Are there Ruling Classes? Surnames and Social Mobility in England, 1800-2011

Gregory Clark, University of California, Davis

Neil Cummins, Queens College, CUNY[1]

Using rare surnames we track the socio-economic status of descendants of a sample of English rich and poor in 1800, until 2011. We measure social status through wealth, education, occupation, and age at death. Our method allows unbiased estimates of mobility rates. Paradoxically, we find two things. Mobility rates are lower than conventionally estimated. There is considerable persistence of status, even after 200 years. But there is convergence with each generation. The 1800 underclass has already attained mediocrity. And the 1800 upper class will eventually dissolve into the mass of society, though perhaps not for another 300 years, or longer.

Introduction

What is the fundamental nature of human society? Is it stratified into enduring layers of privilege and want, with some mobility between the layers, but permanent social classes? Or is there, over generations, complete mobility between all ranks in the social hierarchy, and complete long run equal opportunity? This paper examines this question for 8 generations of the English over the 211 years from 1800 to 2011.

Existing studies of social mobility almost all examine inheritance over one generation. This is because most of these studies are based on modern social science panels which span only the last 40-60 years. Other historical studies could potentially cover more generations. But in practice the difficulty of linking sufficient individual families over 3 or more generations to form such a study with information on earnings, education or wealth has been insurmountable. Here we are able to

[1] We thank Colin Cameron for an important suggestion on how to estimate the true underlying bs. Joseph Burke, Tatsuya Ishii, and Claire Phan provided excellent research assistance. Clark received financial support from NSF grant SES 09-62351, 2010-2012.

measure wealth at death 1858-2011, and educational attainment 1800-2011 for 5-8 generations of rich and poor English families, using rare surnames to link the generations.

Mobility studies typically estimate the degree of regression to the mean, *(1-b)*, when the outcome measure for the second generation, y_1 , is regressed on the same outcome for the previous generation, y_0 in the expression

$$y_1 = a + by_0 + e \qquad (1)$$

The outcome *y* is mostly the log of earnings, or the log of years of schooling. Only a limited group of studies look at wealth. Here we derive the implied regression to the mean for wealth over 5 generations measured as death cohorts (and 6 generations measured as birth cohorts), and for education over 8 generations.

Table 1 outlines the findings on intergenerational mobility for recent years in the USA, UK and Scandinavia. Earnings persistence seems to be highest in the USA and the UK, and much lower in Scandinavia. However, persistence in years of schooling is highest in the UK, and lowest in the USA. Persistence in years of schooling is generally as high, or higher, than persistence in income. Persistence in wealth is similar to persistence in earnings in the US, and moderately higher in the UK, but the number of studies of wealth is extremely limited.

Economists such as Gary Becker have argued that whatever the exact value of b, such studies show that in the long run – meaning 2-3 generations – we live in a world of complete social mobility. For if all that predicts the earnings, years of education or wealth of children is that of their parents, then by iteration over n generations

$$y_n = a + b^n y_0 + u_n \qquad (2)$$

Suppose b is even as high as 0.5. Then $b^2 = 0.25$, $b^3 = 0.125$, $b^4 = 0.06$, $b^5 = 0.03$. Thus within a few generations most of the advantages and disadvantages of earlier generations get wiped out. All that matters for income in generation *n* is the cumulative random component u_n. Indeed if the income distribution is stable then the amount of the variance in y that is explained by inheritance will be b^2. So that even with a *b* of .5, only a quarter of the variance in earnings or inheritance can come from inheritance. Thus Becker and Tomes conclude (admittedly assuming $b = .3$)

Table 1: Modern Intergenerational Elasticities

Country	Earnings (raw)	Earnings (corrected)	Years of Schooling	Wealth
USA	0.40	0.55	0.46	0.37-0.69
UK	0.32	0.30	0.71	0.35-0.61
Scandinavia	0.13	<0.30	0.49	-

Source: Earnings – Jäntti,et al (2006), average of men and women, as reported in Black and Devereaux (2010), table 1. Earnings corrected for measurement bias - Black and Devereaux (2010), p. 16. Schooling - Hertz et al., 2007, table 2. Wealth - Menchik, 1979 (parents, 1930-47, children 1947-1976), Charles and Hurst, 2003, Mulligan, 1997, Horbury and Hitchen, 1979, 120.

> *Almost all earnings advantages and disadvantages of ancestors are wiped out in three generations. Poverty would not seem to be a "culture" that persists for several generations* (Becker and Tomes, 1986, S32).

But there are several reasons why these one generation *b* estimates systematically overestimate true social mobility.

The first problem is measurement error. Earnings and wealth can vary substantially over a person's lifetime. This can be corrected for in the case of earnings, and the true intergenerational elasticity of earnings is as much as 50 percent greater than the measured (see the third column of table 1). The problem does not arise much with years of schooling, as Black and Devereux (2010) point out. There is less error in measurement of years of schooling than of earnings or wealth, and schooling is completed early in the life cycle so that total years of schooling can be observed both for parents and for their children by the time they reach 25-30 years.

But even correcting for such measurement errors, the b's economists estimate are still going to be downward biased. As a measure of underlying social status earnings, years of education, and wealth are all imperfect – no matter how accurately they are observed. Earnings will always be an imperfect measure of the true social status of people (since people trade off earnings for other work conditions). People also trade off wealth for other life attributes. And years of education are an imperfect proxy for the status, earnings and other satisfactions conferred by different types of education. This means that however well done these studies are, they should always tend to underestimate the true persistence of social status.

This measurement problem means that if we classify people as high or low status based purely on their earnings, income, or wealth, then those identified as high status have more positive measurement errors, and those identified as low more negative errors. Even if true socio-economic status was perfectly inherited, the observed status would regress to the mean.

Using multiple generations we can get round this problem, and get true estimates of the underlying bs in two ways.

(1) By using multiple generations of people classified through their surnames in the initial period as being rich or poor, this measurement error problem disappears once we estimate regression to the mean of the second or later generations. Comparing the second generation to the third generation, the second generation will have an average measurement error of 0 across both rich and poor surname groups. They were identified by what happened in the previous generation. After the first generation, the later intergeneration estimates will be unbiased by measurement error.[2]
(2) Even if we perform conventional regressions between generations to estimate b, where those of high status will tend to have a positive measurement error, these estimates can be corrected for the consequent attenuation by using the estimates from later generations.

In particular the expected value of such an estimate of b, for the first to the second generation, $\hat{b}$ is

$$E(\widehat{b}) = b\theta$$

where $0 < \theta < 1$ is an unknown attenuation from measurement error. But when we look from the first to the third generation we similarly get an estimate of b^2 which has an expected value,

[2] This argument applies if we treat the rich and poor as discrete groups and compare their average status.

$$E(\widehat{b^2}) = b^2\theta$$

So by dividing the two estimates we will get an unbiased estimate of the true first generation *b*. By using multiple generations identified by surnames we can get around the problem of measurement error.[3]

A second factor that operates in exactly the same way as measurement error is the substantial component of chance in the attained social status of any specific individual. Individuals will happen to be employed by successful businesses, as opposed to those which go bankrupt. Some will just pass the test for university admission, others will just fail. This correctly measures an aspect of social mobility. It is not measurement error, and should be included in the estimates of the *b* between generations and their successors. But if we use the *b* estimated from such observations of parents and children, and try to then project the long run movement of incomes as b^2, b^3, …. we will fail. Specifically we will overestimate the rapidity of convergence, because in the first generation richer people will have had good luck on average, poorer people bad luck. But again over later generations the descendants of rich and poor will have average luck. So the tendency to regress to the mean will decline after the first generation.

This can be illustrated with a simple example. Suppose that there is not universal regression to the mean, but a society divided into permanent social classes. Suppose that the observed (log) income of any family i of class j in generation t is

$$y_{ijt} = a_j + e_{ijt}$$

where income is correctly measured but has a substantial random component *e*. Children inherit perfectly the social class of their parents.

