The Micro-Evidence for Malthus. Testing the Positive and Preventative Check, and the Iron Law, in France 1650-1820

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Abstract

I test the assumptions of the Malthusian model of population and stagnation at the individual 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 preventative 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. By comparing estimates of village wealth and population I also find support for Malthus's Iron law. Villages follow a Malthusian frontier over the period 1670-1820.

1 The Legacy of Mathus

The shadow of Thomas Robert Malthus (1766-1834) looms large.

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, 2008-16. Taken together the titles are wildly contradictory.

Disagreement about the future is one matter. Disagreement about the past is a failure for historical demography and economic history. The unsettled empirical picture is mainly drawn from aggregate correlations. Our micro evidence base is vanishingly thin. This paper attempts to correct that.

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Title	Date	Source
Malthus was right!	25 March 2008	The New York Times[1]
Malthus, the False Prophet	15 May 2008	The Economist
Are Malthus's Predicted 1798 Food Shortages Coming True?	1 Sep 2008	The Scientific American[2]
Was Malthus right?	15 July 2011	Time
A World of Woe: Why Malthus was Right	7 July 2014	PBS News Hour[3].
Why Malthus Is Still Wrong	1 May 2016	Scientific American
Africa's high birth rate is keeping the continent poor	22 Sep 2018	The Economist

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, 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.
2. Deaths respond *negatively* to living standards.

Clark (2007) details how these 2 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).[4] This paper tests the Malthusian assumptions at the individual and village level for France, 1650-1820.

In general, empirical tests of the Malthusian model rely on the correlations of aggregate time series of the real wage 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

[1] In this article, Paul Krugman states "The fact is that Malthus was right about the whole of human history up until his own era."

[2] In this article Jeffrey Sachs states "Have we beaten Malthus? After two centuries, we still do not really know."

[3] This is an interview with Greg Clark on Clark (2007)

[4] 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).

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 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 does M5 for the preventative check.

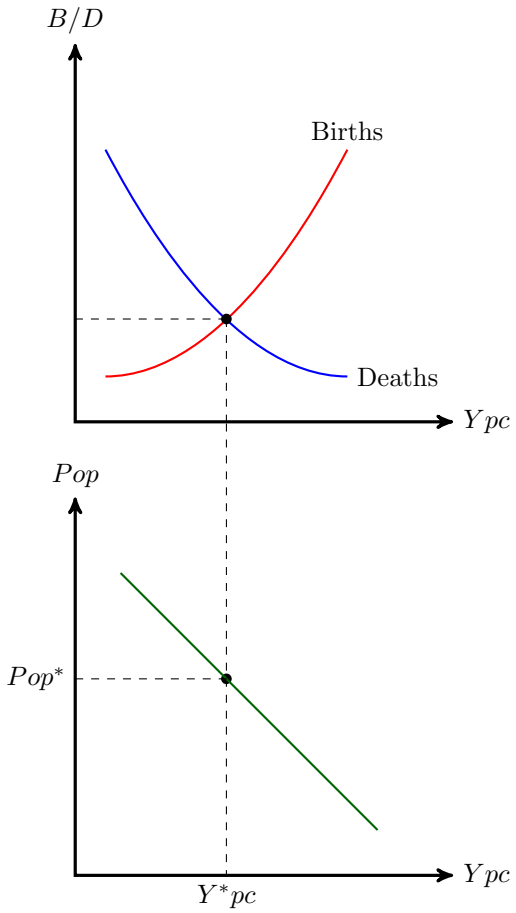


Figure 1.1: The Modern Malthusian Model

Notes: The top axes illustrate the birth and death schedules as implied by the positive and preventative check (see table 1.2 and text). Where $Births > Deaths$, population grows. But due to the Malthusian Iron Law, there is a negative relationship between the level of population and living standards per capita. So 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 $Deaths > Births$.)

stronger positive and preventative checks than England throughout this period (table 6, p.42).[5] However 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.[6] For France, Weir (1995) linked 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 those of Hadeishi (2003) for another village, Nuits in Burgundy.[7]

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 spot on. Twins add exactly one to final family size. There is no adjustment of parents to a random twin birth. After, 1789 parents adjust. 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.[8]

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 preventative check in cross-section, before and after the Revolution. I find strong evidence for the primacy of the preventative 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 preventative 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 top elite group, the Gentry/Independent group, do not display higher fertility. I suspect this is due to the early fertility decline of French elites (see Livi-Bacci (1986)).

Finally, by estimating village level population and living standards, I test the Malthusian Iron law. From 1760 to 1820, increases in estimated village population led to decreases in living standards, as measured by average village occupational wealth, and vice versa. This effect is dependent however on the size of a village. Only more populated villages, I speculate as being closer to the Malthusian frontier, have a statistically significant negative correlation between population and living standards. For these large villages, the Malthusian Iron law is evident, 1650-1820.

Section 2 describes the data for analysis, section 3 the methodology. The individual results for

[5] Perhaps due to the absence of a *Poor Law* system in France (See Kelly et al. (2014)).

