.24	0	5	149
N, 2002	56,763	78.92	72.84	0	58	597
Inferred Wealth	56,763	.74	2.24	0	.17	120.62
Observed Wealth	56,763	.87	5.95	0	.35	1,269.79
Tax Paid	56,763	.25	4.92	0	.02	884.06
Hidden Wealth	56,763	−.28	6.09	−1,269.79	−.09	101.75
Hidden Wealth (>0)	56,763	.30	1.54	0	0	101.75
Proportion Hidden	56,763	−.28	.66	−1	−.5	1
Proportion Hidden (>0)	56,763	.18	.31	0	0	1
Hide Any Wealth	56,763	.30	.46	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.[21] The size of these dynasties varies from 0-149 people dying in 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. 30% of the sample report wealth below what we would expect from their pre-1920 inheritance.[22] 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 2.1).[23]

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[21]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.

[22]There are 3,311 dynasties hiding £3 Billion (£2015). 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.

[23]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)

I calculate deciles based upon the observed wealth at death of a surname and also the inferred wealth, separately.

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 distribution of the proportion of newly created and hidden wealth, as calculated by equation 11, by inferred 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 bimodal. 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 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 36% of their wealth, on average in 1950-80. This estimate corresponds closely to the estimate of apx. 40% of wealth hidden by the top decile of Scandinavian wealth estimated by Alstadsæter et al. (2019) (see their figure 3 bottom panel).[24]

From 1980-92 these relative percentages are 19 and 8 respectively with the 70-80th and 80-90th percentiles falling in between, in both generations.

The 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.

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, I code categorical variables to capture potential non-linear associations.

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[24]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.
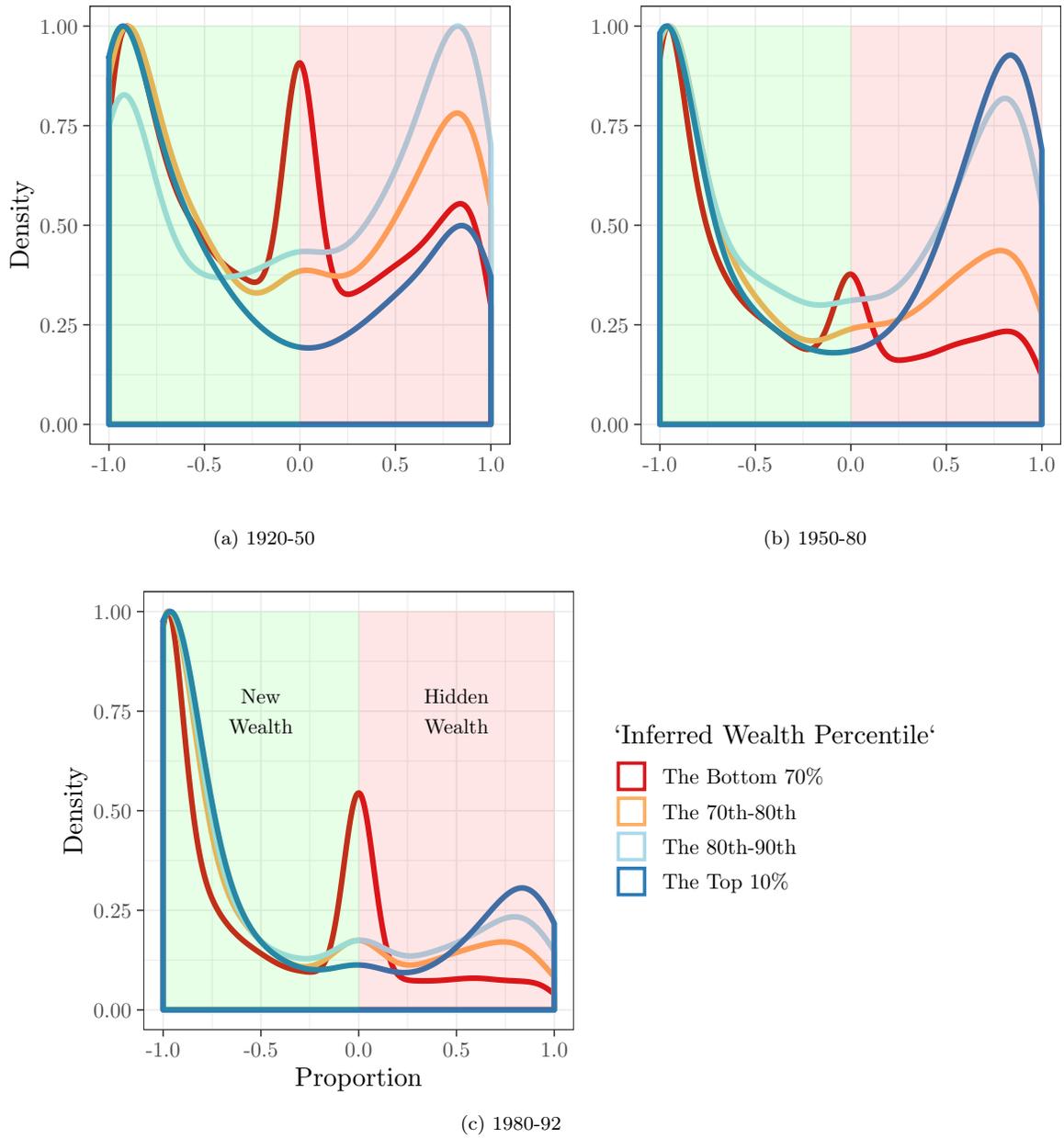
(a) 1920-50