In this society if we regress income of families in one generation on that of the previous generation then we will estimate classic regression to the mean. That is, if we estimate,

$$y_{ijt+1} = a + by_{ijt} + u_{ijt}$$

then the estimated value of b will be

[3] We are grateful to Colin Cameron for pointing this out.

$$\hat{b} = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2} < 1$$

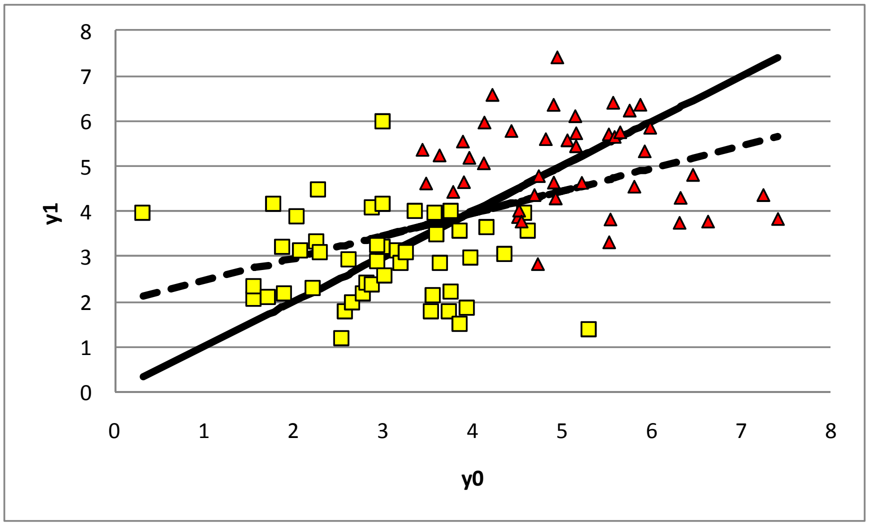
But this would give us completely the wrong impression about the long run convergence of incomes towards the mean. For the b estimated between two groups n generations apart would always be just this first generation b. Here the long run b is actually close to 1. The longer the distance between generations, the closer to 1 would we estimate the true b.

Figure 1 shows a simple simulation of this society of hidden classes where there are two social classes, with the first (shown by the squares) having an underlying inherited component of income a_1 of 3 plus a random shock, and the second (the triangles) an inherited component a_2 of 5 and again a random shock, and where the true b is 0. In this case there are persistent social classes, and the true underlying persistence coefficient b is 1. But if we just pool the data and estimate the coefficient b, then the estimated value is 0.5. The dashed line shows the estimated connection.

In this example, the estimated b linking grandparents and grandchildren, and even more distant generations will always be 0.5. After one generation there will be no further regression to the mean. As can be seen in figure 1 the two groups can never merge in income with this specification, because the groups are regressing to different mean incomes. But here, once we included separate intercepts for each class, the estimated b becomes close to the true 0 (-0.04 for this simulation). There are persistent classes.

If, however, we do not know a priori what the social strata are – because, for example, they are distinguished by race or religion - then there will be no way of disentangling the various social classes looking just at successive generations. Presented with the raw data we would observe just the general regression to the mean of the world of complete long run mobility. So to observe the true rates of social mobility, and whether there are persistent social classes in any society, we need to be able to look at families across multiple generations.

Figure 1: Seeming Regression to the mean with different social classes



Rare Surnames

The key idea of this paper is not to look at specific family linkages across generations, but instead to exploit naming conventions as a way to track families. We can track economic and social mobility using surnames in a society like England because, from medieval times onward, children inherited the surname of their father or mother.

Before 1960 the overwhelming majority of children inherited the father's surname. Only where the birth was illegitimate would the child bear the mother's surname, and such cases constitute typically only 3% or less of births. Also adoption in England only became legally possible in England in 1926.[4] Since 1960 children have increasing derived their surnames from their mothers, with now 25-30% of surnames coming from this source. But until recently surnames also trace the path of the Y chromosome, and their later frequency can also measure reproductive success.

[4] McCauliff, 2006.

At the time of establishment in the Middle Ages many surnames were a marker of economic and social status. Many people, for example, were named after their occupation. By 1881 10 percent of surnames derived from an occupation: *Smith*, *Wright*, *Shepherd*, *Baker*, and so on. Slow but persistent social mobility, however, meant that by 1650 common surnames were of uniform social status. Common surnames were equally likely to be found at all levels of the social hierarchy – criminals, workmen, traders, clergy, members of Parliament, the wealthy.

To trace mobility through surnames after this we can, however, turn to rare surnames.[5] In England there always has been a significant fraction of the population holding rare surnames. Figure 2, for example, shows the share of the population holding surnames held by 50 people or less, for each frequency grouping, for the 1881 census of England. The vagaries of spelling and transcribing handwriting mean that, particularly for many of the surnames in the 1-5 frequency range, this is just a recording or transcription error. But for names in the frequency ranges 6-50, most will be genuine rare surnames. Thus in England in 1881 5 percent of the population, 1.3 million people, held 92,000 such rare surnames.

Such rare surnames arose in various ways: immigration of foreigners to England, such as the Huguenots after 1685 (example, *Abauzit*, *Bazalgette*), spelling mutations from more common surnames (*Bisshopp*), or just names that were always held by very few people, such as *Binford* or *Blacksmith*.

Through two forces – the fact that many of those with rare names were related, and the operation of chance – the average social status of those with rare surnames will vary greatly at any time. We can thus divide people post 1650 into constructed social and economic classes of rich and poor by focusing on those with rare surnames. We will not be able to discern exactly which later person with a surname was related to which earlier one. But by treating everyone with the surname as one large family we can follow people over many generations.

In this paper we construct of initial rich and poor surname samples for the years 1800 on by choosing rare surnames where the average person at death in the interval 1858-1887 was either wealthy or poor. The exact way this is done is described below. This initial window was chosen because national measures of wealth at death become available only in 1858.

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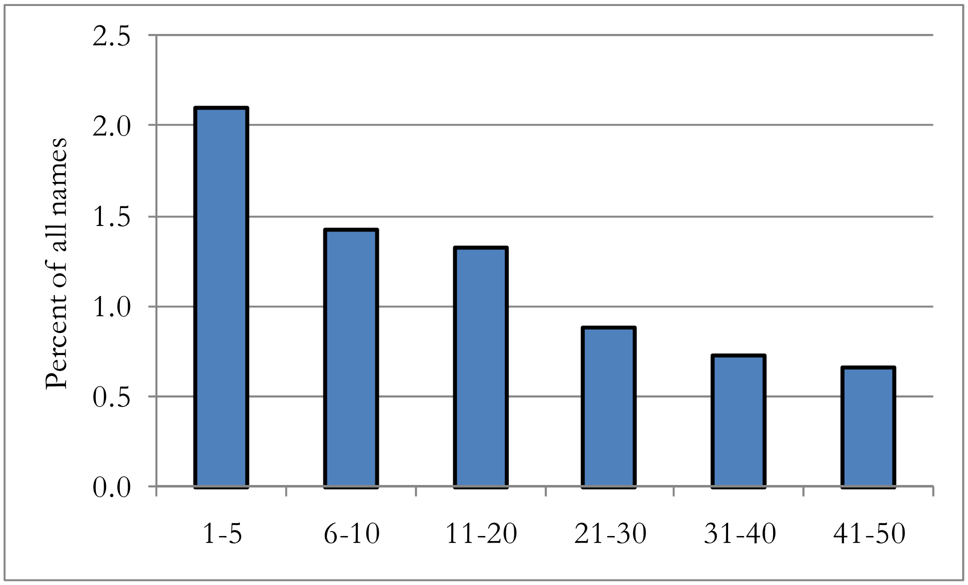
[5] See the interesting study of Güell, Rodríguez Mora, Telmer (2007) which also measures social mobility through rare surnames, but using cross-section data.