[6] 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.

[7] 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.

[8] 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)

the presence of random fertility, and the positive and preventative check are presented in section 4. Section 5 tests Malthus Iron law at the village level and section 6 concludes.

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.[9] The 41 villages represent a random sample of one-tenth of one-percent of the 40,000 odd villages in France at this time.[10] Figure 2.1b reports the fertility patterns before and after the French Revolution and table 2.1 reports the village level summary statistics. These are small rural villages, illustrated from the 18th century *Carte Cassini* in figure 2.2.[11]

The occupational listings of fathers in the sample were coded to the equivalent HISCO code (a standardized occupational classification scheme) and HISCAM occupational score and additionally a 7 level scale as described in Clark and Cummins (2015). HISCAM scores are a stratification scale based on social interactions.[12] Table 2.2 reports the occupational characteristics of the *Henry* data.

Only 18.7% of husbands have a marital occupation recorded that we have been able to code. This is a small proportion but it compares favorably to other 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*. 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%, see Cummins (2013) for more detail).

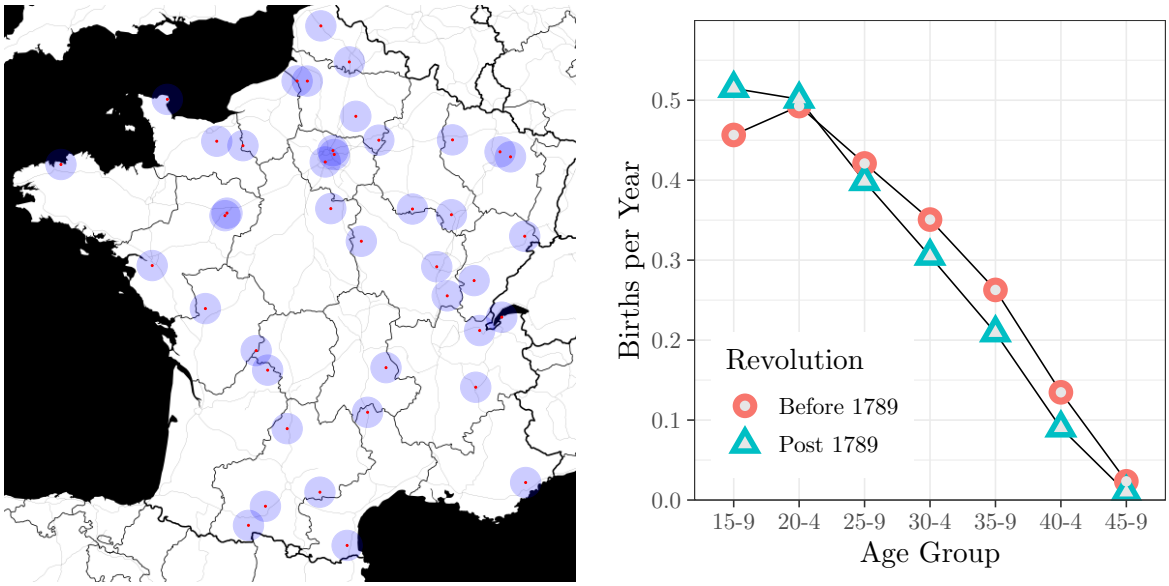
Table 2.2 also reports the average real wealth of men who died under various occupations from 4 sample villages observed in the Napoleonic-era wealth taxation books. I apply the observed medians, of the sum of both cash and property wealth,, by individual occupation, to the sample. Figure 2.3 reports 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 domainted by labourers.

[9] 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).

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

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

[12] See http://www.camsis.stir.ac.uk/hiscam/ for more detail.



(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)).

