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How did the European Marriage Pattern persist? Social versus familial inheritance: England and Quebec, 1650–1850

Gregory Clark [a,b,c], Neil Cummins [b,c], Matthew Curtis [d,*]

[a] University of Southern Denmark, Danish Institute for Advanced Study, Denmark
[b] LSE, United Kingdom
[c] CEPR, United Kingdom
[d] University of Southern Denmark, Denmark

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ABSTRACT

The European Marriage Pattern (EMP), in place in NW Europe for perhaps 500 years, substantially limited fertility. But how could such limitation persist when some individuals who deviated from the EMP norm had more children? If their children inherited their deviant behaviors, their descendants would quickly become the majority of later generations. This puzzle has two possible solutions. The first is that all those that deviated actually had lower net fertility over multiple generations. We show, however, no fertility penalty to future generations from higher initial fertility. Instead the EMP survived because even though the EMP persisted at the social level, children did not inherit their parents' individual fertility choices. In the paper we show evidence consistent with lateral, as opposed to vertical, transmission of EMP fertility behaviors.

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 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 350–500 years. The EMP has been proposed as a 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 and income (Greif, 2006; De Moor and Zanden, 2010; Voigtländer and Voth, 2013; Greif and Tabellini, 2010; James, 2011; Foreman-Peck and Zhou, 2018; Carmichael et al., 2016, 2019; Baten and de Pleijt, 2022).

However, recent scholarship highlights the substantial variability of European marriage patterns across space, time, and different economic conditions (Dennison and Ogilvie, 2014, 2016; Horrell et al., 2020; Perrin, 2021). Even within areas characterized by a strong version of the EMP, individual decisions by couples led to a wide range of behavior. The average age of first marriage by women may have been 25 in England, 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. Consider a modern example, the Haredi (ultra-orthodox) community in Israel. This community has much higher fertility than the rest of the population. As a result their share of the

* Corresponding author.
E-mail addresses: gclark@sam.sdu.dk (G. Clark), N.J.Cummins@lse.ac.uk (N. Cummins), macu@sam.sdu.dk (M. Curtis).

[1] See Hallam (1985), De Moor and Zanden (2010), Voigtländer and Voth (2013), Bennett (2019), and Edwards and Ogilvie (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 (Lee and Campbell, 1997).

[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.

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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]

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 had 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. England is often seen as the archtypical European Marriage Pattern society.[4] Quebec had a low-pressure variant of the EMP adapted to a frontier society (Greer, 1997). While its family patterns were similar to northern France (e.g. nuclear families and neolocal households), Quebec had lower age at first marriage and lower celibacy rates than England. Yet in both societies, average birth intervals varied widely, and were typically two or more years. Thus reproductive biology and/or coital frequency of couples varied significantly. If shorter birth intervals were associated with more surviving children, then across hundreds of years there should be selective pressures towards shorter birth intervals. Galor and Klemp (2019) claim that moderate fecundity, as measured by the first birth interval, maximized the number of descendants in subsequent generations. This would explain the stability of this interval across generations. But we find that there was no such interior optimum. In contrast we find that shorter birth intervals increase net fertility, and descendants in future generations.

We show 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.[5] While the EMP was culturally reproduced from generation to generation, there was little or no direct inheritance of fertility behaviors by children. Indeed there is an ecological prediction that if an environment is constant, as can be argued for pre-industrial European society 1350–1800, any trait correlated with fitness should have a heritability of zero, or else not vary substantially across the population.[6]

The 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.

An alternative view of the EMP is that it was a response to economic opportunities, which explains the lack of correlation across generations of EMP fertility behaviors. There is, however, no simple association between EMP behaviors such as age at marriage and celibacy and economic opportunities. In the FOE genealogy, for example, for men born 1800–49 who had an occupation recorded between ages 30 and 49, we can calculate the percent that never married by the socio-economic status of their occupations. For the lowest status occupations, laborers and the like, 8.1% never married. For medium status, craftsmen and farmers, 8.4% never married. For the highest status, professionals and large landowners, the share unmarried was 11.6%. Poorer economic circumstances were not a barrier to marriage. Similarly the average age of first marriage was 25.5 for the low status men, 26.6 for intermediate status, and 30.0 for high status. Low incomes were not associated with deferring marriage, but instead the opposite.

