The Micro-Evidence for the Malthusian System. France, 1670-1840

Neil Cummins*

6th August 2020

Abstract

I test the assumptions of the Malthusian model at the individual, cross-sectional level for France, 1650-1820. Using husband's occupation from the parish records of 41 French rural villages, I assign three different measures of status. There is no evidence for the existence of the positive check; infant deaths are unrelated to status. However, the preventive check operates strongly, acting through female age at first marriage. The wives of rich men are younger brides than those of poorer men. This drives a positive net-fertility gradient in living standards. However, the strength of this gradient is substantially weaker than it is in pre-industrial England.

1 The Malthusian Model

The intellectual shadow of Thomas Robert Malthus (1766-1834) looms large over all social and biological science. Malthus's ideas inspired Charles Darwin's theory of *Natural Selection* for the origin of species and of mankind itself. Today, his model (from *On the Principle of Population* (1798)) is commonly used by economists to explain both living standards and demographics before 1800 (Becker et al. (1990); Galor and Weil (2000); Hansen and Prescott (2002); Galor (2004)). Greg Clark argues that natural selection within the Malthusian world is itself responsible for the origin of economic growth in Industrial Revolution England (2007).

No other social scientist appears to solicit the emotion and energy that arises with Malthus. 220 years after his essay, fresh news articles fizzle with disdain and venom. Table 1.1 reports a selection of news articles from major international outlets, spanning 2008-16. Taken together, the titles are wildly contradictory.

Disagreement about what will happen in the future is one matter. However, disagreement about what happened in history is a failure of historical demography and economic history. Our empirical characterization of the existence, or not, of Malthusian forces in the pre-Industrial era is primarily drawn from aggregated, economy-wide correlations of real wages and crude vital rates. The micro-evidence base for the Malthus is vanishingly thin despite its central, and controversial, importance. This paper contributes new individual level evidence on the existence and relative strength of the Malthusian forces in pre-Industrial France.

*Thanks to Jane Humphries for excellent and useful commentary, Greg Clark and participants at the New Malthusian Symposium at Jesus College, Cambridge on the 13 December 2019 (in particular Massimo Livi-Bacci) and to Wesley Jessie for research assistance.

Title	Date	Source
Malthus was right![a]	25 March 2008	The New York Times
Malthus, the False Prophet	15 May 2008	The Economist
Are Malthus's Predicted 1798 Food Shortages Coming True?[b]	1 Sep 2008	The Scientific American
Was Malthus right?	15 July 2011	Time
A World of Woe: Why Malthus was Right[c]	7 July 2014	PBS News Hour
Why Malthus is Still Wrong	1 May 2016	Scientific American
Africas High Birth Rate is Keeping the Continent Poor	22 Sep 2018	The Economist

[a] In this article, Paul Krugman states "The fact is that Malthus was right about the whole of human history up until his own era."
[b] In this article Jeffrey Sachs states "Have we beaten Malthus? After two centuries, we still do not really know."
[c] This is an interview with Greg Clark on Clark (2007).

Table 1.1: Recent News Articles on Malthusian Thinking from Major International Outlets

1.1 Testing Malthus's Assumptions

To summarise Malthus (1798): food is essential, fertility is constant within marriage [quote M1 in Table 1.2], deaths are negative in living standards [M2 and M3], the probability of marriage is positive in living standards, and age at first marriage is negative in living standards [both M5].

These observations lead to the first two assumptions of the Malthusian model used by contemporary economists: 1. Births respond *positively* to living standards; and 2. Deaths respond *negatively* to living standards. Clark (2007) details how these two assumptions lead to the 'Iron Law of Malthus': There is an inverse relationship between population and living standards. Demography determines living standards in an endogenous system. All population growth will lead to reductions in living standards, inducing deaths to rise and births to fall until a no-population growth equilibrium is reached. The model is illustrated in Figure 1.1.

The model explains income per capita and population for a given level of technology, all macro level concepts, via assumption 3 but rests on micro level assumptions (1 and 2 above). In other words, "The Malthusian model of population and economic growth has two key components. First, there is a positive effect of the standard of living on the growth rate of population, resulting either from a purely biological effect of consumption on birth and death rates, or a *behavioral response on the part of potential parents to their economic circumstances*" (Weil and Wilde, 2009, my italics). This paper tests the Malthusian assumptions at the individual and village level for France, 1650-1820.

1.2 The Evidence for the Malthusian System

In general, empirical tests of the Malthusian model rely on the correlations of aggregate time series of real wages and vital rates Lee and Anderson (2002); Crafts and Mills (2009) are a selection for England, Fernihough (2013) for Italy). Weir (1984) compares the elasticities of births, marriages and deaths to grain price shocks in England and France, 1670-1870. France exhibits much stronger positive and preventive checks than England throughout this period (Table 6, p.42).[1] However,

[1] Perhaps due to the absence of a *Poor Law* system in France (See Kelly et al. (2014)). Recently, Ridolfi (2019) characterises a new time-series of French real wages, 1250-1860, as stationary, suggesting "strong positive and pre-

I think I may fairly make two postulata. First, That food is necessary to the existence of man. Secondly, That the passion between the sexes is necessary and will remain nearly in its present state. These two laws, ever since we have had any knowledge of mankind, appear to have been fixed laws of our nature…Assuming then my postulata as granted, I say, that the power of population is indefinitely greater than the power in the earth to produce subsistence for man. [M1]

…the actual distresses of some of the lower classes, by which they are disabled from giving the proper food and attention to their children, act as a positive check to the natural increase of population. [M2]

The positive check to population, by which I mean the check that represses an increase which is already begun, is confined chiefly, though not perhaps solely, to the lowest orders of society. [M3]

This check is not so obvious to common view as the other I have mentioned, and, to prove distinctly the force and extent of its operation would require, perhaps, more data than we are in possession of. But I believe it has been very generally remarked by those who have attended to bills of mortality that of the number of children who die annually, much too great a proportion belongs to those who may be supposed unable to give their offspring proper food and attention, exposed as they are occasionally to severe distress and confined, perhaps, to unwholesome habitations and hard labour. This mortality among the children of the poor has been constantly taken notice of in all towns. [M4]

a foresight of the difficulties attending the rearing of a family acts as a preventive check [M5]

Malthus, 1798

Table 1.2: Malthus's Original Words

Notes: M1 indicates the assumption that within marriage fertility is uncontrolled. M2 is the famous positive check, M3 and M4 both indicate that the positive check should be detectable by cross-sectional status differences in mortality as is the case with M5 for the preventive check.

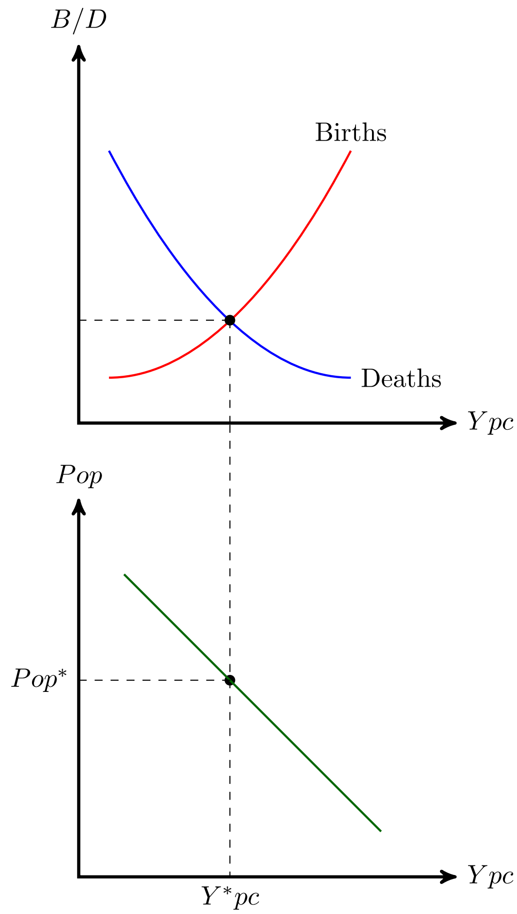


Figure 1.1: The Modern Malthusian Model

Notes: The top axes illustrate the birth and death schedules as implied by the positive and preventive check (see Table 1.2 and text). Where $Births > Deaths$, the population grows. But due to the Malthusian Iron Law, there is a negative relationship between the level of population and living standards per capita. Thus, population growth leads to declining income per capita and subsequently to higher mortality and lower fertility. This results in the long run equilibrium of a Malthusian society being one where $Births = Deaths$ and population growth is *zero*. (The same logic works in reverse where $Deaths > Births$.)

this is a short run analysis based on annual elasticities. The macro-level correlations can mask micro-level variation, especially in a country as vast and heterogeneous as pre-industrial France.

Studies explicitly testing the Malthusian assumptions at the individual level are rare. For England, Clark and Hamilton (2006); Clark and Cummins (2015) report a strong correlation of wealth and fertility in cross-section, for English men, 1500-1879. This conclusion has been supported by recent work by de la Croix et al. (2019), who similarly find a strong effect of status on net fertility but also point out that the 'upper class' elites married less and were more often childless.[2] For France, Weir (1995) links tax data to one village near Paris, Rosny-Sous-Bois, and documents a clear reproductive advantage for the rich, driven by earlier marriage and lower infant mortality. This finding is also supported by that of Hadeishi (2003) for another village, Nuits in Burgundy.[3]

This paper uses the Henry family reconstitution database to test Malthus's assumptions at the individual and village level. Firstly, by measuring the effect of a twin birth on terminal family size, I test whether Malthus was right about the *passion* between the sexes. Before the Revolution, he is correct. Twins add exactly one to final family size. There is no adjustment of parents to a random twin birth. After 1789 parents, there is suggestive evidence that parents begin adjust their fertility to parity. This finding has implications for economic models that have endogenous fertility where parents choose family size (Becker et al. (1990); Galor and Weil (2000); Hansen and Prescott (2002); Galor (2004)). For pre-Revolutionary France, this is not a realistic assumption.[4]

Using the occupational listings of husbands in the marriage registers, I assign three different measures of status to test the power of the positive and preventive check in cross-section. I find strong evidence for the primacy of the preventive check - acting through female age at first marriage - over the positive check. In fact, I find no evidence for any status-mortality gradient. The micro-level operation of the preventive check in France is consistent with Malthus's reasoning. For those that trace Europe's rise to the operation of its marriage markets (as described by Hajnal (1965)) this is a crucial finding (see for example Voigtländer and Voth (2013)).

The Malthusian status-marriage relationship drives a strong and positive fertility-status gradient. Survival of the richest operated in pre-Revolutionary France, just as in pre Industrial England (Clark and Cummins, 2015). However, the richest French do not have as high net fertility as the richest English. This results in a weaker gradient of wealth and fertility in France than England. I suspect this is due to the early fertility decline of French elites (see Livi-Bacci (1986)).