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

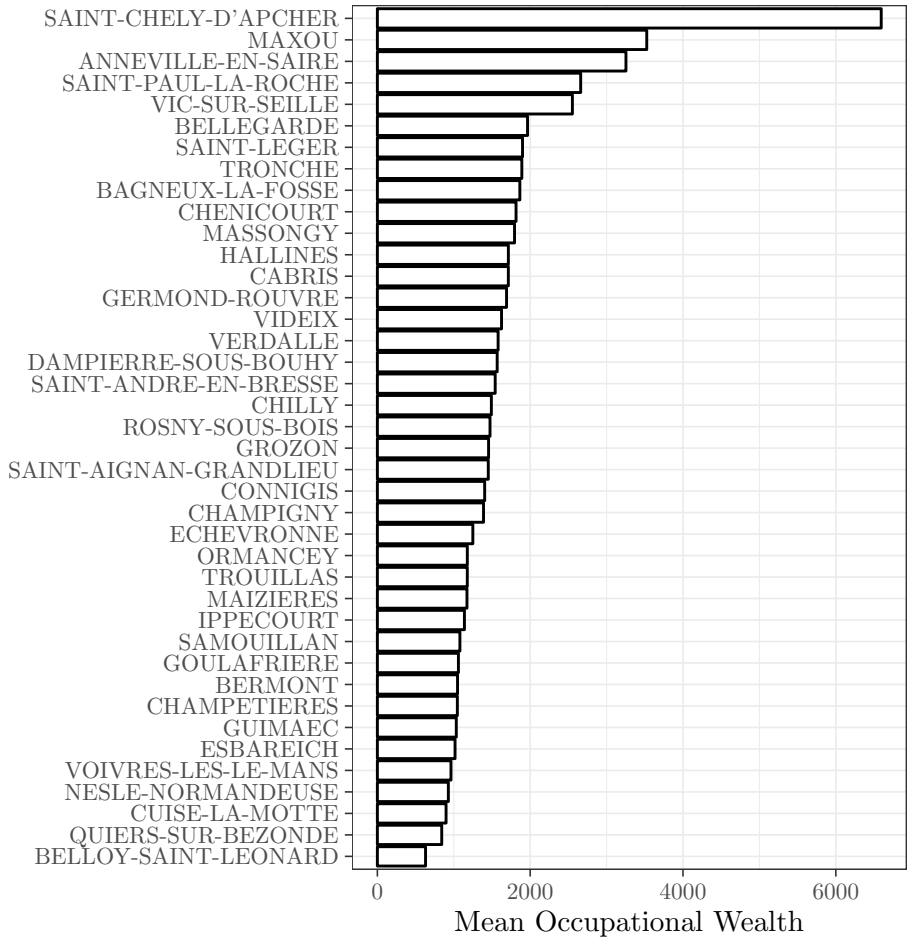


Figure 2.3: Mean Occupational Wealth, by Village

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 median for this measure, by village.

Table 2.1: Summary Statistics, Villages

Village	Dept.	Pop. 1821	Year Min.	Year Max.	N Par-ents	N Chil-dren	Avg. Births pre 1789	Avg. Births post 1789
Anneville-En-Saire	Manche	807	1666	1819	1,303	3,148	5.3	5.3
Bagneux-La-Fosse	Aube	798	1670	1819	1,097	3,533	7.3	7.3
Bellegarde	Loiret	1,295	1675	1819	2,659	7,104	6.6	6.6
Belloy-Saint-Leonard	Somme	284	1684	1819	501	1,326	3.9	3.9
Bermont	Territoire de Belfort	88	1670	1819	1,321	4,026	6.1	6.1
Cabris	Alpes-Maritimes	1,879	1688	1819	2,500	7,741	5.8	5.8
Champetieres	Puy-de-Dome	1,457	1673	1819	2,068	7,327	5.5	5.5
Champigny	Yonne	1,473	1670	1819	2,131	7,494	6.7	6.7
Chenicourt	Meurthe-et-Moselle	279	1676	1819	473	1,186	7.8	7.8
Chilly	Ardennes	328	1670	1819	510	1,384	4.7	4.7
Connigis	Aisne	271	1675	1819	760	1,850	6.3	6.3
Cuise-La-Motte	Oise	959	1672	1819	1,615	5,260	6.8	6.8
Dampierre-Sous-Bouhy	Nievre	1,226	1670	1819	2,019	6,461	6.2	6.2
Echevronne	Cote-d'Or	415	1664	1819	558	1,672	5.4	5.4
Esbareich	Hautes-Pyrenees	894	1673	1819	867	2,597	6.1	6.1
Germond-Rouvre	Deux-Sevres	673	1670	1819	1,482	3,215	4.9	4.9
Goulafriere	Eure	444	1670	1819	1,046	2,346	4.5	4.5
Grozon	Jura	781	1671	1819	1,516	4,684	6.2	6.2
Guimaec	Finistere	1,789	1670	1819	3,173	9,704	5.1	5.1
Hallines	Pas-de-Calais	501	1678	1819	693	1,958	6.3	6.3
Ippecourt	Meuse	400	1674	1819	726	2,456	5.9	5.9
Maizieres	Calvados	652	1671	1819	931	2,298	5.4	5.4
Massongy	Haute-Savoie	705	1671	1819	934	2,487	6.3	6.3
Maxou	Lot	953	1674	1819	1,397	3,484	4.0	4.0
Nesle-Normandeuse	Seine-Maritime	315	1671	1819	619	1,462	4.7	4.7
Ormancey	Haute-Marne	295	1670	1819	558	1,738	6.5	6.5
Quiers-Sur-Bezonde	Loiret	465	1670	1819	745	2,143	6.9	6.9
Rosny-Sous-Bois	Seine-Saint-Denis	822	1632	1819	1,448	4,833	6.5	6.5
Saint-Aignan-Grandlieu	Loire-Atlantique	1,172	1670	1819	2,557	7,568	5.9	5.9
Saint-Andre-En-Bresse	Saone-et-Loire	188	1671	1819	728	1,554	7.2	7.2
Saint-Chely-D'Apcher	Lozere	1,366	1690	1847	3,908	12,433	6.5	6.5
Saint-Leger	Charente-Maritime	656	1686	1819	1,407	3,547	5.0	5.0
Saint-Paul-La-Roche	Dordogne	1,692	1670	1819	4,891	11,225	6.4	6.4
Samouillan	Haute-Garonne	389	1680	1819	325	1,085	6.6	6.6
Tronche	Isere	1,109	1670	1819	3,025	7,059	5.7	5.7
Trouillas	Pyrenees-Orientales	622	1737	1818	748	2,101	6.8	6.8
Verdalle	Tarn	1,137	1670	1819	1,855	4,826	5.0	5.0
Vic-Sur-Seille	Moselle	3,196	1670	1819	7,028	19,240	6.8	6.8
Videix	Haute-Vienne	781	1685	1819	2,278	4,720	6.2	6.2
Voivres-Les-Le-Mans	Sarthe	448	1670	1818	1,261	2,727	4.0	4.0