Further, occupational status was very strongly inherited between fathers and sons, with a correlation in occupational status for men born in the early nineteenth century of 0.7. So if economic status drove marriage decisions then we would find a strong correlation across generations in age of first marriage, which we shall see we do not find. That is why we interpret the decision to marry or not marry, and at what age to marry, by men and women as stemming from cultural factors rather than from economic circumstances.

The third potential explanation for the lack of heritability of fertility behaviors 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. This is the explanation we favor. In support of this we show below 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 2023, the Families of England database. The database currently contains 428,722 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 (FOE) database 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 et al., 2020). In this period there are 95,066 people in the database. 47,865 have age at first marriage, 32,487 complete records of child births, with a total of 71,544 births recorded.

[4] Though arguably the pattern was stronger elsewhere (Dennison and Ogilvie, 2014).

[5] An alternative potential source of the persistence of the EMP is that limited fertility was actually optimal fertility, once we consider three and more generations. We show in the paper that this is not correct for England or Quebec. Galor and Klemp (2019) assert for data from Quebec pre-1800 that indeed maximal long run fertility came from following the norms of the EMP. In Appendix A we show that this result cannot be replicated with the Quebec data.

[6] This is an interpretation of Fisher's Fundamental Theorem. See Fisher (1930), Murphy and Knudsen (2002), p. 236 and Frank and Slatkin (1992).

The FOE database actually has two components: first a set of "average status" surname lineages, which constitutes 86.2% of the observations, and second a set of elite lineages which are the remaining 13.8% of the observations. Both sets of lineages exhibit the European Marriage Pattern for those born 1650–1849. Average age of marriage for women in average lineages is 24.6 compared to 25.8 in the elite lineages. Average age of marriage for men in average lineages is 27.0 compared to 31.0 in the elite lineages. The share of men living to at least age 40 never marrying was 11.8% for average lineages and 12.8% for elite lineages. Because both groups exhibit the EMP, and we are concerned with the transmission of this across generations, we include both groups in the analysis below.

For men born 1780–1859 we can compare occupational status and literacy in the FOE general lineages with occupational status and literacy in a large sample of church marriages transcribed by the FreeReg organization 1837–79. These FreeReg transcriptions are mainly from parishes outside London, so in doing this comparison in each case we look at people located outside London.

Men in the FOE general lineages marrying outside London 1837–79 had an average occupational score of 36.9 on a scale of 0–100. In contrast 771,000 grooms in the Freereg sample in these same years had an occupational score of only 31.1. Thus the men in the average lineages scored nearly 0.3 of a standard deviation higher in occupational status. But since the European Marriage Pattern was observed in a similar fashion across the status spectrum, this modest selectivity of the sample used should have no significant effects on the conclusions drawn here.

The marriage records also record if men and women could sign their names at marriage. In the Freereg sample of 484,888 marriages 1837–79 with records on whether brides and grooms signed, 68% of men and 58% of women were literate. For men and women in the FOE general lineages marrying outside London 1837–79, 73% of men and 58% of women were literate. Here the members of the FOE average lineages show only a very modest elevation in social status compared to the average person in England.

All the results that were derived below using the complete FOE database can be replicated using just the "average status" lineages, with just additional noise from the smaller set of data. The essential results also follow if we concentrate just on families of below average occupational status, or above average status.

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 in the FOE data. Indeed for the families in this database the marriage pattern is remarkably stable all the way from those born 1650 to 1849.[7] 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.

In terms of the comparability of the FOE data to national data we can compare the ages of first marriage in the FOE general lineages to that in the parish records discussed above. For marriages 1837–49, the average age in the parish sample for women and men was 23.4 and 25.1. In the FOE general lineages the average age was 23.7 and 25.8 respectively, so quite comparable.

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.