2 Data

The data for analysis are the *Family Reconstitution* data of Louis Henry. This was a detailed demographic reconstruction of 41 randomly selected French villages, 1650-1829, mapped in Figure 2.1a.[5] The 41 villages represent a random sample of one-tenth of one-percent of the 40,000 odd

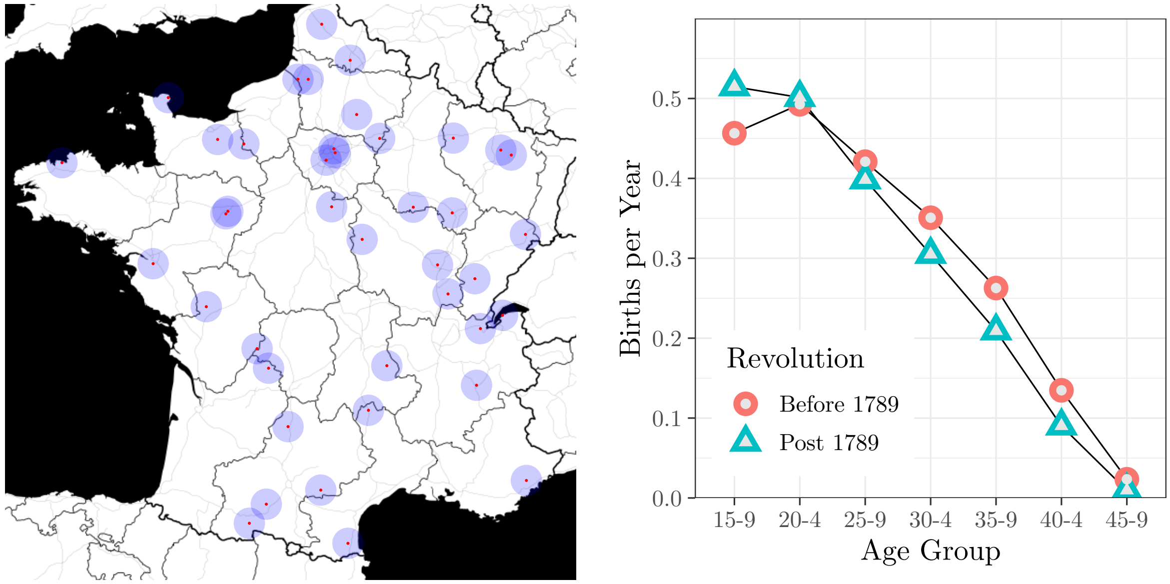
ventive checks, lending support to the Malthusian interpretation" (p.617).

[2]Due to the earlier decline of elite fertility in England (about 1800 Clark and Cummins (2015)), they are unable to generalize this pattern to their entire sample period.

[3]Cummins (2013) was focused on estimating marital fertility controlling for age at marriage and child mortality, did not explicitly test the Malthusian assumption of a positive wealth-fertility gradient.

[4]This result is also discussed and reported, along with similar results for pre-Industrial England and Quebec in a related paper, solely devoted to estimating the response of pre-transition fertility to twins, in Clark et al. (2019)

[5]The summary papers of the Enquête Henry are: Henry (1972); Henry and Houdaille (1973); Houdaille (1976) and Henry (1978). A summary of all studies using the Henry data (before 1997) is listed in Renard (1997), and detailed discussion of the database can be found in Séguy and Méric (1997); Séguy (1999); Séguy and Colençon (1999); Séguy and la Sager (1999); Séguy et al. (2001).



(a) The 41 Reconstitution Villages

(b) French Marital Fertility, Before and After 1789

Figure 2.1: Aspects of the Henry Data

Notes: The 41 communes are generally small, rural villages. The data capture the fertility decline that was underway in some villages before the French Revolution (Cummins, 2013).

villages in France at this time.[6] Figure 2.1b reports the fertility patterns before and after the French Revolution and Table 2.1 reports the village level summary statistics.[7] These are small rural villages, illustrated by the 18th century *Carte Cassini* in Figure A.1.[8]

The occupational listings of fathers in the sample were coded to the equivalent HISCO code (a standardised occupational classification scheme) and HISCAM occupational score, in addition to a 7 level scale as described in Clark and Cummins (2015). HISCAM scores are a stratification scale based on social interactions, as revealed by marriage registers (Lambert et al. (2013)) .[9] Table 2.2 reports the occupational characteristics of the *Henry* data.

Only 18.7% of husbands have a marital occupation recorded that I have been able to code. This is a minority but it compares favorably to comparable historical data. For example, only 10.3% of husbands in the *CAMPOP* English parish reconstitution have an occupation recorded at marriage (own calculations based on the underlying data from Wrigley et al. (1997)).

I link each occupation to its observed median wealth. The source for this wealth data are the *Tables des Successions et Absences* (TSAs). The TSAs were an innovation of the Napoleonic era and recorded all deaths in a locality, along with detailed information on the date of death, residence, profession, age at death and marital status. Every death was recorded, even those with no taxable assets at death, typically recorded as “rien” (25% of deaths were “rien” , see Cummins (2013) for

[6] I use 40 villages only as the sample size for Suze-Sur-Sarthe is insufficient for any statistical inference.

[7] The 1821 population figures are taken from http://cassini.ehess.fr/.

[8] It is worth noting that the sample period reflects a country whose urbanization rate is declining during the sample period (De Vries (2013)).

[9] See http://www.camsis.stir.ac.uk/hiscam/ for the HISCO/HISCAM codes and scores..

more detail). I apply the observed medians, of the sum of both cash and property wealth, by individual occupation, to the sample.

As reported in table 2.2, the HISCAM scale ranks the occupations differently to the Clark and Cummins (2015) 7 scale rank and TSA occupational wealth. The fact that the HISCAM score ranks farmers below weavers and shoemakers, despite farmers having average TSA occupational wealth that is at least 300% higher, questions the validity of the HISCAM measure as as a measure of economic status. The concordance of the Clark and Cummins (2015) 7 scale rank and the average TSA occupational wealth suggests that they are better for estimating relative economic status; thus they are preferred in this analysis.

Figure 2.2 reports the average occupational wealth level for the 41 Henry villages, 1650-1820. The richest village by this measure is *Saint-Chely-D'Apcher.* Inspecting the occupational distribution by eye, it displays unusual prestige: 35 Lords (each assigned a wealth of 85,834 Francs in 1850 prices, 2 Notaries to the King (39,596), and 7 doctors (14,666). In contrast, the poorest village, *Belloy-Saint-Leonard*, is dominated by labourers. *Maxou*, located near Cahors in Lot, is dominated by land owners. Here, mean wealth is close to median wealth.

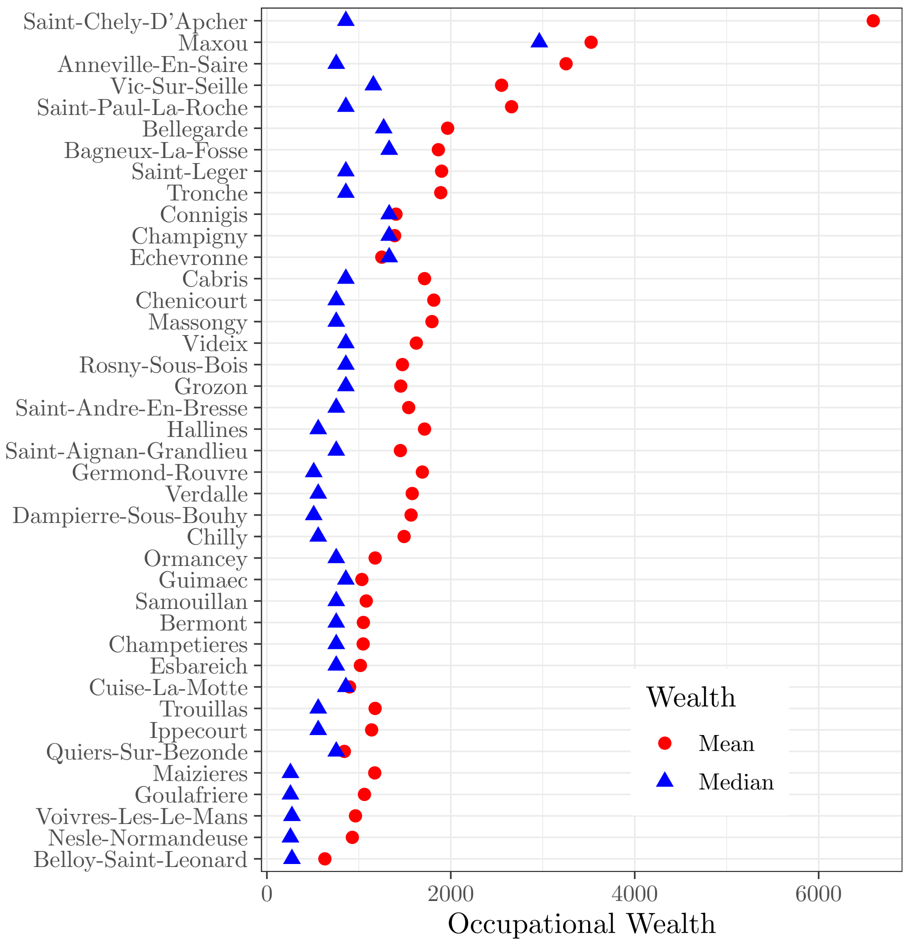


Figure 2.2: Mean Occupational Wealth, by Village

Notes: For every individual occupation listed in the marriage registers I assign the median value for that occupation observed in the Napoleonic-era tax books. The figure then plots the mean and median for this measure, by village. These calculations omit entirely those whose occupation was not recorded in the marriage registers.

