Marital fertility and wealth in transition era France, 1750-1850

Neil Cummins

PARIS SCHOOL OF ECONOMICS
ECOLE D'ECONOMIE DE PARIS

WORKING PAPER N° 2009 - 16

Marital fertility and wealth

in transition era France, 1750-1850

Neil Cummins

JEL Codes: N33, J13, D31
Keywords: economic history, fertility decline, France, family economics, wealth, inequality, social mobility

PARIS-JOURDAN SCIENCES ECONOMIQUES
LABORATOIRE D'ECONOMIE APPLIQUÉE - INRA

48, BD JOURDAN – E.N.S. – 75014 PARIS
TÉL. : 33(0) 1 43 13 63 00 – FAX : 33 (0) 1 43 13 63 10
www.pse.ens.fr

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE – ÉCOLE DES HAUTES ÉTUDES EN SCIENCES SOCIALES
ÉCOLE NATIONALE DES PONTS ET CHAUSSÉES – ÉCOLE NORMALE SUPÉRIEURE

Marital Fertility and Wealth in Transition Era France, 1750-1850

Neil Cummins, Dept. of Economic History, LSE

n.j.cummins@lse.ac.uk

Abstract

The spectacularly early decline of French fertility is one of the great puzzles of economic history. There are no convincing explanations for why France entered a fertility transition over a century before anywhere else in the world. This analysis links highly detailed individual level fertility life histories to wealth at death data for four rural villages in transition-era France, 1750-1850. The results show that it was the richest groups who reduced their family size first and that they used 'spacing' strategies to achieve this. In cross section, measures of the environment for social mobility are strongly associated with the fertility decline. The evidence presented here demonstrates that socioeconomic status mattered during the early French fertility decline. This study is a first step towards re-establishing the French experience as paramount in our understanding of Europe's demographic transition.

Section 1: Introduction

Economic explanations for the European fertility transition, such as demographic transition theory (Notestein 1945), micro economic theory (Becker 1960, 1991) and more recently unified growth theory (Galor 2004) have treated the early French fertility decline as 'noise', the extreme tail end of a normal distribution. This is the intellectual equivalent of treating Britain as the exception in explaining the Industrial Revolution[1]. At the time fertility fell (apx. 1800), France was by far the largest country in Europe, excluding Russia, with a population of almost 30 million people representing 27.7% of the total population of Western Europe (calculated from Maddison 2003).

This analysis links highly detailed individual level fertility life histories to wealth at death data for four rural villages in transition-era France. The period of analysis is approximately 1750-1850 (based on those who died 1810-70). The study presented here is the first to analyze the wealth-fertility relationship during the period of the French fertility decline. The quality of the data collected allows for an in-depth investigation of the wealth-fertility relationship between different demographic regimes, the mechanics behind these patterns and also allows the testing of various hypotheses for why fertility declined in France.

Background

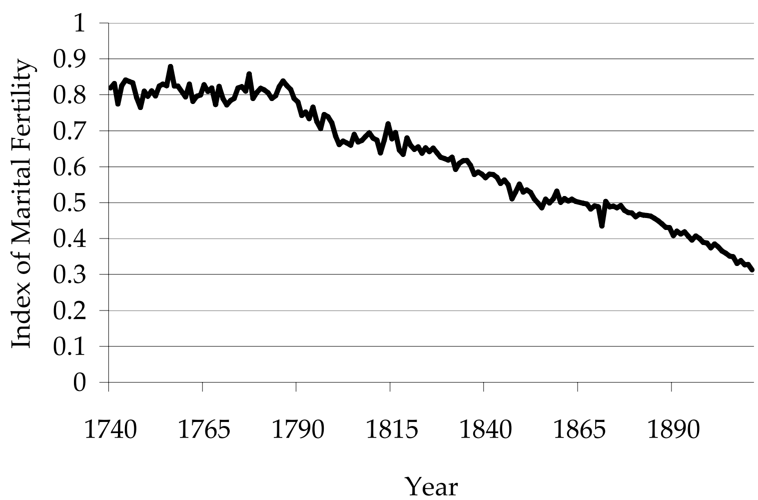
[1] Comparison borrowed from Van de Walle 1974 p.5.

Over the past two centuries, fertility in most of the World has undergone a sustained and seemingly irreversible transition. Today, a low fertility regime is the norm in the developed world, with some regions (particularly in Europe) experiencing sub-replacement fertility. This demographic transition enabled the productivity advances of the Industrial Revolution to be transformed into higher living standards and sustained economic growth. Understanding the revolution in fertility behavior between the Malthusian and the modern eras has therefore been a central research question. Despite this interest, researchers of the transition have not approached a consensus for the causal mechanisms behind the decline of fertility.

The European fertility project (EFP) led by Ainsley Coale at Princeton University during the 1970s and '80s set out to provide an empirical base for demographic transition theory. However, the EFP concluded that the decline of marital fertility during the late 19^{th} century was almost completely unrelated to socioeconomic changes (Coale and Watkins 1986). Time (the decade of the 1890s), as opposed to any socio-economic measure, was the best indicator for the onset of sustained fertility decline. Therefore, the transition was an 'ideational change' and not an economic adaptation. Recent criticisms have somewhat diluted the authority of the Princeton view. Brown and Guinnane (2007) argue that the EFP's conclusions were biased by the level of aggregation. The sub-national districts used (departments, counties, cantons etc.) were too large and internally heterogeneous to be useful as distinct fertility regimes. Further, the socioeconomic data collected was not the most relevant to parent's fertility decisions.

The implications for further research are clear: To go beyond the EFP two issues must be addressed. Firstly, the level of aggregation, and secondly, the relevance of the socioeconomic data. The study presented here directly addresses these two concerns via an individual level analysis of fertility behavior with real wealth information.

Figure 1: The index of Marital Fertility, 1740-1911, France



Source: Weir 1994 p.330-1

A central feature of the European demographic transition is the exceptional early fertility decline of France. The reasons for this spectacular break from the historical pattern and divergence from European trends have never been fully explained. Figure 1 tracks the trend of the index of marital fertility – fertility relative to an observed maximum (that of an early twentieth century religious group, the Hutterites, who married early and prohibited contraception). From the late 18th century on, fertility appears to begin a steady and consistent decline from very high levels (80-90% of the Hutterites) to very low levels (almost 30% of the Hutterites). Econometric testing for structural breaks in this series places the transition at 1776. This is nearly a century before anywhere else in Europe (Belgium (1874)), and 101 years before England and Wales (1877) (see Cummins 2009 (forthcoming) for details).

There have been relatively few previous studies of the relationship between economic status and family size at the individual level for France at this period. Weir, using the Henry demographic data, examined the income-fertility relationship in Rosny-Sous-Bois, using tax records for 1747. In a cross-sectional analysis, he found no difference in marital fertility behavior between the income groupings. Fertility was high and varied little between his three income stratifications, although the evidence does suggest a reproductive advantage for his highest group relative to his lowest (7.3 to 6.2 births per family respectively) (Weir 1995 p.15). Weir's sample size was very small however – he only had a total sample of 47 families to analyze. Hadeishi, with a larger sample size and also using tax records, studied the town of Nuits in Burgundy from 1744-1792, and found a positive relationship between marital fertility and income (2003 p.489). My analysis adds to this literature by linking pre-existing historical demographic data to new wealth data collected from various *Archives Departmentales* in France. The geographic and socioeconomic scope, along with the sample size, is far greater than previous studies. This will allow the identification of differential fertility patterns between socioeconomic strata with greater power.

Further, there has been no previous study (to the author's knowledge) which has examined the wealth-fertility relationship during the period of the demographic transition in France (post 1790s).

The rest of this paper is comprised of five sections. Section 2 details the data and its summary characteristics. Section 3 is a detailed examination of the wealth-fertility associations. Section 4 analyses the mechanics behind the fertility patterns, while section 5 evaluates explanations for the French fertility transition. Section 6 Concludes.