The male celibacy rate of 10% found for births 1800–49 is very similar to the celibacy rates found in the censuses of 1851 and 1861, where that is defined as the proportion of men aged 45–54 who had never married. The proportion of men in the FOE database born 1650–1749 who remain celibate by age 40 is, however, below that reported by Wrigley et al. (1997) for these years. This may reflect that married men, who leave a marriage record, are more likely to have been observed than unmarried men in these earlier years.

2.2. BALSAC Database

The BALSAC Database is a large database of linked vital records from Quebec.[8] It 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 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

Fig. 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.

Potentially it may be the case that while younger brides 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

[7] 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. A relatively constant age at first marriage 1740–1800 is found also, however, in at least one other large scale crowd sourced set of genealogies for England. So we leave this issue for further investigation.

[8] Project Balsac, 2020. It recently incorporated the records from the PRDH database (PRDH, 2020). See Dillon et al. 2018, Bournival et al. 2021 for futher discussion of the data.

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	1961	27.9	24	4	10	1.38
1700–1749	4192	29.1	24.6	8	11	1.40
1750–1799	12,948	28	24.8	12	17	1.28
1800–1849	40,322	27.3	25	10	18	1.35

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. Average of FBI in range 0–5.

Table 2
Outline Statistics for BALSAC Database, 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
1650–1699	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.

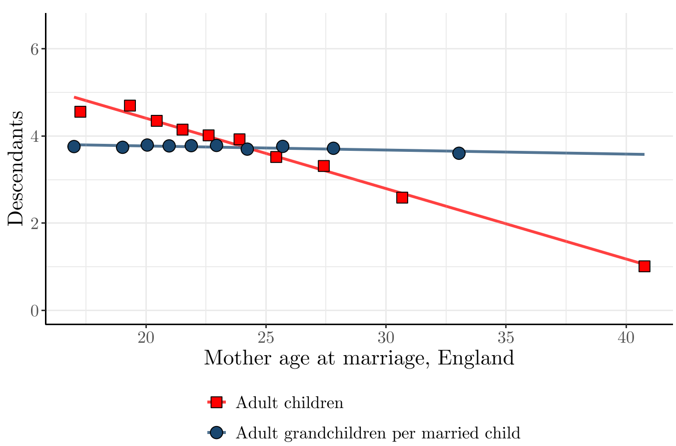

Fig. 1. Age of first marriage and descendants, England.
Note: Data averaged over 10 equal sized bins of marriage age. Best fit line shown. Sample includes all women born in England and Wales 1650–1849 with complete fertility observed. The number of grandchildren per married child only includes married children born in England and Wales 1650–1849 with complete fertility observed and their offspring.

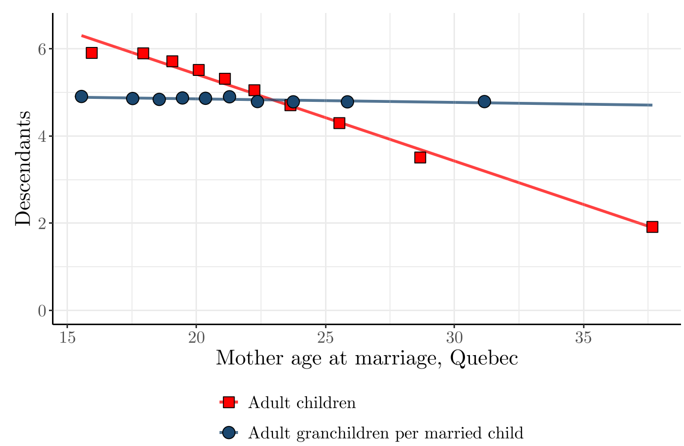

Fig. 2. Age of first marriage and descendants, Quebec.
Note: Data averaged over 10 equal sized bins of marriage age. Best fit line shown. Sample includes all women born in Quebec 1600–1788 (so complete fertility is observed) and all children born in Quebec 1600–1849. The number of grandchildren per married child only includes married children born in 1600–1788 (so complete fertility is observed) and their offspring.