(b) 1950-80

(c) 1980-92

'Inferred Wealth Percentile'

The Bottom 70%

The 70th-80th

The 80th-90th

The Top 10%

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

Table 5.2: Mean Proportion of Wealth Hidden, Surname Level

Inferred	Generation			
Wealth Percentile	1920-50	1950-80	1980-92	N
The Top 10%	.24	.36	.20	5,552
The 80th-90th	.35	.31	.16	5,618
The 70th-80th	.29	.22	.12	5,640
The Bottom 70%	.21	.15	.08	39,530

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

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:

$$Y^j = c + \beta_1 \sum D_{OW}^j + \beta_2 X^j + \beta_3 ln(N_{2002}^j) \tag{12}$$

$$Y^j = c + \beta_1 \sum D_{OW}^j + \sum \beta_{2i} D_{X^j} + \beta_3 ln(N_{2002}^j) \tag{13}$$

$$X^j = \left\{ D_{Hider}^j, HW^j, \alpha^j \right\} \tag{14}$$

$$Y^j = \left\{ D_{Paradise}^j, H_{pcv}^j j, OXB^j \right\} \tag{15}$$

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.[25]

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_{ppcv}^j, 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, $D_{Paradise}$.

---

[25]In appendix table A.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.

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.[26] 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[27]. (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 A.1.)

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 1.35-1.42 relative to the odds of the bottom 70%. The simple hider dummy also indicates a higher odds of appearing (1.2 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 1.4 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 a annual hidden wealth amounting to over £1m is approximately equal to the effect of being in the top 10% of the observed wealth distribution.[28]

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.[29] I have anonomyzed the names. While the method employed here can claim that the Victorian Elite 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 A.2 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.

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[26]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 observations that record at least one death 1980-92.

[27]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.

[28]Investigations of the empirical models of the form in equations 12 and 13 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).

[29]Table A.2, 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.

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	1.020	.996	1.013	1.030	1.029
	$t = .245$	$t = -.049$	$t = .159$	$t = .366$	$t = .354$
80-90	1.130	1.098	1.124	1.139	1.139
	$t = 1.558$	$t = 1.206$	$t = 1.494$	$t = 1.660$	$t = 1.659$
The Top 10%	1.423	1.369	1.412	1.429	1.431
	$t = 4.598^{***}$	$t = 4.161^{***}$	$t = 4.490^{***}$	$t = 4.644^{***}$	$t = 4.659^{***}$
D_{Hider}	1.212				
	$t = 3.060^{**}$				
Hidden Wealth		1.047			
		$t = 2.558^{*}$			
HW: 0-.2m			1.025		
			$t = .238$		
HW: .2m-1m			1.251		
			$t = 2.568^{*}$		
HW:>1m			1.411		
			$t = 3.123^{**}$		
Prop. Hidden, α				1.385	
				$t = 3.356^{***}$	
α: 0-.5					1.099
					$t = 1.041$
α .5-.75					1.359
					$t = 2.918^{**}$
α. 75-.9					1.191
					$t = 1.303$
α>.90					1.330
					$t = 1.927$
N_{2002}	1.004	1.004	1.004	1.004	1.004
	$t = 13.004^{***}$	$t = 12.903^{***}$	$t = 13.034^{***}$	$t = 13.031^{***}$	$t = 13.026^{***}$
Observations	15,975	15,975	15,975	15,975	15,975
Log Likelihood	-5,705.695	-5,707.217	-5,703.138	-5,704.845	-5,704.194
Akaike Inf. Crit.	11,423.390	11,426.430	11,422.280	11,421.690	11,426.390

