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Survival of the Confucians: Social Status and fertility in China, 1400-1900

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Survival of the Confucians: Social status and fertility in China, 1400-1900*

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Abstract
This paper uses the genealogical records of 35,691 men to test one of the fundamental assumptions of the Malthusian model. Did higher living standards result in increased net reproduction? An empirical investigation of China between 1400 and 1900 finds a positive relationship between social status and fertility. The gentry scholars, the Confucians, produced three times as many sons as the commoners, and this status effect on fertility was stronger in the post-1600 period than in the pre-1600 period. The effect disappears once I control for the number of marriages. Increased marriages among upper-class males drove reproductive success in Imperial China. The results add a demographic perspective to explain the lack of modern economic growth in Imperial China.

1 Introduction

Since the time of Malthus (1798), economic historians have long been preoccupied with the relationship between economic growth and population growth. One of the fundamental assumptions behind the unified growth theory is that improved living standards lead to faster population growth. In the Malthusian epoch, income increase leads to fertility increase and mortality decrease; thus, improved

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living standards lead to higher net reproduction. The growing proportion of the rich, together with a quantity-quality trade-off of children, led to the increase of human capital and finally triggered the fertility transition and modern economic growth (Galor and Moav 2002; Galor and Weil 2000; Willis 1973; Becker et al., 1990; Galor 2012).

Empirical evidence from pre-modern England supports this reasoning. Clark and Hamilton (2006) analyse more than 2,000 wills in England in 1585-1638, and find a “survival of the richest” story, that the number of descendants of the richest testators was twice that of the poorest. Boberg-Fazlic et al. (2011) also find a positive relationship between social class and fertility in the family reconstitution dataset of England constructed by Wrigley et al. (1997). However, after including the rates of childlessness and celibacy, de la Croix et al. (2019) find that the same dataset suggests a somewhat different story –it was the middle class, rather than the rich, that had the highest reproduction rate. In addition to the evidence from England, a study by Bandyopadhyay and Green (2013) also shows a positive link between income and reproduction in colonial India.

The positive correlation between living standards and fertility has also changed over history (Skirbekk 2008; Cummins 2009). After extending the English probate data to cover a more extended period starting in the sixteenth century, Clark and Cummins (2015) reveal that the higher net fertility of the rich did not remain stable over the entire pre-transitional period: a rapid decline in net fertility occurred first in the middle and upper classes as early as 1780, and the lower class gradually caught up with the fertility level of the rich.

While scholars have worked on macro-population trends in the same period for the Chinese context (Ho 1959; Perkins 1969), there has been little research examining the socio-economic factors that affecting individual fertility. Two demographic studies, Harrell (1985) and Telford (1995), first examine the rate of population growth across generations at the household level by using genealogical data and observe much higher rates in wealthy segments than in poor ones in the same lineage. Shiue (2017) also explores genealogies in Anhui Province to test the child quantity-quality trade-off in Ming-Qing China and finds a negative relationship between education and fertility before the nineteenth century and its disappearance during the late Qing period. Chen, Lee, and Campbell (2010) study the reproduction of the Manchu Bannermen in Shuangcheng, a rural county in Liaoning Province in northeast China in 1866 to 1907 and reveal a positive relationship between landed estates and reproduction, but an uncertain occupation-reproduction relationship. Another study by Song, Campbell, and Lee (2015) analyse the farming population in Liaoning and also the population from the imperial lineage from 1725 to 1875 and finds that patrilineages with high-status founders could survive longer than the one with low-status founders. Similarly, Che and Cao (2011; 2014) use genealogical records and land contracts of the Que lineage in Zhejiang Province after 1700 to test the effects of landholdings on fertility and conclude the same.

Apart from these works, however, scholars have not rigorously studied status differences in China's fertility patterns. This paper uses a range of quantitative tools to explore the relationship between living standards and fertility on a new dataset comprised of Chinese genealogies, which contains 35,691 males from six lineages between 1400 and 1900. This paper uses seven levels of social status to capture the relative differences in living standards, and the number of sons who survived infancy as a measure for net fertility as boys were the only children recorded officially in China for centuries. It finds a positive status-fertility relationship in Ming (1368-1644) and Qing (1644-1911) China, providing evidence in the Chinese context to support "survival of the richest".

The results demonstrate in the six lineages a positive association between social status and net fertility: climbing up the social ladder would increase the number of sons a male produced. Considering the changes in net reproduction and social status over the five centuries, in the baseline regression, the only control variable included is the birth cohort fixed effect. The unconditional status-fertility relationship shows that an elite in the highest rank in the sample (rank 7) could be expected to have three times as many sons as a commoner (rank 1). The positive feedback is still significant after conditioning on other individual-level factors that could affect male reproduction, including human capital, birth order, survival to adulthood, out-migration, birth cohort, and lineage fixed effects. Controlling further for the number of marriages a male had, however, reduces all the fertility gradients. Males in ranks 2 and 4 (the lower "high social status" males) retain their advantages in reproduction, but promotion from rank 1 to ranks 2 and 4 could only bring about an increase of about fifteen per cent in net fertility; the net fertility of males of ranks 5-7, the higher "high social status" males, is no different from that of commoners. The weakened social status effect suggests that the number of marriages is a key mechanism through which social status impacted on the number of sons.

I then move to analyse the key mechanism, the number of marriages. High social status males, in general, had more marriages over their lifetime than the commoners. A rank 2 man had 32 per cent more marriages than a commoner, and a rank 7 man had 77 per cent more. Moreover, the social status effects on marriages were different in lineages with a low proportion of gentry-scholars and ones with a high proportion of gentry-scholars.

I go on below to argue that although the Chinese elites, the Confucians, could produce more surviving descendants than the commoners could, the type of education and human capital not only impeded a transition to modern economic growth in the late Qing period, but indeed reinforced the existing social and economic structure.