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 Fig. 1. What we see here is that the children of younger marrying grandmothers produced effectively the same number of adult grandchildren each as those of older marrying grandmothers.[9] Thus there was no second generation reproduction penalty from marrying young in the first generation. Women who married young had more descendants in each subsequent generation.

Fig. 2 shows the same data as for Fig. 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.

[9] There were, in fact, statistically significant larger numbers of adult grandchildren from each child of younger grandmothers, but as the figure shows these effects were not quantitatively significant.

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 Figs. 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 Figs. 1 and 2 we see sign of why the European Marriage Pattern could maintain itself unchanged over time.

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*** (0.009)		0.061*** (0.003)	
Daughter in law's age at first marriage		0.053*** (0.008)		0.050*** (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.

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 (0.041)		0.051*** (0.006)	
Son's share children celibate		0.097*** (0.014)		0.037*** (0.006)
N	594	4929	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.

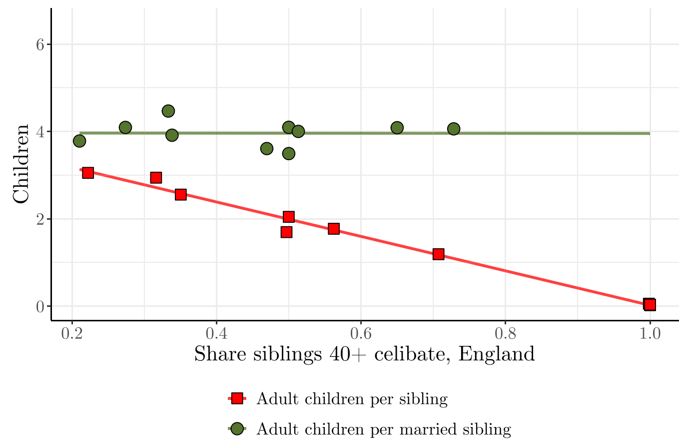

Fig. 3. Share celibate and reproductive success, England.
Note: Data averaged over 10 equal sized bins of sibship celibacy rate. Best fit line shown. Sample restricted to all siblings born in England and Wales 1650–1849 with complete fertility observed, whose mother's complete fertility is observed. 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.

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 implied strong regression to the mean in the age of marriage of daughters compared to their mothers or mothers-in-law. Because younger mothers had more adult children, the average age of mothers or mother-in-laws was 3 or more years less than the average age at marriage in the next generation. But because of that regression to the mean 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.

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 Figs. 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.[10]

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.

[10] 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.

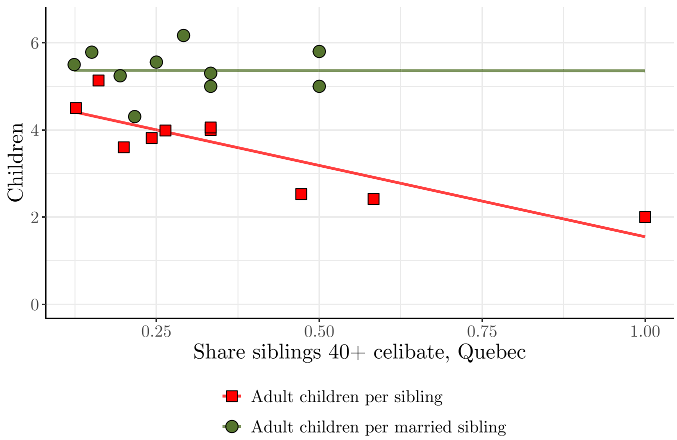

Fig. 4. Share celibate and reproductive success, Quebec.
Note: Data averaged over 10 equal sized bins of sibship celibacy rate. Best fit line shown. Sample restricted to all siblings born in Quebec 1650–1788 (so complete fertility is observed) whose mother's complete fertility is observed, and all children 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.

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. 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. 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 et al. 2020).