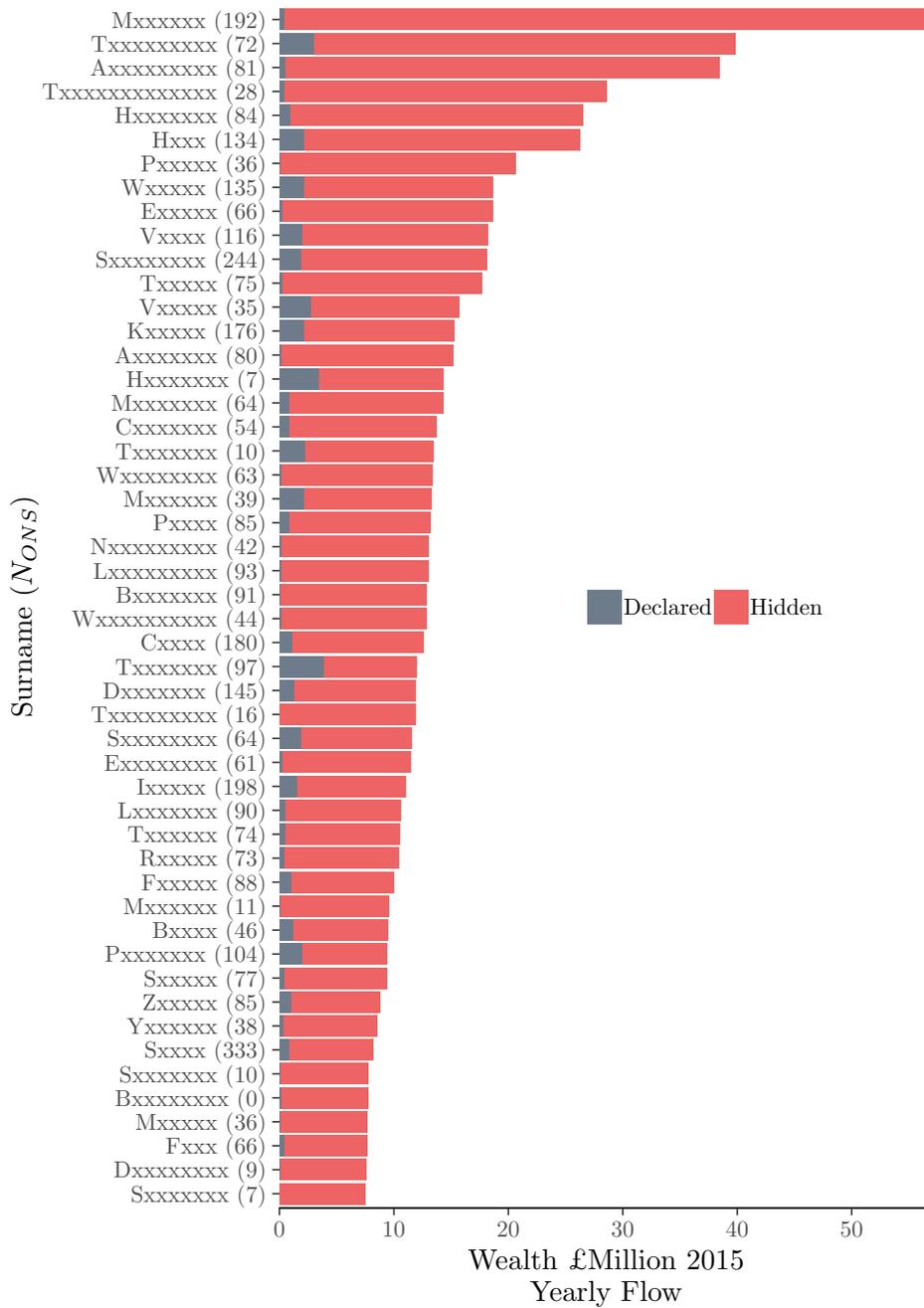| *Note:*	*p<0.05; **p<0.01; ***p<0.001
	Wealth is in 2015 Pounds, Per Annum flow
	No hidden wealth and $\alpha = 0$ are the omitted categories
	Hidden wealth is calculated 1980-92, estimated via logistic regression
	Odds Ratios are reported with t-stats in parantheses

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

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 12 and 13, 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 £100,000 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 £40,000 more expensive (col. 1). Knowing that a dynasty has over £1m in hidden wealth is associated with them, again on average, living in a postcode with nearly £90,000 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 12 and 13) 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 .17 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

5.4 '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 1.1a 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 5.3 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 4.4 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 10% of the 'true' wealth distribution, equivalent to a 33% reversal of the observed decline. Further, from 1940 to 1970, there is no decrease in the 'true' top decile share.[30]

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[30]This finding is similiar 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".