Notes: Year is year of marriage. Village Suze-Sur-Sarthe is dropped due to small numbers.

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

This paper tests the Malthusian assumptions at the individual level, in cross section, for a sample of French rural villages 1650-1820.

First I test the assumption of Malthusian constant marital fertility. As quote [M1] indicates, Malthus did not conceive of any fertility control within marriage. The 'constant passion between the sexes' drives the birth schedule in figure 1.1. I use the random occurrence of a twin birth to test whether twin-parents adjust their terminal family size to this '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

$$B_i = c + \beta_1 D^j_{Twin} + \sum Age^J_i + \sum Parity^j_i \tag{1}$$

with B the number of births to a mother i, $D_{Twin)}$ and indicator variable for child j being a twin, Age a set of mother's age at child j birth dummies and $Parity$ being the number of children born at said birth. If there is no adjustment of mother's to the random shock of a twin, we would expect $\beta = 1$. This would consistent with 'natural fertility' (Henry (1961)) and Malthus's assumptions about sex.

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 test for the presence of cross-sectional differences by 3 different measure of status, through the main empirical estimation formula;

$$Y_i = c + \sum \beta S^{Occ}_i + D_{Village} + Year \tag{2}$$

where S^{Occ}_i is a measure of occupational status for couple i - either occupational wealth, *HISCAM* score or a set of 7 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.

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 this is unlikely. More likely however, is that both husband 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.

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

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

This identification problem does not confound the empirical exercise. Principally, the determination of both endogenous variables by a latent factor, X_i, will not necessarily bias the empirical corrections. The outcomes of high and low status parents, even if they are determined by a 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. The observed correlations matter even if they don't have a causal interpretation. 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.

The French Revolution of 1789 serves as a natural break point to split the sample for equation 2. Malthus would approve:

> 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 [M6]

Child mortality is calculated as the proportion of children surviving to age 14. By summing up repeated names within a family's birth history an adjusted child mortality is calculated for the analysis (See Houdaille (1984) for a deeper analysis of this important issue).

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).

4 Results

4.1 Malthus and Natural Fertility

Was Malthus correct about what determined fertility before 1789 in France? Was the passion between the sexes a God-given constant? Louis Henry himself strongly believed that pre-industrial populations practiced 'natural fertility' just as Malthus would have believed (Henry (1961)).[13]

Table 4.1 reports the twin effect, as detailed in equation 1, before 1789 and after 1810, for the Henry sample. Before 1789, the data is consistent with Henry and Malthus. The twin coefficient is 1.023. Although the 95% confidence interval cannot rule out a small proportion of controllers, the coefficient is statically indistinguishable from 1.

After 1789, the coefficient estimate is substantially smaller than 1, although the confidence interval still overlaps 1. Due to the heterogeneous nature of the French fertility decline, this is suggestive that there is now a significant proportion of controllers, as revealed by this twin test.

At least before 1789, we can conclude that the essential Malthusian assumption, that marital fertility is controlled (M1) is supported by the French micro data collected by Henry.

4.2 Testing the Checks at the Individual Level

Next I apply estimation equation 2 to child mortality, the proportion of children marrying and finally gross and net fertility. If Malthus is right we should see a strong positive gradient of occuaptional status on these outcomes.

[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)).

Table 4.1: The Effect of a Twin on Final Family Size, France, Before and After the French Revolution

	Dependent variable:	
	Twin Effect on Final Family Size	
	Before 1789	After 1810
	(1)	(2)
Twin Birth	1.023	.735
	(.877, 1.168)	(.466, 1.004)
Parity Dummies?	Yes	Yes
Mother Age Dummies?	Yes	Yes
Observations	65,722	11,650
R^2	.467	.608
Note:	OLS, (95 percent Confidence Interval)	

Table 4.2 reports the results for child mortality. This is our primary measure of the Malthusian positive check (M2) for this dataset. Surprisingly there is little consistent support for the existence of the positive check amongst French villagers. Adjusted child mortality does not display cross-sectional trends with respect to living standards.

After 1789 however, there is evidence that the Merchant/Professional class have substantially lower child mortality than the omitted category (Labourers/Servants). The proportion of children dying for this class is about half that of the rest of the sample and the effect is statistically significant at the 1% level. (As will become evident from table 4.7 this group have substantially lower fertility post 1789 too.)