Figure 2: Relative Frequency of Rare Surnames, 1881 Census, England



The list of every tenth name of the rich in the sample dying 1858-87, listed alphabetically, is Auriol, Berthon, Brightwen, Buttanshaw, Clagett, Cornwallis, Daubuz, Filder, Haldimand, Jervoise, Leveson-Gower, Manners-Sutton, Montefiore, Penoyre, Pulteney, Skipwith, Trelawny, Weyland. The similar list for the poor is Backlake, Benniworth, Bollingbrook, Bubbers, Caddie, Coaffee, County, Dadey, Demar, Drone, Furrow, Greenberry, Hatsell, Hutch, Kilborne, Leverno, Manes, Modell, Oldhams, Prop, Sammy, Seeger, Sifton, Strut, Tidder, Vallett, Witticks. The names themselves would not seem to signal high or low status.

We can then measure the average wealth of these surnames for each of four subsequent death generations, 1888-1917, 1918-1952, 1953-1989, 1990-2024. Probate records give an indication of the wealth at death of everyone in England and Wales by name 1858 and later.[6] The generations were allocated on the assumption that the average child was born at age 30 of the parent. The average child would thus die 30 years later, plus any gain in average years lived by adults of that generation.

[6] Those not probated typically have wealth at death close to 0.

The *Bazalgette* surname, for example, yields 19 first generation deaths, 17 in the second, 19 in the third, 18 in the fourth, and 12 in the fifth. We have measures of the stock of each name in 1881 from the census, and in 1998 from the Office of National Statistics.[7] We check against immigration of unrelated people with these surnames from outside England and Wales by making sure the stock in 1998 is close to that predicted by the 1881 stock plus all births since 1881 minus all deaths.

A drawback with such an analysis of wealth at death is that the average age at death was close to 80 by 2010. Thus the people dying in 2010 on average were born in 1930, and completed secondary schooling 1946-48. However the existence of birth and death registers for England and Wales from 1837 on, with age of death recorded after 1866, allows us to also divide our surnames into birth cohorts. Since the average adult 1858-1887 died around age 60, this means we can start with a birth generation of 1780-1809, and then follow with 5 more strict 30 year generations of 1810-39, 1840-69, 1870-99, 1900-29, and 1930-59. Those in the last birth cohort will only be captured if they die age 81 or younger. And this allows us to consider people who completed secondary schooling as late as 1977.

We derive other measures of social status for these same surnames by generation. Most importantly we have measures of the numbers of people with these names who were or are students at Cambridge, Durham, London, Oxford, Sheffield and Southampton Universities in 1800-2011. We can thus consider educational attainment over 8 generations of students: 1800-1829, 1830-59, 1860-89, 1890-1919, 1920-49, 1950-79, 1980-2009, 2000-14.

Rich and Poor Rare Surnames, probates 1858-1887

Rich and poor surname samples were created from surnames held by 40 or less people in 1881, where there was at least one adult death in 1858-1887.[8] Surnames were designated rich or poor based on the log average wealth at death (estimated as personalty) of all those 21 and above with a surname dying in these 30 years.

[7] A drawback of the ONS list of surname frequencies is that it excludes names with 4 or less occurrences.

[8] To identify the the poor surnames we checked the probate records for rare surnames from three sources. First there was the 1861 list of paupers who had been in workhouses across England and Wales for at least 5 years, issued by Parliament. Then there were people convicted of crimes in Essex courts 1860-1862. Finally there were those convicted of crimes in the Old Bailey in London in these same years.

Throughout wealth is normalized by the average wage in England in the year of probate. The rich and poor groups were further subdivided into the very rich, where the average log of normalized wealth was 2.5 or more, and the rich, where average log normalized wealth was 0-2.5. The poor were subdivided into the very poor, where no-one dying 1858-1857 was probated, and the poor, where average log normalized wealth was 0-2.3.[9]

In 1858-87, the average wealth at death of the very rich was 455 times the annual wage, that of the rich was 355 times the annual wage. While the very poor had an estimated wealth of 0.1 of the annual wage on average, the merely poor had estimated bequests of 18 times annual wages on average.

Table 2 gives a summary of the data by death generations. There are a declining number of surnames in the sample over time because some rare surnames die out due to the vagaries of fertility and mortality.[10]

Figure 3 shows the probate rates of the rich and poor surnames by decade, for those dying 21 and older. Also shown as a measure of the general indigenous English population are the probate rates for the surname *Brown.* The extreme difference in probate rates narrows over time. But even by 2000-2011 probate rates for the richest surname group are still above the average of England by at least 16%.

Figure 4 shows the average value of the logarithm of normalized probate values of those probated among rich and poor by decade, as well as for the *Brown* surname. In the years 1988-1998 the majority of probates were expressed in the form of a limited number of values that the estate was "not exceeding." Thus in 1990 there were 17 probates with actual values, 9 "not exceeding" £100,000 and 19 "not exceeding" £115,000. We consequently omitted the years 1988-1998 from the

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[9] We assumed throughout that those not probated had an average wealth of 0.1 of the average wage. We do this because the minimum values for required probate were £10 (1858-1900), £50 (1901-1930), £50-500 (1931-1965), £500 (1965-1974), £1,500 (1975-1983), and £5,000 (1984-2011) (Turner, 628). These values were generally close to 0.2 of the average wage. The minimum value requiring probate jumped from 0.15 of the wage to 0.73 of the wage in 1901. But this had little effect on the implied value of the omitted probates in 1901 compared to 1900. Thus whatever the exact cutoff the bulk of the omitted probates were close to 0 in value.

[10] Since the death register 1858-1865 does not give age at death for these years we estimated age at death where possible from records of age in the 1861, 1851, and 1841 censuses, as well as from the birth records 1837-1865.

Table 2: Summary of the Sample

Period	Surnames	Probates	Deaths	Deaths 21+
RICH				
1858-87	181	1,142	2,263	1,767*
1888-1917	172	1,072	1,987	1,792
1918-1952	168	1,582	2,478	2,383
1953-89	156	1,310	2,008	1,983
1990-2011	143	564	989	980
POOR				
1858-87	273	107	3,300	1,798*
1888-1917	255	275	3,106	1,889
1918-1952	242	638	3,085	2,610
1953-89	246	1,305	3,776	3,654
1990-2011	214	836	2,165	2,135

Note: * Where age was unknown 1858-65, the fraction above 21 was estimated from the 1866-87 ratio of deaths 21+ to all deaths.