This paper is the first attempt to show the social gradients in fertility in China from 1400 to 1900. The two works by Lee, Campbell, and their co-authors (Chen et al. 2010; Song et al. 2015) both touch upon the similar research question. However, the periods they cover are in mid-Qing and late-Qing, and their sample populations are also quite different from the common population resided in China Proper. Besides, Chen et al. (2010) focuses more on the impacts of landholdings, rather than social status, on reproduction. Shiue (2016; 2017) uses genealogical records to demonstrate the historical fertility in China too, but what she shows is an intergenerational relationship between parental fertility and child outcome, rather than the status-fertility relationship within the same generation.

Besides, my research also examines the number of marriages as a critical intermediary variable that links social status and reproduction in an unequal society. Previous studies use the number of marriages as a measure for social status, and men married more than once were assigned to a higher social status compared to men who did not (Telford 1995, p.92, Appendix 3.A; Shiue 2019, Table 1). However, the number of marriages was more of a proxy for wealth than a proxy for social status. Remarrying and having concubines required considerable wealth, but wealth cannot define social status in Ming-Qing China. High social status could bring a man more wealth and thus more marriages, but having more marriages alone did not mean that he was high in social status. Therefore, including the number of marriages into the classification of social status could be misleading, and this research examines it separately.

Finally, this paper showcases a new dataset for anyone interested in understanding demographic trends in China and the potential of genealogical data in economic history research. My research inserts China into the discussion about modern economic growth theories. Since many previous studies have portrayed imperial Chinese society as contrasting with that of the pre-modern Western European states,[1] a more in-depth look at the evolution of Chinese micro-demography in this paper suggests that China did possess similar pre-conditions as Western Europe did. Furthermore, such finding also sheds light from a new demographic perspective on the Great Divergence between China and Europe.

The rest of the paper is structured as follows. Section 2 introduces the historical context of social stratification and the culture of keeping genealogies in imperial China. Section 3 and 4 outline the genealogical data used, and the methodology

[1] See, for example, Malthus 1798, and Voigtländer and Voth 2013.

employed in the empirical research. Section 5 presents the results, the relationship between net fertility and social status, and section 6 reports the robustness of the results. Section 7 discusses the findings, and Section 8 concludes.

2 Historical context and background

2.1 Social stratification in imperial China

The traditional way to describe the social hierarchy of imperial China is to refer to the occupation structure of the time. The male population was divided into two main classes, the elite class (gentry-scholars) and the commoner class (peasants, artisans, and merchants). For a Chinese man in the Ming and Qing dynasties, being blue-blooded would be lucky, but even if he was not, he could join the nobility by passing the *keju* exams.

Keju (Chinese imperial examination system) was one of the most long-standing national civil service examination systems in the world. The system was initiated around 600 A.D. and abolished at the end of the Qing dynasty, in the year of 1905.[2] As Elman (2000, p.14) points out, the exam redefined the "Shih" (the gentry-scholar class), changing it from "men of good birth to men of culture". It transformed China into a meritocracy (Campbell and Lee 2003); a man from an ordinary or even impoverished family had as good a chance as an aristocrat to take the exam and enter the state bureaucracy. However, this meritocracy was also unique, since "merit" was defined as mastery of the Confucian classics, rather than of administrative and management skills (Mokyr 2016, p. 303).[3]

This system had three levels of exams and three corresponding academic degrees. A pass at the lowest – county or prefectural level would earn one the degree of a

[2] Some kinds of civil service exams were set as early as the Han dynasty (206 BC-220 AD), but the candidates who could take them were mostly relatives of the royal families. It was not until the Sui dynasty that the commoners were allowed to take them.

[3] See Elman (1994, pp.114-121) for the formats of the exam during the Ming and Qing dynasties. The format has changed only slightly during the two dynasties, and the central part of the exam was always writing essays based on the quotations from the Confucian classics ("Four Books and Five Classics").

shengyuan. After qualifying with another exam, a *shengyuan* could then take the provincial-level exam, and if successful would become a *juren*. The *juren* from all over the country would be eligible to travel to the capital city for the national-level exam, in which the outstanding performers would be awarded the *jinshi* degree.[4] As Ho puts it (1962, pp. 26-27), becoming a *jinshi* "automatically placed a person in the middle stratum of the officialdom", and earning the intermediate *juren* degree "entitled a person to an eventual minor official appointment".

Only a small fraction of the many *shengyuan* could pass at the provincial level and the final national level of the exam. [5]A *shengyuan* degree could not substantially change a commoner's life, but the two higher degrees could. Being a *juren* or a *jinshi* brought the degree holder not only a position in the government, but it also granted many other kinds of benefits and advantages.[6]

2.2 The history of keeping genealogies in China

"Genealogy is the written record of family or lineage members descended from a common ancestor or ancestors" (Zhao 2001). The origins of keeping genealogies can be traced back to the time of the Six Dynasties (222-589 A.D.). During this period, only noble families, that is, families related to a royal family, could be recognized as "lineages" and were qualified to keep a genealogical record. However, after the collapse of most of these lineages in the Tang-Song transition period (c.900-1000 A.D.), forming lineages and keeping genealogies were not the privileges of the noble class anymore. In Ming and Qing China, lineages evolved into the "fundamental organizing constructs in Chinese society", and compiling genealogical books became widespread among commoners, and was particularly prevalent in Southeast China (Zelin 2009, p. 626; Feng 2009; Feng and Chang 2001).

[4] See Miyazaki (1981) for a more detailed introduction to the *keju*.
[5] Chen, Kung, and Ma (2018) calculate the passing rates of the exams and find that "at each exam about 1,241 *juren* would be selected out of 20,600 *shengyuan*, and about 220 *jinshi* would be selected out of 1,250 *juren*".
[6] A famous story about Fan Jin, a man who lived during the Ming dynasty, clearly presents the big changes in economic and social status that a *juren* degree could bring to the poor. After receiving the *juren* degree, Fan was immediately offered large houses and lands by local officials and merchants who wished to gain his protection (Ho 1962, pp.42-43).