Section 2: The Data

The demographic data[2] to be analysed is taken from Louis Henry's national random sample of 41 villages, roughly covering a span of over two centuries, from the late 17th to early 19th centuries (Weir 1995 p.2). This dataset[3] is the result of the application of the techniques of family reconstitution to parish registers and the fruition of this is a goldmine of individual level information on the demographic characteristics of historical France. Tens of thousands of observations record linked births, deaths and marriages. However, only 20% of the sample recorded the husband's occupation. As van de Walle has stated "unfortunately, the population of the parishes usually is not clearly stratified and most attempts in finding lags in the dates of fertility decline by socioeconomic groups have failed" (1978 p.264). To understand the relationship between wealth and

---

[2] I thank George Alter for providing his version of the Henry dataset.

[3] The summary papers for the INED French family reconstitution are: Henry (1972), Henry and Houdaille (1973), Houdaille (1976), and Henry (1978).

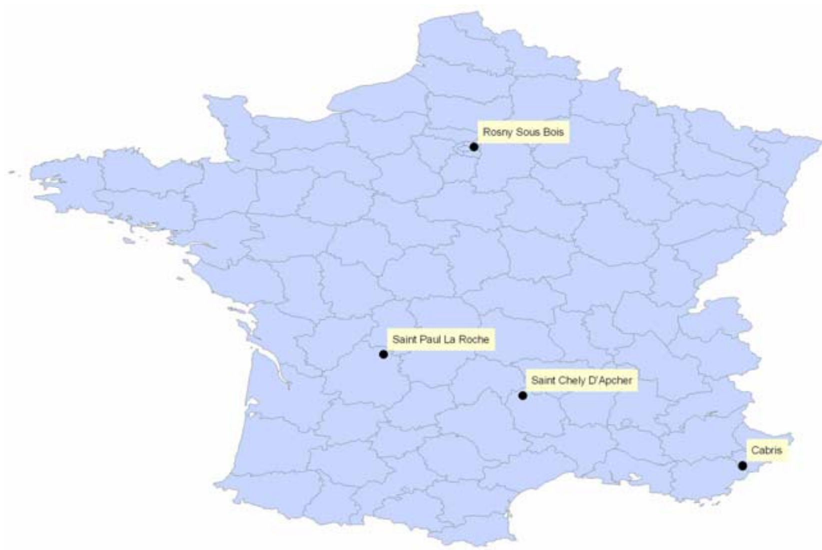
fertility in France at this period, the Henry dataset must be augmented with more detailed data.

The source for wealth data are the *Tables des Successions et Absences*[4] (TSA), which are stored in the various *Archives Departmentales* in France. The TSAs were originally constructed for tax purposes and recorded all deaths in a locality, along with detailed information on date of death, residence, profession, age at death and marital status. Uniquely, the value of an individual's estate at death was noted, with a distinction between cash and property holdings. Crucially, the TSAs recorded everybody, including those with zero assets at death (typically coded as "rien"). Almost ¼ of the individuals in the sample I use fall into this category.

Due to the fact that the property valuation recorded in the TSAs only covered property held in the locality, it is possible that the values calculated here are underestimates of the true property wealth of individuals. However, this bias only affects a small minority of the sample. According to Bordieu et al, 85% of individuals in the "TRA" sample (also based on the TSAs) had one property record, leaving 15% with two or more (2004 p.7). Attempts to assess the accuracy of the wealth information in the TSAs are limited by the fact that "very few alternative sources exist" (Bourdieu et al. 2004 p.25). However, Bourdieu et al. test the validity of the Tables against other published data and find the TSA to yield consistent results (2004 p.26).

[4] In English: "Tables of Bequests and Absent Persons" (Bourdieu et al. 2004 p.4).

Figure 2: Villages in the Sample



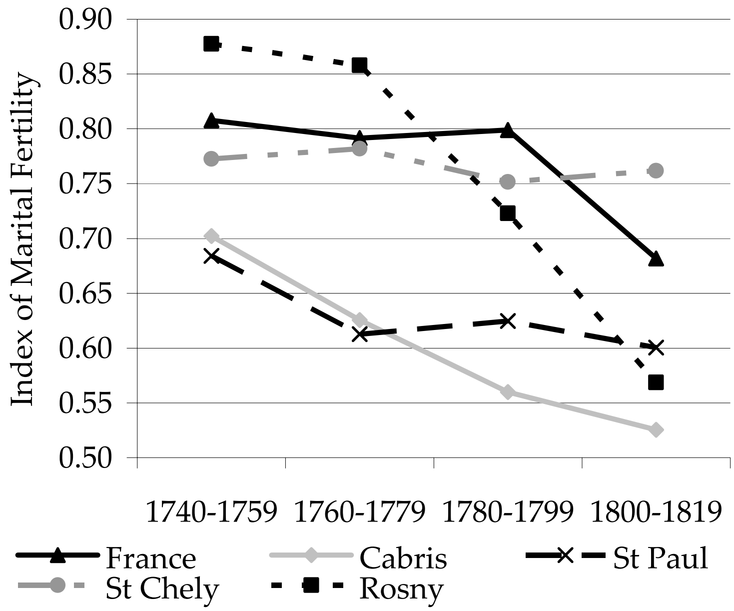
The Henry demographic data set was linked to records from the *Tables des Successions et Absences*. The links were based upon name, profession, sex, age at death and date of death. These criteria serve to place close to 100% certainty in the accuracy of the links. Ultimately, four villages were selected on the basis that they were the best represented after linking. These villages had the properties of holding a significant number of individuals dying after 1810 (when the TSAs start to record estimates of wealth), and also having the TSAs preserved in the relevant *Archive Departmental*.

The sample covers the fertility experience of individuals who died roughly between 1810 and 1870 and were born between the 1720s and the 1820s. The relevant 'fertile period' covered is therefore 1750-1850, roughly speaking. At this time approximately 80% of the French population lived in rural villages of a similar size to those in the sample (Coale and Watkins 1986 p.235). Fertility decline in France cannot be understood without understanding what was happening in these rural villages. However, the sample villages are only 4 out of perhaps 40,000 villages in France as a whole. The occupational distribution of these sample villages closely matched that of the complete Henry Sample (41 villages). The deviations in representativeness are detailed in the appendix. In order to judge how representative the demographic regimes in these villages are, their fertility pattern relative to the National trend is plotted in figure 3.

The National trend in I_g (the index of marital fertility), presented in figure 3, shows a sharp decline from high levels in the 1780-99 period. Interestingly, the sample villages display a high level of heterogeneity with respect to the trend in marital fertility. Rosny has exceptionally high marital fertility which then proceeds to decline dramatically from 1760-79 period to the post 1780s. Both Cabris and St Paul have relatively low levels of marital fertility (to the other villages and the National trend), with a trend towards decline evident in Cabris from the 1740-1759 period.

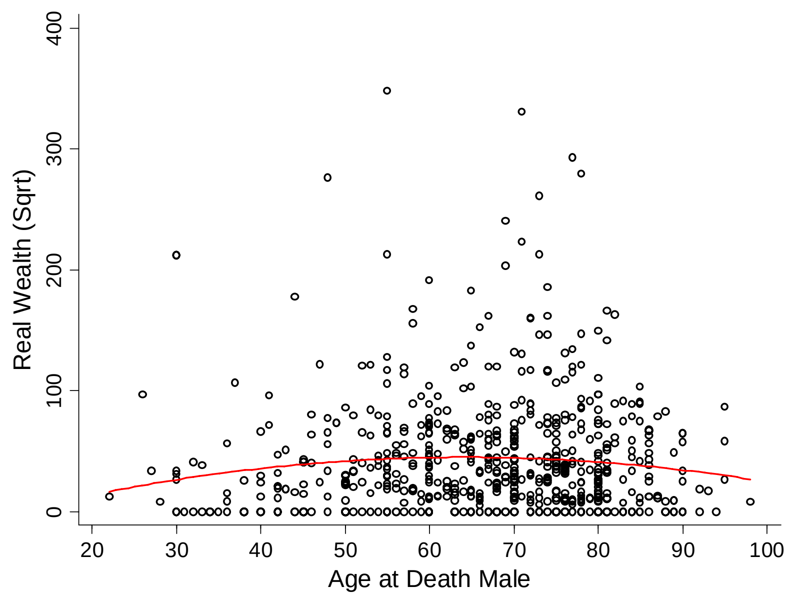
The initial trend towards decline in St Paul stalls after 1760, and along with St Chely, whose fertility remains high throughout, no trend towards sustained decline is evident. The sample villages capture the high level of heterogeneity within France with respect to fertility patterns. Two of the villages – Rosny and Cabris – show

Figure 3: The Index of Marital Fertility, by Sample Village, Contrasted with the National Trend



clear evidence for decline, while the other two – St Paul and St Chely – do not share the same pattern. Examining the trend from the 1760-79 period to 1800-1819, we see that fertility in Rosny falls by nearly 40% and in Cabris by almost 20%. In St Chely and St Paul, fertility remains relatively constant. Therefore it is possible to identify two demographic regimes amongst the sample villages, a high fertility environment and a declining fertility environment. For the analysis, the data from each village will be pooled and the varying wealth effects will be tested for by demographic regime.