Figure 3: Probate Rates of Rich, Poor and *Brown* samples, by decade

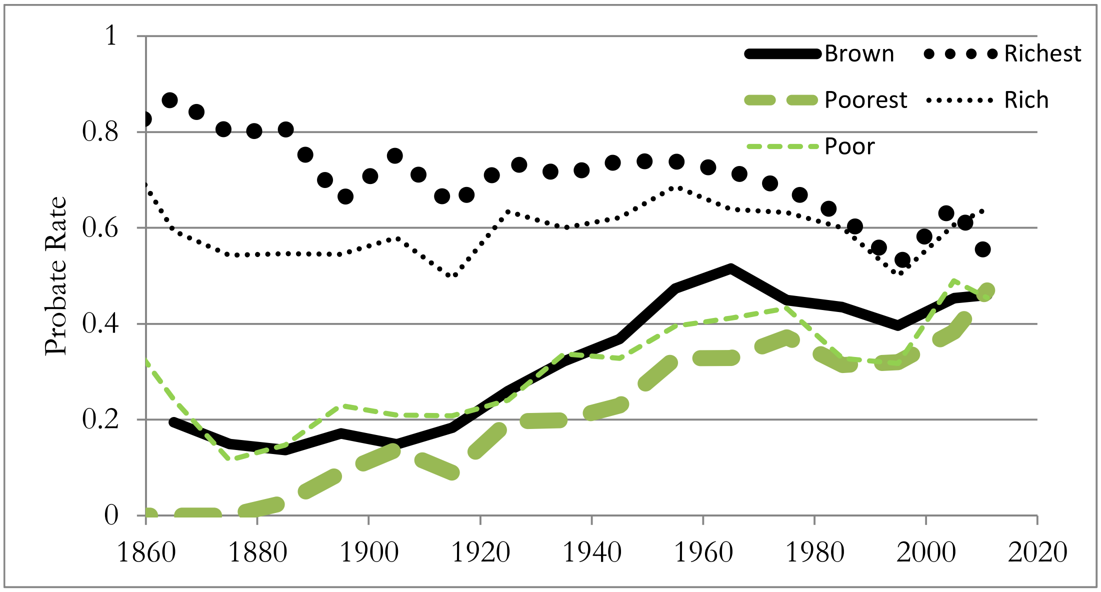
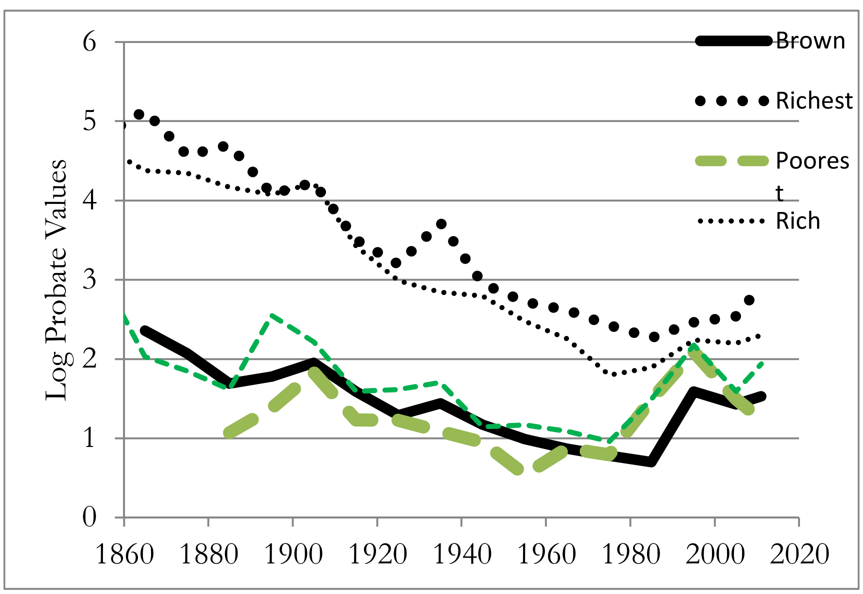


Figure 4: Average Log Probate Value, those probated, by decade



analysis of probate values. For 1981-87 when fewer probates had these value bands, and the so described limits were at the much lower levels of either £25,000 or £40,000, we replaced these values with an expected actual value for this range. This was the average of actual values for these years that fell below £25,000 and £40,000.

The average values for those probated among the rich approach those of the poor surname group over time, but are still higher in 2000-11. Finally figure 5 combines the information in figures 3 and 4 to produce an estimate of the average normalized log wealth at death of the rich and poor surname groups by decade.

Figure 5 shows that there is clearly a process of long run convergence in wealth of the two surname groups towards the social mean (represented by the *Browns*), and that process continued generation by generation, so that eventually there will be complete convergence in wealth of the two groups. For the indigenous population in England there are no permanent social classes, and all groups are regressing to the social mean.

But this process of convergence is much slower than recent estimates of *b*s for income, earnings and education would suggest. Average wealth at death in 2000-11 was still significantly higher for the group identified as rich in 1858-1887. Indeed the average wealth of the richest surname group from 1858-1887 was still 5.6 times that of the poorest surname group in 2000-11.

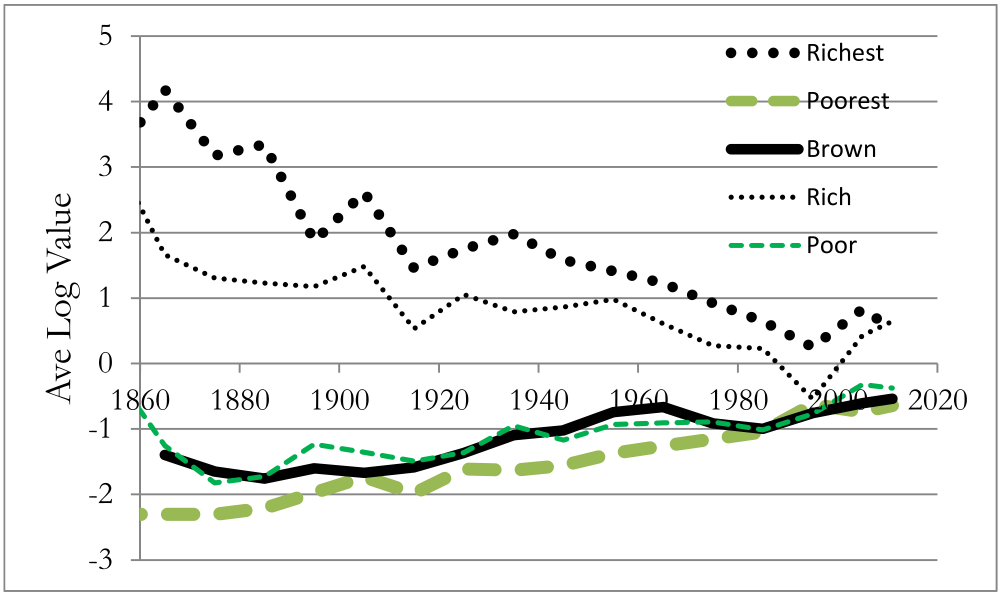
Estimated bs by generation

We can estimate the *b*s, for wealth, in several different ways. If we define $\bar{y}_{Ri}$ and $\bar{y}_{Pi}$ as the average of ln normalized wealth for generation i for the rich and poor surname groups, then the *b* linking this generation with the *n*th future generation can be measured simply as

$$\bar{y}_{Ri+n} - \bar{y}_{Pi+n} = \text{b}(\bar{y}_{Ri} - \bar{y}_{Pi}) \qquad (3)$$

This measure will be, as described in the appendix, in expectation the same as the traditional intergenerational *b* estimates.

Figure 5: Average Log Probate Value, Including Those Not Probated



This estimation has an advantage described above that after the first generation, when rich and poor samples were chosen partly based on wealth, there is no tendency for the *b* estimate to be attenuated by measurement error in wealth, since the average measurement error for both rich and poor groups will be zero. Figure 6 shows the mean log wealth of each group by generation, and table 4 the implied *b*s, along with bootstrapped standard errors.

Table 3 suggests two things. One is that the average *b* values between generations are much higher than are conventionally estimated. The average *b* value across 4 generations is 0.72, much higher than the conventional figures for wealth between generations reported in table 1. These values are so high that there is still a significant connection between wealth 4 generations after the first.

The second suggestion of table 3, however, is that the *b* may have fallen for the last generation, those dying 1999-2011. However, we shall see that there is other evidence that suggests little increase in the rate of mobility in recent generations, and clear evidence that complete equality between the original rich and poor in wealth at death will not be accomplished before 2100.

