The Beckerian Family and the English Demographic Revolution of 1800

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Abstract

In England in 1800 a profound change occurred that ushered in an important component in the regime of modern economic growth. In pre-industrial England, from 1250 to 1800, the rich produced many more surviving children than the poor. From 1800 to 1875 there was no association between wealth and net fertility. And after 1875 wealth became strongly negatively associated with net fertility. Why this change? Using measures of wealth, socio-economic status, and probate rates of sons 1500-1920 the paper tests whether we can explain this through emergence of a quality-quantity tradeoff in children among the rich only after 1800. Conclusive evidence awaits more observations, but the suggestions are that there was little sign of the emergence of such a Beckerian regime only post 1800, even though the years 1800-75 are ideal ones to observe in an unbiased way such a tradeoff.

Introduction

Modern high income societies have a combination of low fertility levels and high levels of nurture and education for children. There is a lot of human capital. Modern poor societies have high fertility levels, lower levels of nurture for children, and less education. Recent economic theory has taken this basic fact, and made it the center of the theory of economic growth. Growth, it is argued, stems at base from higher levels of human capital (see, for example, Lucas, 2002, Becker, Murphy, Tamura, 1990, Galor and Weil, 2000, Galor and Moav, 2002). But only when the circumstances arose in which parents chose to have smaller family sizes was it possible to increase levels of human capital. Parents have a limited budget of time and money. The more children parents choose to raise, the less input each child receives, and the less effective they will be when grown as an economic agent. Economic growth did not come to the world until the last 250 years because before then the typical women gave birth to many children, and these children received little in the way of nurture or education to make them effective economic agents.

Yet this crucial underlying assumption - that the more children a given set of parents have, the less successful as economic agents the children will be - has never been empirically demonstrated. The problem with determining the quality-quantity tradeoff is that the number of children parents have in the modern world is largely determined by conscious fertility choices. These choices correlate with other unobservable features of parents which influence child quality.

The empirical evidence for a quality-quantity tradeoff is generally based on negative correlations between family size and the measurable 'quality' of offspring (for instance educational attainment or health). Most studies of the uncontrolled link in modern populations show a negative correlation between child numbers, and educational and economic achievement. See, for example, Grawe (2004) and Lawson and Mace (*2009*) for Britain, Rosenzweig and Wolpin (1980b) and Kaplan et al. (1995) for the US, Rosenzweig and Wolpin (1980a) and Jensen (2005) for India, Lee (2004) for Korea, Grawe (2003) for Germany, Desai (1995) for 15 developing countries (using heights as a measure of child quality). These studies have also recently highlighted varying trade-offs within groups at different socioeconomic levels. For example, Grawe (2009) for the US finds a stronger quality-quantity tradeoff for richer families, a similar result to Lawson and Mace (2009) for Britain.

Schultz comments, however, that the literature's "empirical regularity" of an inverse relationship between family size and measurable child quality is a "poor test of the quality-quantity tradeoff hypothesis" because the statistical correlations "are not based on exogenous variation in fertility that is independent of heterogeneous parent preferences or unobserved economic constraints" (Schultz, 2007, 19). In capturing the true quality-quantity trade-off, researchers have had to control for the inherent endogeneity between family size and child quality. In particular in the modern world if higher quality parents tend to choose fewer children (which has until recently been true in the aggregate data), then the raw quality-quantity tradeoff may have nothing to do with the numbers of children in a family.

We can portray parent influences on child "quality" as following two potential routes, as in figure 1. Since in the modern world high 'quality' parents also tend to have smaller numbers of children, the observed negative correlation between n and child quality may stem just from the positive correlation of parent and child quality. As figure 2 shows the estimate of the tradeoff between quantity and quality will be too steep using just the observed relationship. Estimates $\hat{\beta}$ of β in the regression

$$q = \beta n + u, \tag{1}$$

where q is child quality, n child numbers, and u the error term are biased towards the negative, because of the correlation between *n* and *u*.

To uncover the true relationship investigators have followed a number of strategies. The first is to look at exogenous variation in family size caused by the accident of twin births (e.g. Rosenzweig and Wolpin, 1980a, Angrist et al., 2006, Li, Zhang, and Zhu, 2008). In a world where the modal family size is 2, there are a number of families who accidentally end up with 3 children because their second birth is of twins. What happens to the quality of these children compared to the quality of the children of such families compared to those of two child families?

Recent studies using the random incidence of twin births as an instrument for child quantity, find the uncontrolled relationship between quantity and quality decreases. Indeed it is often insignificant and sometimes positive (Schultz, 2007, 20). For instance; Angrist, et al. (2006) find "no evidence of a quality-quantity trade-off" for Israel using census data. Qian (2006) similarly rejects any simple quality-quantity tradeoff in China (using school enrolment as a measure of quality). Li, Zhang, and Zhu, 2008, however, do report the expected relationship instrumenting using twins, but only in the Chinese countryside. But in China there are government policies designed to penalize couples who have more than the approved number of children, so we may not be observing anything about the free market quality/quantity tradeoff.

