DISCUSSION PAPER SERIES

DP17475
(v. 2)

How did the European Marriage Pattern Persist? Social versus Familial Inheritance: England and Quebec, 1650-1850

Gregory Clark, Neil Cummins and Matthew Curtis

ECONOMIC HISTORY

CEPR

ISSN 0265-8003

How did the European Marriage Pattern Persist? Social versus Familial Inheritance: England and Quebec, 1650-1850

Gregory Clark, Neil Cummins and Matthew Curtis

Discussion Paper DP17475
First Published 15 July 2022
This Revision 18 July 2022

Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

How did the European Marriage Pattern Persist? Social versus Familial Inheritance: England and Quebec, 1650-1850

Abstract

Eric Turkheimer famously stated as a Law, "All human behavioral traits are heritable." But this poses a puzzle for pre-industrial demographic systems, such as the European Marriage Pattern, where individuals made behavioral choices that limited fertility. Why were these behaviors not replaced over time with those that generated higher fertility? Some have argued the solution to this puzzle is that limited fertility in the first generation was actually maximal fertility in subsequent generations. But we show that there was no fertility penalty to future generations from higher fertility in the initial generation in both England and Quebec. Here we argue instead that the European Marriage Pattern survived for more than 500 years because, for pre-industrial fertility behavior, Turkheimer's Law does not hold. Even though at the social level fertility limiting behaviors transmitted strongly, there was scant familial inheritance of fertility choices. So fertility enhancing deviations did not get transmitted within families across generations, and the European Marriage Pattern could persist indefinitely. In the paper we show evidence consistent with horizontal as opposed to vertical transmission of fertility behaviors.

JEL Classification: N/A

Keywords: European Marriage Pattern, pre-industrial fertility limitation, Horizontal cultural transmission

Gregory Clark - gclark@ucdavis.edu
University of California, Davis and CEPR

Neil Cummins - neiljcummins@gmail.com
London School of Economics and CEPR

Matthew Curtis - mjdcurtis@gmail.com
ECARES, Free University, Brussels

Acknowledgements
Thanks to the participants at the LSE/UCD Coffee Hour, the HEDG Mini Workshop at Southern Denmark University, and the Cliometrics Conference for helpful feedback and comments. Thanks to Michael Dearing for financial support for this research.

How did the European Marriage Pattern persist? Social versus Familial Inheritance: England and Quebec, 1650-1850

Gregory Clark*, Neil Cummins†, and Matthew Curtis‡

July 2022

Abstract

Eric Turkheimer famously stated as a Law "All human behavioral traits are heritable." But this poses a puzzle for pre-industrial demographic systems, such as the European Marriage Pattern, where individuals made behavioral choices that limited fertility. Why were these behaviors not replaced over time with those that generated higher fertility? Some have argued the solution to this puzzle is that limited fertility in the first generation was actually maximal fertility in subsequent generations. But we show that there was no fertility penalty to future generations from higher fertility in the initial generation in both England and Quebec. Here we argue instead that the European Marriage Pattern survived for more than 500 years because, for pre-industrial fertility behavior, Turkheimer's Law does not hold. Even though at the social level fertility limiting behaviors transmitted strongly, there was scant familial inheritance of fertility choices. So fertility enhancing deviations did not get transmitted within families across generations, and the European Marriage Pattern could persist indefinitely. In the paper we show evidence consistent with horizontal as opposed to vertical transmission of fertility behaviors.

*UC Davis, LSE and CEPR. gclark@ucdavis.edu.

†LSE and CEPR. neiljcummins@gmail.com.

‡ECARES, ULB. matthew.curtis@ulb.edu.

Thanks to the participants at the LSE / UCD Coffee Hour, the HEDG Mini Workshop at SDU, the IRES Lunch Seminar, and the Cliometrics Conference for helpful feedback and comments. We thank Jean-Sébastien Bournival and Lisa Dillon for providing and assisting with the IMPQ data. Thanks also to Michael Dearing for financial support for this research. Matthew Curtis also acknowledges financial support by the European Research Council (ERC Starting Grant 947654, IDED, granted to Paula Gobbi).

1 Introduction

The European Marriage Pattern (EMP) had four main features: a late age of first marriage for both men and women, a substantial fraction of men and women never marrying, unrestricted fertility within marriage, and sexual abstinence before engaging to marry. Since the pattern was first documented by John Hajnal (1965, 1982, 1983) there has been debate about when this fertility limiting behavior first emerged.[1]. But in England and France it certainly persisted for at least 350 years, and potentially for more than 500 years. The EMP has been proposed as a — and sometimes the — key mechanism for the rise of Western Europe economically 1400-1800. By limiting fertility and delaying marriage for women, the EMP has been claimed to have fostered a society with more gender equality and higher levels of education (De Moor and Van Zanden (2010), Foreman-Peck (2011), Foreman-Peck and Zhou (2018), Carmichael et al. (2019)).

However, one notable feature of the EMP is the importance of individual decisions by couples. The average age of first marriage by women may have been 25 under the EMP, for example, but some women first married at 14 and some at 40. In some families all children married, in others substantial numbers of children never married. [2]

If individual behaviors varied within the EMP, then a puzzle arises about how the pattern sustained itself for potentially more than 500 years. If deviation from the pattern resulted in more surviving offspring, and these deviations were inherited within families, the pattern would collapse in a few generations. To take a modern example, the Haredi (ultra-orthodox) community in Israel has much higher fertility than the rest of the population. As a result their share of the population has swollen from 1% of the Jewish population in Israel in 1948 to 21% by 2020. Even though Haredi fertility has begun to decline it is projected that by 2059 the ultra-orthodox will be a full 35% of the Jewish population (Cahaner and Malach, 2019).[3]

[1] See Hallam, (1985), De Moor and Van Zanden (2010), Voigtländer and Voth (2013), Bennett (2019), and Edwards and Oglivie (2021)

[2] In contrast in East Asia where fertility was limited by low fertility rates within marriage, there was much less variation among women in the age of first marriage, and almost no variation in celibacy rates.

[3] Similarly the Old Order Amish in North America, who do not practice birth control and have an average of 5 children per couple, are doubling their population each 20 years primarily through internal growth (even though 15% of each generation leave the religion). (Amish Population Profile, 2020). In contrast the Shakers, founded in 1747, who practiced celibacy, died out once they could no longer attract converts.