Figure 6: Average Log Probate value, by generation

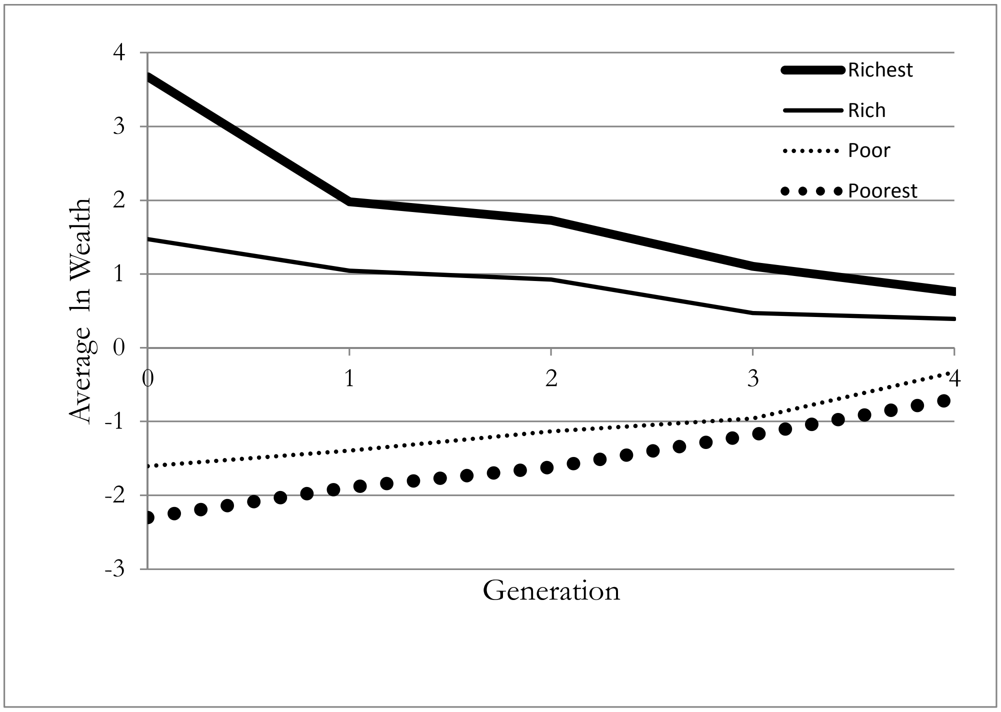


Table 3: b Values Between Death Generations

	1888-1917	1918-1952	1953-1987	1999-2011
1858-1887	**0.71** (.03)	0.62 (.02)	0.42 (.02)	0.26 (.03)
1888-1917		**0.86** (.03)	0.59 (.03)	0.36 (.04)
1918-1952			**0.68** (.03)	0.41 (.05)
1953-1987				**0.61** (.07)

Note: Standard errors in parentheses.

The rise in the average age of death, however, implies that this generation was born on average in 1927, and had left High School by 1945. To get an estimate of *b* that is a more contemporaneous we can instead divide testators into 30 year long birth cohorts, with the first such cohort 1780-1809, and the last (the sixth) 1930-59. The last cohort, however, will have only those who died relatively young for their generation. Since the age-wealth profile is steeper for the rich surname groups, this will bias us towards finding more convergence in this last truncated 1930-59 generation. We thus correct for this in the estimate.

Table 4 shows composition of these birth cohorts. The truncation of the sample at either end implies that the first cohort 1780-1809 dies unusually old for the period, while the last cohort represents people dying unusually young. The truncation also implies that at the ends we do not observe people on average at the midpoints of the 30 year birth cohort. Thus the average birth date for 1780-1809 is 1798, not 1795. And the average birth date for the 1930-59 birth cohort is 1939, not 1945.

Figure 7 shows the average log wealth of these birth cohorts. In the last truncated cohort, those born 1930-59, we observe few people aged 80 or above, and disproportionately many younger people. This will bias downwards, in particular, the estimated wealth of the higher status groups in the last period (since these have a stronger age-wealth gradient). We do not attempt to control for this, but it does imply that the last period estimated b is too low.

Again we get a nice pattern predicting eventual regression to the mean. As average wealth narrows across the groups they always retain their initial ranking in terms of wealth.

Table 5 shows the implied *b* estimates between each period, as well as the bootstrapped standard errors.[11] Over now six generations of these birth cohorts the average one period b is 0.70, compared with 0.72 for the death generations. But there is no longer clear sign that the b has declined for recent generations. Instead the b is lower just for one generation, the move from those born 1870-99 to those born 1900-29. In the last generation observed, 1930-59, who would all have finished secondary schooling post WWII, there is just as strong a connection of wealth with

[11] The raw b's have been revised downwards, by and average of 4%, to allow for the slightly less than 30 interval between the birth dates of the observed cohorts.

Table 4: Wealth at Death by Birth Cohorts, Summary

Birth Period	Surnames	Observations	Average Birth Year (21+)	Average Age at Death (21+)
RICH				
1780-1809	172	828	1797	76.6
1810-39	164	1,489	1826	67.0
1840-69	159	2,134	1855	66.6
1870-99	147	2,121	1883	68.2
1900-29	142	1,144	1912	69.5
1930-59	80	181	1941	57.4
POOR				
1780-1809	204	581	1798	76.0
1810-39	188	1,281	1826	65.1
1840-69	188	1,881	1855	62.3
1870-99	189	2,523	1885	67.1
1900-29	179	1,893	1912	68.7
1930-59	116	354	1942	57.0

Figure 7: Average log wealth by Birth Generation, 1780-1959.

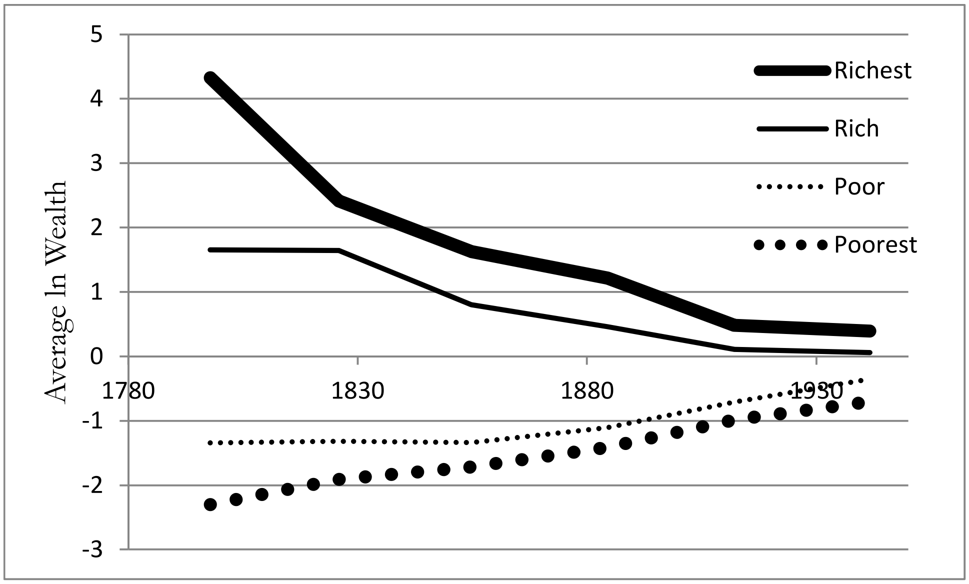


Table 5: b values between birth generations, 1780-1809 to 1930-1959

	1810-39	1840-69	1870-99	1900-29	1930-59
1780-1809	**0.72** (0.03)	0.54 (0.02)	0.41 (0.02)	0.22 (0.02)	0.16 (0.04)
1810-39		**0.75** (0.03)	0.57 (0.02)	0.31 (0.02)	0.23 (0.06)
1840-69			**0.76** (0.03)	0.41 (0.03)	0.30 (0.07)
1870-99				**0.55** (0.04)	0.40 (0.10)
1900-29					**0.73** (0.18)

Notes: b values corrected to a 30 year generation gap. Standard errors bootstrapped.

their parent's generation as in the nineteenth century. And since this estimate does not include people aged 80 and above, who have much higher wealth among the descendants of the rich, this b estimate is downward biased.[12] However, this last estimate has high standard errors because of the small numbers of observations, and the declining difference in wealth between the original rich and poor groups.