Table 2.1: Summary Statistics, Villages

Village	Département	Pop. 1821	Year Min.	Year Max.	N Parents	N Children	Avg. Births
Anneville-En-Saire	Manche	807	1666	1819	1,303	3,148	5.0
Bagneux-La-Fosse	Aube	798	1670	1819	1,097	3,533	6.6
Bellegarde	Loiret	1,295	1675	1819	2,659	7,104	5.9
Belloy-Saint-Leonard	Somme	284	1684	1819	501	1,326	3.7
Bermont	Territoire de Belfort	88	1670	1819	1,321	4,026	5.9
Cabris	Alpes-Maritimes	1,879	1688	1819	2,500	7,741	5.4
Champetieres	Puy-de-Dome	1,457	1673	1819	2,068	7,327	5.5
Champigny	Yonne	1,473	1670	1819	2,131	7,494	6.6
Chenicourt	Meurthe-et-Moselle	279	1676	1819	473	1,186	6.8
Chilly	Ardennes	328	1670	1819	510	1,384	4.7
Connigis	Aisne	271	1675	1819	760	1,850	6.2
Cuise-La-Motte	Oise	959	1672	1819	1,615	5,260	6.8
Dampierre-Sous-Bouhy	Nievre	1,226	1670	1819	2,019	6,461	5.7
Echevronne	Cote-d'Or	415	1664	1819	558	1,672	5.2
Esbareich	Hautes-Pyrenees	894	1673	1819	867	2,597	5.2
Germond-Rouvre	Deux-Sevres	673	1670	1819	1,482	3,215	4.8
Goulafriere	Eure	444	1670	1819	1,046	2,346	4.2
Grozon	Jura	781	1671	1819	1,516	4,684	5.9
Guimaec	Finistere	1,789	1670	1819	3,173	9,704	5.1
Hallines	Pas-de-Calais	501	1678	1819	693	1,958	6.1
Ippecourt	Meuse	400	1674	1819	726	2,456	5.4
Maizieres	Calvados	652	1671	1819	931	2,298	5.3
Massongy	Haute-Savoie	705	1671	1819	934	2,487	6.1
Maxou	Lot	953	1674	1819	1,397	3,484	3.8
Nesle-Normandeuse	Seine-Maritime	315	1671	1819	619	1,462	4.5
Ormancey	Haute-Marne	295	1670	1819	558	1,738	5.5
Quiers-Sur-Bezonde	Loiret	465	1670	1819	745	2,143	6.4
Rosny-Sous-Bois	Seine-Saint-Denis	822	1632	1819	1,448	4,833	6.2
Saint-Aignan-Grandlieu	Loire-Atlantique	1,172	1670	1819	2,557	7,568	5.8
Saint-Andre-En-Bresse	Saone-et-Loire	188	1671	1819	728	1,554	6.3
Saint-Chely-D'Apcher	Lozere	1,366	1690	1847	3,908	12,433	6.6
Saint-Leger	Charente-Maritime	656	1686	1819	1,407	3,547	4.7
Saint-Paul-La-Roche	Dordogne	1,692	1670	1819	4,891	11,225	6.2
Samouillan	Haute-Garonne	389	1680	1819	325	1,085	5.3
Tronche	Isere	1,109	1670	1819	3,025	7,059	5.2
Trouillas	Pyrenees-Orientales	622	1737	1818	748	2,101	6.8
Verdalle	Tarn	1,137	1670	1819	1,855	4,826	4.9
Vic-Sur-Seille	Moselle	3,196	1670	1819	7,028	19,240	6.1
Videix	Haute-Vienne	781	1685	1819	2,278	4,720	6.0
Voivres-Les-Le-Mans	Sarthe	448	1670	1818	1,261	2,727	4.3

Notes: Year is year of marriage. Village Suze-Sur-Sarthe is dropped due to small numbers.
Average fertility is for those parents observed dying at age 50 and over, first marriages only.

Table 2.2: Summary Statistics, Occupations

Rank	Examples	N	HISCAM /100	TSA Wealth
7	Gentry/Independent	744	63.9	18,280.7
6	Merchants/Professionals	568	77.0	17,984.7
5	Farmers	4,070	47.1	2,780.9
4	Traders	2,136	51.5	1,734.6
3	Craftsmen	1,652	50.2	1,271.0
2	Weavers/Shoemakers	1,355	48.9	886.7
1	Laborers/Servants	1,817	45.5	237.5
		53,321		

Notes: The source for the wealth data are the *Tables des Successions et Absences*, Cummins (2013).

3 Methodology

The first Malthusian mechanism tested is parent's control of their fertility. Malthus did not conceive of any fertility control within marriage. I use the random occurrence of a twin birth to test whether twin-parents adjust their *final* family size to this *earlier* 'shock'.

The Henry sample contains 180,000 children, 4,000 of whom are twins. Conditional on a woman's age and parity, twins are essentially a random occurrence. If Malthus is right about constant marital fertility, then the expected effect of a twin on terminal family size should equal 1. If we regress

$$B_i^j = c + \beta_1 D_{Twin}^j + \sum Age_i^J + \sum Parity_i^j + \sum Village_i + \sum Decade_i^j \tag{1}$$

with B the number of births to a mother i of child j, $D_{Twin)}$ and indicator variable for child j being a twin, Age a set of mothers' age at child j birth dummies and $Parity$ being the number of children born at said birth. $Village$ is a categorical variable indicating the village of observation and *decade* is the decade of birth of the child. If there is no adjustment of mother's to the random shock of a twin, we would expect $\beta_1 = 1$. This pattern can also be interpreted as 'natural fertility', that is, fertility in the absence of *conscious parity-dependent control* (Henry (1961)).

Next I test the Henry data for the status gradient in mortality and fertility (the top schedule of Figure 1.1). The empirical strategy is simple. I examine cross-sectional differences by three different measure of status, through the main empirical estimation formula:

$$Y_i = c + \sum \beta S_i^{Occ} + \sum Village_i + \sum Decade_i^M \tag{2}$$

where S_i^{Occ} is a measure of occupational status for couple i - either occupational wealth, *HISCAM* score or a set of seven dummies for the occupational categories in Table 2.2. Y_i is an outcome; child mortality, proportion of children marrying, age at first marriage of wives, and both total births and surviving family size. For the estimations employing wealth as a linear variable, I take the natural logarithm of wealth and then scale $ln(wealth)$ to have mean 0 and SD 1.[10]

The Malthusian system is an endogenous system of equations with multiple feedback loops. Do the correlations generated by equation 2 have a *causal* interpretation? The identification could be confounded by a causal channel from the outcome variables (Y_i) to the occupational status of parents.

As status is measured at marriage, and the outcomes are determined after marriage (child mortality, fertility, etc.) this is unlikely. More likely however, is that both husband's occupational status and the outcome variables are jointly determined by the unobserved underlying characteristics of both parents, X_i (resilience, family cultures, genetics), as described in equations 3 and 4 below.

$$Y_i f(X_i) \tag{3}$$

$$S_i^{Occ} f(X_i) \tag{4}$$

This identification problem does not confound the empirical exercise. Whilst the correlations do not have causal interpretation, the outcomes of high and low status parents, even if they are determined by an underlying process that also determines status, will still reveal the Malthusian forces, if they are present. In fact, this notion is central to Darwin's use of the Malthusian model to explain the origin of species through natural selection. What matters in the Malthusian/Darwinian

[10] This was the transformation which resulted in wealth being approximately normally distributed. (See figure A.2, which plots the raw distribution of wealth, ln(wealth), and both Z-score transformations.)

system is simple, observed outcomes: who outbreeds who, who has higher survival, who marries and at what age. The observed correlations are informative of the operation of Malthusian forces, *even if they don't necessarily have a causal interpretation.*[11]

Child mortality is calculated as the proportion of children surviving to age 14. However, it is very likely that there are substantial omissions of infant deaths from the burial registers. This is documented by Houdaille (1984), who uses the *first-name repetition* technique to estimate the degree of underestimation of deaths for all the 39 *Henry* villages. In pre-industrial Europe, it was uncommon to name newborns with the same forename as a living sibling. However, where a sibling had previously died, it was common for a newborn to be named with the same forename as a deceased same-sex sibling. Using the baptism registers, the number of repeated names within parental unions can thus be compared to the number of burials recorded for that forename/parent combination. Where they agree there is no under-registration. More likely, there are significant omissions, where we find multiple births, with the same forename, within families.

For the individual-level analysis conducted here, I apply a variation of the same-name technique to calculate an *adjusted* child mortality rate. Mechanically, I take the first forename of every baptized child and count the number of children with that exact first forename in each parent union, who are not linked to any death record.[12] I then calculate the adjusted child mortality measure (CM_{Adj}) as:

$$CM_{Adj} = \frac{(N_{RN} - 1) + N_{Dead}}{N_{Born}} : N_{RN} > 0 \tag{5}$$

where N_{RN} is the number of repeated names baptised to a parental union that are not linked to any death record, N_{Dead} is the number observed dying, and N_{Born} is the total count of baptisms, both to that parental union. Where there are no repeated names, child mortality is that observed as:

$$CM_{Adj} = \frac{N_{Dead}}{N_{Born}} : N_{RN} = 0 \tag{6}$$

Figure 3.1 reports the means of the adjusted mortality measures, as well as the observed measures for each of the *Henry* villages. The adjusted child mortality rates are always significantly higher than those calculated naively from the observed burial records.

For each outcome, I estimate the elasticity with wealth for sub-periods. This way, I can flexibly test for the stability of the Malthusian system over time. This also allows for the analysis of the French Revolution of 1789 as a natural break point:

> *the French Revolution ... like a blazing comet, seems destined either to inspire with fresh life and vigor, or to scorch up and destroy the shrinking inhabitants of the earth [Malthus, M6]*

All estimations are executed as *Ordinary Least Squares*. This is to ease interpretation of the marginal effects and their standard errors; the results are not sensitive to estimation method (both *Poisson* and *Negative Binomial* estimates were calculated but are not reported).

[11] Malthus himself used cross-sectional observations to justify his assumptions (quotes M2-5). However, the observation of Malthusian forces in cross section does not mean that we can conclude that *changes* in living standards will necessarily invoke changes in the outcome variables measured by Y_i. To detect this effect the time-series analysis of Weir (1984) is more appropriate.

[12] It should be noted that the Henry data only record the first 3 characters of a person's forename. I specify first forename as a person could have more than one forename.