One possible answer to this puzzle of the survival of the EMP that we explore here is that in practice the norm of the European Marriage Pattern was in fact the reproductively most successful behavior, once we consider fertility across multiple generations. Galor and Klemp (2019) assert for data from Quebec pre-1800 that this was indeed the case. They argue that behaviors which seemingly limited fertility in the first generation actually maximized the fertility of subsequent generations. If this was the case, we'd expect reduced fertility through delay of or abstinence from marriage to provide some survival advantage to one's descendants or relatives. We shall see however, that there is no such evidence of survival advantage from following the norms of the European Marriage Pattern, either in Quebec 1600-1848, or in England 1650-1849. Restraint on fertility through following the norms of the EMP was never optimal in terms of either immediate or ultimate reproductive success.

In both England and Quebec families did not practice deliberate fertility control within marriage before 1880 (Clark, Cummins, and Curtis 2020). Yet the average fecundity of couples, as measured by the average interval between births, varied widely across marriages, and was typically two or more years. The reproductive biology and/or coital frequency of couples varied significantly. If lower birth intervals were associated with more surviving children, then again across hundreds of years there should be selective pressures towards lower birth intervals. Galor and Klemp (2019) claim that the optimal birth interval in Quebec in terms of the numbers of children in the third and later generations is close to the average birth interval, explaining the stability of this interval across generations. But we find that there was no such interior optimum. Using the first birth interval as a metric of fecundity, the shorter the interval between marriage and first birth, the greater is net fertility.[4]

What we show instead in this paper is that the European Marriage Pattern survived because fertility increasing behaviors — early marriage, a high propensity to marry, and short birth intervals within marriage — were not significantly inherited at the familial level. Indeed there is an ecological prediction that if an environment is constant, as can be argued for European society 1350-1800, any trait correlated with fitness should have a heritability of zero, or else not vary substantially across the population.[5]

[4]This is true even when we censor the first birth interval to 10 months or more to rule out cases of premarital intercourse.

[5]This is an interpretation of Fisher's Fundamental Theorem. See Murphy and Knudsen, 2002, p. 236 and Frank and Slatkin, 1992.

This lack of individual heritability of fertility limiting behaviors has two potential sources. The first is that reproductive behaviors were indeed homogeneous across families. The variations in European Marriage Pattern behaviors across individuals were not the product of different reproductive strategies, but instead random shocks within a common behavioral approach to marriage and reproduction. Children were indeed strongly inheriting parent behaviors, except what they were inheriting was a common approach to marriage and reproduction, and not the actual realizations. A woman who marries at 15 and one who marries at 35 can actually be following the same reproductive strategy, but just with different outcomes because of random accidents about how many years it takes them to find a suitable marital partner. We show however, by considering siblings, that reproductive behavior did actually vary systematically across families. Siblings were indeed correlated in fertility outcomes. And siblings correlated with each other more than they did with their parents. The lack of correlation between parents and children in reproductive behaviors thus does imply an absence of individual heritability for these traits.

The second potential source of the lack of individual heritability, despite the persistence of the EMP across many generations, is that children acquired a cultural disposition towards the European Marriage Pattern from society as a whole, not their own parents. As with other cultural behaviors, such as accents, the transmission was lateral and not vertical. In support of this we show in the paper that age at marriage was much more strongly predicted by the average age of marriage in the district a child married in, than it was predicted by parents' age at marriage.

2 Description of the databases

The empirical exercises of this paper utilize two databases. The first is an extensive genealogy of a set of English families with rare surnames (to make tracking people easier) that extends from 1650 to 2021, the Families of England database. The database currently contains 416,000 individuals. To avoid selection and survivor biases the database incorporates everyone with the given set of surnames identified in birth, death and marriage records across this interval. The second database used is one which records vital events for the entire European origin Quebec population 1600-1848.

2.1 Families of England

The Families of England is a genealogical database created by identifying all known holders of a set of rarer surnames in England and Wales 1650-2021. The period of unrestricted fertility within marriage in England and Wales includes men and women in this database born 1650-1849, since there is little fertility limitation for marriages before 1880 (See Clark, Cummins and Curtis, 2020). In this period there are 85,174 people in the database. 45,716 have age at first marriage, 30,351 complete records of child births, with a total of 98,437 births recorded.

The outline statistics for age at marriage, percent celibate, and the length of the first birth interval in table 1 show clearly the European Marriage Pattern. Indeed for the families in this database the marriage pattern is remarkably stable all the way from those born 1650 to 1849.[6] Table 1 shows the marriage parameters for anyone reaching age 21 before death. We can also calculate these marriage parameters just for those who reach age 40. This has little effect on the proportion never marrying, but does raise the average ages of marriage by about 1 year. One advantage of the FOE database is that it follows also people who migrate from England and Wales, for at least one generation.

The nature of the Families of England database is that it follows fertility in all males, but does not capture all marriages and births for females. Thus while the male celibacy rate should be accurate, celibacy for females is overestimated because of missing daughter marriages.

Table 1: Outline Statistics for FOE, Births 1650–1849

Period	Births	Male age at first marriage	Female age at first marriage	Male celibate 40+	Female celibate 40+	FBI
1650-1699	1,961	27.9	24	4	10	2.25
1700-1749	4,192	29.1	24.6	8	11	2.22
1750-1799	12,948	28	24.8	12	17	2.24
1800-1849	40,322	27.3	25	10	18	2.12

Note: Definite celibacy is defined as dying at age 40 or greater without having a spouse recorded. FBI is the interval between marriage and first birth in years.

[6] In this respect the FOE database does not show the decline in marriage ages, and increase in fraction marrying reported by Wrigley et al., 1997, for England 1740–1837.

Table 2: Outline Statistics for IMPQ, Births 1600–1828

Period	Births	Male age at first marriage	Female age at first marriage	Male celibate 40+	Female celibate 40+	FBI
1600-1649	214	26.9	15.5	15	11	2.85
1600-1699	15,194	27.4	21.2	7	9	1.50
1700-1749	73,077	27	23.1	6	7	1.34
1750-1799	246,663	26.4	23.4	8	8	1.38
1800-1828	291,164	24.7	22	12	9	1.40

Note: Definite celibacy is defined as dying at age 40 or greater without having a spouse recorded.

2.2 IMPQ

The Integrated Infrastructure of Historical Microdata of the Population of Quebec (IMPQ) is a large new database of linked vital records from Quebec.[7] The dataset is constructed from all available marriage records from first settlement at Quebec City in 1608 through the mid 20th century as well as births and death records through 1849. The records are linked to reconstruct complete histories of families. To cover all children reaching age 21, we only consider births up to 1828.