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	16.2*	13.1	15.0	17.3*	16.9*
	(7.6)	(7.6)	(7.6)	(7.7)	(7.7)
80-90	47.3***	43.6***	46.3***	48.1***	47.9***
	(7.8)	(7.8)	(7.8)	(7.9)	(7.9)
The Top 10%	95.3***	89.1***	93.4***	95.1***	95.5***
	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)
D_{Hider}	38.4***				
	(6.0)				
Hidden Wealth		13.7***			
		(2.3)			
HW: 0-.2m			11.0		
			(9.6)		
HW: .2m-1m			34.4***		
			(8.5)		
HW:>1m			86.7***		
			(11.6)		
Prop. Hidden, α				57.6***	
				(9.3)	
α: 0-.5					27.9**
					(8.7)
α .5-.75					41.7***
					(10.6)
α. 75-.9					67.1***
					(13.0)
α>.90					27.1
					(14.6)
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 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	.098***	.092***	.096***	.100***	.099***
	(.022)	(.022)	(.022)	(.022)	(.022)
80-90	.124***	.117***	.122***	.124***	.124***
	(.023)	(.023)	(.023)	(.023)	(.023)
The Top 10%	.263***	.251***	.259***	.262***	.263***
	(.024)	(.024)	(.024)	(.024)	(.024)
D_{Hider}	.072***				
	(.017)				
Hidden Wealth		.035***			
		(.007)			
HW: 0-.2m			.035		
			(.027)		
HW: .2m-1m			.051*		
			(.025)		
HW:>1m			.167***		
			(.033)		
Prop. Hidden, α				.100***	
				(.027)	
α: 0-.5					.064*
					(.025)
α .5-.75					.068*
					(.031)
α. 75-.9					.113**
					(.037)
α>.90					.051
					(.042)
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	.041	.042	.042	.041	.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
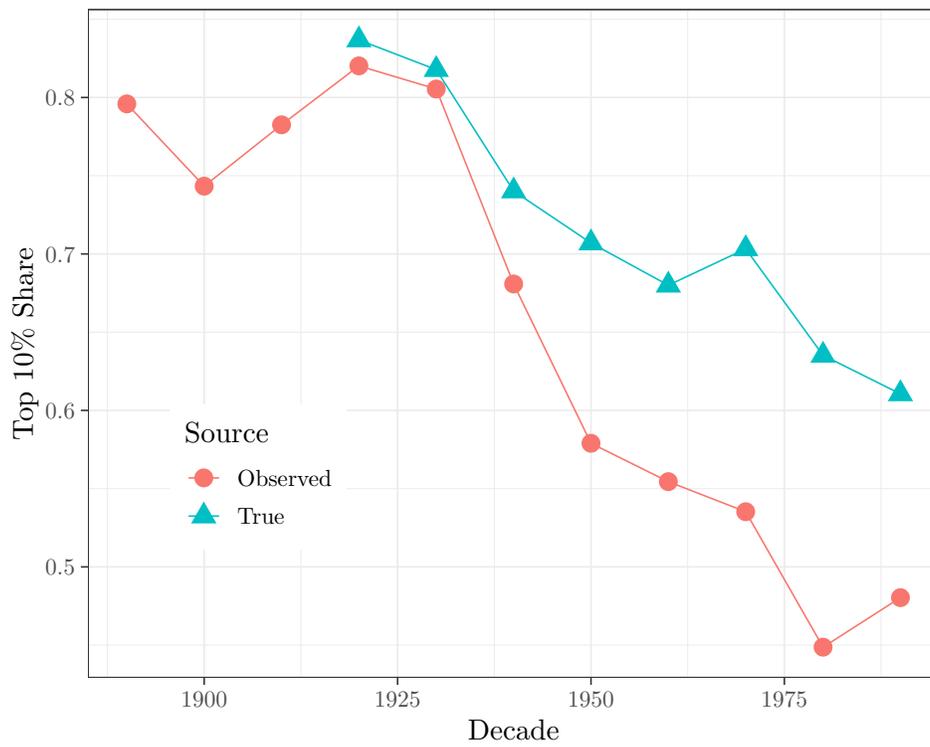
Figure 5.3: Top 10% Shares, Observed and 'True'

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

6 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 3,311 dynasties hiding £3 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 about 20-32% of their true inherited wealth. Hidden wealth, calculated from the pre-WWI era, has a strong effect on the probability of a surname appearing in the *Offshore Leaks Database* of 2013-6. Hidden wealth boosts the value of hiding dynastyies' 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 33% 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

List of Tables

List of Figures

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

Table A.1: 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	.002	−.001	.001	.002	.002
	(.008)	(.008)	(.008)	(.008)	(.008)
80-90	.007	.004	.007	.008	.008
	(.008)	(.008)	(.008)	(.008)	(.008)
The Top 10%	.041***	.037***	.040***	.041***	.041***
	(.009)	(.009)	(.009)	(.009)	(.009)
D_{Hider}	.020**				
	(.006)				
Hidden Wealth		.007**			
		(.002)			
HW: 0-.2m			.004		
			(.010)		
HW: .2m-1m			.025**		
			(.009)		
HW:>1m			.036**		
			(.012)		
Prop. Hidden, α				.033***	
				(.010)	
α: 0-.5					.011
					(.009)
α .5-.75					.033**
					(.011)
α. 75-.9					.014
					(.014)
α>.90					.029
					(.015)
N_{2002}	.001***	.001***	.001***	.001***	.001***
	(.00004)	(.00004)	(.00004)	(.00004)	(.00004)
Constant	.063***	.068***	.063***	.063***	.063***
	(.004)	(.004)	(.004)	(.004)	(.004)
Observations	15,975	15,975	15,975	15,975	15,975
R^2	.020	.020	.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 A.2: Hidden Wealth by Lineage, the top 50