Table 5 also shows that the wealth of people born before 1810 with rare surnames still correlates significantly with the wealth of people with those same surnames 6 generations later born 1930-59. The average wealth at death of the group identified as wealthiest in 1780-1809 still is 3 times as great as those with the surnames of the poorest in 1780-1809, for those dying 1999-2011 and born 1930-59. We will show below that that correlation will continue to those born 1960-1989, and 1990-2011.

People born 1930-1959 were mainly exposed to the post WWII education and access regimes, including the national health service, and quite high redistributive tax rates during their work lives. Yet there is no sign of any greater social mobility than in earlier generations.

A more conventional way to estimate *b* is by taking the average wealth of each surname in each generation as the unit of observation, and then estimate by OLS the *b* values in the regressions

$$y_{i+n} = a + b^n y_i + u_{i+n} \qquad (4)$$

where here y_{n+i} is the average log wealth by surname in period i+n, and we weight by the average number of observations in each surname group in the relevant periods. Table 6 shows these estimates and the associated standard errors. As discussed above the average estimate one period *b* is below that of the previous method (0.62 versus 0.72).

If, however, the one period *b*'s in table 6 were correctly estimated, then we would expect $\hat{b}_{04} = \hat{b}_{01}.\hat{b}_{12}.\hat{b}_{23}.\hat{b}_{34}$. In fact

$$\hat{b}_{04} = 0.28 > 0.15 = \hat{b}_{01}.\hat{b}_{12}.\hat{b}_{23}.\hat{b}_{34}.$$

12 A rough method of correction we can employ is to reweight the observations from the last period in terms of the age distributions of all those dying 1999-2011, using the wealth of those dying aged 70-79 to proxy for those dying 80 and above. This implies a b estimate for the last period of 0.89.

Table 6: b Estimates between Death Generations, Conventional Regression

	1888-1917	1918-1952	1953-1987	1999-2011
1858-1887	**.66** (.030)	.58 (.026)	.38 (.025)	.28 (.038)
1888-1917		**.71** (.030)	.50 (.029)	.28 (.048)
1918-1952			**.60** (.029)	.37 (.052)
1953-1987				**.53** (.065)

Note: Standard errors in parentheses.

Table 7: Attenuation Corrected b Values between Death Generations

	1888-1917	1918-1952	1953-1987	1999-2011
1858-1887	**.82**	.64	.54	-
1888-1917		**.86**	.54	.47
1918-1952			**.70**	.46
1953-1987				**.61**

Note: For some of the bs, there are multiple ways to do the attenuation correction. Thus we can approximate b_{12} as $\frac{\hat{b}_{02}}{\hat{b}_{01}}$ (0.879) or as $\frac{\hat{b}_{13}}{\hat{b}_{23}}$ (0.836). Here we take the average in such cases.

The long run regression to the mean is slower than the one period *b*s predict. Presumably this is because of measurement error, so that the estimated one period bs are the true bs times an attenuation factor $\theta < 1$. In this case

$$E(\hat{b}_{04}) = b_{04}\theta > E(\hat{b}_{01}.\hat{b}_{12}.\hat{b}_{23}.\hat{b}_{34}) = b_{01}\theta.b_{12}\theta.b_{23}\theta.b_{34}\theta = b_{04}\theta^4$$

With a constant attenuation factor can get better estimates of the true bs between periods by taking the ratios of the estimated bs. Thus, for example,

$$\frac{E(\hat{b}_{02})}{E(\hat{b}_{12})} = \frac{b_{02}\theta}{b_{12}\theta} = \frac{b_{01}b_{12}}{b_{12}} = b_{01}$$

Table 7 shows these attenuation corrected b estimates. These echo those of table 3, except for being significantly higher between the first and second generations. But as noted earlier the estimates in table 3 for the first generation will also suffer from attenuation bias. The one generation corrected bs average 0.75.

Table 8 shows the conventional regression estimates of b's between birth generations, and table 9 the attenuation corrected estimates. The one generation b's again average about 0.75. The pattern of estimates here again suggest some decline in b in the most recent generations, but the final period b is underestimated because of the exclusion of the rich descendants born 1930-59 who have not yet died.

Education

We find above very slow rates of regression to the mean for wealth in England. These wealth measures have some drawbacks as a general index of social mobility. First it may be objected that of various components of social status – education, occupation, earnings, health, and wealth – wealth since it can be directly inherited will be the slowest to regress to the mean. Second the wealth measures we have above are for people at the end of their lives, now typically nearly 80. Thus even when we move to birth generations we can only observe the status of people born before 1959.

Using measures of educational attainment we can extend our coverage of the original rich group born 1780-1809 to seven further generations, and to descendants born 1990-1993. The measure is university education. Since almost all people in England attended university between ages 18 and 22 this gives quite precise measures

Table 8: b Estimates between Birth Generations, Conventional Regressions

	1810-39	1840-69	1870-99	1900-29	1930-59
1780-1809	**0.63** (.029)	0.56 (.025)	0.40 (.024)	0.21 (.027)	0.12 (.045)
1810-39		**0.57** (.032)	0.51 (.027)	0.28 (.031)	0.13 (.053)
1840-69			**0.71** (.028)	0.37 (.037)	0.22 (.064)
1870-99				**0.48** (.040)	0.26 (.075)
1900-29					**0.31** (.097)

Table 9: Attenuation Corrected b Values between Birth Generations

	1810-39	1840-69	1870-99	1900-29	1930-59
1780-1809	**0.89**	0.56	0.43	0.38	-
1810-39		**0.77**	0.61	0.38	0.18
1840-69			**0.84**	0.62	0.23
1870-99				**0.68**	0.32
1900-29					**0.54**

of the fates of succeeding birth cohorts. Here we look at university graduates in the periods 1800-29, 1830-59, 1860-89, 1890-1919, 1920-49, 1950-79, and 1980-2009, and 2010-14.[13] These measures thus now span eight generations. These show, again, universal regression to the mean, but at even slower rates than for wealth, so that even now there are differences in educational attainment between the descendants of the 1780-1809 generation.

The specific measure we use here is the relative rates of university attendance of those with rich and poor rare surnames. To this end we have constructed a database of all those who graduated from a number of English Universities 1800-2011: currently the database has data from Cambridge 1800-2014, Oxford 1800-86, and 2011-14, University of London 1837-1926, 2010-14, Durham 1920-2014, Sheffield 2011-14, Southampton, 2007.

The measure we use is the *relative representation* of each surname group at university, where the relative representation is the share of a surname at the university relative to the population share of that surname. Relative representation will be 1 for a surname that is distributed as is the general population in terms of educational status.

Table 10 shows the relative representation of the high and low average wealth rare surnames, based on the wealth at death of those born 1780-1809 who died 1858 and later. In 1800-1829 the high wealth surnames show up at 77 times their share in the population among graduates of Oxford and Cambridge, and there were no graduates with surnames from the poor birth cohort.

The relative representation is estimated after 1837 using the birth and death registers, which allow us to calculate for each name the number of 20 year olds in each decade.[14]

The table shows that the rich group is steadily converging in relative representation towards 1. However, the rate of convergence is again slow. Looking at students graduating university in 2010-11, or currently attending university in 2011 (and so graduating 2011-2014), the rare surnames of those born 1780-1809 who were identified as wealthy are still 7 times more frequent relative to the stock of 20 year

[13] We have records of individuals currently attending universities who will graduate 2011-2014.

[14] For the years 1800-1865 there have to be varying degrees of approximation to this stock of 20 year olds.

olds with that name than are common indigenous English names such as *Brown(e)* or *Clark(e)*. For the high wealth group of surnames, the relative representation at the elite universities of Oxford and Cambridge echoes that for all universities in the sample shown in table 10.

What does the pattern in decline of relative representation shown in table 10 imply about the b for education?