This database has the advantage of following the entire Catholic population, which is mainly the original French settler population but also includes First Nations converts, British and Irish immigrants, and French refugees from Acadia. It also contains many of the Protestants, primarily British immigrants and American Loyalists. The sample is thus highly representative. However, it does not follow every person who leaves Quebec to live elsewhere in Canada or abroad. But, from the Conquest of 1760 to the 1870s, only a small proportion of the Francophone population were migrants.

Between 1600 and 1828 there are 626,312 births in the database. Because of high fertility rates within marriage, as well as relatively young marriage ages, and low celibacy rates, the population in Quebec was expanding rapidly in these years as table 2 shows. Even after the end of French immigration to Quebec in 1759 there was rapid increase in population.

Table 2 shows the same summary statistics for marriages in this population also. This also shows clearly a version of the European Marriage

[7] IMPQ, 2020, BALSAC, 2020, PRHD, 2020. See Dillon et al. 2018 and Bournival et al. 2021 for futher discussion of the data.

Pattern after 1650, though with lower rates of celibacy and younger marriage ages than for England. In the first period the age of first marriage of women was very low and outside the European Marriage Pattern norms. But this was a period where there was a significant shortage of women in the colony, with brides being imported from France specifically with marriage as the objective. In both populations we see that the European Marriage Pattern is stable across hundreds of years, with no decline in ages of first birth, in celibacy rates, or in the first birth interval.

3 The Intergenerational Persistence of the EMP

3.1 Age at marriage

Figure 1 shows the lifetime fertility of women born in England 1650–1849 from the FOE database, measured as numbers of children attaining age 21, as a function of their age at first marriage (by ten equally-sized bins of age at first marriage). The figure thus seeks to capture net fertility rather than just births per woman. Women marrying young have the highest net fertility. There is indeed a close to linear decline in net fertility with age at first marriage. A woman marrying at 17 would have 4.5 surviving children, while one marrying at 30 had just 2.5 surviving children.

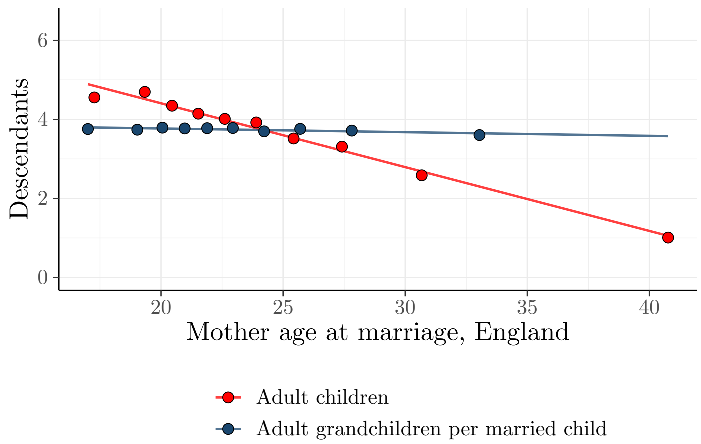

Figure 1: Age of First Marriage and Descendants, England

Note: Data averaged over 10 equal sized bins of marriage age. Best fit line shown. Sample includes all women born in England and Wales 1650-1849 with complete fertility observed. The number of grandchildren per married child only includes married children born in England and Wales 1650-1849 with complete fertility observed and their offspring.

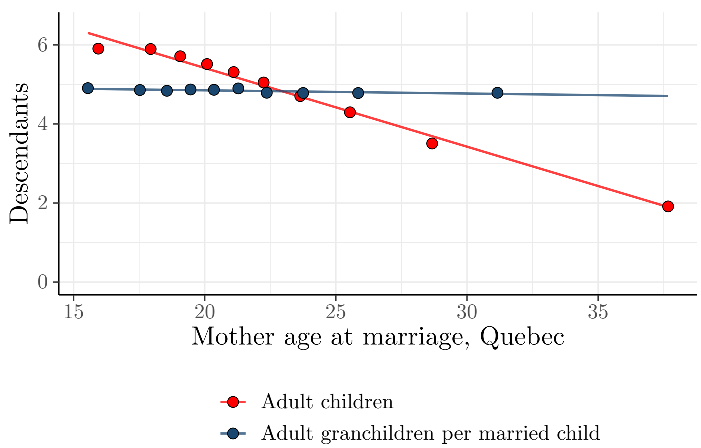

Figure 2: Age of First Marriage and Descendants, Quebec

Note: Data averaged over 10 equal sized bins of marriage age. Best fit line shown. Sample includes all women born in Quebec 1600-1788 (so complete fertility is observed) and all children born in Quebec 1600-1849. The number of grandchildren per married child only includes married children born in 1600-1788 (so complete fertility is observed) and their offspring.

Potentially it may be the case that while younger mothers produce more offspring surviving to age 21, the children of older mothers were more successful in reproduction because of the better nurture they received within smaller birth cohorts. To test this we look for second generational impacts of the age of women at first marriage in the first generation on net fertility of their offspring. The measure is the numbers of adult children produced per married child as a function of the age at first marriage of the grandmother. This is also shown in figure 1. What we see here is that the children of younger marrying grandmothers produced a modestly greater number of adult children than those of older marrying grandmothers. In terms of numbers of adult grandchildren, younger age at first marriage still produced the most grandchildren, but their children were very modestly more successful in terms of net fertility. Thus in terms of net fertility there was a substantial gain from younger marriage in the first generation, and even slight further gains in the second generation in terms of the subsequent fertility of their children.

Figure 2 shows the same data as for figure 1, but this time for women born in Quebec 1600–1788. Net fertility at any age of first marriage is higher in Quebec than in England. But the pattern of net fertility and child net fertility with mother age at first marriage is strikingly similar to England.

For both England and Quebec the grandchild numbers show that we cannot, as Galor and Klemp (2019) attempts to do for Quebec, explain the persistence of the European Marriage Pattern across many generations through positing that reduced fertility optimizes numbers of survivors across multiple generations. In terms of survival there is no sign of any quality-quantity trade-off in the first generation. Grandmothers who married younger had significantly more surviving grandchildren in both societies.

The data in figures 1 and 2 thus reinforce the puzzle of the persistence, across multiple generations, of the European Marriage Pattern. Deviations from the pattern in the form of younger marriage ages by women were associated, even in the second generation, with greater numbers of surviving grandchildren. In England 72% of the second generation of wives had a mother who was less than 25 at first marriage, even though 25 was the mean age at first marriage for women born in England 1650-1849 (table 1). Then 74% of next generation of children in England surviving to age 21 had a grandmother less than 25 at first marriage. If marital behaviors were significantly inherited then we would have seen over time a decline in the average age at marriage in both England and Quebec.