3 Data

3.1 The sample: Genealogical books of six Chinese lineages

To study Chinese demographic history, genealogy is a valuable source. Telford (1986) estimates that more than 10,000 clan genealogies survive in China, but scholars have only studied a small part of them.[7] In Shiue's three recent works (2016; 2017; 2019), she exploits the genealogical data of several lineages in Tongcheng County, Anhui Province, Southeast China. In this paper, I also focus on Southeast China, but two neighbouring provinces of Anhui, Zhejiang and Jiangsu.

I transcribe and construct a sample containing detailed individual information about three common lineages (i.e., families with a low proportion of scholars and officials), and three elite lineages (i.e., families with a high proportion of high-ranking officials) from 1400 to 1900.[8] The three common lineages, Huang, Zhou, and Que, are all located in Songyang County, Chuzhou Prefecture, in the southern part of Zhejiang. Of the three elite lineages, the Zha is from Haining County, Jiaxing, in north Zhejiang, while the other two are both located in south Jiangsu. They are the Gu of Suzhou, with 80 branches settled in six different counties in Suzhou,[9] and the Zhuang of Wujin County, Changzhou (Figure 1 shows the two provinces and four prefectures).

The genealogies of the six lineages contain 96 volumes of genealogical books.[10] The genealogical books record, in chronological order, the names of each of the

[7] Harrell (1985) and Harrell and Pullum (1995) examine the demography by using genealogical records of lineages in Xiaoshan County also in Zhejiang Province. Liu (1981, 1985) mainly studies the lineage genealogies of the Lower Yangzi region, Jiangsu and Zhejiang Province. Telford (1990; 1992) studies lineages in Tongcheng County in Anhui Province. Peng and Hou (1996) study the long-term trend of demographic changes in the Fan Lineage in Jiangsu Province from 1370 to 1900. Lee et al. (1993, 1994) enquire into the Qing imperial lineages, revealing the life pattern of the Qing nobles in the late imperial era.

[8] Che and Cao (2011; 2014) use genealogical records of two branches in the Que lineage after 1700 to test the population pressure and economic shocks in the lineage. I thank their kindness for sharing the data of these two branches with me.

[9] The six counties are Taicang, Changshu, Chongming, Kunshan, Wushan, and Wuxi.

[10] A genealogical book always includes the following sections: an introduction giving the history of the family, the rules of compilation, the rules and regulations that family members need to follow, the contributions of some prominent figures in the family, a family tree which includes all the male members recorded in the book, and finally a detailed entry for each male descendant in the family.

male members of the lineage, with his corresponding mini-biography (see Figure A1 in Appendix A). Each such mini-biography tells us the male's name(s), position among his brothers, birth and death dates, academic degrees and honours, the wives' and concubines' surnames, birth and death dates, and, most importantly, the number of children he sired. Not all the entries, however, contain all the above information: Appendix Table A1 shows the number of individuals who have both birth and death years recorded.

Fig. 1 Map of Jiangsu and Zhejiang, China in 1820.

Source: CHGIS 2007.

A total of 37,622 male mini-biographies appeared in these 96 volumes of genealogical books. Records of all six lineages start before 1400. Since this paper studies the Ming and Qing dynasties, I exclude from the sample males born before 1350 and after 1920. Besides, as the time of the last compiling of the Huang, Gu, and Zhuang genealogies was before 1900, I eliminate males from the last several generations whose fertility records are incomplete in the three lineages. My criterion is also whether the compilers recorded the mini-biography as an incomplete one or not. If the compilers were unable to record accurate details, especially information on the number of sons, they would mark all these mini-biographies with the phrase "failed to trace the information" (失修or 失考). After this process of elimination, the sample contains information on 35,691 males in

Of the 35,691 males, 22,685 have explicit birth year records. With these records, I can impute an approximate birth cohort for the relatives of these males who have no birth year recorded. Finally, I managed to classify 34,140 males into seven birth cohorts, starting with a "pre-1400" interval, ending with a "post-1900" interval, and with five century-long intervals in between.

3.2 The common and the elite lineages

As noted above, I classify the six lineages into two groups, common lineages and elite lineages. The main criterion for distinguishing the two types of family is the number and proportion of "scholar-officials" in the families. Under the strict social class structure of imperial China, more *juren*, *jingshi*, and officials within a lineage represented more wealth and higher social status for the lineage (Ho 1962; Elman 2000). Table 1 shows the different proportions of degree holders in the six lineages. More than ten percent of males in the Zha and Zhuang lineages were degree holders.[11]

The Gu lineage is exceptional. Historically speaking, as claimed by Hao and Clark (2012), the surname Gu was one of the "aristocratic surnames of great antiquity" and was also one of the "big three" regional elite surnames in the Lower Yangzi region. Its earliest recorded ancestor, Yewang Gu, was born in 519 A.D. in Suzhou. Although the proportion of the degree holders is relatively low, the twenty-two generations of male population show thirty-one holders of high degrees. Furthermore, its long span of genealogies alone is enough to demonstrate its "eliteness".

[11] In *Classicism, Politics, and Kinship: The Ch'ang-chou School of New Text Confucianism in Late Imperial China*, Benjamin Elman focuses on two elite lineages in Changzhou, one being the Zhuang lineage. For more of the history and the rise of the Zhuang lineage, see Elman 1990, Chapter 2.

Table 1 Degree Holders in the Six Lineages

Lineage	Generation	High	Medium	Low	Total	% of total male population
Huang	1st-17th	0	0	4	4	0.3%
Que	1st-25th	2	108	41	151	1.7%
Zhou	1st-28th	0	15	22	37	3.5%
Gu	17th-38th	31	101	41	173	1.0%
Zha	1st-20th	64	297	231	592	11.7%
Zhuang	1st-20th	89	293	127	509	11.1%

Note: High degree holders include *jinshi*, *juren*, and *gongsheng*, medium degree holders include *guoxuesheng*, *taixuesheng*, *lingsheng*, *fusheng*, and *zengsheng*, and low degree holders include *xiangsheng* and *yisheng*.