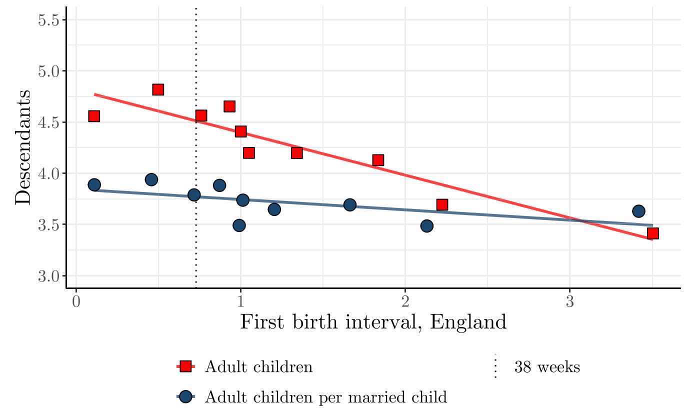

Fig. 5. First birth interval and reproductive success, England.
Note: Data averaged over 10 equal sized bins of first birth interval. Best fit line shown. Dashed line shows a first birth interval of 38 weeks. Sample includes all women born in England and Wales 1650–1849 with complete fertility observed 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.

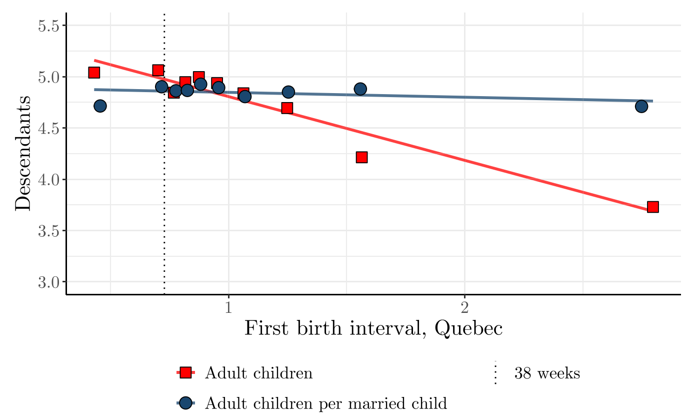

Fig. 6. First birth interval and reproductive success, Quebec.
Note: Data averaged over 10 equal sized bins of first birth interval. Best fit line shown. Dashed line shows a first birth interval of 38 weeks. Sample includes all women born in Quebec 1650–1788 (so complete fertility is observed) with a 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.

Fig. 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. Fig. 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.

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

Table 5
The Intergenerational Correlation of First Birth Interval.

	Mothers's adjusted FBI			
	England	England	Quebec	Quebec
Daughter's adjusted FBI	−0.009 (0.037)		0.028*** (0.006)	
Daughter in law's adjusted FBI		0.020 (0.015)		0.030*** (0.007)
N	727	4187	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 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)
	5003	5207	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.

age is weakly heritable, we first age adjust the first birth interval for both mothers and daughters to correspond to their estimated first birth interval 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 Fig. 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 hereditable trait then the characteristics of the population would be

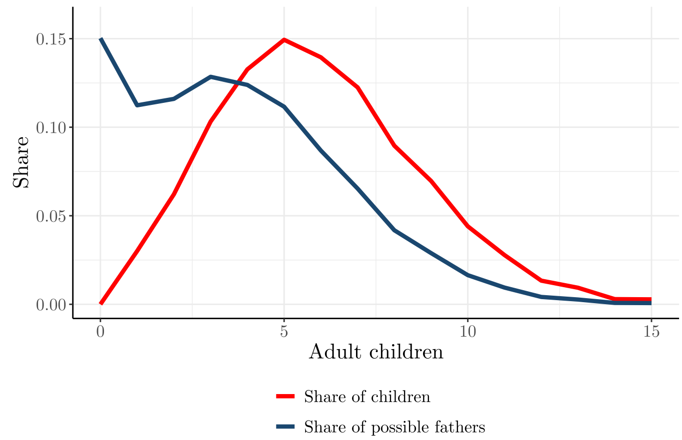

Fig. 7. Shares of child generation from different sibship sizes, England.
Note: Adult children defined as the number of children surviving to age 21+. Sample includes all married men born in England and Wales 1650–1849 with complete fertility observed.