However, already in figures 1 and 2 we see sign of why the European Marriage Pattern could maintain itself unchanged over time. The 74% of grandchildren in England having a grandmother aged less than 25 years compared to 72% of children implies that there was little inheritance of age at first marriage. Otherwise the differential in numbers of surviving offspring would have widened further in favor of younger marrying grandmothers by the time of the third generation.

Table 3 confirms the limited inheritance of female age at first marriage for daughters, or daughters-in-law, in both England and Quebec. The intergenerational correlation of age at first marriage was only in the range 0.05–0.09. This meant that the average daughter or daughter-in-law in England, for example, married for the first time 3 years later than her mother or mother in law. Daughters and daughters in law conformed more closely to the norms of the European Marriage Pattern than did their mothers or mothers-in-law. They moved closer to average social practice in terms of age of marriage, and away from their parents' example. Thus the daughter of an English woman who marriage first at age 15 would typically marry first at age 24, just one year below the social average. We discuss below what would explain this pattern of inheritance.

Table 3: The Intergenerational Correlation of Female Age at First Marriage

	Mother's age at first marriage			
	England	England	Quebec	Quebec
Daughter's age at first marriage	0.091***		0.061***	
	(0.009)		(0.003)	
Daughter in law's age at first marriage		0.053***		0.050***
		(0.008)		(0.003)
N	12,142	14,824	153,396	132,154

Note: England sample includes all parents and children born in England and Wales 1650-1849 who have complete fertility observed. Quebec sample includes all parents and children born in Quebec 1600-1788 (so complete fertility is observed.) Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

3.2 Celibacy

A second feature of the European Marriage Pattern was the significant fraction of women and men who remained celibate throughout their lives.

This is illustrated in both England and Quebec in tables 1 and 2. Since the children of each generation come exclusively from those who were not celibate, again a puzzle arises as to how this cultural pattern persisted across many generations?

One solution would be that celibate and childless individuals aided the reproductive success of their married siblings. Celibacy, at the family level, was a behavior which maximized reproductive success. Therefore, in figures 3 and 4 below, we plot the number of children (surviving to 21+) per sibling in each family in England and Quebec, and the number of children (surviving to 21+) per married child, as a function of the fraction of siblings celibate at age 40.

As shown in these figures, the greater the fraction of siblings who were celibate, the lower is overall reproductive success per child. The greater the fraction celibate the lower the numbers of adult children per sibling in both England and Quebec. There was no interior optimum in terms of celibacy for reproductive success. Further there is no sign even that celibate siblings had any positive effect on the reproductive success of their married siblings. The figures also show as a function of the share of siblings celibate, that a higher fraction celibate was not associated with a greater number of surviving children per married sibling. In England celibate siblings had essentially no effect on their married counterpart's reproductive success. In Quebec the figure suggests even a negative relationship between the fraction of siblings celibate and the reproductive success of married siblings.[8]

If the tendency to marry was significantly inherited then we should observe over time a decline in the fraction unmarried in both these societies. However, again the tendency to marry was weakly inherited within families across generations. Table 4 shows the intergenerational correlation in celibacy rates. It shows the correlation of a mother's children's celibacy rates with each child's children's celibacy rate, divided into female and male children.

[8]This is most likely not a causal relationships. The tendency for siblings to be celibate and other factors that reduce fertility, such as age at first marriage, were probably correlated.

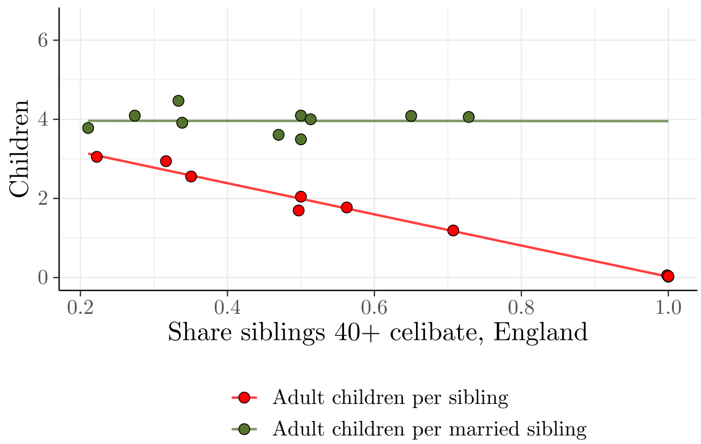

Figure 3: Tendency Towards Celibacy and Reproductive Success, England

Note: Data averaged over 10 equal sized bins of sibship celibacy rate. Best fit line shown. Sample restricted to all siblings born in England and Wales 1650-1849 with complete fertility observed, whose mother's complete fertility is observed. As celibacy was somewhat unusual, the sample is further restricted to families where at least one sibling was celibate in order to more clearly show the relationship between celibate siblings and fertility.

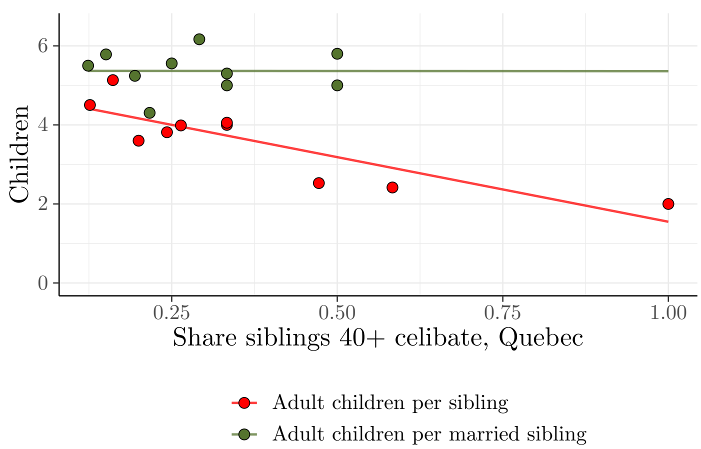

Figure 4: Tendency Towards Celibacy and Reproductive Success, Quebec

Note: Data averaged over 10 equal sized bins of sibship celibacy rate. Best fit line shown. Sample restricted to all siblings born in Quebec 1650-1788 (so complete fertility is observed) whose mother's complete fertility is observed, and all children born in Quebec 1600-1849. As celibacy was somewhat unusual, the sample is further restricted to families where at least one sibling was celibate in order to more clearly show the relationship between celibate siblings and fertility.