Figure 1: Parent influences on child quality

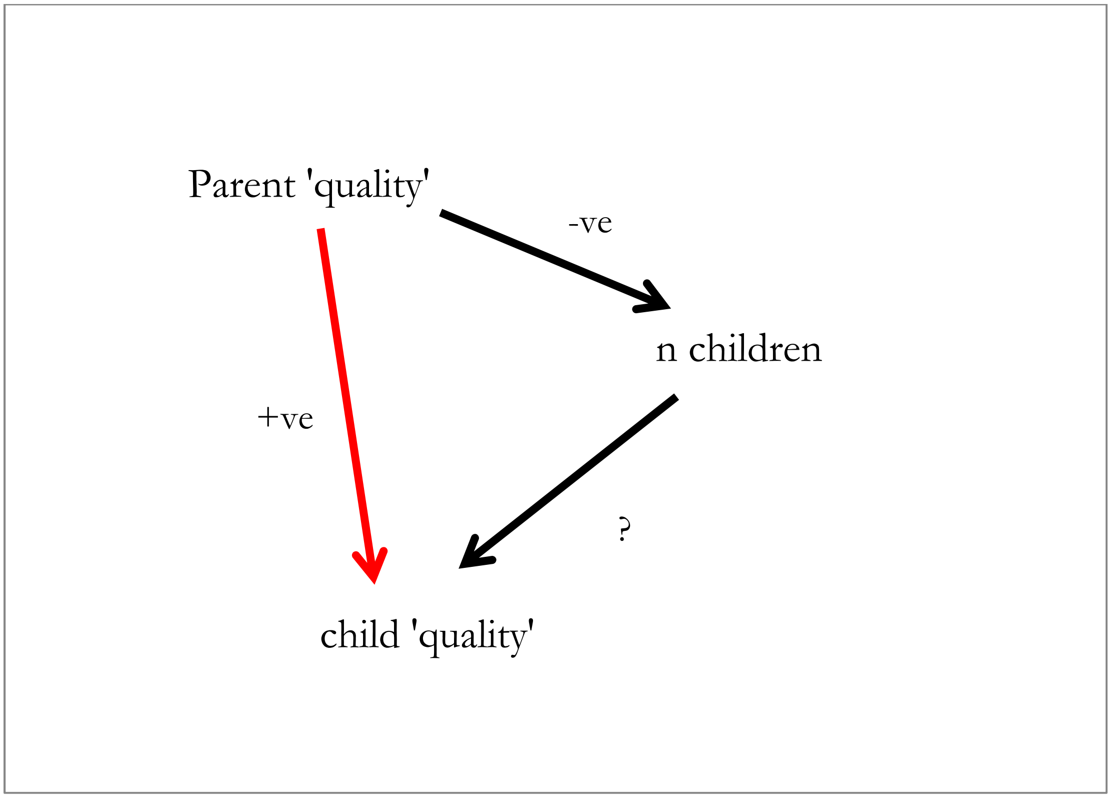
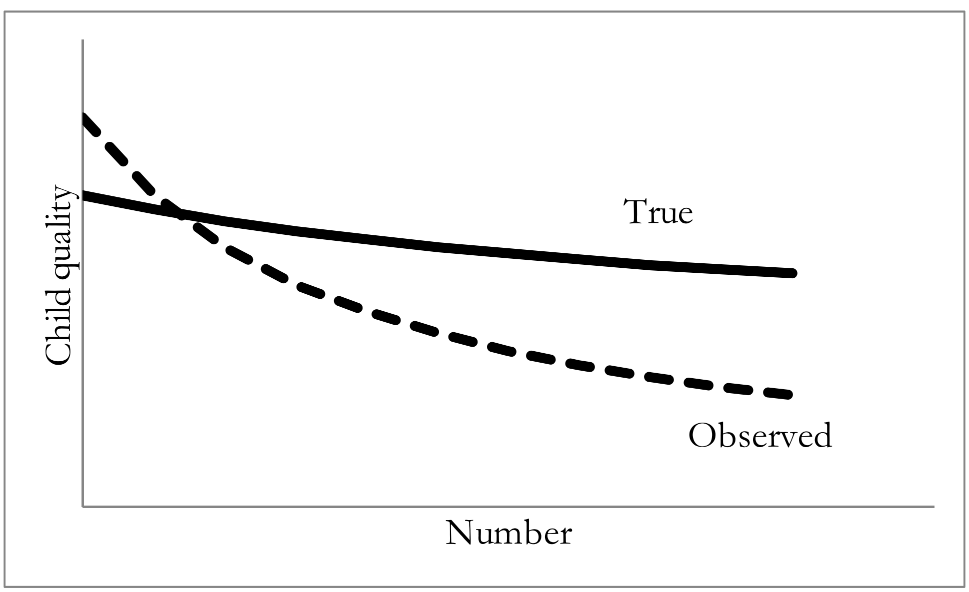


Figure 2: The True and Observed Quality-Quantity Tradeoff



Others have sought to control for selection bias using parental human capital, the sex composition of the first two births (e.g Lee 2004, Jensen 2005) and also the birth order of the child (e.g Black et al. 2005). Black et al. report the standard negative family size–child quality relationship for Norway, but find that it completely disappears once they include controls for birth order (quality here is educational attainment) (Black et al. 2005, 670). Again Li, Zhang, and Zhu, 2008, however, do report the expected relationship even controlling for birth order.

In summary, there is a clear raw negative correlation in modern populations between child numbers and various measures of child quality. However, once instruments and other controls to deal with the endogeneity of child quality and quantity are included, the quality-quantity relationship becomes unclear. The quality-quantity tradeoff so vital to most theoretical accounts of modern economic growth is, at best, unproven.

A second issue that we face is why fertility declined after the Industrial Revolution? One possibility is that with the changes in technology and social organization, education became much more important in determining income, but formal education was expensive so that the quality-quantity tradeoff in children became more adverse. This greater cost of more children led to the decline in fertility characteristic of the modern world.

Fertility in Pre-Industrial England

Here we use two features of fertility in England for births 1500-1870 to attempt to uncover the true relationship between quantity and quality, and its change over time. The first is that the connection between observed family quality (wealth, social status, literacy) and both births and completed family size was very different in preindustrial England than in the modern world.

Figure 3 shows, for example, the net fertility, defined here as numbers of children surviving to age 21 and above, for four groups of people defined by their average wealth at death in 1858-1887. These are the very rich (H2), the rich (H), the poor (P) and the very poor (P2). From 1845 to 1874 the average net fertility of the rich is not less than that of the poor.[1] Only after 1875 does a significantly lower net fertility of the rich appear. There is thus an interval in England where there is no correlation between "quality" and child quantity.