3.3 Status records in the genealogical books

As noted previously, and also emphasized by Ho (1962, p.40), social status in imperial China was primarily determined not by the usual determinants of a man's status in European societies, such as inherited wealth and landed estates, but by academic degrees earned through *keju* exams.

Detailed *keju* results in the genealogy of every lineage make comparisons between lineages possible. Incorporating information from studies on *keju* and social stratification in imperial China (Ho 1953, Chapter I; Chen, Kung and Ma 2018; Telford 1995, p.92, Appendix 3A) and also status descriptions in genealogical records, Table 2 lists a detailed classification of the social levels cited in this paper.[12]

Based on the hierarchy of *keju* and also the bureaucratic system in Ming and Qing China, the classification includes three broad classes and seven social ranks. Both the non-gentry and the near-gentry classes include males without an academic

[12] One of the concerns regarding the status records in the genealogies is that the compilers might incline to exaggerate the status records of their family members. Thanks to the hard work of Lee-Campbell research group (Ren, Chen, Hao, Campbell, and Lee, 2016), I have managed to match thirty-one officials from the Zha lineage to the Jin Shen Lu (缙绅录, Qing China Government Employee Records). I found their records of official positions in the two types of sources are the same, proving that the status records in the genealogies are reliable.

degree, but the near-gentry males, at least, had other non-*keju* status indicators. The "gentry" group includes all the degree holders and males who managed to attain official positions. Ranks 3 and 4 represent all the lower degree holders who failed to obtain office after earning the degree. They are the lower-class males in the gentry group. A male from rank 5 could be a lowest-ranking employee in the bureaucratic system, a prospective official who was in the waiting list for an official position, or a middle-class gentry-scholar who failed to obtain office. Ranks 6 and 7 denote the upper-class gentry-scholars. I consider males in the near-gentry and the gentry groups (ranks 2-7) as "Confucians" in the present paper.

Table 2 Classification of Social Ranks

Rank	Description
Non-gentry	
1	No status
1	Honoured by later generations with poems or discourses
Near-gentry	
2	Literate and educated but without a degree (teacher in the village school or editor of genealogical books)
2	Lineage chief; donor to the lineage and the county
2	Given an award by the emperor for having Confucian virtues
Gentry	
3	Lower degree holder (Normal *shengyuan*)
4	Students at the Imperial Academy (*taixuesheng*, *guoxuesheng*); civil *shengyuan* (*lingsheng*, *zengsheng*, *jiansheng*)
5	Clerks (*wei'ruliu*); prospective officials (*houbu*, *houxuan*)
5	Intermediate degree holders (*juren*, *gongsheng*), but without official position
6	Low-ranking civil official (bureaucratic strata 8 and 9), lower degree, or inherited/purchased degree holder
6	Intermediate degree holder, with an official position; medium-ranking local official (bureaucratic strata 4 to 7); low-ranking court official
7	Higher degree holder (*jinshi*); high-ranking local official (bureaucratic strata 1 to 3); medium-ranking court official
7	High-ranking court official; *jinshi* with an official position
7	Top-level post in the state bureaucracy (*Hanlin* Academy, Six Central Boards, etc.)

Source: Ho 1953, Chapter 1; Telford 1995, p.92, Appendix 3A; Shiue 2017, p. 364, Table 1.
Note: There were nine main ranks in the bureaucracy of Ming and Qing China, the lowest being the ninth and the highest the first. Ho (1962, pp.24-46) divides the nine ranks into three strata. The highest stratum included officials of the first, second, and third ranks; the middle stratum consisted of all the officials from the fourth rank to the seventh rank; and the lowest stratum were officials of the eighth and ninth ranks.

4 Methodology

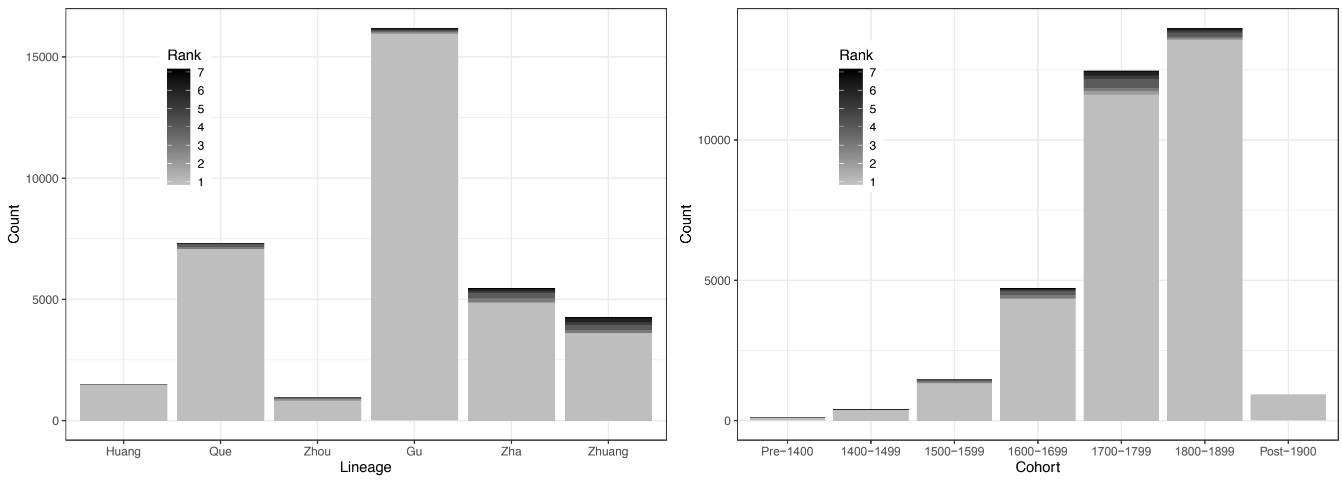
Here I describe the empirical methods used in this analysis. Given that the outcome of interest is an over-dispersed count variable (mean = 1.132, variance = 1.843), I chose first to use the methods of ordinary least squares (OLS), Poisson regression and negative binomial regression based on:

$$S_i = \alpha + \rho Rank_i + \gamma Marriage_i + W_i\beta + \varepsilon_i, \qquad (1)$$

where S is the recorded number of sons that a male produced, i denotes male individuals, α is the constant, and *Rank* is a set of categorical variables ranging from 1 to 7 that measure the male's social ranks as expressed in Table 2. *Marriage* is the total number of marriages the male had, including both marriages in sequence (wives non-concurrently) and concurrent marriages (wives and concubines at the same time). W denotes the independent variables that would be successively controlled for, including the male's human capital, whether he was the first son or the only son in his family, whether he migrated out of his village, or survived to adulthood, his birth cohort, and the lineage that he belonged to. β represents the set of respective coefficients for these variables. ε is the error term.

Table A2 in Appendix A presents the summary statistics of the variables. Figure 2 shows the distribution of observations of each social rank in the six lineages and the distribution of observations of each social rank over time.[13] Section 4.1 discusses the description of all the variables and reasons for controlling them.

Fig. 2 Rank Distribution by Lineage and Cohort



Notes: 1. See detailed rank description in Table 2. 2. See the accurate number of males of each social rank in the six lineages in Table A3a, and the number of males of each social rank over time in Table A3b.
Source: The lineage sample.

[13] See also Table A4 in Appendix A for the distribution of lineage by sub-period.

4.1 Description of variables

Number of sons. This is the dependent variable in the model. I used the recorded number of sons per married male, which equals the number of sons who survived infancy, to measure net reproduction.

The two main reasons for this choice are as follows. On the one hand, that daughters, and sons who died in infancy are under-recorded in genealogical books.[14] On the other, Clark and Cummins (2015) employ this kind of male-relative fertility measure to examine fertility in England by using probate records. Though it differs from the conventional female-relative fertility measures, as they point out, "there is no conceptual reason not to treat this measure of fertility as a valid measure of long-run fertility changes" (Clark and Cummins 2015). In this paper, I also consider net fertility in terms of sons who survived infancy a valid measure to show overall fertility, and the relative differences between lineages and between social ranks in the long run.

Social ranks. Social status is the key variable in the model. The classification of social ranks applied in this paper is presented in Table 2.

Number of marriages. The marriage system in imperial China was complicated and different to practices in the West. It was a system between monogamy and polygamy where men were officially only allowed to have one wife at a time however they could also have multiple concubines at the same time. Whilst concubines were inferior to wife in status, their children were considered legitimate and therefore have been recorded in the genealogies. Still, the data suggests having concubines was more of an upper-class privilege than universal practice. In my lineage sample, 3,020 males (about 8.46 per cent of the total) married more than once, and only 502 of them had concubines (where the wives of the remaining 2,518 men were the result of consecutive marriages).[15]

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[14] I will also discuss the omission of daughters and infant deaths in more detail in Section 4.3.

[15] This proportion of remarriage is comparable to the findings from the previous genealogical studies. In Liu (1995, p. 105, Table 4.3), she reports the proportion of remarried men in five lineages in South China, which ranged from 8.4% to 26.1%. In Telford's sample of 8,295 males in

The number of marriages is treated as a continuous predictor because the main incentive for Chinese men to have one more marriage was to produce more sons. Hence, every one-unit change in the number of marriages should bring the same amount of change in the number of sons. However, as a robustness check, I also show results by treating the number of marriages as an ordinal variable in Section 6.4.

Zi and *Hao*. I use the two dummies to proxy for human capital and educational attainment, neither of which can be fully captured by the *keju*-related social rank variable. *Zi* (字, courtesy name) and *hao* (号, pen name) are two types of particular name that show respect and a higher level of literacy; they were used widely among literate people in traditional China. Males were given *zi* by their fathers or their teachers when they turned twenty years old. *Hao* was the pen name that a highly educated male would give himself and always used when he was writing in either prose or poetry. Given the cost of education, we would also assume that males who had both *zi* and *hao* were from wealthier families than males who had one or neither.

First-born. Following traditional Chinese practice, the birth order of a male could also affect his net fertility. However, since the birth status of the individual vis-à-vis his brothers is naturally related to the size of his family of origin, it is difficult to control for it without any adjustment.[16] Given that a first-born son is usually expected to take greater responsibility in family events and maintaining the patriline than his younger brothers do, I use the *First-born* dummy to indicate whether the male is the first-born (or the only) son in his family of origin.[17]

Tongcheng County (1992, p.27, Table 2), 580 (6.99%) of them had more than one wife. Since Telford used no "elite lineages" in this study, he predictably found a relatively low proportion of remarriages.

[16] Many studies have explored the relationship between birth order, health outcomes and educational attainment (Booth and Kee 2009; Hatton and Martin 2010). Booth and Kee (2009) also construct a birth order index to deal with the issue generated from the correlated birth order and family size. Since birth order is not the critical predictor variable studied in this paper, I do not apply this index.

[17] Such "demographic privilege" enjoyed by the first-born has been demonstrated by Lee and Campbell (1997, pp.138-139) in northeast China; Li and Zhen (2015) also show this in their study of the family division records of the Que lineage.

Out-migration. Out-migration is a dummy used to control for a possible omission of information because the individual concerned was away from home. It equals one if the individual was out of the village and never came back, if he decided to become a monk, or if he was removed from the lineage due to disobedience to family rules. In these cases, genealogy compilers were unable to acquire updated information, or they had to eliminate the initially recorded information, which caused an inevitable gap between the actual number of sons and the recorded number of sons of these males.