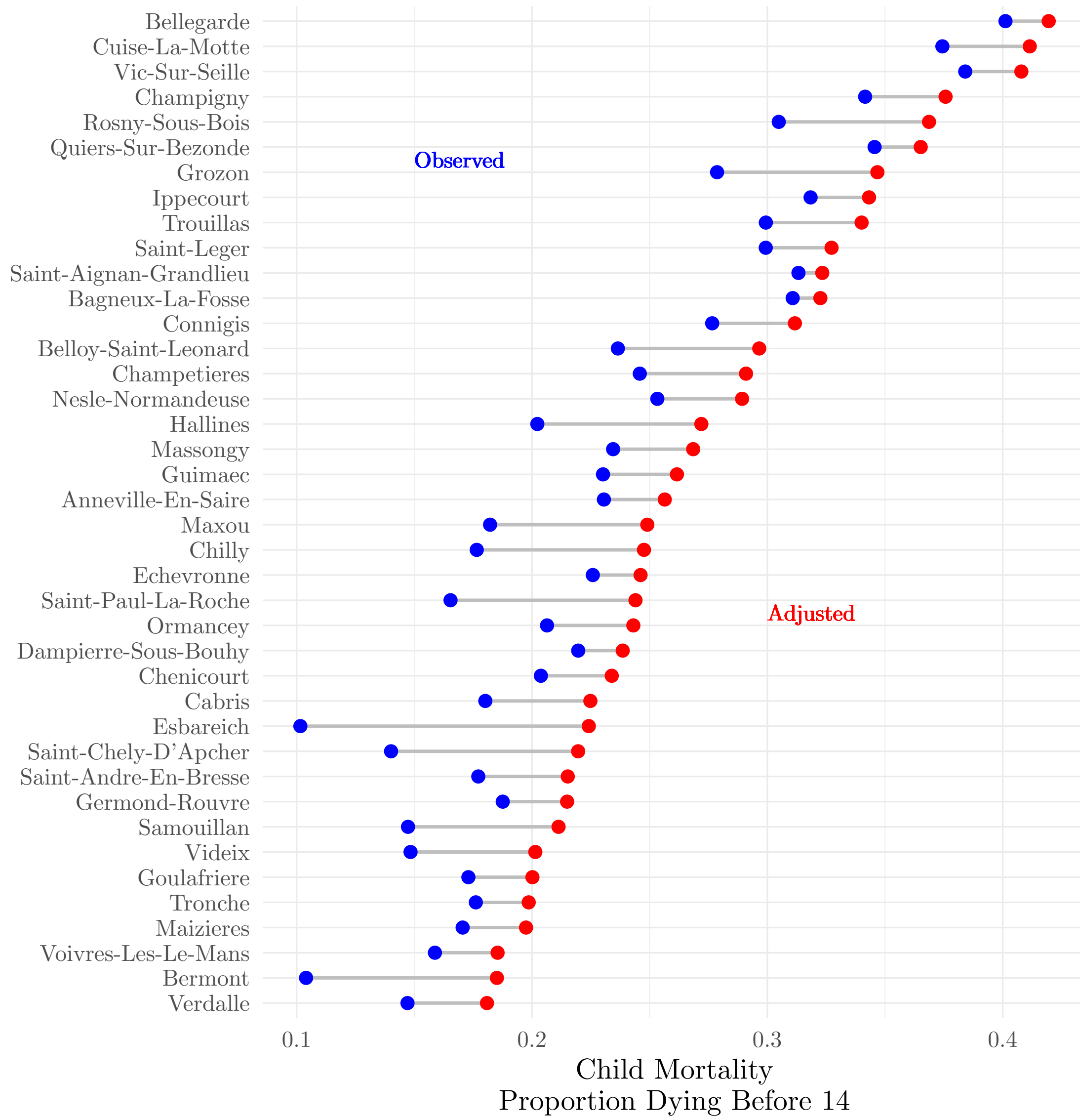


Figure 3.1: Observed and Adjusted Child Mortality, by Village

Notes: Child mortality is adjusted using a variation of the same-name technique. Repeated first names, not linked to a death, are summed within each family to calculate missing deaths. These missing deaths are then added to observed deaths, as equation 5.

4 Results

4.1 The Evidence for 'Natural Fertility'

Louis Henry, the principal agent behind the collection of the data under analysis here strongly believed that pre-industrial populations practiced 'natural fertility' just as Malthus (Henry (1961)).[13] Table 4.1 reports the 'effect' of a twin birth on final family size, as detailed in equation 1 for the Henry sample. As twin-mothers might suffer from higher maternal mortality, appendix Table A.3 reports the same test but for a smaller sub-sample of parents, who both die over the age of 50.

Table 4.1: The Effect of a Twin on Final Family Size

	Dependent variable: Final Family Size			
	Births			
	All	First	Final	Others
	(1)	(2)	(3)	(4)
Twin Birth	1.013	.928	1.000	1.127
	(.059)	(.166)	(0.000)	(.093)
Parity Dummies?	✓		✓	✓
Mother Age Dummies?	✓	✓	✓	✓
Village Fixed Effects?	✓	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓	✓
Observations	92,553	20,430	20,236	55,106
R^2	.511	.194	1.000	.076
Note:	OLS, Standard Errors in Parentheses			

To understand the simple test, first look at column 3. Here I restrict the sample to those births which are the final births to a couple. The coefficient for the twin-birth dummy is 1.000, with a standard error of 0.000. As this is the final birth, there is no chance for parents to adjust and a twin birth will always add exactly 1 to terminal family size.[14]

In column 2, I restrict the sample to first births only. Here there is ample opportunity for adjustment. Perfect adjustment would be represented by a coefficient of 0. However, the estimated coefficient is .928 with a standard error of .166. I cannot reject the null hypothesis that the coefficient is equal to 1. However, given the standard error, I cannot rule out the possibility of a small minority

[13] Some recent papers have claimed to have found empirical evidence of fertility control in a variety of pre-industrial European populations: England, France, Germany, Sweden (Cinnirella et al. (2017), Amialchuk and Dimitrova (2012), Anderton and Bean (1985), Bengtsson and Dribe (2006), David and Mroz (1989),Dribe and Scalone (2010), Kolk (2011), Van Bavel (2004)).

[14] Note that this coefficient estimate, where a twin birth is the last birth, is equal to 1 (with a standard error of 0), by construction. Relative to other women of the same parity, a final twin-birth will mean those women have a final family size 1 more than women who have a single-child final birth. A twin-birth as the final birth is often used as an instrument for child quantity in many empirical papers, for example Rosenzweig and Wolpin (1980); Angrist et al. (2006).

of fertility 'controllers' within the population. In column 1 I report the twin coefficient for all births and in column 4 all *non* first nor final births. In each of these regressions, the coefficient on the twin birth dummy is also statistically indistinguishable from 1. Table A.3 gives similar results for the restricted sample, where both parents die over 50.[15]

The estimates from Tables 4.1 and A.3 support the idea of 'natural fertility'. French villagers did not adjust their fertility to the shock of a twin. The evidence here, of the absence of pre-industrial fertility control in France, confirms the convictions of Henry and Malthus.

However, we know that the early French fertility decline preceded that of England by over 100 years (Coale and Watkins, eds (1986); Weir (1994)). Does this twin-test of parity dependent fertility adjustment detect the new fertility regime, as evidenced within the Henry sample (Cummins (2013))?

To detect change over time I estimate equation 1 by sub-period. The resulting coefficient estimates are plotted in Figure 4.1, and the underlying regressions reported in appendix Tables A.1 and A.2. I report two estimates: one for all parents, and one for only those parents who both survive to at least age 50. The 95% confidence intervals are large, so the movement in the coefficient point estimates should be interpreted with caution. There is suggestive evidence that the twin-effect diminishes in the last sub-period, 1810-40. However, the estimate are still statistically indistinguishable from 1.

Whilst the twin-test is conceptually sound, as can be seen from its execution here, it does require a large number of observations, of clean data. With the advent of large genealogical databases to conduct scientific analysis (e.g. Cummins (2017); Kaplanis et al. (2018)), the hope is that this test could be employed on new and larger data to more precisely date the onset of parity-specific control in human populations.

4.2 The Micro Evidence for the Malthusian 'Checks'

Next I apply estimation equation 2 to child mortality, the proportion of children marrying, wives' age at first marriage, and finally gross and net fertility. If Malthus is right, we should see a strong positive gradient of occupational status on each of these outcomes (and a negative effect on wife's age).

4.3 The Evidence for the Positive Check

Table 4.2 reports the results for adjusted child mortality.[16] As we are interested in status differentials, I express child mortality as a Z-score, with mean 0 and standard deviation 1. Errors are clustered at the village level because of village specific differences in burial omission rates (see

---

[15] Birth intervals post a twin birth are shorter than average birth intervals (2.48 years versus 2.22 years). This may reflect the higher probability of having twins of higher fecundity women. This tendency of twin mothers to have shorter intervals could confound the twin-test. To test this, I ran a model of birth intervals as

$$BI_i^j = c + \beta_1 D_{Twin}^j + D_{pID} + \sum Age_i^J + \sum Parity_i^j + \sum Village_i + \sum Decade_i^j \tag{7}$$

where the notation is as equation 1 but with BI, the birth interval as the dependent variable. I also include a dummy indicating whether the preceding birth had died in the interval (1) or had survived (0). Table A.4 , in the appendix, reports this estimation. There is no effect of a twin-birth on the length of birth intervals preceding and following the twin birth.

[16] In table A.8, reported in the online appendix, I report the results using unadjusted child mortality. The results are robust to both measures, the coefficients and standard errors in tables 4.2 and A.8 are substantively equivalent.

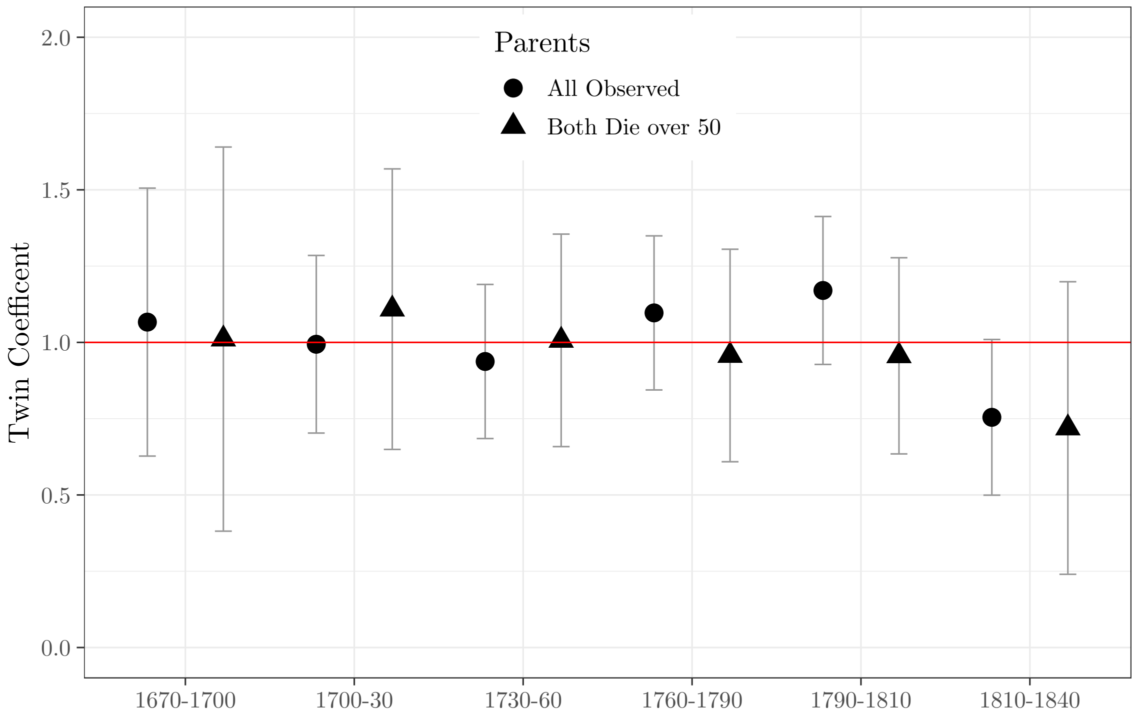


Figure 4.1: The Effect of a Twin on Final Family Size, 1760-1830, by sub-period
Notes: 95% confidence intervals are indicated by the bars. The period is based on year of birth of child for marriages 1670-1819. Source: Henry Database.

Figure 3.1). This is our primary measure of the Malthusian positive check (M2) for the *Henry* dataset.