Table 4: The Intergenerational Correlation of Tendency Towards Celibacy

	Mothers's share children celibate			
	England	England	Quebec	Quebec
Daughter's share children celibate	0.059		0.051***	
	(0.041)		(0.006)	
Son's share children celibate		0.097***		0.037***
		(0.014)		(0.006)
N	594	4,929	27,677	24,371

Note: England sample includes all parents and children born in England and Wales 1650-1849 who have complete fertility observed and survived to at least age 40. Quebec sample includes all parents and children born in Quebec 1600-1788 (so complete fertility is observed) who survived to at least age 40. Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

As can be seen, that correlation is low, only in the order of 0.03-0.10. This means that though families with higher marriage rates produced more grandchildren, those grandchildren inherited very little of the previous generation's tendency to higher marriage rates. If the average marriage rate was 0.90, then a family with universal marriage among siblings would have an expected marriage rate for the next generation of 0.905. There was very weak selective pressure on marriage rates, and thus again the European Marriage Pattern could survive.

Indeed remarkably while all children came from parents who had not chosen celibacy, their children on average chose celibacy at rates similar to the general population, little influenced by their family background with regards to celibacy.

3.3 Fecundity

There were significant differences across couples in their fecundity within marriage. Fecundity is often measured in pre-industrial populations using the first birth interval — the time between marriage and the first birth (Klemp and Weisdorf (2018), Galor and Klemp (2019)). But this is problematic for populations with the European Marriage Pattern, since sex before marriage was common, so that many births occurred before 38 weeks after the marriage. In the Families of England database, for example, 22% of first births are within the first 38 weeks of marriage. The first birth interval is then sometime measured starting at 38 weeks to exclude such premarital conceptions. But that means that less fecund couples who engaged in premarital sex will be included among the genuinely fecund who engaged in sex only after marriage. Here we look at net fertility as a function of the first birth interval, where we also include the interval 0-38 weeks as reflecting through premarital sex another form of reproductive behavior.

What caused these differences in fecundity across couples is not known. Some of the individual differences would undoubtedly be of genetic and environmental origin. But there also may well have been a behavioral component. The average first birth interval, for example, was much shorter in Quebec than in England, as tables 1 and 2 show. Thus for marriages 1750-99 this was 2.24 years in England and 1.38 in Quebec. Differences in the environment in England compared to Quebec perhaps explains some of this difference but the difference is so large there may well also be behavioral elements. However, we do know that the birth spacing does not seem to represent any attempt at parity dependent birth control (See Clark, Cummins and Curtis 2020).

Figure 5 shows for England total numbers of children surviving to age 21, for first birth intervals between 0 and 5 years, with the data placed in 10 equal sized bins in ascending order of birth interval. Figure 6 shows the same information for Quebec. The figures also show the numbers of surviving children per married child as a function of the grandparent first birth interval. As the figures show, in both societies there is a near linear relationship between the first birth interval and the total number of surviving children. Families with the shortest first birth intervals produced the most children. There is no sign that less fecund parents have better survival rates for their offspring, so that there is a quantity-quality trade-off in terms of net fertility. Once again there should have been a selective pressure towards the children of more fecund women in the next generation.

These figures, however, suggest that fecundity is also very weakly inherited at the family level. For if we look at surviving children per married child as a function of grandparent fecundity, there is a very modest decline with longer birth intervals.

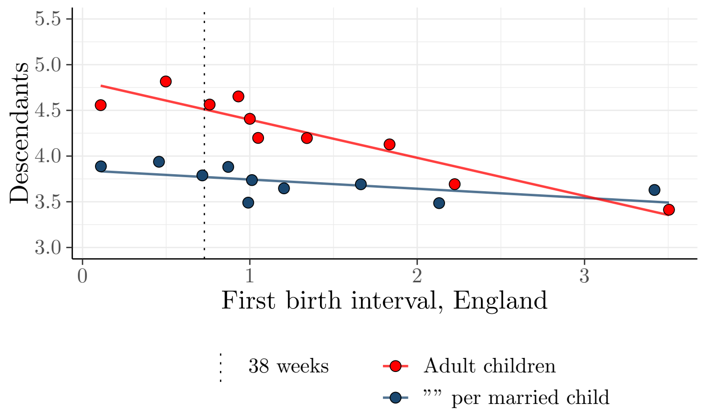

Figure 5: First Birth Interval and Reproductive Success, England

Note: Data averaged over 10 equal sized bins of first birth interval. Best fit line shown. Dashed line shows a first birth interval of 38 weeks. Sample includes all women born in England and Wales 1650-1849 with complete fertility observed and a first birth interval of 0-5 years. The number of grandchildren per married child only includes married children born in England and Wales 1650-1849 with complete fertility observed and their offspring.

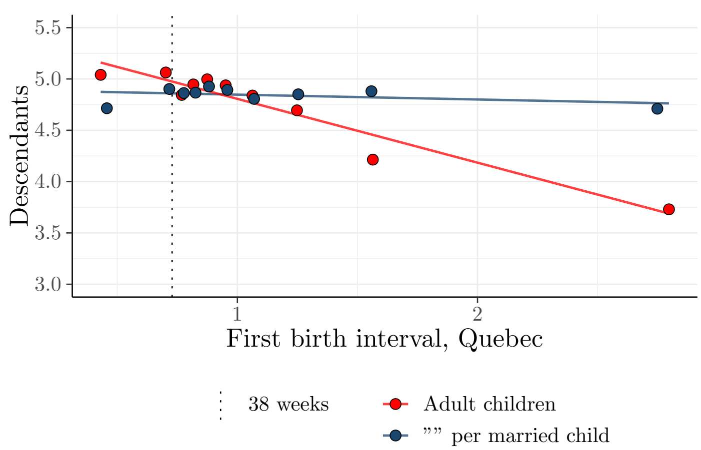

Figure 6: First Birth Interval and Reproductive Success, Quebec

Note: Data averaged over 10 equal sized bins of first birth interval. Best fit line shown. Dashed line shows a first birth interval of 38 weeks. Sample includes all women born in Quebec 1650-1788 (so complete fertility is observed) with a first birth interval of 0-5 years and all children born in Quebec 1600-1849. The number of grandchildren per married child only includes married children born in Quebec 1650-1788 (so complete fertility is observed) and their offspring.