Figure 4: Life Course Effects



The wealth variable used in this study has the major disadvantage of being measured at death. In aggregate, people tend to accumulate wealth over the life cycle, before dissaving and intervivos bequests to offspring act to reduce the wealth held. This will have the effect of biasing the estimates from the TSA downward, with respect to true wealth, for those who died after this point. The data I use supports this notion, as the figure 4 illustrates (based on 672 male observations).

An OLS regression was run with the Square root of real wealth as the dependent variable, with age and age squared as the independent variables. The results are reported in table 1. The reported coefficients on age at death, which are both significant at

Table 1: OLS Regression on the Square Root of Real Wealth

Variable	Coeff.	SE	***P***
Age at Death	2.04	0.96	0.03
Age at Death Squared	-0.016	0.007	0.03
Constant	-20.8	29.5	.48
Adjusted R-Squared	0.004		
Observations	672		

the 5% level, indicate a turning point age of 63.75[5], beyond which the relationship between wealth and age at death turns negative. There is a possibility that the life course pattern of wealth accumulation and subsequent decline may blur the true level of wealth of an individual in the sample. However, I consider this probability quite small as the slope of the line is so flat. There are no significant negative associations revealed by the analysis of the aggregate data between the level of real wealth and age at death. In total over 60% of the sample died above 64, and taking their value of wealth at death carries a risk of undervaluation due to the life course effects. The OLS regression on the square root of real wealth allows us to calculate an average bias (assuming the true level of wealth is reached at age 64) based on the average life course relationship between wealth and age[6].

---

5 Equivalent to the point on the quadratic fit of the wealth and age observations where the slope is equal to zero. Calculated via differentiating the regression equation of the quadratic fit, setting equal to zero, and solving for age at death.

6 These numbers are calculated using the deviation of the regression line from a flat line from age 64 onwards.

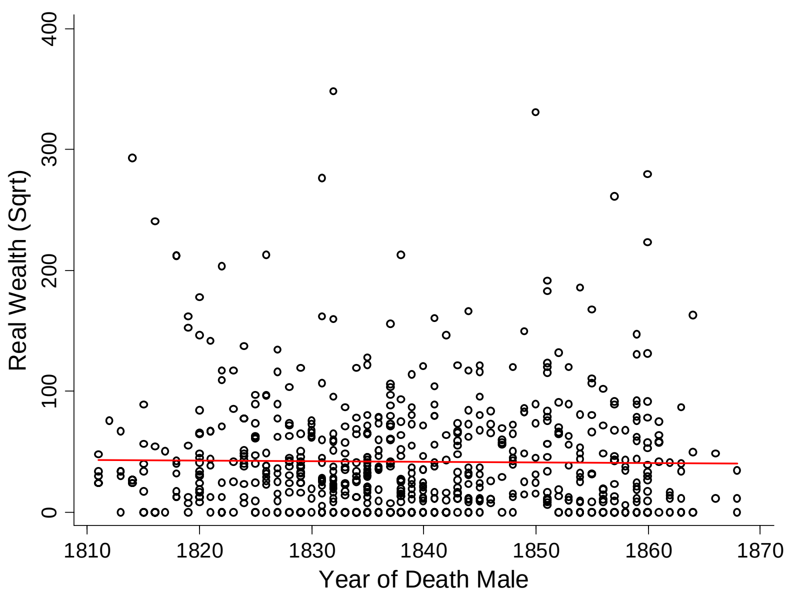
While the majority of the sample is at risk from underestimation of true wealth due to life course effects, any serious bias (>10%) is likely to only affect less than 5% of the sample. Ultimately the analysis presented here will split the wealth distribution in three. The possibility of bias from underestimation must be considered minimal as a result of such a wide division of the sample.

Table 2: Estimated Biases from Life Course Effects

Estimated Possible Downward Bias	Affected Age Groups	Obs	% of Sample affected
5%+	64-98	421	61.61%
10%+	86-98	42	4.32%
20%+	95-98	4	0.15%

There is a statistically insignificant effect of year of death on Real Wealth, with a linear fit completely flat for the sample period (figure 5). For analysis, the sample will be split into three wealth groups. As there was no time trend in the evolution of real wealth during this period, the division of wealth is calculated over the entire sample, disregarding sub-period. The choice of three wealth cuts follows Weir (1995) and Gutmann and Watkins (1990), and makes sense when we consider that these villages were primarily agricultural and the socio-economic stratification, as perceived by the population themselves, was probably relatively simple. The division split the sample into even thirds, with those dying with the sum of 0-141 Francs been designated to group 1, those with wealth at death between 141 and 2,100 Francs designated into group 2, and those with a wealth at over 2,100 been designated to group 3[7]. The nominal levels of wealth reported in the *Tables* were converted to real levels using a cost of living index from Lévy-Leboyer & Bourguignon (1990)[8].

Figure 5: Real Wealth by Year of Death (Males)



Raw Wealth Correlations

Table 3 reports the average number of children born and the number of children surviving to 10 ('net family size'). These values represent the actual gross and net reproductive success between the wealth groups. The different demographic regimes have very

---

[8] Which was kindly supplied to me by Pierre-Cyrille Hautcoeur

different wealth-fertility relationships. Where fertility is high and unchanging, the wealth-fertility relationship is positive. The Richest group here has a family size over 21% larger than the poorest (over 30% if we measure this in 'net' terms). Where fertility is declining, the wealth fertility relationship is the reverse. The differential between the richest and the poorest group's family size is now *minus* 30%! (23% in 'net' terms). The varying family sizes of the sample follow a clear and direct wealth-pattern, once we control for the type of fertility regime revealed by the aggregate trends.

Table 3: Average Children Born and Surviving to 10 Years, per Wealth Group

	Wealth Group		
	1	2	3
Non- Decline Villages			
Children Ever Born	4.87	5.90	5.93
Net Family Size	3.42	4.03	4.47
Decline Villages			
Children Ever Born	5.50	4.88	3.88
Net Family Size	4.62	4.14	3.57

The raw averages discussed above say nothing on the mechanics of the fertility differentials between the groups. How was the lower cross sectional fertility of the rich achieved in those villages where fertility was declining? Further, why was fertility so low amongst the poorest groups in the villages where fertility was not declining? Malthusian logic would immediately propose the female age at marriage, the classic European 'preventative' check as the driver behind these patterns. Also, differential female mortality between the wealth groups could be generating a lot of the variation. Does the perceived wealth effect act through these channels? The following section details regressions designed to detect the wealth effects controlling for these demographic variables and also event dummies such as the French Revolution.

Section 3: Deconstructing the Wealth Effects

The equations below detail the components of net family size. Any wealth effects on net family size have to operate through differentials in these values.

$$NetF = CEB - CED$$

$$NetF = MFR * MD - CED$$

$$MD = EU - FAgeM$$

$$EU = \min(MAgeD, FAgeD, FAgeM, 50)$$

Where $NetF$ is net family size, CEB and CED are children ever born and died respectively, MFR is the marital fertility rate, MD is the duration of the marriage, EU is the end of the union (marriage), $MAgeD$ is the husbands age at death, $FAgeM$ and $FAgeD$ are female age at marriage and death respectively.