But this period, for births 1800-1875, is preceded by an era where the correlation between child numbers and parent quality was positive, the opposite of the modern world, so that $\hat{\beta}$ will be biased towards 0. Figure 4 shows the numbers of surviving children male testators in England had as a function of their estimated asset incomes at death, for men born before 1770. There is a strong positive relationship all across the asset range. The figure also shows this relationship for men born 1770-1840. Now the relationship changes and becomes flat with asset incomes. For marriages 1800-1870 parent quality and numbers of children are uncorrelated, so that $\hat{\beta}$ will be unbiased.

Figure 5 shows this effect. Any negative effects of quantity on quality found will be underestimated, as opposed to the bias in estimating β in modern studies. The positive connection between parent quality and numbers of children before 1800 continues all the way across the spectrum of wealth, though it flattens out as we get to very high levels of wealth, as figure 6 shows.

[1] Fertility is measured here using rare names to identify family lineages. See Clark and Cummins, 2011.

Figure 3: Net Fertility of Rich Versus Poor, 1845-1909

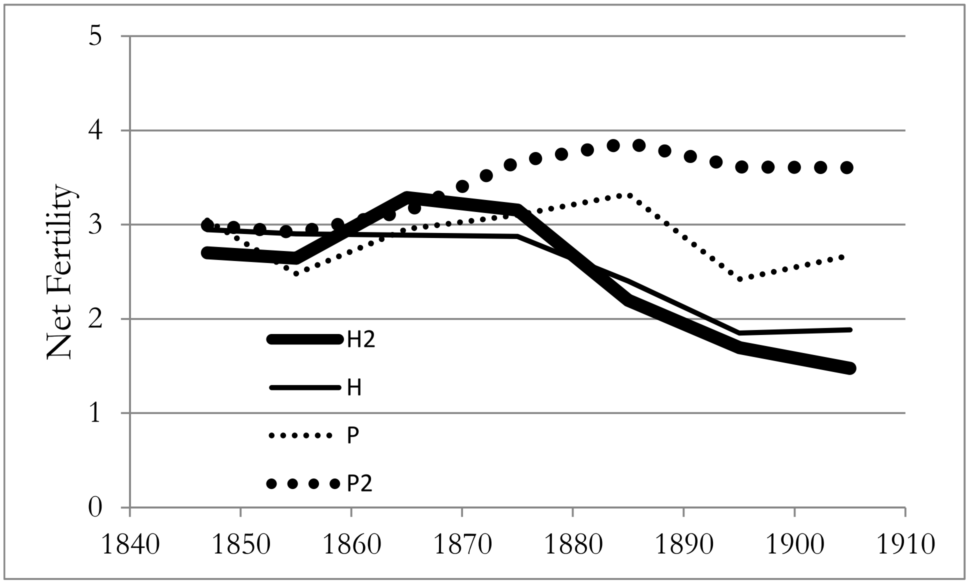


Figure 4: Asset Class and Children at Death, men born 1500-1840

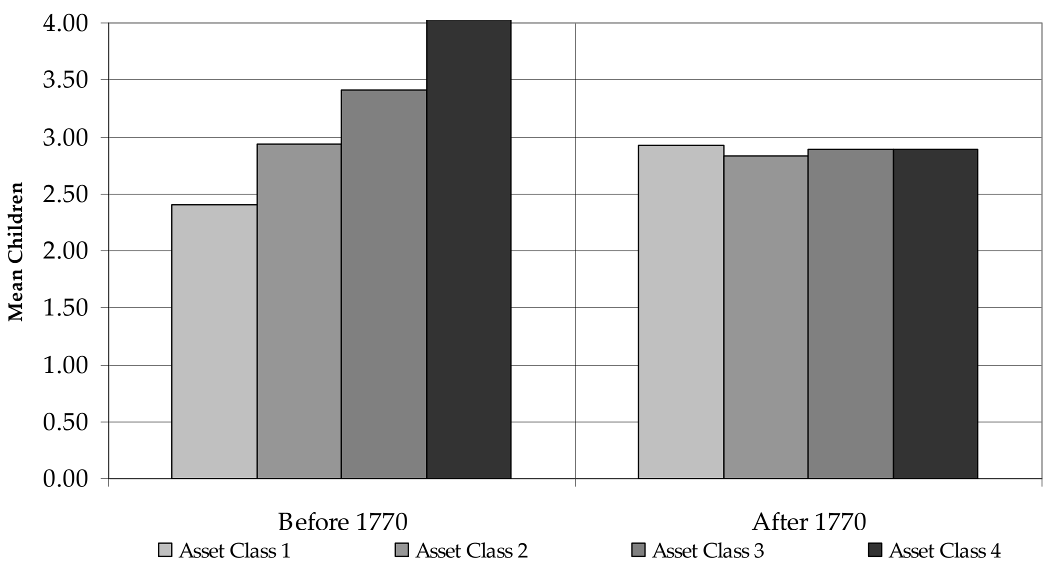


Figure 5: The True and Observed Quality-Quantity Tradeoff, pre 1800

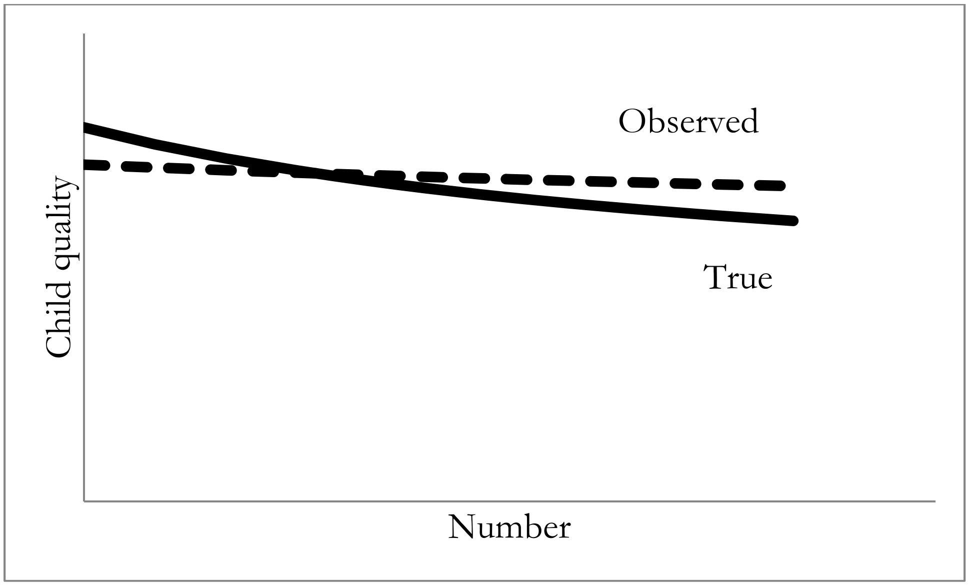
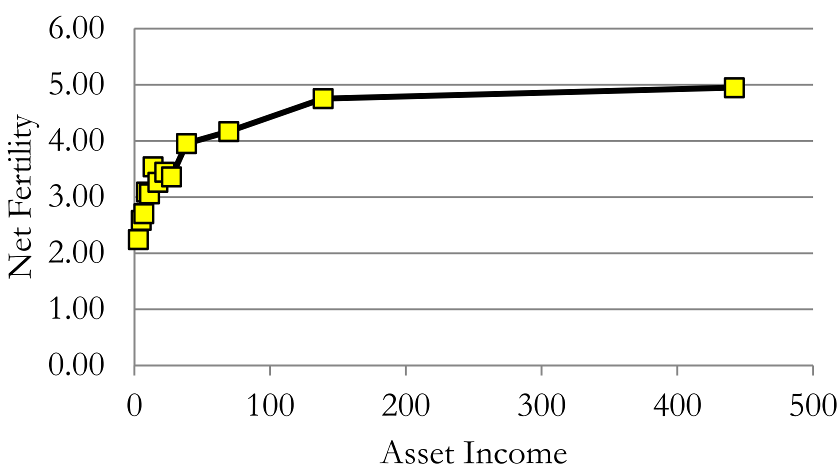


Figure 6: Asset Income and Net Fertility before 1800

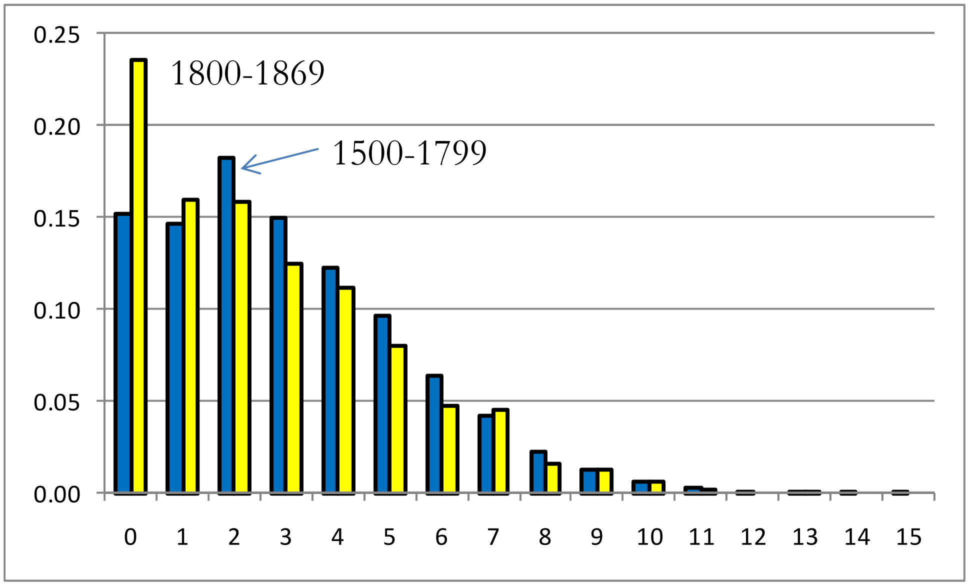


The second advantage of the pre-industrial data from England for observing the quality quantity tradeoff is the much greater variation in family sizes before 1870 than in the modern world, and the evidence that this variance was largely the product of chance, like the modern twin births. Figure 6 shows the distribution of the number of surviving children per father, at the time of the father's will, for fathers marrying 1500-1800, and 1800-1870. This number may include children from more than one wife, if a first wife died and the husband remarried.

We can measure family size in two ways. A second is the number of births per family, gross fertility. This is shown in figure 7, giving the distribution of births per mother for the wives of men marrying in England 1500-1799, where the husband had only one wife. Thus despite the average of 5 births per wife, in 10% of all marriages there was only one child born, in about 20% only two. The number of baptisms is the overwhelming explanator of the number of surviving children per man. The R^2 of the regression predicting numbers of surviving children from the number baptized is 0.73. On average 0.62 of each child born would be alive at the time of the will. If we include in this regression indicators for location, social status, wealth, and time period then the R^2 increases only marginally to 0.75. At the individual family level both gross fertility, births, and net fertility, the number of surviving children, were largely random variables. Only a tiny fraction of the variation in each is explained by correlates such as wealth, occupation, literacy and location.