Table 5: The Intergenerational Correlation of First Birth Interval

	Mothers's adjusted FBI			
	England	England	Quebec	Quebec
Daughter's adjusted FBI	-0.009		0.028***	
	(0.037)		(0.006)	
Daughter in law's adjusted FBI		0.020		0.030***
		(0.015)		(0.007)
N	727	4,187	29,261	22,167

Note: England sample includes all parents and children born in England and Wales 1650-1849 who have complete fertility observed. Quebec sample includes all parents and children born in Quebec 1600-1788 (so complete fertility is observed). First birth interval adjusted by partialling out age at first marriage fixed effects for the mothers, daughters, and daughters in law. Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

Table 5 shows the intergenerational correlations of first birth intervals between mothers and daughters and daughters in law. Since there is a connection between mother's age and fecundity and mother's age is weakly heritable, we first age adjust the first birth interval for both mothers and daughters to correspond to their estimated FBI marrying at age 24. These mother-daughter correlations are in the range 0.00-0.03. Again the correlations, though statistically significant in Quebec, are extremely low. Interestingly these correlations are again also very similar between England and Quebec. There was little selective pressure towards either the behaviors or the biology that generated shorter birth intervals.

Again, note that these analyses include couples who gave birth before 38 weeks. This includes couples who engaged in premarital sex, as well as those who gave birth to premature children. Interestingly there is indication in both figures that such early births were associated with greater descendants, implying that breaking the strong social norms against premarital sex increased the number of one's descendants. However, such behavior was so weakly inherited that there was no demographic pressure eroding the norms of pre-marital sexual abstinence.

4 Heritability of Net Fertility

Here we consider the heritability of net fertility, defined as the numbers of children living to age 21 or greater, for families in the period before fertility control within marriage. In these years because of a great range across individuals in the numbers of adult children they produced, a large fraction of the surviving children come from the largest families. As figure 7 shows for England, before 1850 two thirds of all children surviving to age 21 come from the one third of men who had 5 or more adult children. Again if reproductive success was a heritable trait then the characteristics of the population would be changing over time in terms of reproductive success. Figure 8 shows a similar pattern, albeit with even larger average family sizes, for Quebec.

Table 6: Parent Child Correlations in Net Fertility

	Net Fertility			
	England		Quebec	
	Mothers	Fathers	Mothers	Fathers
All children	0.066***	0.060***	0.066***	0.051***
	(0.008)	(0.008)	(0.003)	(0.003)
	15,419	16,184	123,374	110,183
Daughters	0.048***	0.044***	0.070***	0.056***
	(0.014)	(0.014)	(0.004)	(0.004)
	5,003	5,207	63,826	56,649
Sons	0.067***	0.064***	0.059***	0.044***
	(0.010)	(0.010)	(0.004)	(0.004)
	10,416	10,977	59,548	53,534

Note: Adult children defined as the number of children surviving to age 21+. All individuals were born in England and Wales 1650-1849 with complete fertility observed or in Quebec 1600-1788 (so complete fertility is observed). Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

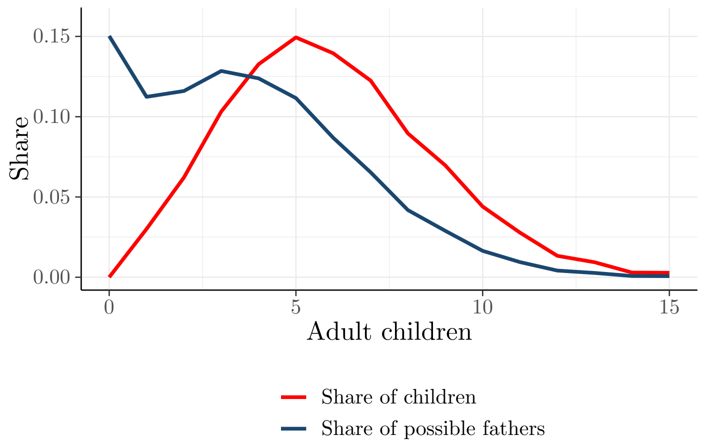

Figure 7: Shares of Child Generation from Different Sibship Sizes, England

Note: Adult children defined as the number of children surviving to age 21+. Potential fathers are all married men born in England and Wales 1650-1849 with complete fertility observed.

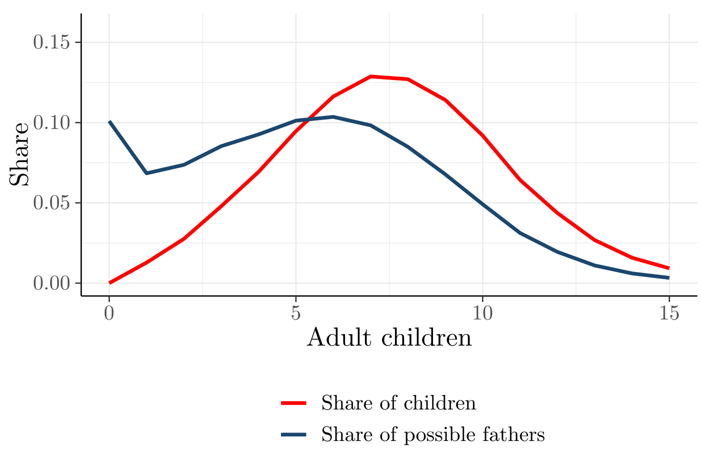

Figure 8: Shares of Child Generation from Different Sibship Sizes, Quebec

Note: Adult children defined as the number of children surviving to age 21+. Potential fathers are all married men born in Quebec 1600-1788 (so complete fertility is observed).

Table 6 shows the correlation between reproductive success of fathers and mothers and all children, as well as sons and daughters. In all cases, the correlations are very small, in the order of 0.04-0.07. Again the correlation is of equal magnitude in England as in Quebec. And also the magnitudes for daughters and sons are similar. The EMP could persist because overall the correlation in net fertility between parents and children was only around 0.05.

5 How was the EMP transmitted across generations?

That individuals overall inherited the set of behaviors we identify as the European Marriage Pattern in pre-industrial England and Quebec, but systematically did not inherit deviations from the pattern by their own parents remains puzzling.

One potential explanation is that the European Marriage Pattern consists of a strategy towards marriage and reproduction, but a strategy that created actual reproductive behavior such as getting married, or the age at marriage, only with very substantial random elements. The fathers and mothers who deviated from the norms of this pattern were not deviating in terms of strategy, just in terms of how that strategy played out in their circumstances, in terms of finding a suitable marriage partner, the age they married, and the realized fecundity of the couple. Some men or women met a potential marital partner who satisfied their criteria early in life, some only later in life, and some not at all.