Further, it can be expected that other forces, operating at the village level, and also at the national level (for instance the

Revolution and the effects of the Napoleonic wars), have a influence upon individual's fertility choices . To examine the specific wealth effects in the sample, a regression framework was established.

The model to be estimated takes the following functional form:

$$CEB f.(C, D, FageM_i, FageD_i, REV, NWARs, IM, Wealth)$$

Where C represents a constant, D is a fertility regime fixed effect, IM represents a measure of infant mortality, and REV and $NWARs$ are categorical variables representing the Revolution and Napoleonic wars respectively. The last mentioned 'event' variables were coded relative to year of marriage, with those with a year of marriage in 1789 or later receiving a Revolution effect, and those married between 1802 and 1814 receiving a war effect. The $Wealth$ variable is included in the regression as a categorical variable in order to account for expected non-linearities in the wealth fertility relationship.

Any analysis of fertility must account for the impact of child deaths upon parent's fertility decisions. Further, these child mortality estimates must take into account the significant likelihood of the omission of child deaths in the death registers. A popular way to detect under registration in death records is to examine the frequency of first name repetition within a family. Typically, later born siblings would be given the name of a previously deceased child. Houdaille has conducted an in-depth analysis of the Henry dataset for these features. However, his results are based on the village level and will tell us nothing on the wealth differentials *within* the villages with respect to infant and child mortality. One result that is relevant here is the completeness of the death records in Rosny, where no under registration was detected at all (Houdaille 1984 p.88). For this study, I employed a simple version of this technique. First, I counted up the number of repeated names within a family. This was then compared with the number of recorded child deaths. Where the number of repeated names exceeded the number of child deaths, I corrected the child deaths upwards to account for the probable omission of a death from the records. Table 4 reports the corrected and non corrected values by fertility regime and wealth division.

There are huge differences in child mortality between the villages. Within those were fertility is high, child mortality is high too. Within the villages, child mortality varies to a far less extent, with almost no differences between the wealth groups where fertility is high. The wealthiest group in the *decline* villages have child mortality far below any other group in the sample, and their rate is half that of the richest group in the *non-decline* villages.

Is the decline in fertility related to a reduction in child mortality at this period? To examine this, I will proceed with a multivariate regression. There is a probable endogenous relationship between fertility and infant mortality. Firstly, the number of child deaths can never exceed the number of births. This induces a positive correlation between fertility and mortality (Guinnane et al.

Table 4: Child Mortality (until 10 years) by Fertility Regime and Wealth Group, Rates per 1000 births

	Wealth Group		
	1	2	3
Non- Decline Villages			
Corrected	326.8	342.1	335.1
Uncorrected	283.1	320.6	314.2
Decline Villages			
Corrected	201.5	211.0	166.6
Uncorrected	181.2	197.9	162.0

2006 p. 472). Secondly, parents may choose to replace a deceased infant. Any interpretation of a parent's gross family size must therefore factor in the effects of the mortality experience. Following Guinnane et al., I factor in mortality by including the proportion of children dead as an independent variable in the regression. This removes the structural correlation between mortality and fertility but does not remove the endogenity.

As the dependant variable is a count variable and because the data is 'over dispersed' relative to the Poisson distribution, the appropriate method is to use negative binomial regression. The

Table 5: Negative Binomial Regressions on Children Ever Born

Variable	Coefficient (Standard Error)
Demographic variables	
Age at Marriage, Female	-0.038***
	(0.005)
Age at Death, Female	0.035***
	(0.004)
Proportion of Children dead	0.269**
	(0.001)
Event variables	
Revolution	-0.149**
	(0.059)
Napoleonic Wars	-.043
	(0.054)
Wealth Effects	
Wealth Group1 (ref.)	0
Wealth Group2	0.181*
	(0.049)
Wealth Group3	0.145
	(0.093)
Wealth-Fertility Regime Interactions	
Main Decline Effect	0.085
	(0.078)
Wealth Group1 (ref.)	0
Wealth Group2	-0.291**
	(0.102)
Wealth Group3	-0.397***
	(0.104)
Constant	.945***
	(0.252)
N	411
Psuedo R2	0.088

*** Significant at .001% level
** Significant at .01% level
*Significant at .05% level

distribution of both gross and net fertility matched the negative binomial distribution closely, and a comparison with the Poisson distribution is detailed in the appendix.

Table 5 details the results of a negative binomial regression on children ever born. Female age at marriage and at death are highly significant and act in the expected directions[9]. The proportion of dead children is also highly significant and it's effect is large. Intended to capture the effects of infant mortality, a reduction in this value decreases the number of children born. The Revolution has a significant negative effect on fertility, but the Napoleonic wars are insignificant. The wealth effects are capture by interactions in the model, and their 'net' effects are reported in table 6.

Table 6: Net Wealth Effects on Children ever born

	Wealth Group		
	1	2	3
Non- Decline Villages	5.95	7.14	6.88
Decline Villages	6.48	5.81	5.04

The 'net' wealth effects on fertility in table 6 are calculated from the interaction coefficients in the negative binomial regressions. A constant age at marriage for females (24) and complete life course fertility (surviving to at least 50) is applied for each wealth group[10]. These values represent the wealth effects on fertility 'net' of wealth differentials in age at marriage, death and the proportion of children

[9] Women who marry later should have fewer children for biological reasons, and women who die during their reproductive years should have fewer children.
[10] The average age at marriage for all women in the sample as a whole was 23.8.

dead. Once the net effect is calculated for each wealth group, the coefficient is exponentiated (as the beta coefficients of the negative binomial regression are given in logarithms) to give the expected numbers for each wealth group. These numbers can be understood as representing the net wealth effects controlling for the factors listed in the regression, and ignoring the effects of the Revolution and Napoleonic Wars. In relation to the richest and poorest groups, the strong positive wealth fertility relationship almost completely disappears within the *non-decline* villages. Those in the middle of the wealth distribution in the *non-decline* villages – Wealth Group 2, appear to have the highest marital fertility. Where fertility decline has already begun, the net wealth fertility relationship is still sharply negative, with the richest groups having over 22% fewer births. In summation: Pre-transition villages have a positive wealth-fertility profile, whereas transition villages have a negative wealth-fertility profile. This strongly implies that it is the rich, the top third of the wealth distribution in these rural villages, who are the pioneers of the decline in French fertility.

As mentioned, one feature the regression results highlight is the high relative fertility of Wealth Group 2 in the *non-decline* villages. One postulation on this feature could be that a proportion of the richest groups in the *non-decline* villages are beginning to control their fertility, but this proportion is too small to move the size of the wealth effect below that of the poorest group. The quality of the Henry dataset allows us to examine in fine detail the mechanics of the wealth fertility differentials, and this is described in the next section.

Section 4: The Mechanics behind the Fertility Patterns

The results from the regressions demonstrate systematically that economic status mattered during the period of fertility decline in France. What were the mechanics behind these patterns? The regressions indicate that both the gross family size correlations with wealth were independent of marriage age and age at death. The significant negative association, particularly for Rosny and Cabris (the '*decline* regime' villages) for marriages after 1800, must therefore represent an implementation of fertility limitation strategies within marriage. There are two ways for couples to control their desired family size. Firstly, they can stop bearing children once they reach a certain target family size – this is known as 'stopping' behavior . Secondly, they can increase their birth intervals–'spacing' behavior . The European demographic transition has overwhelmingly been attributed to 'stopping behavior '. However, the aggregation of those pursuing different reproductive strategies may blur the true picture. As van Bavel has stated; "research explicitly analyzing stopping and spacing has hardly ever differentiated between social status groups" (2002 p.7). The French fertility patterns discussed here are delineated by economic categories, and this section evaluates to what extent stopping and spacing can be attributed.