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. So I interpret this set of correlations with caution; Pre 1789, perhaps unsurprisingly, the children of farmers and local traders are more likely to be observed marrying. Both period suggest an 'inverted U' relationship between marriage probability and occupational status (using the evidence from column 3 and 6). 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. Here, there are no status correlations (reported in table A.1 in the appendix).

Table 4.4 reports the results for female age at marriage. Here we find strong and consistent correlations with all measures of occupational status before 1789. The wives of higher status men are constantly younger at marriage than those of lower status men. The wives of the gentry/independent class marry over 2 years younger than those of laborers and servants. For farmers and merchants, it is about 1-1.5years. Even craftsmen marry women who are about 9 months younger. The standardized correlations are powerful too, for both occupational wealth and Hiscam.

After 1789, this Malthusian preventative check in cross section largely disappears. However craftsmen and the gentry class still marry younger women (of about 1 year). The standardized

Table 4.2: Adjusted Child Mortality Rate and Occupational Status

	Proportion of Children Dead					
	Pre 1789			Post 1789		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	.004			−.013		
	(.011)			(.017)		
Hiscam, Z		−.011***			−.019***	
		(.003)			(.007)	
No Occupation			−.056***			−.027*
			(.009)			(.016)
Weavers/Shoemakers			.008			−.0003
			(.013)			(.021)
Craftsmen			.003			.014
			(.012)			(.020)
Traders			.028**			.018
			(.012)			(.021)
Farmers			.006			−.001
			(.010)			(.017)
Merchants/Professionals			−.014			−.091***
			(.017)			(.032)
Gentry/Independent			.024			.023
			(.020)			(.022)
Constant	−1.398***	.327***	.314***	.185***	.180***	.178***
	(.190)	(.024)	(.017)	(.027)	(.027)	(.029)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,308	5,180	17,171	2,453	2,216	5,142
R^2	.142	.136	.132	.083	.084	.071

Note: *p<0.1; **p<0.05; ***p<0.01
OLS, Laborers/Servants are the omitted category

Table 4.3: Proportion of Children Observed Marrying and Occupational Status

	Proportion of Children Known to be Married					
	Pre 1789			Post 1789		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	−.043			.014		
	(.030)			(.030)		
Hiscam, Z		−.011			−.006	
		(.010)			(.014)	
No Occupation			.007			.028
			(.019)			(.032)
Weavers/Shoemakers			−.035			.054
			(.027)			(.041)
Craftsmen			−.022			.041
			(.027)			(.042)
Traders			−.006			.043
			(.024)			(.042)
Farmers			−.016			.030
			(.022)			(.034)
Merchants/Professionals			−.053			−.066
			(.046)			(.061)
Gentry/Independent			−.022			.065
			(.049)			(.041)
Constant	.100	.921***	.932***	.952***	.946***	.933***
	(.456)	(.071)	(.049)	(.054)	(.055)	(.058)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,556	1,519	4,006	787	697	1,394
R^2	.049	.047	.030	.083	.089	.054

Note: *p<0.1; **p<0.05; ***p<0.01
OLS, Laborers/Servants are the omitted category.
Excluding unknowns

Table 4.4: Female Age at Marriage and Occupational Status

	Female Age at Marriage					
	Pre 1789			Post 1789		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	−.993***			−.367		
	(.292)			(.387)		
Hiscam, Z		−.307***			.154	
		(.095)			(.155)	
No Occupation			−.402*			−.298
			(.242)			(.365)
Weavers/Shoemakers			−.207			.503
			(.373)			(.494)
Craftsmen			−.832**			−1.012**
			(.344)			(.485)
Traders			−.177			.120
			(.324)			(.484)
Farmers			−1.275***			−.493
			(.290)			(.403)
Merchants/Professionals			−1.367***			.679
			(.489)			(.766)
Gentry/Independent			−2.108***			−.941*
			(.499)			(.521)
Constant	11.966**	28.430***	27.915***	27.137***	27.247***	27.639***
	(5.659)	(.721)	(.479)	(.544)	(.536)	(.559)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,769	3,658	12,061	2,616	2,362	6,705
R^2	.076	.074	.070	.090	.089	.063

Note: *p<0.1; **p<0.05; ***p<0.01
OLS, Laborers/Servants are the omitted category. First Marriages only

correlations are indsitiuqushable from zero.

Before 1789, this set of micro cross-sectional tests of the Malthusian Model suggest that it is the preventative check, acting through female age at first marriage, that dominates in French rural villages. The positive check is not evident from the cross sectional differentials in French rural villages.

Malthus proposed that constant fertility and the preventative check should lead to a positive fertility gradient (M1 and M5). Was this the case in *Ancien Régime* France?