Surname	Hidden Wealth	α	N_{2002}	$D_{Paradise}$	Victorian Elite
Mxxxxxx	56,662,762	0.992	192	0	1
Axxxxxxxxx	37,881,553	0.985	81	0	1
Txxxxxxxxx	36,813,438	0.925	72	0	1
Txxxxxxxxxxxxx	28,182,689	0.986	28	0	1
Hxxxxxxx	25,525,283	0.963	84	0	1
Hxxx	24,067,787	0.917	134	1	1
Pxxxxx	20,565,130	0.997	36	1	1
Exxxxx	18,375,274	0.987	66	0	1
Txxxxx	17,413,324	0.985	75	0	1
Wxxxxx	16,472,154	0.881	135	0	1
Sxxxxxxxx	16,227,424	0.893	244	1	1
Vxxxx	16,209,211	0.890	116	0	1
Axxxxxxx	14,962,730	0.988	80	0	1
Mxxxxxxx	13,440,458	0.939	64	0	1
Wxxxxxxxx	13,180,048	0.987	63	0	1
Kxxxxx	13,126,538	0.857	176	1	1
Vxxxxx	12,923,619	0.825	35	0	1
Nxxxxxxxxx	12,843,163	0.985	42	1	1
Lxxxxxxxxx	12,832,084	0.985	93	1	1
Cxxxxxxx	12,814,435	0.935	54	0	1
Bxxxxxxx	12,784,589	0.994	91	0	1
Wxxxxxxxxxx	12,644,799	0.985	44	0	1
Pxxxx	12,306,241	0.933	85	0	1
Txxxxxxxxx	11,867,111	0.999	16	0	1
Cxxxx	11,479,812	0.912	180	0	1
Exxxxxxxxx	11,200,291	0.978	61	0	1
Txxxxxxx	11,199,033	0.830	10	1	1
Mxxxxxx	11,135,647	0.835	39	0	1
Hxxxxxxx	10,880,556	0.757	7	0	1
Dxxxxxxx	10,588,493	0.886	145	0	1
Lxxxxxxx	10,036,708	0.944	90	0	1
Rxxxxx	10,020,063	0.955	73	0	1
Txxxxxx	10,002,901	0.946	74	0	1
Sxxxxxxxx	9,678,004	0.837	64	0	1
Mxxxxxx	9,457,449	0.992	11	1	1
Ixxxxx	9,426,180	0.855	198	0	1
Fxxxxx	8,983,592	0.899	88	0	1
Sxxxxx	8,940,986	0.951	77	1	1
Bxxxx	8,231,496	0.869	46	0	1
Yxxxxxx	8,199,986	0.960	38	1	1
Txxxxxxx	8,070,667	0.673	97	0	1
Zxxxxx	7,708,226	0.878	85	1	1
Sxxxxxxx	7,633,713	0.980	10	0	1
Bxxxxxxxx	7,572,820	0.977	0	0	1
Mxxxxx	7,551,155	0.982	36	0	1
Dxxxxxxxx	7,518,020	0.987	9	0	1
Sxxxxxxx	7,450,607	0.996	7	0	1
Pxxxxxxx	7,433,521	0.789	104	0	1
Sxxxx	7,293,531	0.894	333	0	1
Fxxx	7,206,546	0.939	66	1	1

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

Years	All	Probated
1892-1980	0	0
1981	.13	.30
1982	.25	.55
1983	.27	.59
1984	.28	.63
1985	.23	.59
1986	.22	.56
1987	.23	.60
1988	.24	.63
1989	.25	.67
1990	.29	.77
1991	.30	.80
1992	.25	.84

Table A.3: Proportion of All Decedents and those Probated with Banded Probate Valuations

A.1 Banded Probate Valuations After 1980

After 1980 there was a change in the system for valuing probates in the calendars. As opposed to an exact valuation, which was the practice 1892-1980, a proportion of valuations appear as bands. Namely, these are £25,000, £40,000, £70,000, £100,000, £115,000 and £125,000 with each entry listed as "Not Exceeding" the named amount. Table A.3 reports the overall incidence of the banded values, 1892-1992. As noted in Cummins (2019)(see the discussion there in appendix A.1), it is evident that these bands are loosely applied.

Where estate values are reported as a banded value, I generate a normally distributed random number. This random number is calibrated on the observed data. For example, where the estate value is listed as "£100,000", I generate a random estate value with the observed means and standard deviation of all non-banded estates under £100,000 and above £70,000 (the next lower band). Table A.4 reports the attributed means and standard devotions for these estimates as well as the numbers of observations transformed.