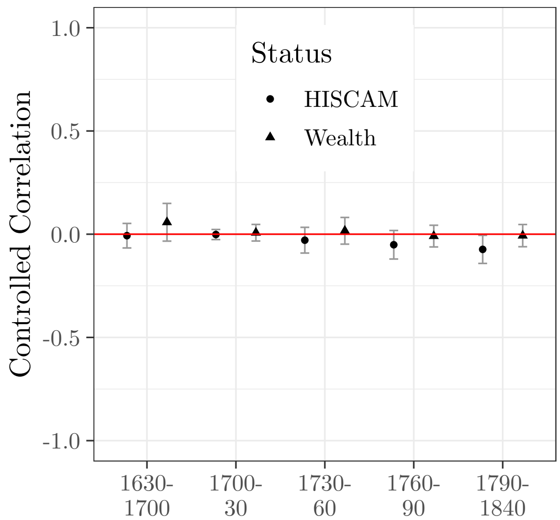
Surprisingly there is little consistent support for the existence of the positive check amongst French villagers. There is the presence of a statistically significant negative correlation with the HISCAM score, but this is not replicated by wealth nor the occupational categories. Traders appear to have higher mortality. The inclusion of village fixed effects rules out that this is some sort of urban effect, so is somewhat of a mystery. However the standard errors are large in both cases. In sum, the evidence here suggests that child mortality does not display cross-sectional trends with respect to living standards in pre-industrial France.

Table 4.2: Adjusted Child Mortality Rate and Occupational Status

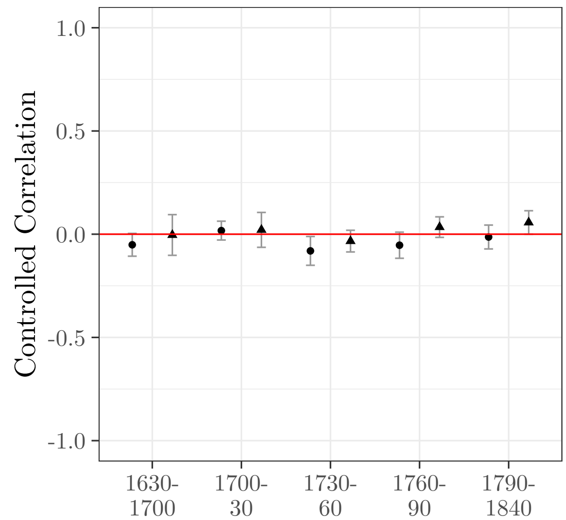
	Prop. Children Dead, Z		
	(1)	(2)	(3)
ln(Occupational Wealth), Z	.0005		
	(.021)		
Hiscam, Z		−.040*	
		(.018)	
Weavers/Shoemakers			−.004
			(.033)
Craftsmen			.033
			(.051)
Traders			.120*
			(.053)
Farmers			.036
			(.066)
Merchants/Professionals			−.104
			(.069)
Gentry/Independent			.027
			(.108)
Village Fixed Effects?	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓
Observations	7,790	7,396	7,746
R^2	.118	.124	.120

Note: *p<0.05; **p<0.01; ***p<0.001
OLS, Labourers/Servants are the omitted category.
Errors are clustered at Village level

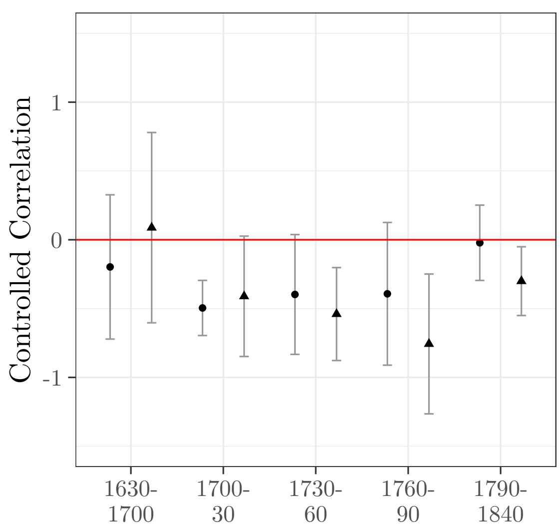
In Figure 4.2a, I plot the correlations, with 95% confidence intervals for $ln(wealth)$ by subperiod. There is no evidence of any large, significant effect in any period and the effect, estimated at zero, is consistent across time. After 1789, however, there is evidence that the Merchant/Professional class have substantially lower child mortality than the omitted category (La-



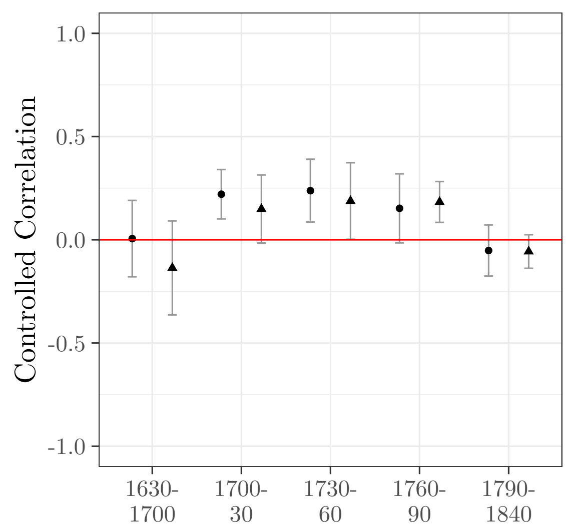
(a) Child Mortality



(b) Prop. Children Marrying



(c) Age of 1st Wife



(d) Net Fertility

Figure 4.2: The Conditional Correlation of Status and Outcomes, Rural France, 1670-1840, by period

Notes: The values are the coefficients of a linear model of equation 1 by period. Status is measured as $ln(wealth)$, re-scaled to mean 0, standard deviation 1 (Z-score). The units of the dependent variable are as in the separate regressions in the paper, namely: (a) Child Mortality, Z-score, (b) Prop. Children Marrying, Z-score, (c) Age of 1st Wife, years and (d) Net Fertility, integer value.

borers/Servants). This is evidenced by the estimation of the occupational group dummies by sub-period, reported in appendix Table A.5. The proportion of children dying for this class is approximately half that of the rest of the sample and the effect is statistically significant at the one-tenth of one-percent level.

This intriguing finding suggests that merchant and professionals were forerunners of the later, 19th century mortality decline. Whilst there is no gradient with status per se at this time, the reduced child mortality of this specific group could be a clue for future research on the secular decline of mortality. For our assessment of the Malthusian positive check, we have to conclude that there is no support, at the individual cross-sectional level. This is broadly consistent with the English evidence. There aristocrats lived approximately as long as peasants (Fogel (1986); McKeown (1976)). Throughout the pre-industrial world, the absence of evidence for a positive gradient of status and mortality is a challenge for the Malthusian model.

4.4 The Evidence for the Preventive Check

4.4.1 The Proportion of Children Marrying

Table 4.3 reports the results for the proportion of children *known* to have married. This measure is likely to be biased against more mobile classes as children who migrate from the parish will of course not be observed. I interpret this set of correlations with caution; column 3 suggests an 'inverted U' relationship between marriage probability and occupational status, with craftsmen and traders more likely to have a higher proportion of their offspring know to be married. However, this could purely be the result of the weakness of the family reconstitution data. Parish records will only observe 'stayers' - the more mobile poorer and elite classes will simply not be observed. Supporting this are the results of the child marriage probability test, using a smaller sample consisting of only children observed dying or marrying, columns 4-6).[17] Here, there are no consistent, statistically significant status correlations.

In Figure 4.2b I report the controlled correlations and their 95% confidence intervals over time. There is no evidence for any structural break at any point. Thus, there is no strong micro evidence base to conclude that the preventive check operated through the proportion of children marrying at any point in France, during the period spanning 1670-1830.

4.4.2 Wife's Age at First Marriage

Table 4.4 reports the results of the estimation of equation 2 for female age at marriage, measured in years.[18] I estimate separately for all marriages (columns 1-3) and first marriages only (columns 4-6).

Here we find strong and consistent correlations with all measures of occupational status before 1789. The wives of higher status men are younger at marriage than those of lower status men. The wives of the gentry/independent class marry almost 2.5 years younger than those of labourers and servants. For farmers and merchants, the estimate is approximately about 1.3-1.6 years. Even craftsmen marry women who are around 1.1 years younger. However, here the HISCAM score does not have a statistically significant association. The concordance of wealth and occupational

[17]For this reason, I avoid over interpreting the highly statistically significant coefficient on HISCAM (row 2) as it fails to be replicated in column 5 (where the sample is stayers only).

[18]The age of women at first marriage can only be observed for women who are also born in the parish of marriage. This analysis can only claim validity for this group.

Table 4.3: Proportion of Children Marrying and Occupational Status

	Prop. of Children Known to be Married, Z-Score					
	All			Stayers Only		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Occupational Wealth), Z	.029			.001		
	(.016)			(.020)		
Hiscam, Z		$-.047^{**}$			$-.023$	
		(.014)			(.036)	
Weavers/Shoemakers			.047			$-.006$
			(.049)			(.066)
Craftsmen			.048			$-.012$
			(.038)			(.072)
Traders			$.193^{***}$			.037
			(.054)			(.053)
Farmers			$.157^{***}$			.014
			(.039)			(.056)
Merchants/Professionals			$-.091$			$-.211$
			(.076)			(.222)
Gentry/Independent			.112			.021
			(.068)			(.063)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,792	7,397	7,748	2,343	2,216	2,333
R^2	.087	.087	.092	.051	.053	.053

Note: *p<0.05; **p<0.01; ***p<0.001
OLS, Labourers/Servants are the omitted category.
All includes all children known to be married, that die in the parish and who are not later observed. *Stayers* are only those known to be married and observed dying in the parish

groups supports the assessment that status does truly correlate with females' age at marriage. (This agreement also supports the idea that they may be superior measures of status than HISCAM.)

Table 4.4: Female Age at Marriage and Husband Occupational Status

	Female Age at Marriage					
	All Marriages			First Marriages		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Occupational Wealth), Z	$-.468^{***}$			$-.323^{***}$		
	(.112)			(.076)		
Hiscam, Z		$-.134$			$-.146$	
		(.100)			(.085)	
Weavers/Shoemakers			$-.372$			.111
			(.290)			(.309)
Craftsmen			-1.169^{**}			$-.959^{***}$
			(.374)			(.259)
Traders			$-.435$			$-.158$
			(.394)			(.290)
Farmers			-1.624^{***}			-1.121^{***}
			(.335)			(.281)
Merchants/Professionals			-1.290^{*}			$-.692$
			(.589)			(.374)
Gentry/Independent			-2.422^{***}			-1.633^{***}
			(.593)			(.389)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,871	7,418	7,819	6,420	6,020	6,383
R^2	.057	.055	.060	.077	.073	.082

Note: *p<0.05; **p<0.01; ***p<0.001
OLS, Labourers/Servants are the omitted category.

Figure 4.2c reports the *ln*(*wealth*) and HISCAM scores over time. For 1700-1789, there is consistent evidence for a negative effect of wealth on female age at marriage (the confidence intervals for the HISCAM results are too large for this interpretation, apart from 1700-1730, where a significant negative effect is estimated). After 1790, this negative association disappears and the status effect of wealth on female age at marriage disappears. The standardised correlations are indistinguishable from zero.