Survival to adulthood. Lifespan beyond doubt affects fertility. However, since less than one-third of the males in the genealogies had a complete set of vital statistics, most of the sample had a lifespan that cannot be conjectured. However, males who failed to survive to adulthood (twenty *sui*, which is approximately equivalent to nineteen years old) are specially marked with such words as *shang*, *yao*, *youzu*, *zaozu*, *zaoshi* in their mini-biographies.[18] I use the variable *Survival to adulthood* to control for the strong negative impact of a short lifespan on fertility.

Birth cohort. I control for the time fixed effects on net reproduction and social ranks by including a set of century-long periods in the model.[19] I group the males into seven birth cohorts as discussed in Section 3.1.

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[18] *Shang* (殇) and *yao* (夭) denote the death of children who died between one and four years old; *youzu* (幼卒) refers to children who died under the age of eight sui (six to seven years old). *Zaozu* (早卒) and *zaoshi* (早逝) mean that the individual died young between the ages of fifteen and twenty sui (around thirteen to nineteen years old).

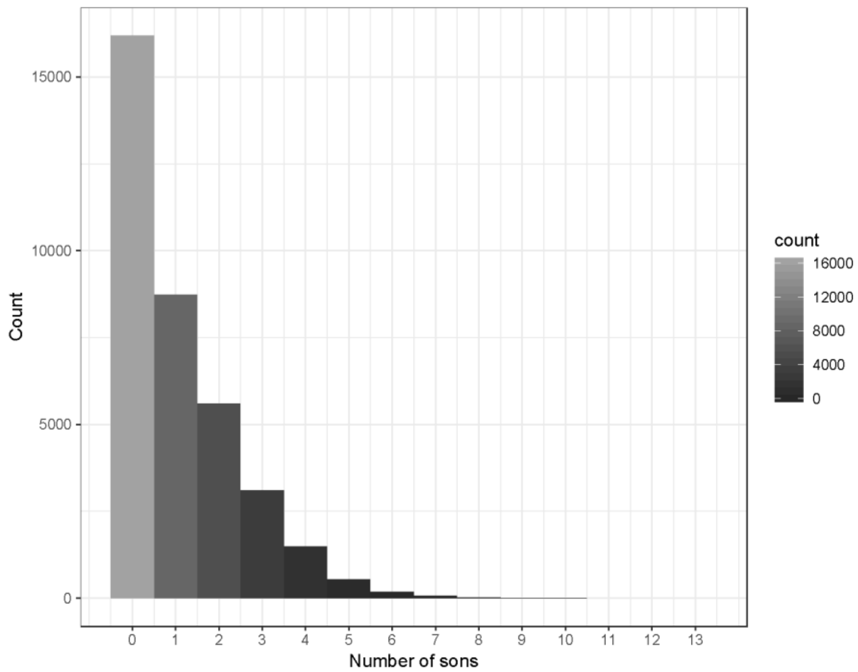
[19] Despite the consistency of *keju* in the two dynasties, the achieved degrees were not of the same value. For instance, the Ming court first started to publicly sell studentships of the National Academy, namely *gongsheng* or *jiansheng,* which had the same currency as the intermediate degree, *juren* degree. However, by the late Qing dynasty, the degree had lost much of its value, given the significant increase in the total number of the *jiansheng* degree holders. Mainly after Qianlong's reign, the quota of the *jiansheng* degree expanded dramatically. In the local gazettes of Huizhou prefecture, a place which is well-known for its successful Huizhou merchants, "almost all of the numerous biographical sketches of local tradesmen who donated to local philanthropy are prefaced by the term *chien-sheng* [*jiansheng*]" in the Qing dynasty (Ho 1962, p.34).

Lineage. Because of the varying amounts of resources that common lineages and elite lineages could access, along with some other family-related biological and cultural characteristics, lineage fixed effects are also included.

4.2 An excess of men without heirs

As shown in Figure 3 and Figure 4a, many men in the genealogies had net sons of zero. 44.11 per cent of males, most of them were from the rank 1 group in the sample, failed to produce any son.[20] Because a negative binomial model would underestimate the number of zeros, I also considered a zero-inflated negative binomial model to deal with the issue.

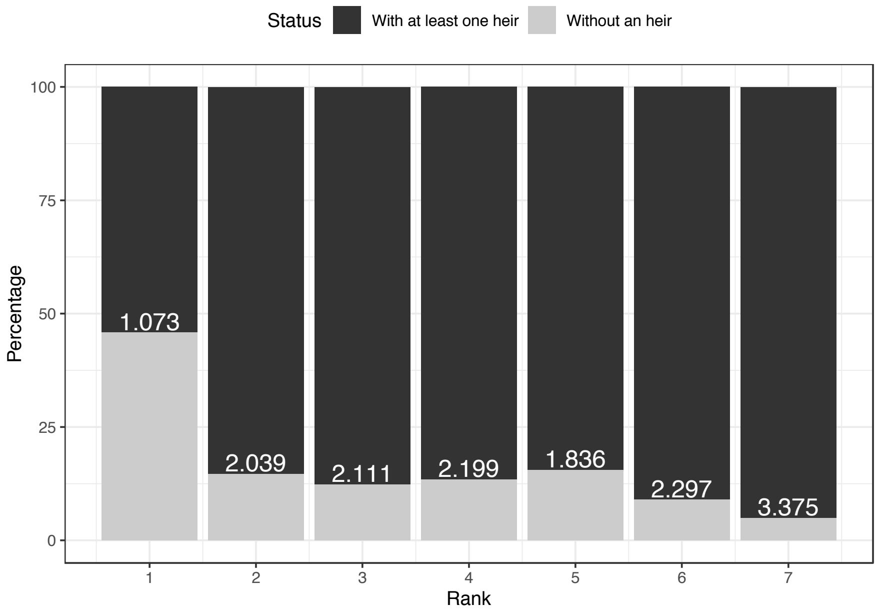
Fig. 3 Distribution of the Recorded Number of Sons.