'Stopping' Behaviour

The Henry demographic dataset allows the calculation of fertility measures such as Age Specific Fertility Rates, Coale's index of marital fertility, the Total Marital Fertility Rate and the Coale and Trussell fertility control measures "M" and "m" (referred to as big and little m respectively). The Coale-Trussell parameters are calculated from the Age Specific Fertility Rates and represent deviations from the age pattern of 'natural fertility'. An M value of 1, and an 'm' value of 0 indicate no fertility control. Typically, researchers look for an 'm' value greater than .200 for an unambiguous sign of a controlling population. M, is harder to interpret, but may catch 'spacing' effects. The appendix details the statistical derivation of the Coale-Trussell parameters. However, these measures have been criticized in the literature and are far from fool proof. Table 7 summarizes the calculated Age specific marital fertility rates, Total Marital Fertility Rates and the Coale and Trussell fertility control parameters.

The reproductive advantage of the richest group in the *non-decline* villages is emphasized by the high value for M, 0.927. This means that the richest group here has a fertility level very close to that of the natural fertility schedule. For the *non-decline* villages, M has decreased and the scale of the decrease is, again, closely related to economic status. The richest have the lowest level of fertility and the poorest wealth group have the highest. Focusing on 'm' – the parameter indicating significant deviation from a natural age pattern of marital fertility, the results indicate no unambiguous signs for stopping behavior in any of the regimes. However, this value is largest for the richest group in the *decline* villages (0.146). Despite

Table 7: Demographic Measures by Fertility Regime

	Wealth Group		
	1	2	3
***Non-decline* Villages**			
Age Specific Marital Fertility Rates			
20-25	0.364	0.313	0.373
25-30	0.357	0.360	0.432
30-35	0.302	0.389	0.349
35-40	0.268	0.321	0.303
40-45	0.155	0.176	0.158
45-50	0.008	0.027	0.000
Total Marital Fertility	7.75	8.43	8.70
Coale Trussell Measures			
M	0.802*	0.795**	0.927
S.E.	0.105	0.087	0.092
"m"	0.029	-0.141	0.064
S.E.	0.119	0.095	0.113
***Decline* Villages**			
Age Specific Marital Fertility Rates			
20-25	0.302	0.250	0.216
25-30	0.343	0.313	0.261
30-35	0.313	0.273	0.228
35-40	0.242	0.209	0.164
40-45	0.133	0.100	0.084
45-50	0.009	0.007	0.009
Total Marital Fertility	7.58	6.82	5.86
Coale Trussell Measures			
M	0.768**	0.682***	0.587***
S.E.	0.096	0.085	0.087
"m"	0.058	0.104	0.146
S.E.	0.107	0.099	0.100

failing to be significant and above the 0.200 threshold, the value is indicative of a small proportion of 'stoppers'.

Another way to detect 'stopping' behavior is to look at the average age women have their last birth. These values are reported for the regime and wealth group combinations in table 8. The values are calculated only for those women and their husbands who died after 50. The mean age at last birth in populations practicing 'natural fertility' is approximately 40-41 years (Bongaarts (1983) as cited by Kohler et al. 2002 p.28). Amongst the villages where fertility was not declining, there is no significant variation to report. Age at last birth is high, around 37-38 years for all wealth groups. For the villages where fertility was declining, the top 2 wealth groups do show evidence for 'stopping' behavior ; the mean age at last birth is significantly below that of the other groups in the sample.

Table 8: Age at Last Birth by Fertility Regime

	Wealth Group		
	1	2	3
Non-Decline Villages	37.81	38.62	36.92
Decline Villages	37.80	35.90	35.37

'Spacing' behavior

Having established some partial evidence for the presence of 'stopping' behavior amongst the wealthiest groups in the sample villages, the question of 'spacing' arises. It is far easier to detect 'stopping' behavior in population sub-groups then it is to detect 'spacing' behavior. One way to detect spacing is to model the birth intervals directly using a Cox proportional hazards model. The results will describe the effects of the covariate independent variables in terms of a 'hazard rate', which is defined as the instantaneous probability of the event in question (in this case a birth), and is therefore directly related to the length of the birth interval. As the model is intended to reveal differences in spacing behavior, only closed birth intervals are used. The formulation of the birth interval model follows previous analyses by Alter (1988), Bengtsson and Dribe (2006), Van Bavel (2004a, 2004b) and Van Bavel and Kok (2004). After consideration of the varying inclusion of demographic factors in these studies, it was decided to concentrate on those factors most commonly found to affect the birth interval. This was done with the aim of producing a parsimonious model which could capture the wealth effects (if any) on the duration of the birth interval. The demographic factors included were the age of the mother (in 5 year age bands), the duration of the marriage, parity, and the life status of the previous born child. In common with the analysis by Bengtsson and Dribe, I include shared frailty at the individual level to control for unobserved family-specific heterogeneity in the sample (2006 p.736).

The Cox proportional hazards model is based on the following identity:

$$h_i(t) = h_0(t)\exp(\beta' x)$$

Table 9: Cox Regression on Closed Birth Intervals

	$e^{coeff.}$	$se^{coeff.}$	p
Women's Age			
15-19	0.707	0.177	0.166
20-24	0.976	0.075	0.756
25-29 (ref.)	1	-	-
30-34	0.920	0.063	0.223
35-39	0.743	0.071	0.002
40-44	0.297	0.043	0.000
45-49	0.043	0.020	0.000
Parity	1.108	0.025	0.000
Marital Duration	0.906	0.010	0.000
Infant Alive	0.168	0.015	0.000
Decline Effect	0.868	0.111	0.268
Main Wealth Effects			
Wealth Group 1 (ref.)	1	-	-
Wealth Group 2	1.221	0.152	0.108
Wealth Group 3	1.276	0.170	0.067
Wealth-Fertility Decline Interactions			
Wealth Group 1 (ref.)	1	-	-
Wealth Group 2	0.716	0.121	0.049
Wealth Group 3	0.543	0.095	0.000
Frailty variance	0.298	0.050	0.000
N – Number of birth Intervals		2186	
Likelihood Ratio χ^2		83.77	0.000

The hazard rate h for the i^{th} individual is a multiplicative function of the baseline hazard h_0 and the regression coefficients, $\beta' x$

(Cleves et al 2004 p.147-8). The great advantage of the Cox proportional hazard model is that the functional form of h_0 , the baseline hazard, is left unspecified. To account for unobserved heterogeneity at the individual level a frailty component is included. Rewriting the hazard:

$$h_i(t) = h_0(t)\alpha_i \exp(\beta' x)$$

Where α_i represents the shared frailty term, assumed to have mean one and a variance estimated from the data (Cleves et al 2004 p.147-8). This is intended to capture mother specific effects on the birth interval, constant across all the covariates. As mentioned, the results reported in table 9 are presented as *hazard ratios*[11]. Where the reported coefficient equals 1, there is no effect of that variable on the hazard of a birth.

The Cox regressions on the hazard of a birth place attach high significance to parity, marital duration and the presence of an infant. Further, the natural fall off in fecundity is reflected by the falling hazard ratios for age groups past the 25-29 reference category. The

---

[11] The critical proportional hazards assumption was tested by analyzing the Schoenfeld residuals. Using stata's spthtest revealed that there was a deviation from the proportional hazards assumption in the original formulation of the birth interval model (table 9). Variable by variable analysis indicated that the parity, marital duration and female age grouping variables were driving this violation of the proportional hazards assumption. The analysis was repeated omitting these variables and the new wealth coefficients were compared with the original models. They were extremely similar in both magnitude and significance. Therefore it was decided to report the original model's results. The proportional hazards assumption was also checked graphically using stata's stphplot command.