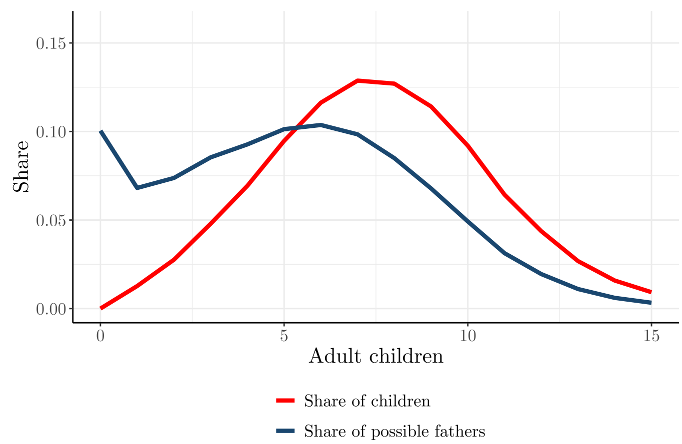

Fig. 8. Shares of child generation from different sibship sizes, Quebec.
Note: Adult children defined as the number of children surviving to age 21+. Sample includes all married men born in Quebec 1600–1788 (so complete fertility is observed).

changing over time in terms of reproductive success. Fig. 8 shows a similar pattern, albeit with even larger average family sizes, for Quebec.

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

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)
	5291	7262	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)
	8371	9001	71,750	66,523
Same-gender parent	0.103***	0.155***	0.053***	0.094***
	(0.033)	(0.013)	(0.004)	(0.004)
	884	6193	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.

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. This could be within-family dynamics between children (Caron et al., 2017), such as 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.[11]

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 behaviors 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 7 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 hereditability of fertility is incorporated into population projections (Collins and Page, 2019), 108).

CRediT authorship contribution statement

Gregory Clark: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing. **Neil Cummins:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing. **Matthew Curtis:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare no competing interests.

[11] 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.

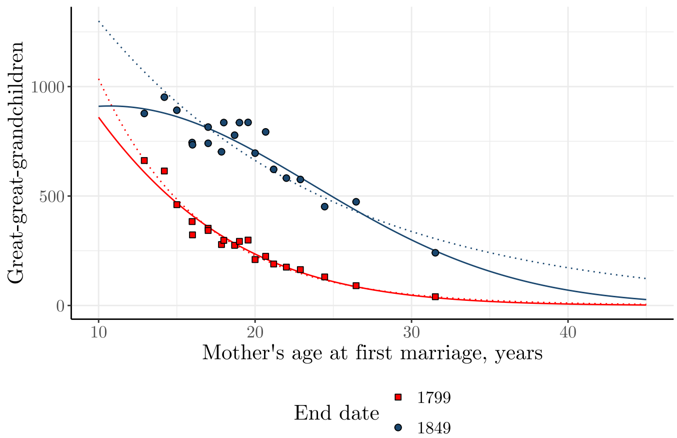

Fig. A.1. Mother's age at first birth and number of great-great-grandchildren. Notes: Solid line is the fit of a negative binomial GLM regression on a second-order polynomial of mother's age at first marriage. Dotted line is same except a first-order polynomial. Points are averaged over the vigintile of mother's age at first marriage. The samples consist of heads of lineages born before 1686, with no known death or birth location outside of Quebec.