Before 1789, this set of micro cross-sectional tests of the Malthusian model suggest that it is the preventive check, acting through female age at first marriage, that dominates in French rural villages. Recently, there has been a focus on the *European Marriage Pattern,* of a relatively high female age at marriage and a large celibate proportion, first noted by Hajnal (1965), as the potential reason for the origin of modern economic growth in North West Europe (De Moor and Van Zanden (2010); Voigtländer and Voth (2013)). The dynamics of the marriage market in France meant not only a relatively high age at first marriage (25.2 in the Henry data) but also a gradient where the rich married younger than the poor. This was perhaps related to the fixed cost of establishing a new household upon marriage and the time it took to save for a daughter's dowry (Blacker (1957), Hanley (2003)). After the revolution, this gradient diminished.[19]

It is clear that in 18th century France, the marriage market was segmented along class lines (see, for example, Barber (1955), on the Bourgeoisie). That this segmentation resulted in consistently different female ages at marriage between these classes is a novel finding. The status gradient in age at marriage is perhaps another, previously missed, feature of the *European Marriage Pattern.* It is possible that the equalising social forces of the 1789 revolution dismantled the segmented marriage market and dissolved the Malthusian gradient in female age at marriage.

For France, pre-Revolution, the Malthusian preventive check is supported by this evidence of status differences in female age at marriage.

4.5 Survival of the Richest in France?

Building on Malthus and Darwin, Clark (2007) claims that the positive wealth-fertility gradient throughout English history was responsible for 'survival of the richest' and, through this selection, also responsible for the origin of modern economic behaviour and growth. England became rich and escaped the Malthusian trap through this endogenous, Malthusian dynamic. There has, however, been little discussion of this mechanism outside of England.[20] For France, Cummins (2013) fails to find any positive effect of wealth on family size *during* the fertility transition. However, that study confined itself to wealth measured during the Napoleonic era. What was the status-fertility gradient in France before the secular decline, roughly coincident with 1789?

Tables 4.5 reports the individual correlations of fertility, gross and net, with occupational wealth, HISCAM score and the 7-point occupational division for the *Henry* sample. There is a moderate correlation of .1-.16 for $ln(wealth)$ but HISCAM is statistically indistinguishable from zero. The gradient across the occupational groups is consistent with $ln(wealth)$ correlation and roughly positive. Farmers have around an extra .8 of a child relative to labourers, merchants and professionals .7 and the gentry/independent class approximately .65. These fertility differences are slightly more muted for net fertility (calculated as the number of children surviving to at least 14).[21]

Figure 4.2d reports the coefficient point estimates for net fertility, by sub-period, for $ln(wealth)$ and HISCAM. In general, these estimates support the existence of a Malthusian gradient in net fertility in 18th century France that diminishes after the Revolution.[22] This result conclusively shows that the early French fertility decline was *not* a neo-Malthusian response, as suggested by Wrigley (1985a,b). If marital fertility limitation replaced marriage as the lever of individual's control over family size, we would expect the Malthusian gradient in fertility to persist after 1789, just as it dominated before. What we in fact observe is the disappearance of the Malthusian fertility gradient entirely. In several villages, it actually becomes sharply negative (see Cummins (2013)).

Figure 4.3 compares the status-fertility gradient in France with that of England, both pre-1780. The source for the English data is Clark and Cummins (2015, Table 8, p.19). The English data is

[19]This was not a result of higher status of women, the revolution did little for female status (see Phillips (1976)).

[20]Recently, Hu (2020) has uncovered strong evidence for the existence of this mechanism in China and has proposed a 'survival of the Confucians' effect. Skirbekk (2008) conducts a meta-analysis of the status-fertility gradient for 129 contemporary and historical sources, although the vast majority are for after 1900.

[21]All regressions include village level fixed effects. However, this could cloud fertility differences generated by sorting into higher fertility villages. Table at the village level. as reported in appendix table A.6 in the appendix tests for fertility differences across individuals by village wealth. There are no consistent, significant effects.

[22]Estimating the occupational group coefficients for the period after 1789 reveals that the Merchant/Professional class has significantly lower gross fertility (a coefficient of -.1), regression not reported here.

Table 4.5: Individual Level Correlations of Occupational Status and Fertility

	Fertility					
	Gross Fertility			Net Fertility		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	.121**			.086**		
	(.044)			(.031)		
Hiscam, Z		.081			.128***	
		(.043)			(.030)	
Weavers/Shoemakers			.276			.170
			(.164)			(.117)
Craftsmen			.670***			.513***
			(.153)			(.110)
Traders			.706***			.319**
			(.151)			(.109)
Farmers			.896***			.646***
			(.138)			(.099)
Merchants/Professionals			.948***			.818***
			(.215)			(.154)
Gentry/Independent			.072			.091
			(.238)			(.170)
Constant	3.808***	4.101***	3.344***	2.645***	2.810***	2.294***
	(.292)	(.305)	(.307)	(.209)	(.216)	(.219)
Village Fixed effects?	✓	✓	✓	✓	✓	✓
Observations	6,730	6,491	6,699	6,344	6,119	6,314
Adjusted R^2	.035	.033	.040	.074	.076	.080

Note: $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$
OLS, Labourers/Servants are the omitted category

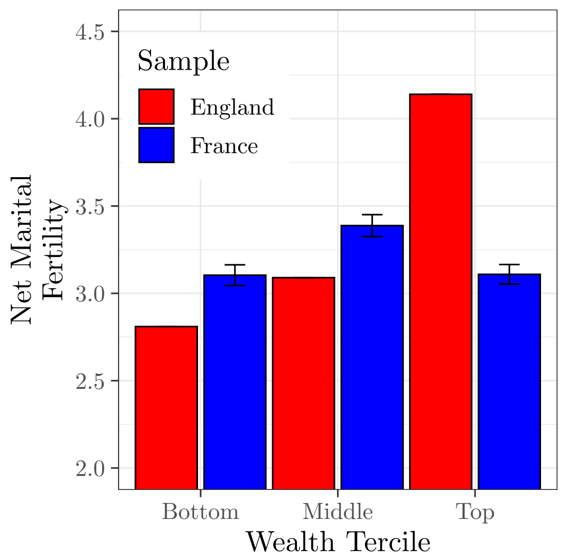


Figure 4.3: Net Marital Fertility, France and England Compared, Pre 1780
Source: *Henry* data and Clark and Cummins (2015, Table 8, p.19).

drawn from parish registers linked to probated wills that are read and the listed assets are translated into a cash value. For both samples, I have created three bins, or terciles, of the wealth distribution, from 1 (the poorest third), 2 (the middle) and 3 (the richest). On the vertical axis, net fertility, the number of children surviving until age 14 is measured. For both samples, all individuals are married (but could also be childless).[23] The comparison is revealing. When we compare the effect of wealth on net marital fertility, between England and France, we find that the gradient is substantially steeper in England. This 'super-fertility' of the richest English is not found in France. The wealth effect in France is weaker than in England.

The English evidence is far more supportive of a Malthusian fertility system than the French evidence analysed here. Yet we know France has been characterised as a a demographic system displaying greater sensitivity to economic shocks than England (Weir, 1994). However, within France we fail to find a *strong* status-fertility relationship. What could explain this absence? One speculation is that even by the 18th century, the French elite had begun to limit their fertility. Livi-Bacci documents declining fertility rates of the French elite (1986, p.185). Whilst the twin test of Table 4.1 fails to find evidence of significant parity-specific control in rural France, it is still possible that a minority practiced it, thus explaining the lack of a Malthusian fertility schedule. For now we have to admit that the reasons for the low fertility of the richest French are a mystery.

It would be a wild intellectual leap to dare to suggest that the weak status-fertility gradient in France was responsible for France's relatively slow industrialisation in the 19th century. That is obviously beyond the scope of the analysis here. Yet understanding these differences in the

[23]This is due to the limitation of the data sources used, we can only compare net-fertility within marriage. However the results of table 4.3 and figure 4.2b suggest that in France at least the status-ever-married gradient was flat. Future research, that triangulates genealogical records with the kind of parish records used here, could answer that question definitely.

Malthusian system *between* countries could help us understand differences in the timing of the onset of modern economic growth, given the selection mechansims proposed by both Clark (2007) and Galor and Moav (2002).

5 Conclusion

In pre-industrial France, the poor delayed marriage. This 'safety valve' regulated population expansion and in the Malthusian system meant that France was richer than it otherwise would have been. Malthusian forces existed in pre-Revolutionary France. However, a close analysis of the Henry micro-data reveals that the preventive check, acting through female age at first marriage, dominated the positive check of child mortality. Pre-1789, survival of the richest was a French reality, just as it was in England. However, the elites of the small French villages display surprisingly low fertility when compared to the richest English. All Malthusian characteristics more or less disappeared after the Revolution.

The emergence of modern economic growth during the Industrial Revolution was followed by a fertility transition in England. In France the fertility transition preceded modern growth by over a century. The role of elites and their non-Malthusian fertility choices is a potential fruitful avenue for future research which seeks to understand these two events, whether they are connected to a child quality-quantity trade-off, desires to climb the ladder of social life ('social capillarity'), as the 19th century French author Dumont (1890) speculated) or some other as yet unspecified mechanism. One promising future direction would be the exploitation of modern Big Data compilations of family genealogies linked to historical sources such as Kaplanis et al. (2018) and Cummins (2017).

References

Amialchuk, Aliaksandr and Elitsa Dimitrova, "Detecting the Evolution of Deliberate Fertility Control before the Demographic Transition in Germany," *Demographic Research*, 2012, *27* (19), 507–542.

Anderton, Douglas L. and Lee L. Bean, "Birth Spacing and Fertility Limitation: A Behavioral Analysis of a Nineteenth Century Frontier Population," *Demography*, 1985, *22* (2), 169–183.

Angrist, Joshua D., Victor Lavy, and Analia Schlosser, "Multiple Experiments for the Causal Link between the Quantity and Quality of Children," September 2006. MIT Department of Economics Working Paper No. 06-26.

Barber, Elinor G., *The Bourgeoisie in 18th-Century France*, Princeton University Press, 1955.

Bavel, Jan Van, "Deliberate Birth Spacing before the Fertility Transition in Europe: Evidence from Nineteenth-Century Belgium," *Population Studies*, 2004, *58* (1), 95–107.

Becker, Gary S., Kevin M. Murphy, and Robert Tamura, "Human Capital, Fertility, and Economic Growth," *The Journal of Political Economy*, 1990, *98* (5), S12–S37.

Bengtsson, Tommy and Martin Dribe, "Deliberate Control in a Natural Fertility Population: Southern Sweden, 1766-1864," *Demography*, 2006, *43* (4), 727–46.

Blacker, J. G. C., "Social Ambitions of the Bourgeoisie in 18th Century France, and their Relation to Family Limitation," *Population Studies*, 1957, *11* (1), 46–63.

Cinnirella, Francesco, Marc Klemp, and Jacob Weisdorf, "Malthus in the Bedroom: Birth Spacing as Birth Control in Pre-Transition England," *Demography*, 2017, *54.2*, 413–436.