4.3 Malthus and the Fertility Gradient

Building on Malthus and Darwin, Clark (2007) claims that the positive wealth-fertility gradient in English history was responsible for a 'survival of the Richest' and, perhaps, through selection, also responsible for the origin of modern economic behavior and growth. For France, Cummins (2013) failed 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?

First I look at the village level. Before 1789, the mean wealth of a village is highly correlated with surviving children (but not births), as reported in table 4.5. After 1789, this correlation reverses. 'Survival of the richest' operated at the village level in France. The economic size of this effect is large. Evaluated at the mean, the elasticities in table 4.5 reveal that a village twice as rich as it's neighbor would have an extra 1.8 children on average. After 1789, the richer village has 1.3 kids less than it's poorer neighbor. (See figure 2.3 reports the spread of wealth across the randomly sampled values in the Henry data. Prerevolutionary France is very unequal.)

Table 4.5: Village Level Correlations of Wealth and Individual Surviving Children

	ln(Fertility)			
	Gross	Net	Gross	Net
	pre 1789		post 1789	
	(1)	(2)	(3)	(4)
ln(Mean Village Wealth)	−.041	.056***	.020	−.045**
	(.040)	(.010)	(.069)	(.020)
Observations	26,678	17,171	8,127	5,141
Adjusted R^2	.002	.002	.001	.004
Note:	*p<0.1; **p<0.05; ***p<0.01			
	OLS			
	Decadal time trend included.			

Is this village-level pattern reflected at the individual level? Tables 4.6 and 4.7 report the individual correlations of occupational wealth, Hiscam score (both standardized) and the 7 point occupational division, before and after 1789. Before 1789, fertility is positive in status. This effect disappears after the revolution.

In *general*, at the micro-level, the richer occupational groups outbred the poor; the correlations for occupational wealth and Hiscam are sizable and statistically significant across the specifications.

Table 4.6: Individual Level Correlations of Occupational Status and Fertility, pre 1789

	Fertility					
	Gross Fertility			Net Fertility		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	.652***			.468***		
	(.144)			(.103)		
Hiscam, Z		.081*			.128***	
		(.043)			(.030)	
No Occupation			−1.411***			−.867***
			(.096)			(.072)
Weavers/Shoemakers			.269*			.141
			(.146)			(.111)
Craftsmen			.495***			.384***
			(.137)			(.104)
Traders			.563***			.236**
			(.130)			(.099)
Farmers			.610***			.474***
			(.118)			(.089)
Merchants/Professionals			.734***			.657***
			(.194)			(.147)
Gentry/Independent			.051			.105
			(.216)			(.163)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,665	6,491	26,678	6,281	6,117	25,238
Adjusted R^2	.036	.033	.088	.076	.076	.088

Note: *p<0.1; **p<0.05; ***p<0.01
OLS, Laborers/Servants are the omitted category

Table 4.7: Individual Level Correlations of Occupational Status and Fertility, post 1789

	Fertility					
	Gross Fertility			Net Fertility		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	−.240			−.131		
	(.173)			(.129)		
Hiscam, Z		−.174**			−.071	
		(.069)			(.050)	
No Occupation			−1.442***			−1.062***
			(.147)			(.108)
Weavers/Shoemakers			.230			.071
			(.200)			(.148)
Craftsmen			.402**			.314**
			(.196)			(.145)
Traders			.350*			.250*
			(.195)			(.145)
Farmers			.264			.210*
			(.163)			(.120)
Merchants/Professionals			−.577*			−.211
			(.296)			(.217)
Gentry/Independent			.327			.050
			(.214)			(.158)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,121	2,826	8,129	2,979	2,694	7,738
Adjusted R^2	.063	.069	.104	.075	.083	.105

Note: *p<0.1; **p<0.05; ***p<0.01
OLS, Laborers/Servants are the omitted category

The surprising finding from table 4.6 is the low gross and net fertility of the most elite occupational group; the Gentry and Independent class. They have a fertility statistically indistinguishable from that of Laborers and Servants. This non-Malthusian finding could reflect an earlier fertility decline of these elites as reported by Livi-Bacci (1986) (p.185). This result is also worth comparing to the recent finding of surprising low fertility by the same socioeconomic class in England, using similair data de la Croix et al. (2019).

The tables conclusively show that the early French fertility decline was *not* a neo-Malthusian response supporting earlier analyses of a smaller sample of villages (Weir (1994); Cummins (2013)). 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 become sharply negative (see Cummins (2013)).

5 Malthus Iron Law: Population and Living Standards at the Village Level

In this final section I calculate the revealed Malthusian 'Iron Law' schedule, as sketched theoretically in figure 1.1 b) for French rural villages over the sample period. The idea is simple; do the 41 randomly selected villages display a Malthusian constraint? This is a period in which urbanization rates are not dramatically increasing De Vries (2013) and most of the French population live in small villages like the ones used here. By triangulating population and village wealth from the census, the birth records and the occupational classifications of marriage I can report the observed relationship between population and living standards.