Table 10: Net Hazard Ratios and Mean Birth Interval (Months) by Fertility Regime and Wealth Group

	Wealth Group		
	1	2	3
Non-Decline Villages			
Hazard rate	1.000	1.221	1.276
Interval	30.60	27.74	27.57
Decline Villages			
Hazard rate	0.868	0.760	0.602
Interval	32.08	33.23	36.41

wealth effects are reported as interactions in the regression table. In order to calculate the net wealth effects, these values are multiplied, producing the values reported in table 10. The wealth effects are large. For the *non-decline* villages, the hazard ratio for a birth increases with the wealth category, indicating that the top 2 wealth groups have significantly shorter birth intervals than the poorest group. For the *decline* villages, the opposite is true. The richest here have much longer birth intervals than the poorest group. The mean birth interval for each wealth group varies with the hazard rates, and are also reported in table 10. These results strongly indicate that spacing played a substantial role in the declining fertility of the richer groups in the sample. In comparison with the Coale-Trussell measures and the age at last birth calculations, it appears that it was spacing, not stopping, which was the primary driver behind the French fertility decline.

Figure 6: The Age Pattern of Marital fertility for Rich and Poor

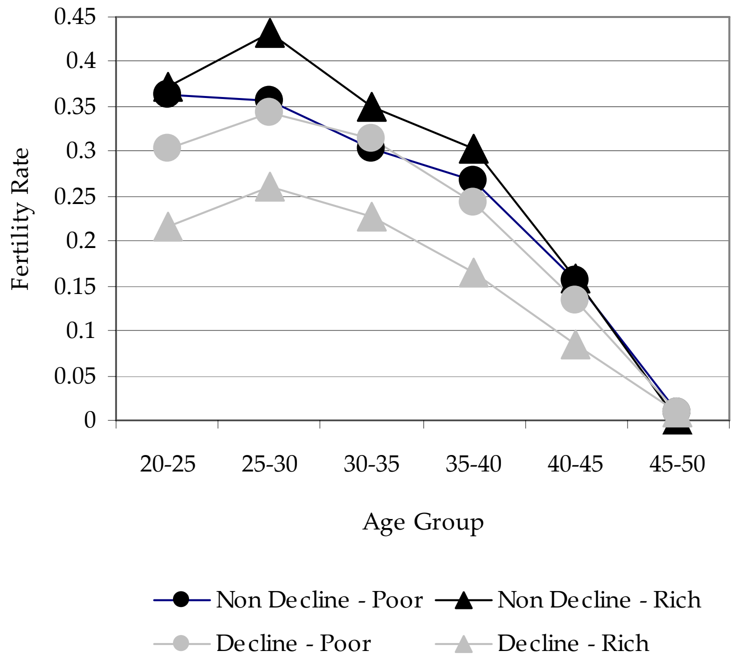


Figure 6 illustrates the age pattern of marital fertility for the richest and poorest groups in both fertility regimes (the top and bottom thirds of the wealth distribution respectively). As the Coale-Trussell estimates indicated, the age pattern of marital fertility does not vary to a large extent between these sub-groups. However, the level of the fertility rate at each age group varies enormously. There is a large positive 'upward shift' in the age fertility schedule between the poorest and richest wealth groups in the *non-decline* villages. For the *decline* villages, this shift is downward. The Cox model reveals that the lower cross-sectional fertility of the richer groups in the *decline* villages is overwhelmingly a result of spacing practices. This is also implied by figure 6, where the level of fertility at each age group is significantly lower for the richest group in the *decline* villages.

Section 5: Why did fertility decline in France?

Any socioeconomic explanation for early French fertility decline must consider that England, with a higher level of GDP per capita, a smaller agrarian sector and a larger urbanization rate lagged behind French fertility trends by over 100 years. This fact undermines demographic transition theory, the microeconomic theory of fertility and unified growth theory[12]. All of these theories rely on changes in income, modernization and the labor force structure of the economy in initiating a substitution of child quantity for quality. None of them can explain why France was first.

The French themselves have long been preoccupied with the unusual characteristics of their demographic history. An intellectual climate obsessed with depopulation and the decline in French fertility arose around the turn of the 20 century. Van de Walle briefly discusses this mostly forgotten literature, criticizing its "outdated and weak statistical content", and states that the work amounted to a no more than a series of hypotheses (1974 p.6). Some of these hypotheses have survived to today, and I focus upon those forwarded by Tony Wrigley and David Weir[13].

---

[12] At least in explaining the fertility transition.

[13] Another popular explanation for the French fertility decline is the change in the inheritance laws which accompanied the Revolution. The Napoleonic code replaced primogeniture with equal partition. In order to preserve a concentration of wealth within the family, parents now had to curb their family size, as wealth could not solely be assigned to the eldest male. Chesnais questions this interpretation by pointing out that other countries adopted the same principles but didn't experience a fertility decline. Further, primogeniture was not practised widely in the North, except amongst the aristocracy, and the South-West of

Neo-Malthusian Explanation

Wrigley sees the early adoption of family limitation in France as "a variant form of the classic prudential system of maintaining an equilibrium between population and resources to which Malthus drew attention". Essentially, the preventative check now operated through marital fertility directly, and not indirectly through age at marriage. The net reproduction rate in France from the late 18th to late nineteenth century was always close to 1, suggesting that the population was still finely constrained by available resources (Wrigley p.55 1985). As previously mentioned, almost 80% of the French population were rural, and nearly 70% lived off farming at the time of the decline (Chesnais 1992 p.335). Chesnais also points out that "farming remained primitive" and that there were numerous indicators of overpopulation (such as increase in wheat prices from the 1760s-1820s) (1991 p.336). These features certainly lend themselves to a Malthusian interpretation of the fertility pattern.

The testable implication of this hypothesis, as stated by Weir, is that there should be a strong positive relationship between real income and fertility (1984a p.31). However, this 'neo-Malthusian' reasoning for the early decline for French fertility fails to be supported by the individual level data collected in this analysis. If the restriction on births was a response to an economic constraint, we

France, where primogeniture was common, had relatively low fertility in the *Ancien Regime*, and followed the same fertility pattern elsewhere post Revolution (1991 p.338).

would expect those closest to subsistence to initiate fertility control. This is clearly not the case for the four villages in the sample. Where fertility is declining, the wealth-fertility relationship is negative. Fertility decline here is more pronounced for the richer groups; they are the first to employ this new variant of the preventative check, but this is not a 'neo-Malthusian' response.

The Revolution

Many scholars (Weir 1984b, and more recently Murphy and Gonzalez-Bailón 2008) have explicitly linked the Revolution to the fertility decline. At a superficial (and highly aggregated) level, the events are near simultaneous (see figure 1). However, econometric tests on the aggregate fertility rate place the decline in fertility before the Revolution (1776, see Cummins 2009). Further, it is widely accepted that many localities began their fertility transition long before 1789 (Chesnais 1992 p.338). In the data collected for this analysis, Rosny and Cabris have substantially declining fertility rates before the Revolution (see figure 3). However, the ideological and socioeconomic causes of the Revolution were germinating long before 1789. Could these forces have also contributed to the fertility revolution as well as the political?

An economic rationale for the decline in French fertility, associated with the Revolution has been forwarded by Weir. He states "evidence on fertility by social class is scarce, but tends to support the idea that fertility control was adopted by an ascendant "bourgeois" class of (often small) landowners" (1984b p.613). The

Revolution enabled an element of the rural population to increase their control over the land, while others lost out and became more reliant on wage labour. For the new rural bourgeoisie, children became "superfluous as labourers and costly as consumers" (Weir 1984b p.613). The decline of fertility in France in the early to mid 19th century was primarily due to the decline of the demand for children by this new class. It was only after 1870 when France joined the rest of Europe in a fertility transition which transcended the social order (Weir 1984b p.614).