Table A.4: Attributing Ranged Random Values to Banded Probate Values, 1981-92

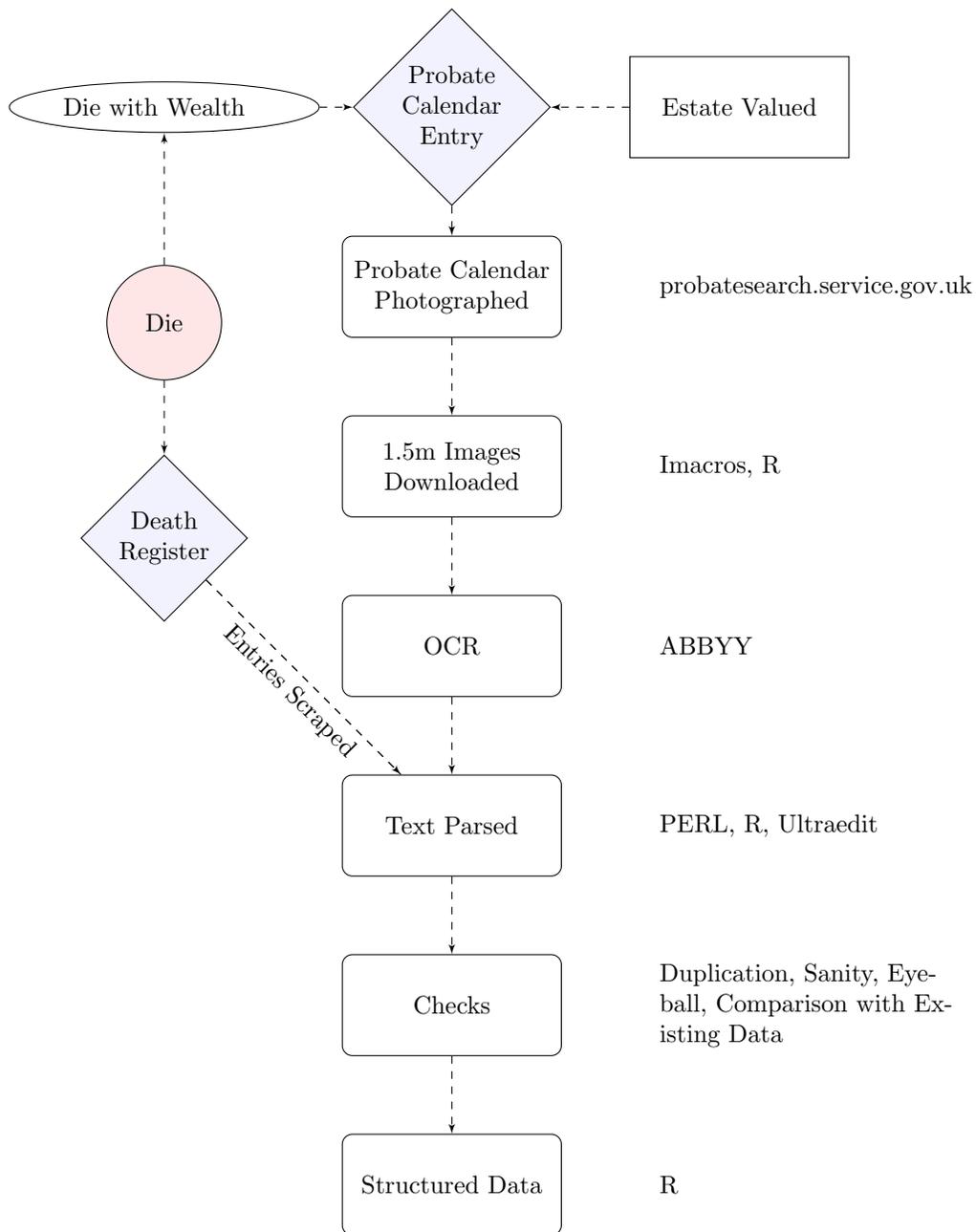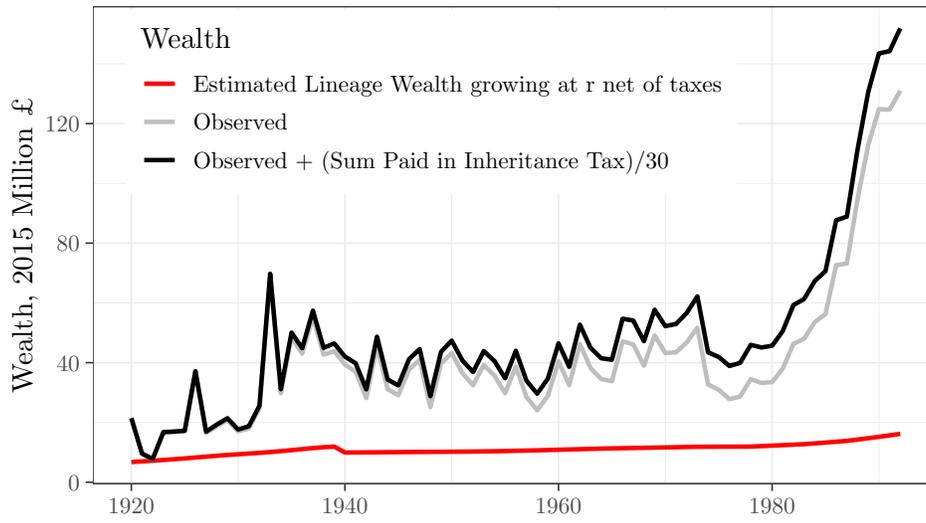| Band	Mean	SD	N
25,000	9,096	6,502	291,105
40,000	32,401	4,353	546,098
70,000	54,913	8,670	265,861
100,000	84,833	8,596	148,498
115,000	113,947	7,211	164,913
125,000	120,236	2,921	244,297