Figure 5.1 reports the naive relationship between village population and village mean occupational wealth for 1821. There is a positive relationship. Does thus nullify Malthus 'Iron law' of population? As these villages will potential have different levels of technology (different resources, land quality etc. as suggests by figure 2.2), the Malthusian frontier for each of them is *unidentified* and this observed correlation is no evidence that Malthusian forces are absent.

To identify the Malthusian frontier I use *village-level* movements in population and living standards. Figure 5.2 maps out conceptual Malthusian Iron law technology frontiers (red lines) and alternatively Boserupian paths (where population has a positive effect on living standards). Starting from the mid-point of a graph, if a village is ruled by Malthusian forces it is forced to move along the red line. (Of course it could obey neither Malthus nor Boserup and move in any conceivable direction, or back and forth.)

I use the relationship between actual population in 1821 and 1793, and observed village births in the 20 year period around both those years to estimate population from births in 1760, 1720 and 1670[14].

Figure 5.3 and table 5.1 report the results. The sample villages split evenly into Malthusian and Boserupian paths, approximately speaking. However, small villages could be well inside the frontier and their movements could not reflect a binding Malthusian constrain. Table 5.1 reports fixed-effect estimates for the 'within-village' slope of population and living standards. Over a population of 750, the effect is strongly Malthusian.

[14]Population is taken from http://cassini.ehess.fr/cassini/fr/html/6_index.htm. The estimated β in $Pop_i = \beta NB_i$ where i is village and Pop is population in either 1793 or 1821 and NB is number of births in the 20 year period surrounding 1793 or 1821 is .67 with an r^2 of .95.