Source: The lineage sample.

[20] Many of these men could have un-recorded daughters, so the proportion of childless men would be less than 44.11 per cent.

Fig. 4a Proportion of the Heirless by Rank.

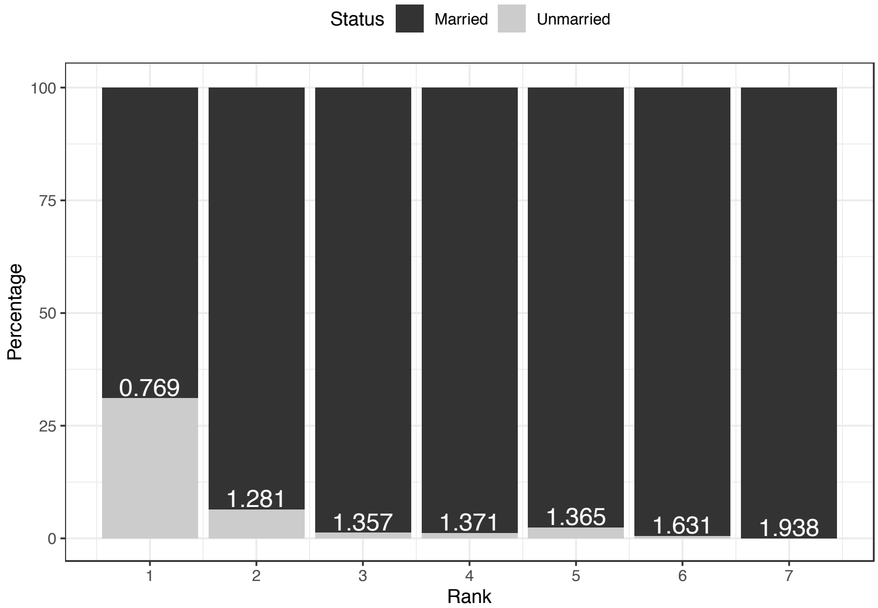


Note: 1. The value in each bar shows the mean number of sons by rank. 2. See Appendix Table A6a for detailed number at each rank.
Source: The lineage sample.

Theories of zero-inflated models suggest that the excessive zero counts originate from two processes – one "always zero" process, which cannot be predicted by a Poisson or a negative binomial model and one usual process (see, for example, Lambert 1992; Greene 1994; 2018, p.905). The number of zeros could be inflated in the dependent variable through the former process and would be disguised as over-dispersion; thus it is important to differentiate the two processes.

In the present paper, the two different processes that lead to the dependent variable value of zero are that the male had no wife and thus no sons, or the male had one or several wives but still produced no son. The former male was certain to have had no sons, but the latter could have had at least one son. The two different processes should be distinguished in this research.

Fig. 4b Proportion of the Unmarried by Rank.



Note: 1. The value in each bar shows the mean number of marriages by rank. 2. See Appendix Table A6b for detailed number at each rank.
Source: The lineage sample.

As Figure 4b shows, the high proportion of men without heirs is primarily due to bachelorhood. 29.60% of the males in the sample remained single all their lives; most of them were commoners. For males of the near-gentry and gentry classes, the average number of marriages is greater than one, and all the rank 7 males succeeded in marrying at least once. Since Chinese genealogical books record only legitimate births, sons of unmarried males are not recorded.[21] Of the 25,125 married males, 5,181 (20.62%) of them produced no sons.[22] I also report the proportions of unmarried and heirless males by lineage in Table A5 of Appendix A.

[21] The illegitimate births (out-of-wedlock births) were rare in China. Lee and Wang (1999, p. 88, p.161, and p. 188) mention that the share of illegitimate births was nearly zero in the historical population of China. There was the existence of bastardy, as shown in Sommer (2015), but only in the extremely impoverished population.

[22] The percentage of fathers without heirs in the Tongcheng lineages studied by Telford (1995, pp.76-77, Tables 3.2 and 3.5) and in five Southeast Chinese lineages studied by Liu (1995, pp.102-105, Table 4.3) are all around 20%. Again, the percentage of childless married men would be less, because of the issue of missing daughters in the genealogies.

Therefore, in the zero-inflated negative binomial model applied in this paper, I use the number of marriages as the predictor to distinguish the two types of zero outcomes. The zero counts generated by the unmarried males belong to the "always zero" group, and the zero counts generated by the married males belong to the "not always zero" group.

4.3 Selection biases

As previously discussed in Section 2.2, although keeping genealogies was not a privilege for the elites in the Ming and Qing dynasties, and was remarkably widespread in Southeast China, not every single Chinese family would indeed keep genealogies, and the wealthier and higher-social-status families were more inclined to keep genealogies than the ordinary families. Therefore, the commoners in the sample still could have higher social status compared to the "real" commoners in society. This potential selection bias, however, could not affect my results. Even with a potentially higher-social-status commoner group in the sample, I still find a positive status-fertility relationship, then comparing the net reproduction of a high-ranking male to that of a "real" commoner could only find a more considerable difference than what I can find in the research, which proves that my results are robust to this bias.

In terms of the quality of the data, the continuing editing and compiling of genealogies ensure the reliability. Every lineage formulates clear rules for compiling genealogies; one common rule is that family members should compile the genealogy every sixty years (or every three to five generations). As Table A1 shows, the interval between two large-scale compilations of the six lineages is on average shorter than sixty years. During the interval, family members would record all the changes in the lineage in handwritten *caopu* (*草谱*, draft books). Yet, as Harrell (1995, p.5) points out, "…genealogies are compiled for ritual rather than demographic reasons"; hence, the voluntary selection in genealogies could bias the test towards finding spurious fertility gradients. Shiue (2016), however, examines the genealogy sample of Tongcheng County and finds no severe biases. This section investigates selection biases in my lineage sample of the six lineages.