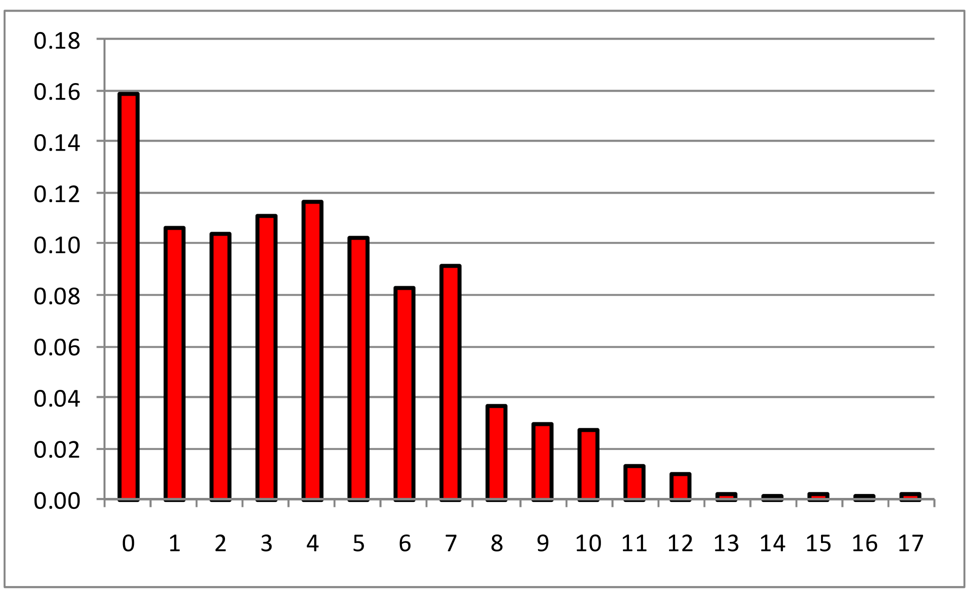
In the years before 1890 extensive demographic research has failed to uncover any sign of conscious fertility control within marriage. The main element controlling gross fertility for married couples that was under control was thus just the age of the bride at marriage. But even this tended to be independent or even *negatively* correlated with measures of parent quality such as wealth, occupational status or literacy. Table 1 shows the connection between wife's age at marriage and wealth and husbands literacy for deaths before and after 1800. The wealth quartiles are arranged in ascending order. But even in the years before 1800 the positive correlation between fertility and parent quality induced by the conscious decision of earlier marriage for the wives of richer men would be very small.

Figure 6: The distribution of net family sizes in pre-industrial England



Note: Number of observations before 1800, 6,940, after 1800, 1,418.

Figure 7: The Distribution of number of baptisms per wife, 1500-1799



Note: Number of observations before 1800, 818.

Table 1: Wife's First Marriage Age and Wealth of Husband at Death

Wealth	Deaths before 1800	Average age	Deaths 1800-1914	Average Age
Quartile 1	31	24.6	43	24.5
Quartile 2	37	25.0	60	23.7
Quartile 3	42	23.6	102	23.1
Quartile 4	46	23.7	108	24.7
Illiterate	42	24.8	31	23.1
Literate	86	23.5	249	24.2

This is illustrated in the following regression results. Table 2 shows the coefficient estimates for a negative binomial regression of the numbers of surviving children at time of father's death as a function of location, wealth, and literacy with controls also for occupational status. Even though there is a strong positive association between wealth and numbers of surviving children before 1800, and strong effects of location, the Pseudo R^2 of the regression is always very small, 2 percent or less. For men dying 1820-1914 the ability to predict completed family size is even lower, with the Pseudo R^2 now only 0.006. Table 2 also shows the same regression estimates for a smaller sample where we observe the numbers of births to the father (for those with one wife only in the course of their life). Here location no longer matters, but wealth is still positively associated with births before 1800. Again after 1820 wealth effects disappear. The Pseudo R^2 is again extremely low. Nor is occupational status significantly linked to status. The share of variance in child numbers thus explained by unmeasured variation in parent quality is thus likely to be extremely small, given that observable measures of parent quality explain so little directly.

Table 2: Predicting Gross and Net Fertility before the Demographic Transition

Variable	Net Fertility Deaths 1500-1800	Net Fertility Deaths 1820-1914	Gross Fertility Deaths 1500-1800	Gross Fertility Deaths 1820-1914
London Resident	-0.429**	0.039	0.000	0.090
	(0.051)	(0.086)	(0.099)	(0.148)
Town Resident	-0.157**	-0.171**	-0.063	-0.005
	(0.035)	(0.051)	(0.072)	(0.081)
Farm Resident	0.226**	0.002	0.077	0.167
	(0.035)	(0.085)	(0.096)	(0.155)
Wealth class 2	0.141**	-0.065	0.109	-0.063
	(0.039)	(0.074)	(0.087)	(0.118)
Wealth class 3	0.238**	-0.001	0.178	-0.012
	(0.043)	(0.072)	(0.093)	(0.121)
Wealth class 4	0.400**	0.134	0.360**	0.149
	(0.046)	(0.069)	(0.099)	(0.121)
Literate	-0.054	-0.027	-0.041	-0.147
	(0.036)	(0.088)	(0.070)	(0.115)
Controls	Occupation	Occupation	Occupation	Occupation
Pseudo R^2	0.022	0.006	0.018	0.019
N	3,622	1,946	500	371

Note: ** = significantly different from zero at 1% level, * = significant at 5% level. Standard errors in parentheses.

When the coefficient β in the equation

$$q = \beta n + u$$

the OLS estimate of β will be

$$\hat{\beta} = \beta + \frac{cov(n,u)}{var(n)}$$

But in pre-industrial England the degree of bias this will impart will be small because n was largely a random variable, so the bias in estimating β will be correspondingly very slight.

Thus suppose $n = \theta u + e$. Then

$$\frac{cov(n,u)}{var(n)} = \frac{\theta var(u)}{\theta^2 var(u) + var(e)}$$

The greater is var(e), the random component in n, then the less the bias in the estimate of β. We show below that for marriages formed before 1870 var(e) was enormous relative to θ^2var(u). We can thus use the observed correlation between quality and quantity in this period as a measure of the true underlying causal connection between quantity and quality in the years before and during the Industrial Revolution.