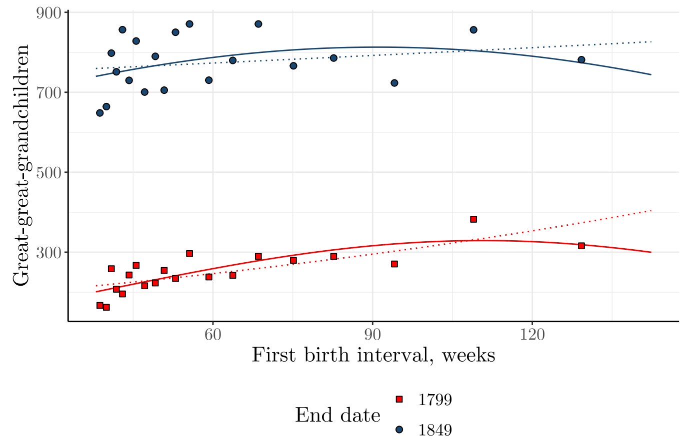

Fig. A.2. First birth interval and number of great-great-grandchildren. Notes: Solid line is the fit of a negative binomial GLM regression on a second-order polynomial of first birth interval. Dotted line is same except a first-order polynomial. Points are averaged over the vigintile of first birth interval. The samples consist of heads of lineages born before 1686, with no known death or birth location outside of Quebec, and a first birth interval of between 38 weeks and 2 years and 38 weeks.

Data availability

A replication package for this paper is available at http://dx.doi.org/10.7910/DVN/QNBMVM (Clark et al., 2024). The Families of England data used are provided. Access to the BALSAC data is restricted to protect confidentiality. They are available upon request from the BALSAC Project.

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Appendix A. Replicating Galor and Klemp (2019)

We show above that looking across three generations, people who deviate from the norms of the EMP by marrying younger, being more fecund, or by marrying more frequently, all produce more grandchildren than those who stuck to the norms. The norms of the EMP did not generate maximum long run fertility. Galor and Klemp assert, using data from Quebec pre-1800, that maximal long-run fertility actually came from following the norms of the EMP. They argue that behaviors which seemingly limited fertility in the first generation actually maximized descendants in subsequent generations. To show this Galor and Klemp focus on just one aspect of fertility, which is the first birth interval (FBI). Looking at the fourth generation of descendants they find statistically significant evidence that women with a near average FBI were producing the maximal number of descendants four generations later. However, if we turn to another important aspect of the EMP, which was the age at first marriage, we find no such effect. As Fig. A.1 shows, women who married at the youngest ages were those who produced the greatest number of descendants in the fourth generation. Those who married at the average age under the EMP produced many fewer descendants.

Even the Galor and Klemp demonstration that in the fourth generation, the most reproductively successful first birth interval is close to the average first birth interval proves to be ambiguous. Galor and Klemp relied on data covering only births in Quebec in the period 1600–1799. Since then the BALSAC database has been expanded to cover births 1600–1848. This allows us to observe many more descendants in the fourth generation than Galor and Klemp were able to observe. Fig. A.2 shows the numbers of descendants as a function of the first generation FBI, using births 1600–1799 and using births 1600–1848.

Now the evidence of an interior optimum in terms of later descendants and the FBI is ambiguous, using either the 1799 or 1848 cutoff for births. In both cases, there now seems to be a positive association between FBI and ultimate numbers of descendants. There is little evidence for an interior optimum in the FBI for maximal reproductive success in the 4th generation.

Table A.1
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.

Appendix B. Three-generational correlations

Table A.1 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.

References

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

Baten, Joerg, de Pleijt, Alexandra M., 2022. Female autonomy generated successful long-term human capital development: Evidence from 16th to 19th century Europe. World Dev. 158, 105999.

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

Bournival, Jean-Sébastien, Marc, St-Hilaire, Vézina, Hélène, 2021. Historical Canadian censuses and quebec civil registers: An assessment of linked datasets to compare population microdata. Histoire Soc. (Soc. History) 54 (110), 145–171.

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

Carmichael, Sarah G., de Pleijt, Alexandra, van Zanden, Jan Luiten, Moor, Tine De, 2016. The European marriage pattern and its measurement. J. Econ. History 76 (1), 196–204.

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

Caron, Marianne, Neyrinck, Ward, Dillon, Lisa Y., Matthijs, Koenraad, 2017. Sibling influence on access to marriage: A comparative study of Québec and Flanders, 1842–1912. J. Fam. History 42 (3), 271–307.

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

Clark, Gregory, Cummins, Neil, Curtis, Matthew, 2020. Twins support the absence of parity-dependent fertility control in pretransition populations. Demography 57 (4), 1571–1595.