Based on the numbers of graduates with common surnames such as *Brown* relative to the estimated numbers of 20 year old *Browns*, graduates at Oxford or Cambridge represent an elite of about 0.7% of the indigenous population in England now, but only 0.3% in the 1870s. But earlier very few women attended university, so effectively Oxbridge was taking 0.6% of each cohort in the 1870s. Thus Oxbridge has represented a fairly similar elite 1800-2014.

If we assume a normal distribution of status, and that all those of high status had the same variance as the general population, then we can estimate what the b for educational status was 1800-2014. Since the high status surnames had a relative representation of 77 among the top 0.7% of the educational hierarchy in 1800-29, this fixes what the mean status of those names had to be, relative to the social mean. For each possible b their relative representation would decline generation by generation in a predicable manner. Figure 8 shows the actual pattern, as well as the single b that best fits the data.[15] That is $b = 0.86$. Notice also that there is no strong sign that educational mobility has speeded up in the last few generations.[16]

Thus despite the many changes in England over these generations, the educational elite of 1800-29 is losing its place only slowly. Yet in this interval the nature of universities, and the way in which they recruited students, changed dramatically.

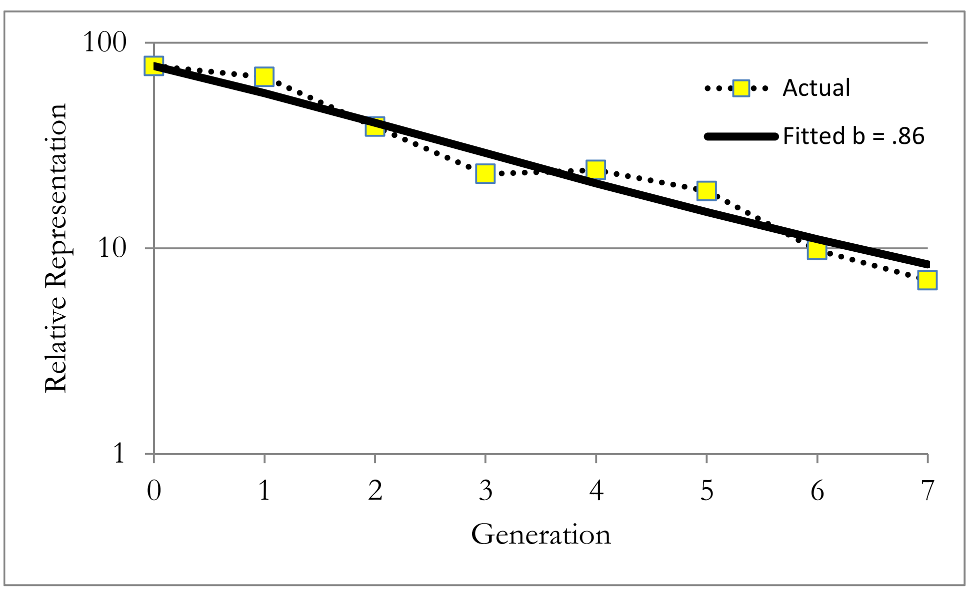
In the early nineteenth century, when Oxford and Cambridge were the only English universities, they were places largely closed to those outside the established Church of England. Not until 1871 were all religious tests for graduation from

[15] Judged by minimizing the sum of squared deviations.
[16] Assuming the variance of status among the elite was lower than for the general population would result in a higher estimate of the b in this case, since then the mean estimated status of the elite would be closer to the social mean in the first generation.

Table 10: Representation by Birth Cohorts at Universities, 1800-2011

Generation	Period	Sample Size	Relative Representation, High Status	Relative Representation, Low Status
0	1800-29	10,138	77	0
1	1830-59	14,178	68	0.5
2	1860-89	21,312	39	0
3	1890-1919	13,615	23	0.7
4	1920-49	39,044	24	0.8
5	1950-79	90,193	19	0.9
6	1980-2009	178,833	9.8	0.9
7	2010-14	85,739	7.0	2.3

Figure 8: Relative Representation at Oxbridge, 1800-2014



Oxford and Cambridge finally removed. As late as 1859 one of the rich group in our sample, Alfred de Rothschild, who was Jewish, had to petition to be excused attendance at Anglican service at Trinity College, Cambridge, which was granted as an especial indulgence.[17]

Before 1902 there was little or no public support for university education. Oxford and Cambridge supplied financial support for some students. But most of their scholarships went to students from elite endowed schools, who had the preparation to excel at the scholarship exams. In 1900-13, for example, nine schools, which had been identified as the elite of English secondary education in the Clarendon report of 1864, and which includes Eton, Harrow and Rugby, supplied 28% of male entrants to Oxford.[18] Further before 1940 entrants to Oxford were required to complete a Latin entrance exam, which excluded students from less exclusive educational backgrounds.

Many more university students were provided financial support by local authorities 1920-1939. After World War II, there was a major increase in government financial support for secondary education, and for universities. Also Oxford and Cambridge devised entry procedures which should have reduced the admissions advantage of the tradition endowed feeder schools. This would seemingly imply a great deal more regression to the mean for elite surname frequencies at Oxford and Cambridge in the student generations 1950-79, 1980-2009, and 2010-14. Yet there is no evidence of this in figure 8. The elite we identified through wealth at death, born 1780-1809, has persisted even more tenaciously as an educational elite than as a wealth elite.

The implied rate of mobility is so low that the rich elite names would not, at this rate, have a relative representation at Oxford and Cambridge below 1.1 until after another 20 generations (600 years). If we just focus on the decline of relative representation between 1980-2009 and 2010-14, however, the estimated b would be 0.83, but this for a generation gap of only 17 years. Projecting that to the regular 30 year generation gap would imply a b as low as 0.72 for this current generation. This is still very high, but would ensure convergence in only another 10 generations (300 years).

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[17] Winstanley, 1940, 83.
[18] Greenstein, 1994, 47.

On the other hand, the low status surnames had fully moved to the average by 2010. But here the absence of evidence as to where exactly this group started in the social hierarchy, make an accurate estimate of their b impossible.

Other Status Measures

Another measure of group status is the shares of these surnames in elite jobs such as doctor, solicitor, or barrister in 2011. Table 11 shows these measures for the current stock of doctors, solicitors and barristers, compared to a sample of common surnames such as Smith, Clark, Taylor, and White. Those with the surnames of the formerly rich are 4 times as likely as someone with a common surname to be a doctor or attorney, where the measure is the number of doctors/attorneys with a surname relative to the stock of people in the England and Wales in 1998 with that surname. There has not yet been complete regression to the mean for generations 5 and 6 by birth cohorts from the original high status generations of 1780-1809. This is consistent with the university attendance results, though the overrepresentation in these professions is less than we would expect from the overrepresentation of these surname groups of the same birth generation in universities.

But for the poor there is sign of complete regression to the mean within these generations. Our poor surname sample is actually moderately overrepresented compared to common surnames among doctors, and attorneys. This probably reflects not a greater speed of upward mobility, but rather the fact that the rich surname group started off much further from the social mean than the poor surname group.