The Quantity-Quality Tradeoff

We have three measures of child quality for sons born over the years 1500-1875

(1) The wealth of those probated.
(2) The socio-economic status of those probated
(3) The probate rates of all sons.

The likelihood of a man being probated was strongly linked to their wealth and social status. Probate was only required if the estate of the deceased exceed a certain limit. In 1862 65% of men of high socio-economic status (professionals and gentlemen) were probated, compared to 2% of laborers (Clark and Cummins, 2011).

Given their wealth and socio-economic status did fathers with more children produce sons who were of lower "quality" on the above three dimensions?

The data used to examine this question are the probate records of male testators from England in 1500-1920. These records contain some or all of the following information: occupation of testator, marital status (married, widowed, single), place of residence, number of children of each gender, birth order, literacy of testator (measured by whether the will was signed), value of the personalty and indications of the value of real estate. These sources are described in Clark and Hamilton (2006), Clark (2007), and Clark and Cummins (2009).

The larger will database was assembled to look at the question of the link between wealth, status and net and gross fertility before and after the Industrial Revolution. But for a subset of the testators we have information on the wealth at death and social status of both fathers and at least one of their sons. We use only sons because in pre-industrial England men were much more likely to be probated, and they are much easier to link to fathers since they retain the same surname.

The sample of father-son pairings is very much biased towards the rich. As table 3 shows will makers in the years 1500-1920 were disproportionately from the upper social groups. In 1862 the bottom two social groups in the table were 40 percent of men dying, but they represent only 17 percent of those probated in our will database, and only 8 percent of fathers and sons where both were probated (Clark and Cummins, 2010, table A.12). In contrast the top 3 social groups represented 13 percent of men dying in 1862, but 49 percent of those probated, and a full 67 percent of those where both father and son were probated. Thus what we are principally looking at here is the effects of family size on the outcomes for children of the upper third of the population in pre-industrial England. But this is the group whose behavior was changing first around 1800, then around 1875 in the two stage demographic transition observed in Industrial Revolution England.

Table 3: Social Distribution among Will Makers, and Father-Son Pairs

Social group	N all wills	% all wills	N father-son	% father -son
Gentry/Independent	405	7	220	15
Merchants/ Professionals	506	9	167	11
Farmers	1906	33	605	41
Traders	883	15	152	10
Craftsmen	1132	19	217	15
Husbandmen	708	12	99	7
Laborers/Servants	268	5	16	1

Family Size and Wealth

We estimate the wealth of fathers and sons either from the will, or from the probate value (which excludes real estate), or from the duty valuation (which again measures just personalty). We used the same measure for each father-son pair. To control for the movement of prices and of wealth levels over time we deflated these values by a measure of annual wages in England.

We estimated the effect of family size on wealth through

$$lnW_s = b_0 + b_1 lnW_f + b_2 lnN + b_3 DFALIVE \quad (2)$$

Where:

N = number of surviving children

lnW_s = average log wealth of sons of a given father

DFALIVE = fraction of sons for whom the father was alive at the time of son's probate

DFALIVE is a control for the effects of sons who die before fathers, and thus likely receive smaller transfers of wealth from fathers. Such sons will also tend to be younger. And in this data wealth rises monotonically with age until men are well past 60. Since some fathers had more than one probated son, we averaged wealth across the probated sons and treated each family as the unit of observation.

With this formulation, b_3 is the elasticity of son's asset income as a function of the number of surviving children the father left. N varies in the sub-sample of fathers and sons from 1 to 13. The coefficient b_2 shows the direct link between fathers' and sons' wealth, independent of the size of the fathers' family.

Table 4 shows the estimated coefficients from equation (2) for father's dying 1500-1900. The results are reported for the data pooled across all years, and for fathers dying 1500-1819 (who would have sons born up until 1800 typically), and those dying 1820-1900. The link between father's and son's wealth as revealed by the estimate of b_2 is highly significant and stable across the sub-periods. This suggests the wealth data is of reasonably high quality.

In all cases the coefficient on family size is negative, and quantitatively significant (though only statistically significantly different from 0 for the whole sample). Unfortunately, however, we do not yet have enough data to conclude that there was a stronger a quality-quantity tradeoff in wealth for births after 1800 (we anticipate increasing by 5-6 times the number of observations of father-son pairs in the second period).

The predicted quantitative effects of sibling size on wealth at death are shown in table 5, where wealth at sib size 2 is fixed at 100. Pooling all the data, the effects of family size on the outcomes for children measured in terms of wealth are actually reasonably modest. Moving from a family of one child (with our data by definition a boy), to one of 10 children, reduces the average wealth of sons by only 46 percent.

Table 4: Son's Wealth and Family Size

Variable	All	Father Died 1500-1819	Father Died 1820-1920
Constant	2.13	1.90	2.43
LnW_f	0.496** (.045)	0.537** (.060)	0.459** (.071)
LnN	-0.264** (0.107)	-0.183 (.110)	-0.450 (.268)
Dfalive	-1.092** (.506)	-1.371** (.595)	-0.651 (.838)
N	708	593	115
Adj. R2	0.27	0.28	0.27

Note: ** = significantly different from zero at 1% level, * = significant at 5% level. Standard errors in parentheses. Analytic weights used (based on the number of probated sons).

Table 5: Sibling Size and Predicted Relative Wealth at Death, births 1500-1875

Sibling Size	All	Pre 1820	1820-1875
1	100	100	100
2	83	88	73
4	69	78	54
6	62	72	45
8	58	68	39
10	54	66	35

Table 6: Son's Wealth and Family Size and Gender Composition

Variable	All	Father Died 1500-1819	Father Died 1820-1920
Intercept	2.11	1.89	2.40
LnW_f	0.494**	0.535**	0.454**
	(.045)	(.060)	(.073)
LnN	-0.129	-0.108	-0.179*
	(0.139)	(.141)	(.457)
LnN_b	-0.170	-0.097	-0.319
	(0.138)	(.140)	(.454)
Dfalive	-1.048**	-1.350**	-0.578
	(.508)	(.587)	(.888)
N	708	593	115
Adj. R2	0.27	0.28	0.27

Note: ** = significantly different from zero at 1% level, * = significant at 5% level. Standard errors in parentheses. Analytic weights used (based on the number of probated sons).