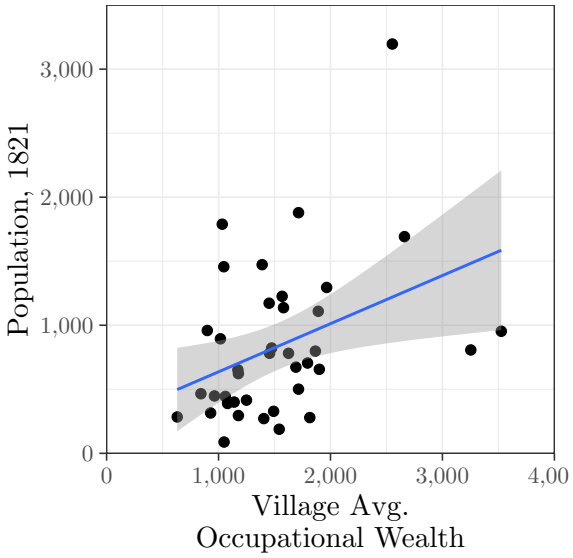


Figure 5.1: Village Population and Average Occupational Wealth in 1821

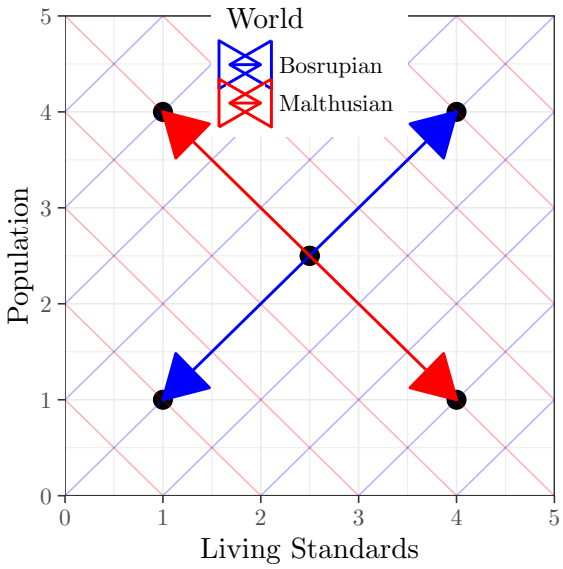


Figure 5.2: Identifying Malthusian and Boserupian Frontiers

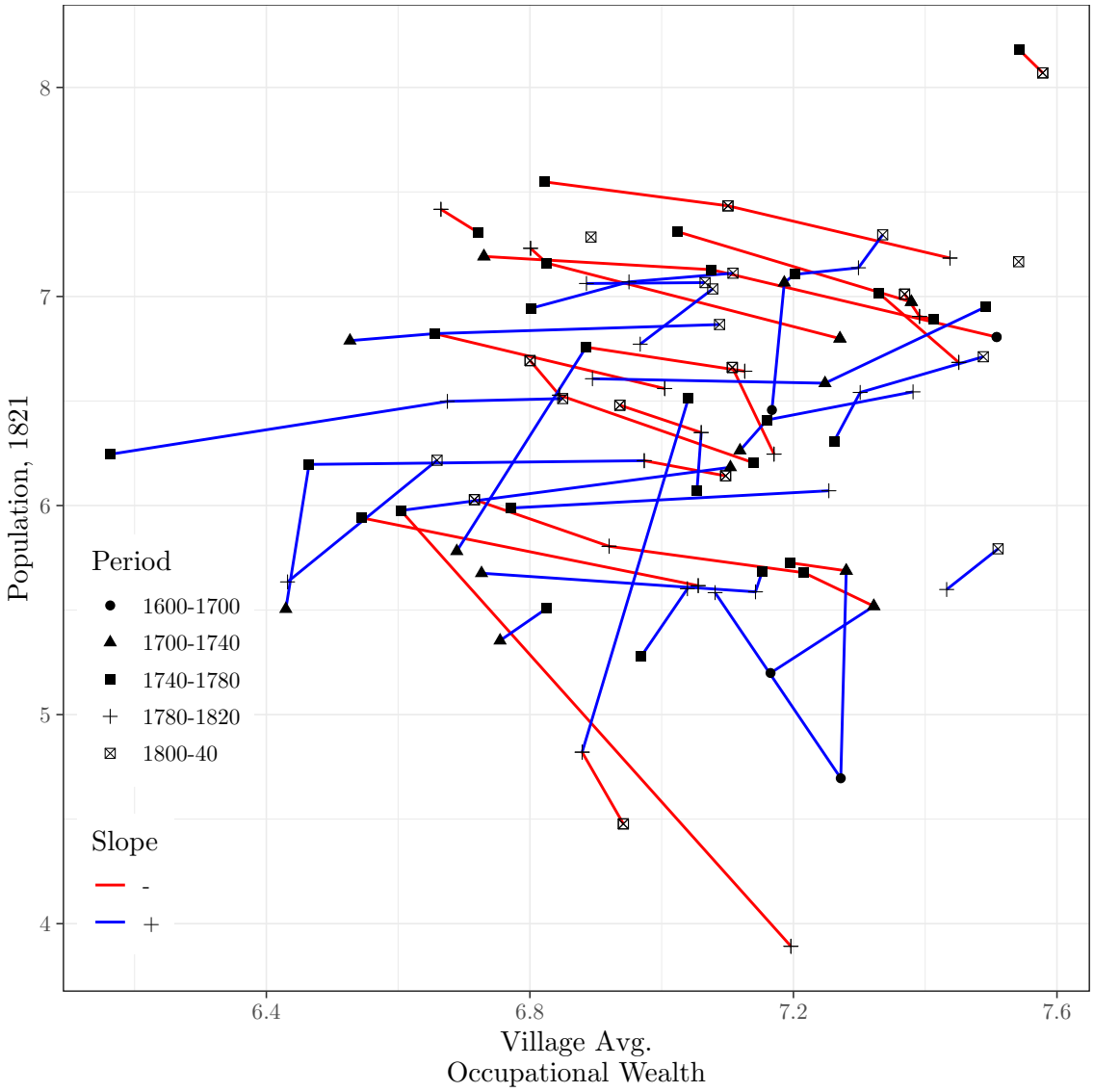


Figure 5.3: Population and Living Standards, French Villages, 1650-1840

Table 5.1: Village-Period Correlations of Population and Village Mean Occupational Wealth

	ln(Wealth)					
	All	All	<500	>500	>750	1,000
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Population)	.066*	−.042	−.135	−.099	−.667***	−.614*
	(.039)	(.071)	(.110)	(.176)	(.234)	(.328)
Village Fixed effects?	No	Yes	Yes	Yes	Yes	Yes
Observations	95	95	34	60	42	28
Adjusted R^2	.019	.441	.300	.502	.617	.706
Note:						*p<0.1; **p<0.05; ***p<0.01
						OLS

6 Conclusion

In sum, Malthusian forces existed in pre-Revolutionary France. However a close analysis of the Henry micro-data, reveal that the preventative 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. All Malthusian characteristics more or less disappeared after the Revolution. However throughout the entire sample period, 1650-1870, these small rural villages moved along a Malthusian frontier. Increases in population meant decreases in living standards.

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 the are connected a child quality-quanittiy trade-off or some other as yet unspecified mechanism.

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A Extra Results

Table A.1: Proportion of Children Observed Marrying and Occupational Status

	Proportion of Children Known to be Married					
	Pre 1789			Post 1789		
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational Wealth, Z	−.043			.014		
	(.030)			(.030)		
Hiscam, Z		−.011			−.006	
		(.010)			(.014)	
No Occupation			.007			.028
			(.019)			(.032)
Weavers/Shoemakers			−.035			.054
			(.027)			(.041)
Craftsmen			−.022			.041
			(.027)			(.042)
Traders			−.006			.043
			(.024)			(.042)
Farmers			−.016			.030
			(.022)			(.034)
Merchants/Professionals			−.053			−.066
			(.046)			(.061)
Gentry/Independent			−.022			.065
			(.049)			(.041)
Constant	.100	.921***	.932***	.952***	.946***	.933***
	(.456)	(.071)	(.049)	(.054)	(.055)	(.058)
Village Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,556	1,519	4,006	787	697	1,394
R^2	.049	.047	.030	.083	.089	.054

Note: *p<0.1; **p<0.05; ***p<0.01
OLS, Laborers/Servants are the omitted category.
Excluding unknowns