The results of this analysis support Weir's hypothesis on the French fertility transition. The new class of landowners created by the Revolution would certainly lie within the top wealth category as constructed here. The results clearly show, as Weir expected, that fertility decline was initiated by this wealthy group. Further, the effect of the Revolution on family size is large, negative and significant (see table 11). This is captured in the negative binomial regressions by coding a categorical variable for those who married after 1789. A more precise testable implication of Weir's hypothesis is that those who have greater property wealth should have the lowest fertility. Further, the cash component of total wealth at death should be an insignificant predictor for family size. By splitting the wealth measures into the property and cash components we can test for this in the sample data. Once the value is separated, the distribution is split into even thirds with respect to cash and property

Table 11: Negative Binomial Regressions on Children Ever Born with the Components of Wealth

Variable	Coefficient (Standard Error)
Demographic variables	
Age at Marriage, Female	-0.036*** (0.005)
Age at Death, Female	0.034*** (0.004)
Proportion of children dead	0.305** (0.102)
Event variables	
Revolution	-0.127* (0.052)
Napoleonic Wars	-0.008 (0.054)
Property Wealth Effects	
Wealth Group1 (ref.)	0
Wealth Group2	-0.000 (0.055)
Wealth Group3	-0.157** (0.058)
Cash Wealth Effects	
Wealth Group1 (ref.)	0
Wealth Group2	0.024 (0.057)
Wealth Group3	0.053 (0.061)
Constant	0.948*** (0.243)
N	372
Pseudo R2	0.069

*** Significant at .001% level
** Significant at .01% level
*Significant at.05% level

separately[14]. Table 10 reports the results of a negative binomial regression, similar to the previous exercise, but this time dividing wealth into its constituent parts.

The results agree exactly with Weir's predictions. The wealth category which has significantly fewer children is composed of the richest property owners. However, the driving factor in his hypothesis is the changing cost of children, due to the substitutability of wage labor by poorer socioeconomic groups. This does not uniquely identify a particular French characteristic as this process must surely have been existed in other countries. At this time, the English population was far less reliant on the agricultural sector and children must have been as expensive, if not more so, as they were in France.

In France, however, serfdom had disappeared by the 18th century, and most peasants owned their own land, in contrast to most of Europe (Chesnais 1992 p.336). The fertility decline

[14] The division for property was all those with 0 value at death in group 1, all those with property over 0 and less than 2000 Francs in group 2, and all those with over 2000 Francs property wealth going to group 3. For cash, all those with 0 wealth at death were designated to group 1, those with over 0 and under 155 Francs in group2, and all those over 155 in group 3. The following matrix describes the relationship between the various groups in terms of observations:

	Cash Wealth Group			
Property Wealth Group	1	2	3	Total
1	154	45	12	211
2	59	85	60	204
3	39	33	135	207
Total	252	163	207	622

originated amongst the wealthiest of this property holding class[15]. According to Chesnais, almost 63% of the population was represented by landowners and their families in 1830 while the comparable figure for Britain is 14% (1991 p.337). The widespread ownership of land amongst the rural population is a unique feature of the French socio-economic landscape at this time. Because of this, economic inequality was lower in France than in England during the 19th century (Piketty et al. 2006 p.250). This implies that the environment for social mobility was more fluid in 18th and 19th century France than anywhere else in Europe. Arsene Dumont, writing a century after the onset of the transition, placed social mobility as the 'raison de etre' of the French fertility decline and termed "social capillarity" as the phenomenon driving the limitation of family sizes (Dumont 1890). The Revolution served "to increase the thirst for equality and stimulate the social ambition of families, both for themselves and their progeny" (Chesnais 1992 p.334). The old social stratifications under the *Ancien Regime,* where hereditary rights had determined social status, were weakened by the Revolution. All of this served to facilitate individuals' social ambition, and the limitation of family size was a tool in achieving upward social mobility[16]. This phenomenon, while associated with the Revolution, originated before the political climax of 1789.

---

[15] In aggregate terms. The nobility restricted their fertility far earlier than the rest of the population, see Livi Bacci 1986.

[16] Recently, the issue of social mobility and relative status in understanding Europe's fertility decline has been coming to the fore. Skirbekk (2008) and Van Bavel (2006) discuss the issue explicitly. Van Bavel (2006) finds a negative relationship between family size and children's subsequent socioeconomic status (p.15) and suggests that these intergenerational motivations may be important in understanding the fertility transition (p.16).

The testable proposition of this hypothesis is that fertility should be negatively related to the opportunities for social mobility. A crude proxy for the social mobility environment is the level of economic inequality. In a society with a large rural, landless majority and a small group of elites, the prospects for social mobility are limited. It makes no sense to control fertility if family size has no impact upon a family's relative social standing. The economic distance between the bottom and the top status groups is too great, and therefore upward social mobility is unattainable for the majority of the population. However, changes in the distribution of wealth/income between groups in the population reflect a changing environment for the possibility of social mobility. As economic inequality declines, fertility is induced to decline also, as parents now realize that social mobility is possible and the prospects for it are affected by family size.

One way to evaluate the strength of this hypothesis is to examine the level of economic inequality in cross section in the individual wealth data collected for transition era France. Table 12 reports gini coefficients based on total real wealth, by village, for the sample. The levels of inequality are very high, and typical of the pre-industrial era. For the villages where fertility is declining, the gini coefficient is significantly lower than where it is not. This suggests that the level of inequality was associated with the onset of the fertility transition.

Table 12: Gini Coefficients by Village

	Gini Coefficient (based on deaths 1810-1870)
Non-decline Villages	
St Paul	.861
St Chely	.818
Decline Villages	
Cabris	.705
Rosny	.722

Another way to test the social mobility environment is to examine the relationship between father and son's wealth at death. Where the environment for social mobility is more open, father's wealth should have less importance in the determination of son's wealth, than would be the case where social mobility is limited. For a very small subsample, I was able to investigate this relationship. Table 13 reports the results of an OLS regression on son's wealth, with father's wealth as an independent variable.

Where fertility is high and not declining, father's wealth is a highly significant predictor of son's wealth. This relationship appears to be far weaker where fertility is declining. The effective coefficient on father's wealth in the determination of son's wealth in these *decline* regimes is one quarter of that of the villages where fertility is stagnating (.864 vs. .195). When both father and son's family size are controlled for, the coefficient on father's wealth in the *non-decline* villages is ten times its corresponding value in the *decline* villages (.798

Table 13: Father's Wealth as Determinant of Son's Wealth

Decline Regime Villages	56.56*	35.42
	(24.47)	(33.89)
Fathers Wealth (Sqrt)	0.864***	0.798***
	(0.177)	(0.210)
Fathers Wealth*Decline Regime	-0.669*	-0.724*
	(0.305)	(0.349)
Son's Family Size		-3.761
		(3.854)
Father's Family size		-3.300
		(3.394)
Constant	2.13	62.38
	(20.99)	(52.38)
Observations	42	40
Adj. R^2	0.346	0.320

*** Significant at .001% level
** Significant at .01% level
*Significant at.05% level

vs. .074). This result strongly implies that the strength of the intergenerational transmission of wealth, it's 'stickiness' within families, and the social mobility environment this implies, is associated with the presence of fertility decline.

As I have stated before, demographic transition theory, the microeconomic theory of fertility and unified growth theory cannot explain why French fertility fell first in Europe because they all predict that fertility should have declined in England before anywhere else. Wrigley's neo-Malthusian response cannot be valid as it was the richest groups who reduced their fertility, and Weir's explanation, again, does not uniquely identify France. What was unique to France was the pattern of landholding and relative affluence (to the rest of the world). There are many good reasons to suspect that social mobility may be a factor behind the decline. The level of inequality and the perseverance of wealth within families, both highly related to the social mobility environment were both found to be negatively associated with the presence of declining fertility.

Section 6: Conclusion

Through linking the Henry demographic dataset to individual measures of wealth, the socioeconomic correlates of the fertility transition have been examined in this paper. The principal result is the major shift in the wealth fertility relationship at the individual level. Where fertility is high and non-declining, this relationship is positive. Where fertility is declining, this relationship is negative. It is the richest groups who reduce their fertility first. This result contributes to a revisionist interpretation of the European fertility decline. In opposition to the EFP's conclusions, this disaggregated analysis finds strong socioeconomic correlates for the decline of fertility in France. The second principal result of this paper is that spacing strategies, as opposed to stopping strategies, played the strongest role in achieving a lower family size for the richest groups, for the villages where fertility was declining. Thirdly, existing theories on why fertility declined in France failed to be supported by the empirical data collected. However, a fresh look at an old hypothesis, does receive some support. Social mobility, as proxied by the level of inequality in the villages and the perseverance of wealth within families, is strongly associated with fertility decline.