Clark, Gregory, Cummins, Neil, Curtis, Matthew, 2024. Replication Package for: How did the European Marriage Pattern persist? Social versus familial inheritance: England and Quebec, 1650–1850. Harvard Dataverse http://dx.doi.org/10.7910/DVN/QNBMVM.

Collins, Jason, Page, Lionel, 2019. The heritability of fertility makes world population stabilization unlikely in the foreseeable future. Evol. Hum. Behav. 40 (2019), 105–111.

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

Dennison, Tracy, Ogilvie, Sheilagh, 2014. Does the European marriage pattern explain economic growth? J. Econ. Hist. 74 (3), 651–693.

Dennison, Tracy, Ogilvie, Sheilagh, 2016. Institutions, demography, and economic growth. The J. Econ. History 76 (1), 205–217.

Dillon, Lisa, et al., 2018. The programme de recherche en démographie historique: Past, present and future developments in family reconstitution. History Fam. 23 (1), 20–53.

Edwards, Jeremy, Ogilvie, Sheilagh, 2021. Did the Black Death Cause Economic Development by 'Inventing' Fertility Restriction?. Oxford Economic Papers, p. gpaa056.

Fisher, R.A., 1930. The Genetical Theory of Natural Selection. Clarendon Press, Oxford.

Foreman-Peck, J., Zhou, P., 2018. Late marriage as a contributor to the industrial revolution in England. Econ. Hist. Rev. 71, 1073–1099. http://dx.doi.org/10.1111/ehr.12651.

Frank, Steven A., Slatkin, Montgomery, 1992. Fisher's fundamental theorem of natural selection. Trends Ecol. Evol. 7 (3), 92–95.

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

Greer, Allan, 1997. The People of New France. University of Toronto Press, Toronto.

Greif, Avner, 2006. Family structure, institutions, and growth: The origins and implications of western corporations. Am. Econ. Rev.: Pap. Proc. 96 (2), 308–312.

Greif, Avner, Tabellini, Guido, 2010. Cultural and institutional bifurcation: China and europe compared. Am. Econ. Rev.: Pap. Proc. 100 (2), 135–140.

Hajnal, John, 1965. European marriage patterns in perspective. In: Glass, David V., Eversley, David E.C. (Eds.), Population in History: Essays in Historical Demography. Arnold, London, pp. 101–143.

Hajnal, John, 1982. Two kinds of preindustrial household formation system. Popul. Dev. Rev. 8 (3), 449–494.

Hajnal, John, 1983. Two kinds of preindustrial household formation system. In: Wall, Richard, Robin, Jean, Laslett, Peter (Eds.), Family Forms in Historic Europe. Cambridge University Press, Cambridge, pp. 65–104.

Hallam, H.E., 1985. Age at first marriage and age at death in the lincolnshire fenland. Popul. Stud. 39 (1), 55–69, 1252–1478..

Horrell, Sara, Humphries, Jane, Weisdorf, Jacob, 2020. Malthus's missing women and children: demography and wages in historical perspective. Eur. Econ. Rev. 129 (2020), England 1280-1850.

James, Foreman-Peck, 2011. The Western European marriage pattern and economic development. Explor. Econ. Hist. 48 (2), 292–309.

Klemp, Marc, Weisdorf, Jacob, 2018. Fecundity, fertility and the formation of human capital. Econ. J. http://dx.doi.org/10.1111/ecoj.12589.

Lee, James Z., Campbell, Cameron D., 1997. Fate and Fortune in Rural China: Social Organization and Population Behavior in Liaoning 1774-1873. Cambridge University Press.

Murphy, M., 1999. Is the relationship between fertility of parents and children really weak? Soc. Biol. 46 (1–2), 122–145.

Murphy, M., Knudsen, L.B., 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. Popul. Stud. 56 (3), 235–248.

Perrin, Faustine, 2021. On the origins of the demographic transition: Rethinking the European marriage pattern. Cliometrica 17 (2021).

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

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

Voigtländer, Nico, Voth, Hans-Joachim, 2013. How the west "invented" fertility restriction. Amer. Econ. Rev. 103 (6), 2227–2264.

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