A test of this explanation for the very low inheritance of marital behaviors would be in the correlation between siblings in such elements of the EMP as age of marriage and celibacy. If everyone is employing the same marital strategy, and the random elements are unique to each individual, then the correlation between siblings will be as low as that between parents and children. However, as table 7 shows for England and Quebec, sibling associations in marital behaviors are stronger than the intergenerational associations. The correlation between same gender siblings in age at first marriage is on average twice as great as the correlation between same gender parent and child. There is some common influence on the marital behavior of children in families that is different from the example of their own parents.

Table 7: Correlation of Ages of First Marriage, Siblings versus Parents

	Age at First Marriage			
	England		Quebec	
	Daughters	Sons	Daughters	Sons
Same-gender sibling	0.175***	0.219***	0.216***	0.231***
	(0.010)	(0.008)	(0.002)	(0.002)
	9,646	14,456	352,454	334,358
Same-gender parent	0.074***	0.148***	0.046***	0.082***
	(0.014)	(0.012)	(0.003)	(0.003)
	5,291	7,262	125,837	124,662

Note: All individuals were born in England and Wales 1650-1849 with complete fertility observed or in Quebec 1600-1788 (so complete fertility is observed). Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

Table 8: Correlation of Ages of First Marriage, Peers versus Parents

	Age at First Marriage			
	England		Quebec	
	Daughters	Sons	Daughters	Sons
Location × decade	0.390***	0.360***	0.457***	0.417***
	(0.010)	(0.010)	(0.003)	(0.004)
	8,371	9,001	71,750	66,523
Same-gender parent	0.103***	0.155***	0.053***	0.094***
	(0.033)	(0.013)	(0.004)	(0.004)
	884	6,193	63,732	53,495

Note: Location × decade is the average for all *other* marriages of the same gender in that decade and county / region of marriage. All individuals were born in England and Wales 1650-1849 with complete fertility observed or in Quebec 1600-1788 (so complete fertility is observed). Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

This could be within-family dynamics between children (Caron et al 2017). For example, children having to wait to marry until older siblings get married, local norms as to marital behaviors, or local marriage market conditions.

A test of whether the correlation of sibling marital behavior is driven by within-family dynamics or by local norms or economic conditions is to compare the correlation of an individual with the average age at first marriage in their marriage location and decade to that of their same-gender parent. As table 8 shows, individuals correlate even more strongly in age of first marriage with their peers in the community they marry within, than they do with either siblings or with their parents. The strength of this connection is again similar between England and Quebec. The test in table 8 does not differentiate from the effect of community norms on marriage ages versus the effects of local economic conditions. But the estimates are consistent with the behaviors of the EMP being transmitted to the new generation mainly through peer effects as opposed to through parental influence.[9]

6 Conclusion

We have posited here a puzzle of how in any pre-industrial society, such as northwest Europe, fertility limiting behaviors such as the European Marriage Pattern could survive over as many as 12-20 generations. It is evident that the fertile are those who inherit the earth, and if their children inherit their proclivities, then restraint cannot persist. One possible solution proposed to this puzzle is where restrained fertility was actually optimal fertility in terms of long run reproductive success. But we show for both England and Quebec that there was no significant cost in terms of child survival or subsequent child fertility for those who had the highest fertility.

Here we argue instead that the European Marriage Pattern survived across 12-20 generations because, for pre-industrial fertility behavior, there was scant familial inheritance of fertility behaviors. Fertility enhancing deviations from the EMP did not get transmitted across generations, and the European Marriage Pattern could persist indefinitely. But while we can at the immediate level resolve the puzzle of the persistence of the European Marriage Pattern, that resolution creates a new puzzle. Most social behav-

[9] One might worry that averaging over a community reduces measurement error and thus mechanically creates a stronger correlation. However, note that the parents are just as weakly correlated with the community averages.

iors show significant inheritance at the family level. Why were marriage behaviors an exception to this rule? By looking at siblings we can show that this was not just that everyone was inheriting the same marital strategies but getting randomly different realizations. Instead, some factor shared strongly by children — but weakly between parents and children — drove familial variation in such EMP behaviors as age at first marriage. The fact that the age of marriage of children was strongly correlated with the average age at marriage of their peers in local communities argues for this being horizontal transmission of marital behavior norms, though we cannot rule out that this effect was produced by children responding to local economic conditions.

Interestingly there is evidence that after the demographic transition the correlation in fertility between parents and children has increased, and is now around 0.2 in developed countries (Murphy, 1999), compared to the average of 0.056 reported in table 6 above. This inheritance is strong enough that when incorporated in population projections it leads to significant increases in estimated world population by 2100 (Collins and Page, 2019). For example, the projected total fertility rate in Europe rises from 1.83 in 2100 to 2.46 once the heritability of fertility is incorporated into population projections (Collins and Page, 2019, 108).

7 Works Cited

Amish Population Profile. 2020. Young Center for Anabaptist and Pietist Studies, Elizabethtown College.

Bennett, Judith. 2019. "Wretched girls, wretched boys and the European Marriage Pattern in England (c. 1250–1350)." Continuity and Change, 34(3), 315-347.

Bisin, Alberto, and Thierry Verdier. 2011. "The Economics of Cultural Transmission and Socialization." In Jess Benhabib, Alberto Bisin and Matthew O. Jackson editors: Handbook of Social Economics, Vol. 1A:339–416. Netherlands, Elsevier.

Booth, Alison L. and Hiau Joo Kee. 2009. "Intergenerational Transmission of Fertility Patterns." Oxford Bulletin of Economics and Statistics, 71(2): 183–208.

Borgerhoff Mulder, M. 2000. "Optimizing Offspring: The Quantity-Quality Tradeoff in Agropastoral Kipsigis." Evolution and Human Behavior, 21(6), 391–410.

Bournival, Jean-Sébastien, Marc St-Hilaire, and Hélène Vézina. "Historical Canadian Censuses and Quebec Civil Registers: An Assessment of Linked Datasets to Compare Population Microdata." Histoire Sociale / Social History 54, no. 110: 145–71.

Cahaner, Lee and Gilad Malach. 2019. "Statistical Report on Ultra-Orthodox (Haredi) Society in Israel 2019." Israel Democracy Institute.

Carmichael, Sarah G., Alexandra de Pleijt, Jan Luiten van Zanden, and Tine De Moor. 2016. "The European Marriage Pattern and Its Measurement." Journal of Economic History 76(1): 196–204.

Carmichael, Sarah., De Moor, Tine, Zanden, Jan Luiten van. 2019. Capital Women: The European Marriage Pattern, Female Empowerment and Economic Development in Western Europe 1300-1800. United Kingdom: Oxford University Press.

Caron, Marianne, Ward Neyrinck, Lisa Y. Dillon, and Koenraad Matthijs. 2017. "Sibling Influence on Access to Marriage: A Comparative Study of Québec and Flanders, 1842–1912." Journal of Family History 42, no. 3: 271–307.