Clark, Gregory, *A Farewell to Alms: A Brief Economic History of the World*, Princeton, NJ:: Princeton University Press, 2007.

_ and Gillian Hamilton, "Survival of the Richest: The Malthusian Mechanism in Pre-Industrial England," *The Journal of Economic History*, 2006, *66* (3), 707–736.

_ and Neil Cummins, "Malthus to modernity: wealth, status, and fertility in England, 1500–1879," *Journal of Population Economics*, 2015, *28* (1), 3–29.

_ , _ , and Matthew Curtis, "Twins Reveal Absence of Fertility Control in Pre-Industrial Western European Populations," 2019.

Coale, Ansley J. and Susan. C. Watkins, eds, *The Decline of Fertility in Europe: The revised proceedings of a conference on the Princeton European Population Project*, Princeton University Press, 1986.

Crafts, Nicholas and Terence C. Mills, "From Malthus to Solow: How did the Malthusian economy really evolve?," *Journal of Macroeconomics*, 2009, *31* (1), 68 – 93. Advances in Historical Macroeconomics.

Cummins, Neil, "Marital fertility and wealth during the fertility transition: rural France, 1750–1850," *The Economic History Review*, 2013, *66* (2), 449–476.

_ , "Lifespans of the European Elite, 800–1800," *The Journal of Economic History*, 2017, *77* (2), 406–439.

David, Paul A. and Thomas A. Mroz, "Evidence of Fertility Regulation among Rural French Villagers, 1749-1789: A Sequential Econometric Model of Birth-Spacing Behavior (Part 1)," *European Journal of Population / Revue Europï¿œenne de Dï¿œmographie*, 1989, *5* (1), 1–26.

de la Croix, David, Eric B. Schneider, and Jacob Weisdorf, "Childlessness, Celibacy and Net Fertility in Pre-Industrial England: The Middle-class Evolutionary Advantage," CAGE Online Working Paper Series, Competitive Advantage in the Global Economy (CAGE) 2019.

De Moor, Tine and Jan Luiten Van Zanden, "Girl power: the European marriage pattern and labour markets in the North Sea region in the late medieval and early modern period1," *The Economic History Review*, 2010, *63* (1), 1–33.

Dribe, Martin and Francesco Scalone, "Detecting Deliberate Fertility Control in Pre-transitional Populations: Evidence from six German villages, 1766-1863/ Mise en ï¿œvidence d'un contrï¿œle volontaire des naissances dans des populations prï¿œ-transitionnelles: Le cas de 6 villages allemands, 1766-1863," *European Journal of Population / Revue Europï¿œenne de Dï¿œmographie*, 2010, *26* (4), 411–434.

Dumont, Arsene, *Dépopulation et Civilisation: Étude Démographique*, Paris: Lecrosnier et Babé, 1890.

Fernihough, Alan, “Malthusian Dynamics in a Diverging Europe: Northern Italy, 1650–1881,” *Demography*, 2013, *50* (1), 311–332.

Fogel, Robert W, “Nutrition and the decline in mortality since 1700: some preliminary findings,” in “Long-term factors in American economic growth,” University of Chicago Press, 1986, pp. 439–556.

Galor, Oded, “From Stagnation to Growth: Unified Growth Theory,” 2004. CEPR Discussion Papers 4581.

_ **and David N. Weil**, “Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and beyond,” *The American Economic Review*, 2000, *90* (4), 806–828.

_ **and Omer Moav**, “Natural Selection and the Origin of Economic Growth,” *The Quarterly Journal of Economics*, 2002, *117* (4), 1133–1191.

Hadeishi, Hajime, “Economic Well-Being and Fertility in France: Nuits, 1744-1792,” *The Journal of Economic History*, 2003, *63* (2), 489–505.

Hajnal, John, “European marriage patterns in perspective,” in Eversley DE Glass DV, ed., *Population in history: essays in historical demography*, 1965.

Hanley, Sarah, “"The Jurisprudence of the Arrêts": Marital Union, Civil Society, and State Formation in France, 1550-1650,” *Law and History Review*, 2003, *21* (1), 1–40.

Hansen, Gary D. and Edward C. Prescott, “Malthus to Solow,” *American Economic Review*, September 2002, *92* (4), 1205–1217.

Henry, Louis, “Some data on natural fertility,” *Eugenics Quarterly*, 1961, *8*, 81.

_ , “Fécondité des mariages dans le quart sud-ouest de la France, de 1720 à 1829,” *Annales. Histoire, Sciences Sociales*, 1972, *27* (3), pp. 612–640.

_ , “Fécondité des mariages dans le quart Sud-Est de la France de 1670 a 1829,” *Population (French Edition)*, 1978, *33* (4/5), 855–883.

_ **and Jacques Houdaille**, “Fécondité des mariages dans le quart nord-ouest de la France de 1670 a 1829,” *Population (French Edition)*, 1973, *28* (4/5), 873–924.

Houdaille, Jacques, “Fécondité des mariages dans le quart nord-est de la France de 1670 a 1829.,” in “Annales de Demographie Historique” 1976, pp. 341–392.

_ , “La mortalite des enfants dans la France rurale de 1690 a 1779,” *Population (French Edition)*, 1984, *39* (1), 77–106.

Hu, Sijie, “Survival of the Confucians: Marital Fertility and Social Status in China, 1400-1900,” 2020.

Kaplanis, Joanna, Assaf Gordon, Tal Shor, Omer Weissbrod, Dan Geiger, Mary Wahl, Michael Gershovits, Barak Markus, Mona Sheikh, Melissa Gymrek, Gaurav Bhatia, Daniel G. MacArthur, Alkes L. Price, and Yaniv Erlich, “Quantitative analysis of population-scale family trees with millions of relatives,” *Science*, 2018, *360* (6385), 171–175.

Kelly, Morgan, Joel Mokyr, and Cormac ï¿œ Grï¿œeda, "Precocious Albion: A New Interpretation of the British Industrial Revolution," *Annual Review of Economics*, 2014, *6* (1), 363–389.

Kolk, Martin, "Deliberate Birth Spacing in Nineteenth Century Northern Sweden," *European Journal of Population / Revue européenne de Démographie*, Aug 2011, *27* (3), 337–359.

Lambert, Paul S., Richard L. Zijdeman, Marco H. D. Van Leeuwen, Ineke Maas, and Kenneth Prandy, "The Construction of HISCAM: A Stratification Scale Based on Social Interactions for Historical Comparative Research," *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 2013, *46* (2), 77–89.

Lee, Ronald and Michael Anderson, "Malthus in state space: Macro economic-demographic relations in English history, 1540 to 1870," *Journal of Population Economics*, May 2002, *15* (2), 195–220.

Livi-Bacci, Massimo., "Social-group forerunners of fertility control in Europe," in Ansley J. Coale and Susan C. Watkins, eds., *The Decline of Fertility in Europe: The revised proceedings of a conference on the Princeton European Population Project*, Princeton, NJ: Princeton University Press, 1986, pp. 182–200.

Malthus, Thomas Robert, *An essay on the principle of population* 1798.

McKeown, Thomas, *The modern rise of population*, Vol. 11, Edward Arnold London, 1976.

Phillips, Roderick, "Women and Family Breakdown in Eighteenth-Century France: Rouen 1780-1800," *Social History*, 1976, *1* (2), 197–218.

Renard, Claude, "Enquête Louis Henry: Bibliographié de lénquête," *Institut National d'Études Démographiques: Documents de travail*, 1997, *61.*

Ridolfi, Leonardo, "Six Centuries of Real Wages in France from Louis IX to Napoleon III: 1250–1860," *The Journal of Economic History*, 2019, *79* (3), 589–627.

Rosenzweig, Mark R. and Kenneth I. Wolpin, "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment," *Econometrica*, 1980, *48* (1), 227–240.

Séguy, Isabelle, "J.-N. Biraben's Survey of the Population of France from 1500 to 1700. Presentation, Sources, Bibliography," *Population*, 1999, *11* (1), 133–154.

_ **and Corinne Colençon Henri an Méric**, "Enquête Louis Henry: Notice descriptive de la partie nominative," *Institut National d'Études Démographiques: Documents de travail*, 1999, *76.*

_ **and Corinne Méric**, "Enquête Louis Henry: Notice descriptive de la partie non nominative," *Institut National d'Études Démographiques: Documents de travail*, 1997, *57.*

_ **and Fabienne la Sager**, "Enquête Louis Henry: Notice descriptive de données informatiques," *Institut National d'Études Démographiques: Documents de travail*, 1999, *77.*

_ **, Henri Colençon, Corinne Méric, and Fabienne le Sager**, *La population de la France de 1670 à 1829: l'enquête Louis Henry et ses données*, Paris: Institut National d'Études Démographiques, 2001.

Skirbekk, Vegard, "Fertility trends by social status," *Demographic Research*, 2008, *18* (5), 145–180.

Voigtländer, Nico and Hans-Joachim Voth, "How the West "Invented" Fertility Restriction," *American Economic Review*, 2013, *103* (6), 2227–64.

Vries, Jan De, *European Urbanization, 1500-1800*, Routledge, 2013.

Weil, David N. and Joshua Wilde, "How Relevant Is Malthus for Economic Development Today?," *American Economic Review*, May 2009, *99* (2), 255–60.

Weir, David R., "Life Under Pressure: France and England, 1670-1870," *The Journal of Economic History*, 1984, *44* (1), 27–47.

_ , "New Estimates of Nuptiality and Marital Fertility in France, 1740-1911," *Population Studies*, 1994, *48* (2), 307–331.

_ , "Family Income, Mortality, and Fertility on the Eve of the Demographic Transition: A Case Study of Rosny-Sous-Bois," *The Journal of Economic History*, 1995, *55* (1), 1–26.

Wrigley, Edward A., "The Fall of Marital Fertility in Nineteenth-Century France: Exemplar or Exception? (Part I)," *European Journal of Population*, 1985, *1* (1), 31–60.

_ , "The Fall of Marital Fertility in Nineteenth-Century France: Exemplar or Exception? (Part II)," *European Journal of Population*, 1985, *1* (2), 141–177.

_ , Ros S. Davies, Oeppen James E., and Roger S. Schofield, *English population history from family reconstitution, 1580-1837*, Cambridge: Cambridge University Press, 1997.