A.2 Extra Results

Figure A.2: Flow-Chart of Probate Data Generation

Notes: See Cummins (2019) for a detailed account of the source, construction and validation of the PPR data.
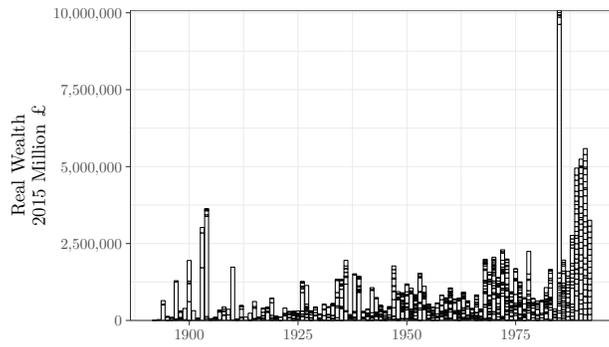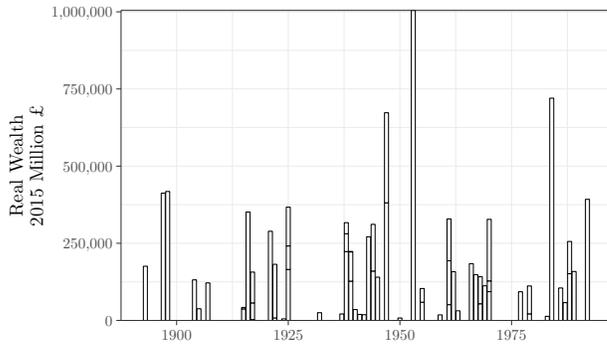
(a) Victorian 'Middling' Lineages
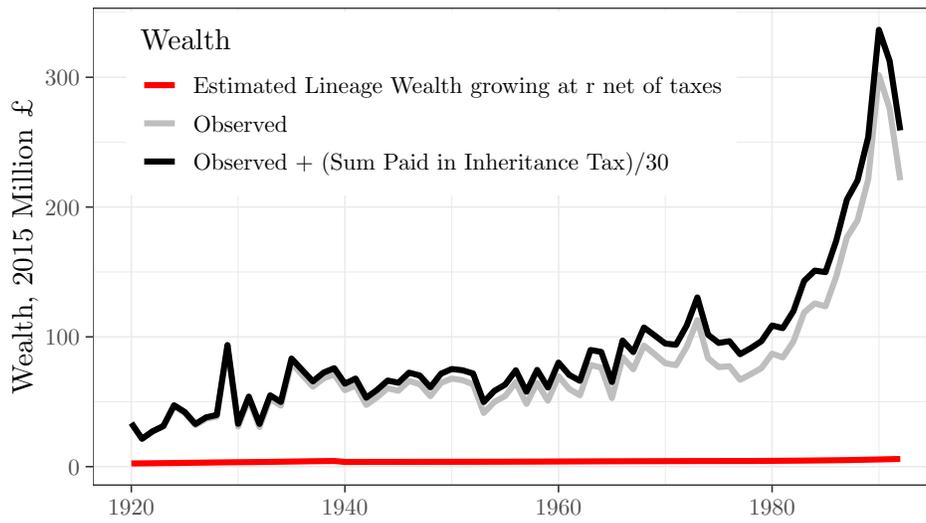
(b) Victorian Bottom Lineages