Charnysh, Volha and Leonid Peisakhin. 2022. "The Role of Communities in the Transmission of Political Values: Evidence from Forced Population Transfers." British Journal of Political Science,52(1): 238-58.

Clark, Gregory, 2014. The Son Also Rises: Surnames and the History of Social Mobility. 1st ed. The Princeton Economic History of the Western World. Princeton: Princeton University Press.

Clark, Gregory, Neil Cummins, and Matthew Curtis. 2020. "Twins Support the Absence of Parity-Dependent Fertility Control in Pretransition Populations." Demography 57(4): 1571–95.

Collins, Jason, and Lionel Page. 2019. "The heritability of fertility makes world population stabilization unlikely in the foreseeable future." Evolution and Human Behavior 40 (2019) 105–111.

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

Dennison, Tracy and Ogilvie, Sheilagh. 2014. "Does the European Marriage Pattern Explain Economic Growth?" Journal of Economic History, 74(3): 651– 693.

Dillon, Lisa et al. 2018. "The Programme de Recherche En Démographie Historique: Past, Present and Future Developments in Family Reconstitution". The History of the Family 23.1, pp. 20–53.

Edwards, Jeremy and Sheilagh Ogilvie. 2021. "Did the Black Death cause economic development by 'inventing' fertility restriction?" Oxford Economic Papers.

Fisher, R. A. 1930. The genetical theory of natural selection. Oxford: Clarendon Press.

Foreman-Peck, James. 2011. "The Western European marriage pattern and economic development," Explorations in Economic History, 48(2): 292–309.

Foreman-Peck, J. and Zhou, P. 2018. "Late marriage as a contributor to the industrial revolution in England." The Economic History Review, 71: 1073-1099.

Frank, Steven A and Montgomery Slatkin. 1992. "Fisher's fundamental theorem of natural selection." Trends in Ecology and Evolution, 7(3): 92–95.

Galor, Oded and Marc Klemp. 2019. "Human genealogy reveals a selective advantage to moderate fecundity." Nat Ecol Evol 3: 853–857.

Hajnal, John. 1965. "European Marriage Patterns in Perspective." In Population in History: Essays in Historical Demography, edited by David V. Glass and David E. C. Eversley, 101–43. London: Arnold.

Hajnal, John. 1982. "Two Kinds of Preindustrial Household Formation System." Population and Development Review 8, no. 3 (1982): 449–94.

Hajnal, John. 1983. "Two Kinds of Preindustrial Household Formation System." In Family Forms in Historic Europe, edited by Richard Wall, Jean Robin and Peter Laslett, 65–104. Cambridge: Cambridge University Press.

Hallam, H. E. 1985. "Age at First Marriage and Age at Death in the Lincolnshire Fenland, 1252–1478." Population Studies 39(1): 55–69.

IMPQ. 2020. Integrated Infrastructure of Historical Microdata of the Population of Quebec. Trois-Rivières, Québec: Centre Interuniversitaires d'Études Québécoises.

Klemp, Marc, and Jacob Weisdorf. 2018. "Fecundity, Fertility and The Formation of Human Capital." The Economic Journal.

Murphy, M. 1999. "Is the relationship between fertility of parents and children really weak?", Social Biology, 46:1-2, 122-145.

Murphy, M and L B Knudsen. 2002. "The Intergenerational Transmission of Fertility in Contemporary Denmark: The Effects of Number of Siblings (Full and Half), Birth Order, and Whether Male or Female." Population Studies , 56(3): 235-248

PRDH. 2020. Programme de Recherche En Démographie Historique. Registre de La Pop- ulation Du Québec Ancien (RPQA) [Data Set]. Montréal, Canada: Département de Démographie, Université de Montréal.

Project Balsac. 2020. BALSAC [Data Set]. Québec, Canada: Université du Québec à Chicoutimi.

Reid, A.M., Arulanantham, S.J., Day, J.D., Garrett, E.M., Jaadla, H., Lucas-Smith, M. 2018. Populations Past: Atlas of Victorian and Edwardian Population. https://www.populationspast.org/. Accessed 2021.

Steenhof L, and A C Liefbroer. 2008. "Intergenerational transmission of age at first birth in the Netherlands for birth cohorts born between 1935 and 1984: evidence from municipal registers", Population Studies, 62(1): 69–84.

Szołtysek , Mikołaj, Bartosz Ogórek and Siegfried Gruber. 2021. "Global and local correlations of Hajnal's household formation markers in historical Europe: A cautionary tale." Population Studies, 75:1, 67-89.

Turkheimer, Eric. 2000. "The Three Laws of Behavioral Genetics and What They Mean." Current Directions in Psychological Science, 9(5): 160–164.

Van Bavel, J. and J. Kok 2009. "Social Control and the Intergenerational Transmission of Age at Marriage in Rural Holland, 1850–1940." Population 64(2): 343-360.

Van Poppel, F, C Monden, and K Mandemakers. 2008. "Marriage timing over the generations," Human Nature, 19(7): 7–22.

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

Wrigley, E.A., R.S. Davies, J.E. Oeppen and R.S. Schofield. 1997. English Population History from Family Reconstitution 1580–1837. Cambridge: Cambridge University Press.

Wrigley, E.A. and R.S. Schofield. 1981. The Population History of England: A Reconstruction. Cambridge: Cambridge University Press.

Appendix 1 Three-generational correlations

Table 9 shows that classical measurement error does not substantially alter our conclusion of weak intergenerational heritability of EMP-related behaviors. The grandparent-grandchild correlation of fertility is higher than the near-zero correlation one would predict purely from the parent-child correlation. This is what one would expect to observe there was inheritance of some latent trait that only loosely translated to observed fertility (c.f. Clark (2014).) However, it is still an extremely weak correlation, meaning that even if deviation from the norm persisted slightly longer than two-generation correlations imply, grandchildren were still much more similar to the general population than their grandparents were.

Table 9: Three-Generation Correlations in Net Fertility

	Quebec			
	Daughter	Daughter	Son	Son
Mother	0.068***			
	(0.004)			
Grandmother		0.043***		
		(0.004)		
Father			0.037***	
			(0.005)	
Grandfather				0.034***
				(0.005)
N	53,473	53,473	38,254	38,254

Note: Net fertility is defined as number of children surviving to age 21+. Sample restricted to groups of three linked individuals where each individual was born in Quebec 1600-1788 (so complete fertility is observed) and had observed family sizes. Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.