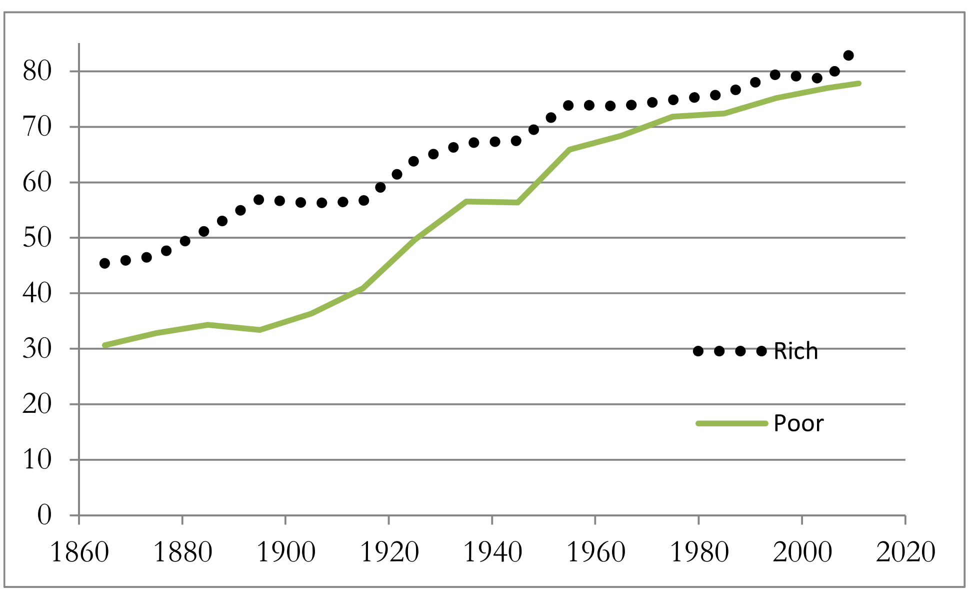
Another indicator of status is average age at death. Life expectancy in England, as in other societies, has since at least the nineteenth century been dependent on socio-economic status. In 2002-2005 life expectancy for professionals in England and Wales was 82.5 years. For unskilled manual workers it was only 75.4.[19]

[19] Office of National Statistics, "Variations persist in life expectancy by social class", http://www.statistics.gov.uk/pdfdir/le1007.pdf.

Table 11: Occupational Status, 2011

Surname	Stock 1998	Doctors /1000	Lawyers /1000
		Generations 5-6	Generations 5-6
Common	1,985,332	2.8	2.1
Rich	3,141	10.5	8.6
Poor	10,545	3.2	2.7

Figure 9: Average Age at Death, by Decade



Source: England and Wales, Death Register, 1866-2011.

Figure 9 shows the average age of death of the rich and poor surnames (measured from the death cohorts of 1858-1887), by decade from 1866 to 2011. 1866 was when the death register in England and Wales began recording age at death. In 1858-1887 average age of death by surname group differs dramatically: 47.8 for the rich, 32.6 for the poor. As figure 9 shows these average ages at death converged steadily over time. For the fifth generation, deaths 1990-2011 the average age of death of the rich surname group was 79.3, compared to 76.1 for the poor surname group, a difference of 3.2 years. Again the poor surname group had converged on the average age at death, as represented by the *Brown* surname, by this generation. But the rich surname group was dying at above average age.

The reason for the extreme difference in life expectancy in the first generation is actually a combination of lower death rates for the rich at each age, but also greater fertility by the poor which exposed more of the poor population in the early years to high child mortality risks.

Since the age at death difference between rich and poor surnames was 4.7 years for generation 3, and 3.2 years for generation 4, we can calculate an analogous 'b' for this difference by generation of 0.68 for the last generation. This is again high, and implies that complete convergence in age at death will take several more generations.

A final measure we have of differences in status, is location. From the 1999 electoral register we were able to obtain the addresses of registered voters with rich and poor surnames. We calculated from the *UK Land Registry database*, the average value of houses by the first 3 characters of the British postal codes (such as G72) in 2010. Names identified as wealthy among deaths 1858-1887 lived in postal code districts with an average house value of £308,000, while those identified as poor lived in districts with an average house value of £225,000.

Conclusions

What the rare surname datasets imply is somewhat paradoxical. On the one hand the Beckerian vision of ultimate regression to the social mean seems to apply to England all the way from 1800 to 2011. The rich and the poor of the early nineteenth century have seen their descendants regress towards the mean, though they are not at the mean yet for the descendants of the rich. There were, and are, no permanent upper classes and under classes, but instead long run equality. The

Herrnstein and Murray dystopia of perfectly persistent upper and lower classes did not hold in the past, and shows no sign of arising in the present.[20]

On the other hand, the estimated persistence of wealth is much higher than would be expected from modern two-generation studies. The true b for wealth in England in these years averages 0.72-0.75, compared to an average of about 0.5 suggested by other studies. Because the amount of variance in wealth in future generations explained by inheritance is b^2, difference in terms of the importance of inheritance in explaining outcomes is much greater than might appear. A b of 0.5 implies inheritance explain 25% of wealth variation, but a b of 0.75 means it explains 56% percent of wealth variance, more than twice as much.

In education again we see universal regression to the mean. But the persistence parameter here for the initial elite is 0.86, implying 74% of educational status is derived from inheritance of characteristics from parents. The persistence of the wealthy born 1780-1809 as an educational elite is indeed much greater than their persistence in terms of wealth. These b estimates are again much greater than is conventionally estimated. We may not be in the Herrstein and Murray dystopia, but we are very close to it.

A further surprise is that the rate of regression to the mean for both wealth and educational status seems to have changed little over time, even though between 1800 and 2011 there have been enormous institutional changes in England. Wealth and income was lightly taxed, or not taxed at all, for most of the nineteenth century, but heavily taxed for much of the late twentieth century. The elite universities, Oxford and Cambridge, were exclusive clubs with strong ties to particular schools in the nineteenth century. By the 1940s they began a process of opening up admissions to students from a wider variety of educational backgrounds. And state financial support for students from poorer backgrounds became very considerable.

The modest effects of major institutional changes on social mobility implies that the important determination of persistence is transmission within families – either through genes or family environments. Indeed there almost seems to be a *social physics* here within families which controls the rate of regression to the mean, and makes it largely immutable from many outside institutional changes.

[20] Herrnstein and Murray, 1996.

Appendix 1 – deriving b measures from name cohorts

We are concerned to measure the connection in status between parents and children when we estimate b in the expression

$$y_{ij,t+1} = a + by_{it} + u_{ij,t+1} \qquad (a1)$$

where i indexes the family, and j the individual children. Yet when we employ surname cohorts we instead estimate

$$\bar{y}_{it+1} = a + b\bar{y}_{it} + u_{it+1} \qquad \text{(a2)}$$

$\bar{y}_{it+1}$ and $\bar{y}_{it}$ are now measured as averages across a group of parents and a group of children with the same surname. Will the *b* estimated in this way be the same as that within the family?

Suppose each man with surname *i*, indexed by *j,* in generation *t* has n_{jt} children who carry his surname, and that the total number of members of each surname cohort is N_{it} . Denote each child in the next generation with the given surname as y_{ijk}, $n_{jt} \geq k \geq 1$. Then

$$\bar{y}_{it} = \sum_{ij} \frac{y_{ij}}{N_{it}}$$

and

$$\bar{y}_{it+1} = \sum_j \sum_k \frac{y_{ikjt+1}}{N_{t+1}} = \frac{1}{N_{it+1}} \sum_j \sum_1^{n_{jt}} \left(a + by_{ijt} + u_{ijt+1}\right)$$

$$= a + \mathrm{b}\frac{1}{\mathrm{N_{it+1}}} \sum_{ij} n_{jt}\, y_{ijt} + u_{t+1} \qquad \text{(a3)}$$

where $N_{it+1} = \sum_{ij} n_{jt}$.

Estimating *b* in (a1) using *(a2),* rather than the correct expression which weights every y_{it} by the number of children observed in the next generation, as above in (a3), will thus produce only an approximation to the true *b*. The method used here thus weights equally people in generation t who have no children as those who have many children. Thus it will introduce some measurement error in y_t, which will reduce the observed value of *b*.

As the number of observations gets large this measurement error will disappear, as will the downwards bias on b, as long as there is no correlation between n_j and y_j.

There is however, 1850-1949, a negative correlation between n_j and y_j. Richer fathers had fewer children. For this period thus, the surname method will tend to overweight the rich in the initial period, and thus underestimate the true b, since it will give too much weight to high y_{it}s in the earlier generation. However, we observe empirically that this bias is modest. Splitting the rich into the very rich and the merely rich, and estimating the b's separately for each sub group produces b estimates that are similar for both groups, and no higher on average than the combined b estimates.

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