Figure A.3: Estimated and Observed Lineage Wealth, with taxes paid, Victorian mid and bottom Lineages
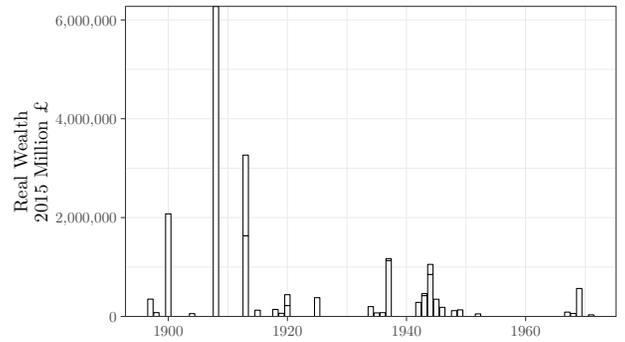
Source: 100% PPR Calendar Sample.
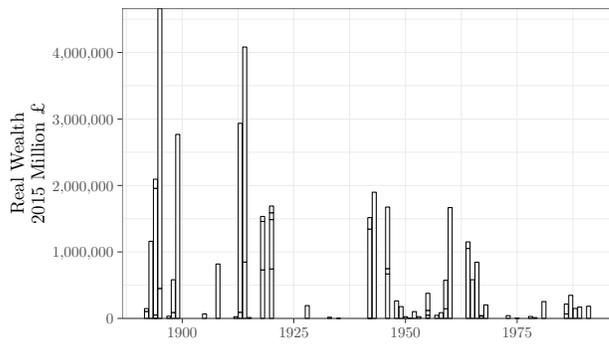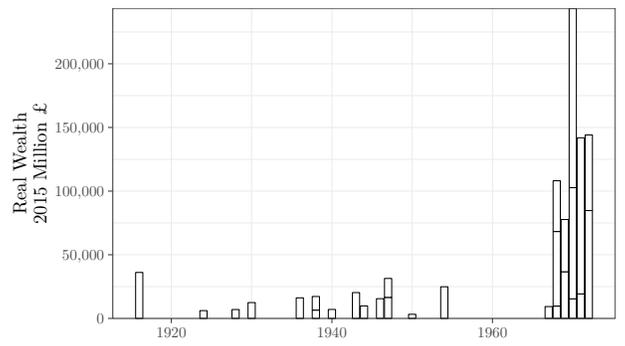
(a) Cummins's

(b) Comyns's

(c) Xxxxxx's

(d) Axxxx's

(e) Dxxxxxxxx's

Figure A.4: Example of Lineage Wealth by Rare Surname

Source: 100% PPR Calendar Sample.

Table A.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	1.127	1.109	1.123	1.131	1.131
	[3.829]***	[3.338]***	[3.695]***	[3.938]***	[3.926]***
Observed Wealth Squared	.998	.999	.998	.998	.998
	[−1.368]	[−.986]	[−1.269]	[−1.460]	[−1.450]
Observed Wealth Cubed	1.000	1.000	1.000	1.000	1.000
	[.645]	[.330]	[.563]	[.726]	[.717]
D_{Hider}	1.216				
	[3.123]**				
Hidden Wealth		1.048			
		[2.602]**			
HW: 0-.2m			1.034		
			[.318]		
HW: .2m-1m			1.249		
			[2.558]*		
HW:>1m			1.418		
			[3.173]**		
Prop. Hidden, α				1.402	
				[3.495]***	
α: 0-.5					1.095
					[1.001]
α .5-.75					1.356
					[2.911]**
α. 75-.9					1.204
					[1.391]
α>.90					1.363
					[2.094]*
N_{2002}	1.004	1.004	1.004	1.004	1.004
	[13.785]***	[13.635]***	[13.809]***	[13.824]***	[13.822]***
Observations	15,975	15,975	15,975	15,975	15,975
Log Likelihood	-5,705.336	-5,706.928	-5,702.866	-5,704.227	-5,703.688
Akaike Inf. Crit.	11,422.670	11,425.860	11,421.730	11,420.450	11,425.380

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 A.6: Examples of English Lineage Names Found in Paradise Papers

Name	Source	Hidden Lineage Wealth	α	N, 2003	N, Paradise	Victorian Elite
XXX XXXXXXXXX	Paradise Papers - Samoa corporate registry	2,283,369	0.59	209	13	1
XX. XXXXXX XXXXX XXXXXXX	Panama Papers	858,169	0.88	52	3	1
XXXXXXXXX XXXXXX	Paradise Papers - Malta corporate registry	190,674	0.79	21	2	
XXXXXX XXXX XXXXXXXXX	Panama Papers	2,127,503	0.40	233	3	1
XXXXX XXXXXXX X.	Paradise Papers - Barbados corporate registry	199,070	0.82	111	2	
XXXXXX XXXXXXXX	Paradise Papers - Barbados corporate registry	95,132	0.25	168	4	
XXXXXX XXXX XXXXXXXX	Paradise Papers - Barbados corporate registry	1,255,102	0.96	132	2	
XXXXXXX XXXXXX XXXXXXX XXX	Paradise Papers - Appleby	83,087	0.32	29	4	

Hidden Wealth is Annual Flow, in 2015 pounds