A ONLINE APPENDIX

A.1 Extra Results

(a) Rosny-Sous-Bois

(b) Saint-Chely-D'Apcher

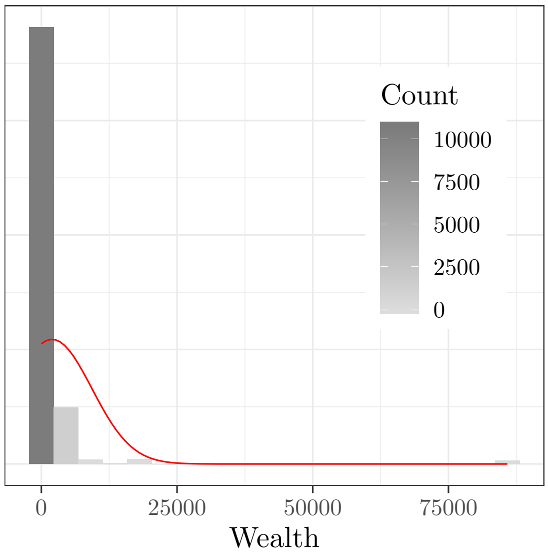
(c) Cabris

(d) Belloy-Saint-Leonard

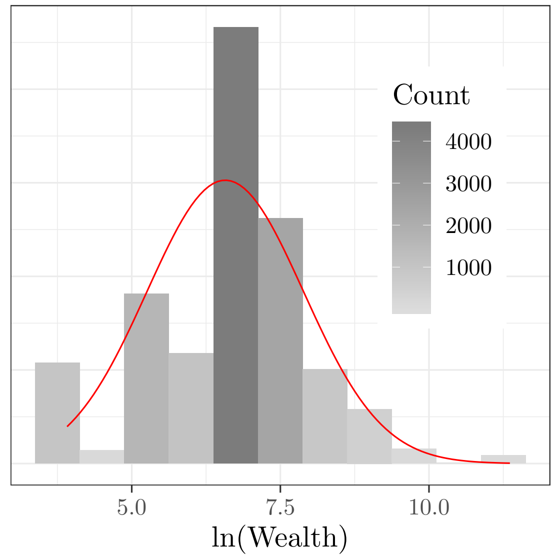
(e) Saint-Paul-La-Roche

(f) Anneville-En-Saire

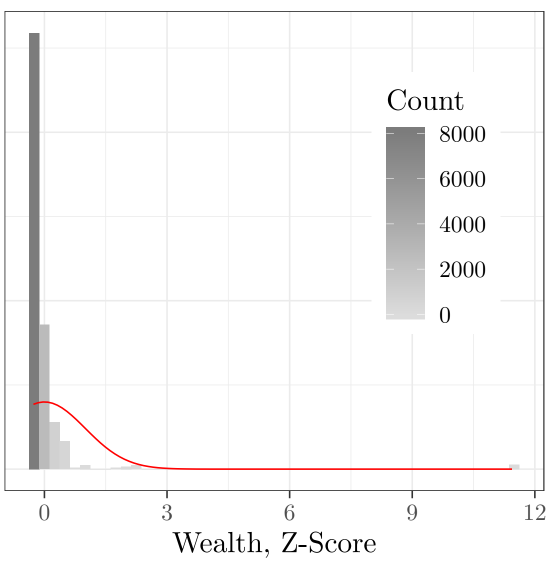
Figure A.1: A selection of the Henry Villages as represented in the Carte Cassini
Source:`https://www.geoportail.gouv.fr/carte`.



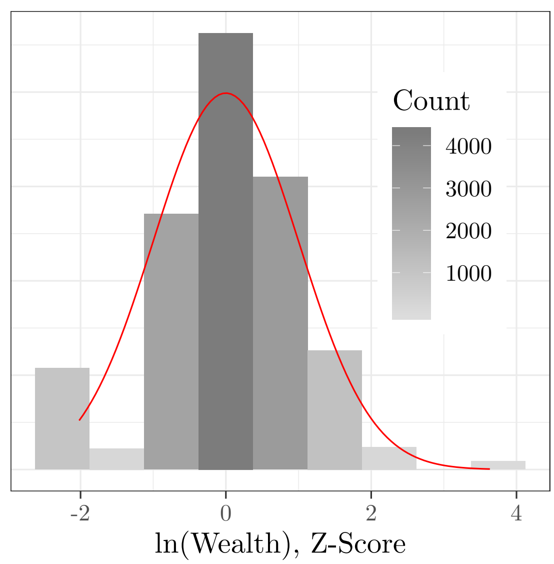
(a) Raw



(b) Log Wealth



(c) Z-Score (Raw)



(d) Z-Score (log)

Figure A.2: The Distribution of Wealth

Notes: Y axis labels are omitted as we are interested in relative distributions.

Table A.1: The Effect of a Twin on Final Family Size, Over Time, All Observations

	Dependent variable:					
	Twin Effect on Final Family Size					
	pre 1700	1700-30	1730-60	1760-1790	1790-1810	post 1810
	(1)	(2)	(3)	(4)	(5)	(6)
Twin Birth	1.066	.994	.937	1.097	1.170	.754
	(.224)	(.148)	(.129)	(.124)	(.129)	(.130)
Parity Dummies?	✓	✓	✓	✓	✓	✓
Mother Age Dummies?	✓	✓	✓	✓	✓	✓
Village Fixed Effects?	✓	✓	✓	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓	✓	✓	✓
Observations	7,452	15,820	20,882	22,335	14,414	11,650
R^2	.394	.488	.492	.519	.558	.650
Note:	OLS, Standard Errors in Parentheses					

Table A.2: The Effect of a Twin on Final Family Size, France, Over Time, Complete Fertility Observed

	Dependent variable:					
	Twin Effect on Final Family Size					
	pre 1700	1700-30	1730-60	1760-1790	1790-1810	post 1810
	(1)	(2)	(3)	(4)	(5)	(6)
Twin Birth	1.011	1.109	1.007	.957	.956	.719
	(.321)	(.235)	(.178)	(.164)	(.226)	(.245)
Parity Dummies?	✓	✓	✓	✓	✓	✓
Mother Age Dummies?	✓	✓	✓	✓	✓	✓
Village Fixed Effects?	✓	✓	✓	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓	✓	✓	✓
Observations	2,226	5,687	8,442	9,966	4,737	1,848
R^2	.551	.594	.559	.605	.640	.762
Note:	OLS, Standard Errors in Parentheses					

Table A.3: The Effect of a Twin on Final Family Size, France, Both Parents Observed until Death

	Dependent variable: Final Family Size			
	Births			
	All	First	Final	Others
	(1)	(2)	(3)	(4)
Twin Birth	.977	.788	1.000	.983
	(.089)	(.278)	(0.000)	(.148)
Parity Dummies?	✓		✓	✓
Mother Age Dummies?	✓	✓	✓	✓
Village Fixed Effects?	✓	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓	✓
Observations	32,906	5,830	5,776	21,744
R^2	.584	.378	1.000	.102

Note: Both Parents Die Over 50.
OLS, Standard Errors in Parentheses

Table A.4: Birth Interval preceding and following a Twin Birth

	Dependent variable: Birth Interval			
	Preceding		Following	
	(1)	(2)	(3)	(4)
Twin Birth	.039	.007	$-.048$	$-.044$
	(.030)	(.050)	(.031)	(.052)
Preceding Infant Death	$-.594^{***}$	$-.612^{***}$	$-.593^{***}$	$-.611^{***}$
	(.009)	(.016)	(.010)	(.016)
Parity Dummies?	✓	✓	✓	✓
Mother Age Dummies?	✓	✓	✓	✓
Village Fixed Effects?	✓	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓	✓
Both Parents Die Over 50?		✓		✓
Observations	91,522	35,510	91,522	35,510
R^2	.196	.204	.196	.204

Note: *p<0.1; **p<0.05; ***p<0.01
Preceding Infant Death in the inerval after a twin birth is 1 where both twins die, 0 otherwise.

Table A.5: Adjusted Child Mortality Rate and Occupational Status, by Occupational Group and Period

	Proportion of Children Dead, Z-score				
	pre 1700	1700-30	1730-60	1760-1790	1790-1810
	(1)	(2)	(3)	(4)	(5)
Weavers/Shoemakers	−.180	−.031	.061	.021	−.013
	(.158)	(.087)	(.061)	(.086)	(.078)
Craftsmen	−.075	.042	.086	−.017	.060
	(.150)	(.105)	(.077)	(.100)	(.067)
Traders	.010	.077	.215*	.157	.034
	(.141)	(.100)	(.086)	(.094)	(.071)
Farmers	.217	−.060	.084	.015	−.021
	(.150)	(.102)	(.115)	(.087)	(.054)
Merchants/Professionals	−.028	−.034	−.055	.054	−.350***
	(.188)	(.091)	(.155)	(.136)	(.094)
Gentry/Independent	−.241	−.235	.047	−.052	.101
	(.357)	(.202)	(.199)	(.120)	(.079)
Village Fixed Effects?	✓	✓	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓	✓	✓
Observations	606	995	1,722	2,055	2,368
R^2	.210	.349	.216	.101	.105

Note: *p<0.05; **p<0.01; ***p<0.001
OLS, Labourers/Servants are the omitted category. Errors are clustered at Village level

Table A.6: Village Level Correlations of Wealth and Individual Surviving Children

	ln(Fertility)			
	Gross	Net	Gross	Net
	(1)	(2)	(3)	(4)
ln(Mean Village Wealth)	$-.029$	.071		
	(.217)	(.248)		
ln(Median Village Wealth)			.384	.038
			(.246)	(.161)
Observations	34,805	33,019	34,805	33,019
Adjusted R^2	.006	.004	.009	.004

Note: *p<0.1; **p<0.05; ***p<0.01
OLS
Decadal dummies included.

Table A.7: Gross Fertility and Husband Occupational Status, by Occupational Group and Period

	N Children		
	pre 1750	1750-90	post 1790
	(1)	(2)	(3)
Weavers/Shoemakers	$.759^{***}$	.077	.139
	(.200)	(.296)	(.430)
Craftsmen	1.053^{***}	.282	.057
	(.174)	(.335)	(.375)
Traders	$.557^{**}$	$.806^{**}$	.018
	(.185)	(.297)	(.438)
Farmers	$.797^{***}$	1.053^{***}	.242
	(.169)	(.278)	(.334)
Merchants/Professionals	1.314^{***}	.414	-1.133^{**}
	(.335)	(.408)	(.409)
Gentry/Independent	.354	.559	.301
	(.513)	(.329)	(.429)
Village Fixed Effects?	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓
Observations	2,414	2,641	1,411
R^2	.045	.051	.112

Note: *p<0.05; **p<0.01; ***p<0.001
OLS, Labourers/Servants are the omitted category.
Errors are clustered at Village level

Table A.8: Unadjusted Child Mortality Rate and Occupational Status

	Prop. Children Dead, Z		
	(1)	(2)	(3)
ln(Occupational Wealth), Z	−.004		
	(.023)		
Hiscam, Z		−.051**	
		(.019)	
Weavers/Shoemakers			−.010
			(.036)
Craftsmen			.015
			(.054)
Traders			.092
			(.061)
Farmers			.020
			(.069)
Merchants/Professionals			−.140
			(.073)
Gentry/Independent			.004
			(.118)
Village Fixed Effects?	✓	✓	✓
Decade Fixed Effects?	✓	✓	✓
Observations	7,790	7,396	7,746
R^2	.132	.139	.134

Note: *p<0.05; **p<0.01; ***p<0.001
OLS, Labourers/Servants are the omitted category. Errors are clustered at Village level