The evidence presented here demonstrates that socioeconomic status mattered during the early French fertility decline but cannot, of course, claim to have cracked one of the greatest unsolved puzzles in economic history. The root causes behind the World's first fertility decline are still poorly understood. It is perhaps time to reassess conceptual models of the fertility transition. Empirically, a comparative analysis with other European countries based upon detailed individual level information can hopefully illuminate the mystery of the early French fertility decline. This study is a first step towards re-establishing the French experience as paramount in our understanding of Europe's demographic transition.

References

Archives Départementales de la Alpes-Maritime, serie Q3, *Tables Des Successions et Absences*.

Archives Départementales de la Dordogne, serie Q3, *Tables Des Successions et Absences*.

Archives Départementales de la Lozere, serie Q3, *Tables Des Successions et Absences*.

Archives Départementales de la Seine - St. Denis, serie Q3, *Tables Des Successions et Absences*.

Becker, Gary S., 1960 'An Economic Analysis of Fertility' in Ainsley J. Coale, ed., *Demographic and Economic Change in Developed Countries*. Princeton, NJ: Princeton University Press: 209-40

Becker, Gary S. 1991 *A treatise on the family. Enlarged ed.* Cambridge, MA: Harvard U. Press.

Bengtsson, Tommy and Martin Dribe 2006 "Deliberate control in a natural fertility population: Southern Sweden, 1766–1864" *Demography* 43(4): 727–746.

Bongaarts, John. 1983. "The proximate determinants of natural marital fertility," in Rodolfo A. Bulatao and Ronald. D. Lee (eds.), *Determinants of Fertility in Developing Countries* New York: Academic Press: 103–138.

Bourdieu, Jérôme, Gilles Postel-Vinay and Akiko Suwa-Eisenmann 2004 "Défense et illustration de l'enquête 3000 familles" *Annales de démographie historique*: 19-52.

Box-Steffensmeier, Janet M., and Bradford S. Jones 2004 *Event History Modelling: A Guide for Social Scientists* New York: Cambridge University Press

Brown, John C. and Timothy W. Guinnane 2007 "Regions and Time in the European Fertility Transition: Problems in the Princeton Project's Statistical Methodology" *Economic History Review*, 60(3): 574-595

Burch, Thomas K. 1995 "Icons, Strawmen and Precision: Reflections on Demographic Theory of Fertility Decline" *University of Western Ontario Discussion Paper* 94 (4)

Castro, Nina. and Neil J. Cummins 2006 "The Relationship between Socioeconomic Status and Marital Fertility in 18th Century France" *Unpublished ICPSR Project*

Chesnais, Jean Claude 1992 *The Demographic Transition: Stages, Patterns and Economic Implications* Oxford: Oxford University Press

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

Clark, Gregory and Gillian Hamilton. 2006 "Survival of the Richest. The Malthusian Mechanism in Pre-Industrial England." *Journal of Economic History*, *66*(3) (September): 707-36.

Cleves Mario. A., William W. Gould and Roberto G. Gutierrez, 2004 *An Introduction to Survival Analysis Using Stata. Revised Edition* College Station (TX): Stata Press

Cummins, Neil J. 2009 *A Comparative Analysis of the Relationship between Wealth and Fertility during the Demographic Transition: England and France* PhD Thesis London School of Economics (forthcoming)

Dumont, Arsene 1890 *Dépopulation et civilisation: étude démographique Paris: Lecrosnier et Babé.*

Galor, Oded 2004 "From Stagnation to Growth: Unified Growth Theory," *CEPR Discussion Papers 4581*

Guinnane, Timothy W., Carolyn M. Moehling and Cormac O'Grada 2006 "The fertility of the Irish in the United States in 1910" *Explorations in Economic History* 43(4): 465-485

Guttmann, Myron P. and Susan C. Watkins 1990 "Socio-Economic Differences in Fertility Control. Is There an Early Warning System at the Village Level?" *European Journal of Population* 6(1):69-101

Hadeishi, Hajime 2003 "Economic Well-Being and Fertility in France: Nuits, 1744–1792." *Journal of Economic History*: 489-505.

Houdaille, Jacques 1984 "La mortalité des enfants dans la France rurale de 1690 a 1779" *Population* 1: 77-106

Houdaille, Jacques 1976 "Fécondité des mariages dans le quart nord-est de la France de 1670 a 1829" *Annales de Demographie Historique*: 341-92

Henry, Louis and Jacques Houdaille 1973 **"**Fécondité des mariages dans le quart nord-ouest" *Population (French Edition)* 28: 873-924

Henry, Louis 1972 "Fécondité des mariages dans le quart sud-ouest de la France" *Annales E.S.C* 27: 612-39, 977-1023

Henry, Louis 1978 "Fecondite des mariages dans le quart sud-est de la France" *Population (French Edition)* 33: 855-83

Kohler, Hans-Peter, Francesco C. Billari, and José Antonio Ortega 2002 "The emergence of lowest-low fertility in Europe during the 1990s" *Population and Development Review* 28(4): 641–680

Levy-Leboyer, Maurice and François Bourguignon 1990 *A Macroeconomic Model of France during the 19th Century: An Essay in Econometric Analysis* Cambridge, Cambridge University Press

Livi-Bacci, Massimo 1986 "Social-group forerunners of fertility control in Europe" in Ansley J. Coale and Susan C. Watkins (eds.) *The decline of*

fertility in Europe Princeton, New Jersey, Princeton University Press: 182-200
Maddison, Angus 2003 *The world economy: historical statistics* Paris: OECD
Murphy, T. and Sandra Gonzalez-Bailón 2008 "When Smaller Families Look Contagious: A Spatial Look At The French Fertility Decline Using An Agent-Based Simulation Model" *Oxford Discussion Papers in Economic and Social History* series 71
Notestein, Frank 1945 "Population; the Long View" in Schultz, Theodore, *Food for the World*: 36-57
Okun, Barbara 1994 "Evaluating Methods for Detecting Fertility Control: Coale and Trussell's Model and Cohort Parity Analysis" *Population Studies* 30: 193-222
Piketty, Thomas, Gilles P. Vinay and Jean L. Rosenthal "Wealth concentration in a developing economy : Paris and France, 1807-1994" *American Economic Review* 96(1): 236-256
Schmertmann, Carl P. and André J. Caetano 1999 "*Estimating Parametric Fertility Models with Open Birth Interval Data" Demographic Research* available at http://www.demographic-research.org/Volumes/Vol1/5 (accessed 22 Jan 2008)
Skirbekk, Vergard 2008 "Fertility trends by social status" *Demographic Research* 18(5): 145-180
Stata Library, Analysing Count Data UCLA: Academic Technology Services, Statistical Consulting Group from http://www.ats.ucla.edu/stat/stata/library/count.htm (accessed 20 January 2008)
Van Bavel, Jan 2002 "Detecting Stopping and Spacing Behavior in Historical Fertility Transitions: A Critical Review of Methods" Working Paper, Department of Sociology, KU Leuven.
Van Bavel, Jan 2004 "Deliberate birth spacing before the fertility transition in Europe: evidence from nineteenth-century Belgium" *Population Studies* 58(1): 95-107
Van Bavel, Jan & Jan Kok 2004 "Birth spacing in the Netherlands. The effects of family composition, occupation and religion on birth intervals, 1820-1885" *European Journal of Population* 20(2): 119-140
Van de Walle, Etienne 1978 "Alone in Europe: The French Fertility Decline until 1850" In *Historical Studies of Changing Fertility*, edited by Charles Tilly, 257–88. Princeton, NJ: Princeton University Press: 257988
Weir, David. R. 1984a "Life Under Pressure: France and England, 1670-1870" *Journal of Economic History* 44(1) : 27-47
Weir, David. R. 1984b "Fertility Transition in Rural France, 1740-1829" *Journal of Economic History* 44(2) :612-4

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

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

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

Xie, Yu and Ellen E. Pimentel 1992 "Age Patterns of Marital Fertility: Revising the Coale-Trussell Method" *Journal of the American Statistical Association* 87: 977-84