This is not a very strong effect if the main transmission of wealth was through division of a fixed pie of wealth among children. For in that case the expected coefficient on *lnN* should be -1. The average wealth of the children of a family of 12 would be only 10% of that of a family with only one sibling.

Sons and daughters were not treated equally in wills, at least before 1800. Typically daughters would inherit less than sons in cases where we can compare the value of the bequests. This would imply that the gender composition of siblings, as well as their number, would determine outcomes for the sons whom we observe. Table 5 shows the estimates when we augment equation (2) with a term lnN_B where N_b is the number of sons. Though with the quantity of data we now have the coefficient estimates of numbers of sons are not statistically significant, they are as predicted negative in both periods.

The wealth results open the possibility that the decline in the net fertility of the rich after 1800 was the result of a more adverse quantity-quality tradeoff after the Industrial Revolution. However, the results on both socio-economic status and family size, and probate rates and family size suggest that there was no change in the incentives relating to family size.

Family Size and Socio-Economic Status

We also often observe the socio-economic status of fathers and sons. For this period we divide testators into 7 socio-economic groups, whose characteristics are shown in table 7. These groupings correspond well to average assets for testators born both before and after 1770, and also to literacy rates before 1770.

Another way we can examine the effects of family size 1500-1875 on children's outcomes is to look at sons socio-economic status compared to their father's. In larger sized families are children more likely to decline in occupational status? To do so we treat status as a cardinal number ranging from 1 (lowest) to 7 (highest), and estimate

$$S_s = b_0 + b_1 S_f + b_2 dNSTAT_f + b_3 lnN + b_4 DFALIVE \qquad (3)$$

where S is the index of status(coded 0 where no status for a father is reported), and $dNSTAT_f$ is an indicator variable equal to 1 when no status is reported for the father. This is a somewhat crude procedure, since the gaps in socio-economic status between the groups need not be in any way constant. But it will reveal some indication of the effects of family size on the inheritance of status.

Table 8 reports the results of this estimation. There is a strong connection between the status of fathers and sons, with the expected regression to the mean. However while adding another child always has a negative estimated effect on status, this effect in insignificant both statistically and in quantitative terms. On a scale of 1-7 the average socioeconomic status of sons overall was 4.83. The estimated effect of moving from a family of 1 to 10 children overall on socio-economic status is a decline of 0.23, a trivial amount. For the years post 1820 the estimated effect is much larger. But this estimate comes with a very large standard error, so it is not statistically different from the earlier estimate.

Table 7: Social Status, Assets and Literacy

Social group	Average assets pre-1770 (£)	Average assets post-1770 (£)	Literate pre-1770 (%)
Gentry	2,030	5,612	90
Merchants/professionals	922	3,855	96
Farmers	516	1,692	61
Traders	360	1,816	74
Craftsmen	239	842	64
Husbandmen	148	438	36
Laborers /Servants	104	259	23

Table 8: Son's Socio-Economic Status and Family Size

Variable	All	Father Died 1500-1819	Father Died 1820-1920
Intercept	2.22	2.18	2.83
LnW_f	0.585** (.048)	0.587** (.059)	0.552** (.089)
LnN	-0.141 (0.103)	-0.130 (.118)	-0.328 (.196)
Dfalive	-0.188 (.524)	-0.823 (.476)	0.159 (.859)
$dNSTAT_f$	2.33** (.36)	2.22** (.40)	3.05** (.62)
N	641	539	102
Adj. R2	0.28	0.26	0.33

Note: ** = significantly different from zero at 1% level, * = significant at 5% level. Analytic weights used (based on the number of probated sons).

Family Size and Probate Probability

The results in the previous two sections are just for sons probated. The rate at which sons were probated is another indication of the wealth and status of families. Figure 8, for example, shows the probate rates of groups of high and low status rare surnames by decade, 1860-2011. High status surnames had probate rates well above those of an average surname such as "Brown", and low status rare surnames had probate rates even lower. We would thus expect that if larger family sizes resulted in a decline in socio-economic status among children, that they would be probated at lower rates than children with fewer siblings.

To estimate probate rates by family size, since a family only gets in the sample if at least one son was probated, we use the ratio

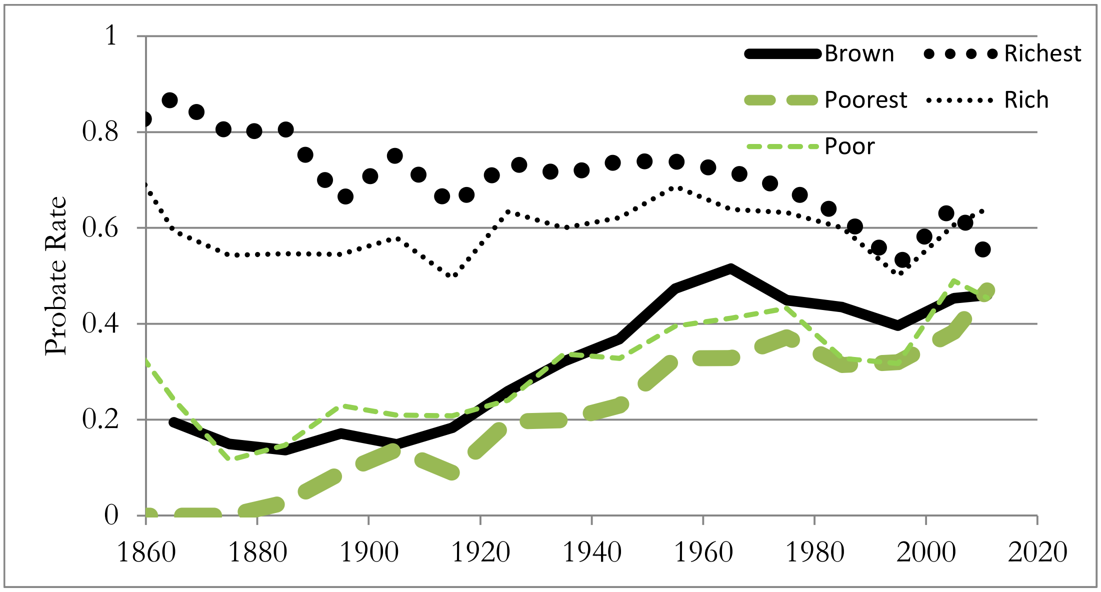
$$Prate = \frac{N_p - 1}{N_b - 1}$$

where $N_p \geq 1$ is the number of probates among adult sons, and $N_b > 1$ is the number of adult sons. Table 8 reports on the estimation of the coefficients in the equation

$$Prate = b_0 + b_1 lnW_f + b_2 lnN + e$$

As table 9 shows, there is no sign that probate rates were smaller for children of larger families for births before 1875. While father's wealth has the expected effect of increasing probate rates, the size coefficient is insignificantly different from zero both statistically and in quantitative effects. Nor is there any sign that this coefficient was becoming negative after 1800.

Figure 8: Probate Rates of Rich, Poor and *Brown* samples, by decade



Source: Clark and Cummins, 2011, Figure 3.

Table 9: Probate Rates and Family Size

Variable	All	Father Died 1500-1819	Father Died 1820-1920
Constant	-0.10	0.07	-0.33
LnW_f	0.047** (.012)	0.016 (.009)	0.077** (.022)
LnN	0.033 (0.033)	-0.011 (.026)	0.113 (.085)
N	564	467	97
Adj. R2	0.07	0.01	0.20

Note: ** = significantly different from zero at 1% level, * = significant at 5% level. Analytic weights used (the number of sons -1).

Implications

The results above are ambiguous. Did richer families before 1800 have larger families because of the absence of the modern quantity-quality tradeoff? For the wealth of those probated there is a clear but modest quantity-quality tradeoff. But another indication of wealth and status, probate rates, are not driven down in larger sized families. And the effects of size on the social status of sons is negligible.

For births 1800-1875 there are substantially greater estimated wealth and status costs to larger family size, but no sign of a decline in probate rates with family size. However, the current small numbers of observations for 1800-1875 births means that the standard errors are large enough that we cannot conclude that there was a statistically significant increase in either the wealth or status quantity. Thus it is unclear from the existing behavior if there was a switch to a more Beckerian world around the time of the Industrial Revolution which was associated with the decline in net fertility for the rich.

Note also that while we expect an unbiased estimate of quantity effects on child quality for births 1800-1875, for the years before 1800 we would expect the quantity effects in lowering child quality to be underestimated by the observational data, since then high "quality" families are having more children. Though, as we argue above, the strength of this bias for families before 1875 will be modest given the large random elements in determining completed family sizes.

However, we are in process of adding what we expect will be another 500 observations for this period, by linking our database of rare name surname deaths and probates from 1858 on to the English censuses of 1841-1911, which reveals family linkages and numbers of surviving children. With these we hope to be able to determine whether there was any change in the quality-quantity tradeoff around 1800.

It may also be possible with this data to collect a sufficient sample of sons born 1875 and later to look at whether there was any change also in the quantity-quality tradeoff for the rich post 1875, when their net fertility fell substantially below that of lower status families.

Appendix – Probate Data

The wills before 1858 come mainly from local Ecclesiastical courts in Essex, Suffolk and Surrey (before 1858 church courts handled all matters of wills and testaments). Some also come from the Prerogative Court of Canterbury, which handled estates of higher value with assets distributed across a wider area. After 1858 the wills come from the records of the Principal Probate Registry in London which has preserved all probated wills in the south of England after 1858. For wills after 1841 we are also able to link many testators to individual census records giving the age of the testator at death. For the earlier wills we can get the age at death for a subset of the testators from parish records giving baptisms and marriages.

For those testators where we do not have a direct estimate of age at death we can infer this from the observed features of the testator such as their marital status, numbers of children reported in the will, numbers of grandchildren, whether one of their parents is alive, and whether they have a child aged 21 or above.

The assets of testators were estimated in two ways. For many wills probated in 1786 and later we get an estimate of the "personalty" – assets other than real estate – from estate tax declarations. We add these to estimates of real estate from houses and land mentioned in the will to get a total value of the bequest. In only about 20% of cases where land was bequeathed was the area of the land indicated. But we are able to approximate the area from other details of the will such as the testators occupation and cash bequests.

The major flaws with using probate valuations as true measures of wealth other than real estate are the omissions of settled property and debts and credits (Owens et al 2006, 384). Before 1898, the reported probate valuations are estimates of "the gross value of an individual's unsettled personal property", and were estimated for tax purposes (Owens, Green, Bailey and Kay 2006, 383). After 1898, settled property was included (Rubinstein 1977, 100). The executors or administrators of the wills submitted estimates, and because of a fine for undervaluation "the gross valuation was always likely to be an upper estimate of an individual's worth" (Owens et al. 2006, 386).

This "gross" estimate omitted any debts or credits due by or to the deceased individual. For the period after 1881, Rubenstein estimates that the difference between the gross and net value of an estate, was on average 5 to 15% (Owens et al 2006, 387). Before 1881, effects are reported as an approximation, under a certain set threshold level (e.g. under £50, under £100). As Owens et al. noted, the effect of these tax bandings is to inflate the already rough estimates of wealth (Owens et al. 2006, 387).

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