One inevitable bias of Chinese genealogies is the omission of daughters and children who died in infancy.[23] Many genealogical studies have already shown that the inclusion of individuals in the genealogies was mainly from ritualistic considerations (Harrell 1995; Telford 1986; Shiue 2016). In traditional Chinese culture, all men were ritualistically significant, and so were their wives and mothers, in that they produced the descendants for the family. However, daughters were not significant because they were no longer members of their original family after they married.[24] Children who died in infancy were also insignificant as regards continuing the family line. The incomplete records of gross fertility limit this paper to examining male descendants who survived infancy, and I use this sons-only version of net fertility to proxy for net reproduction.

Although every male, whatever his wealth and status, was qualified in the rituals of ancestor worship, the records may still have been biased towards high-status males, causing an omission of records of low-status males. However, the representation of different social ranks in the sample suggests that this bias is absent. According to Chang's estimates (1955, p. 114, Figure 2), before 1850, the percentages of gentry-scholars in total population were about 1.3% in Jiangsu Province and 1.4% in Zhejiang Province; after 1850, the percentages increased to 2.5% and 5.0% respectively. As shown in Table A3a, about 95% of the male population in the sample were commoners, and less than 2% of the males held office during their lifetime. I also compared the proportion of degree holders and civil officials in my sample with the proportion in the Tongcheng sample studied in Shiue (2017, Table 1). Applying the status classification used in this paper to the Tongcheng sample, 90.53% of the 8,892 males were of rank 1, 1.75% of them were of rank 2, and 7.72% of them were of ranks 3-7. This distribution of different ranks is comparable with the distribution of my lineage sample (see Table A3a).

[23] Only 9,409 daughters were recorded in the sample, compared with 40,233 sons.
[24] Surprisingly, in the Zha lineage, one of the elite lineages, only twenty-five men had records of their daughters.

Another potential bias in the data concerns whether the recorded number of sons is complete. Theoretically, in order to record the patrilineal history, the number of sons who survived infancy that each male family member produced is the essential information for inclusion in the genealogical books, and this would not be affected by the male's social status. However, the quality of the records may still induce bias. If high-ranking males had complete records of sons, but commoners were selective, this selectiveness would induce spurious findings and drive the status-fertility relationship to something positive. Nonetheless, as I show in Section 5.2 below, the results are robust to potential bias.

4.4 A potential reverse causality problem

If having more sons can increase the father's social status, there is a risk of reverse causality. Although sons were forbidden to inherit *keju*-related status from fathers, one practice in imperial China was for the Emperor to reward the father of a high-ranking official with an official position or an honorary title to acknowledge the official's outstanding performance.

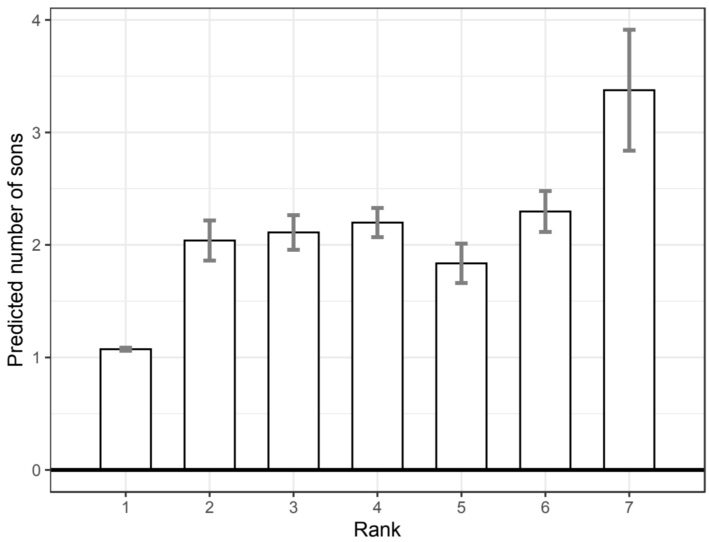
Different terms and words would be used in the status records of these fathers, making their status distinguishable from status earned through regular approaches. In the sample, twenty-five males were rewarded with titles of honour because of their sons or grandsons. However, since eighteen of them received this reward posthumously, their fertility was unaffected by it. I did not count the higher ranks conferred after death on these eighteen males as their ranks, but classified them into the groups that their own achievements merited. The remaining seven males were rewarded with these honorary positions while they were still alive, but because the genealogies did not record when they received them, I excluded them from the sample to deal with the possible endogeneity problem.

5 Results

5.1 Baseline results

This section presents the baseline results for the relationship between net fertility and social status. I first report the results of Equation (1) under the OLS regression, the Poisson regression, and the negative binomial regression (see Table 3).[25] Figure 5 plots the unconditional rank effects by showing the predicted number of sons by social rank calculated by the negative binomial regression.

Fig. 5 Unconditional Status-fertility Relationship.



Notes: 1. Values are the average adjusted predictions, the expected number of sons at each level of rank calculated by the negative binomial regression in column (5) of Table 3. 2. Error bars indicate 95 per cent confidence intervals.

The results of the three models are closely comparable. All the "rank" coefficients in the three models are statistically and quantitatively significant, and the rank effects are mainly linear, as also displayed in Figure 5, with only a relatively lower rank 5 coefficient.

In general, higher social ranks did translate into more recorded sons. The OLS coefficients in column 1 suggest that the predicted number of sons of a rank 1 male

[25] See also Table A7 for the average number of sons by status in the six lineages.

was 1.073 sons, and males in ranks 2 to 6 and rank 7 were predicted to have about one more son and two more sons respectively than the males in rank 1.

The coefficients of the Poisson regression in column 3 are the same as the ones of the negative binomial regression in column 5. As shown in the two columns and also in Figure 5, rank 1 males could be expected to have one son, and males of ranks 2-6 could be expected to have about two sons. Rank 7 had the largest positive effect, and a rank 7 male was expected to have about 3.2 times as many sons as a rank 1 male had.

Conditioning on the birth cohorts of the males does not change the positive status-fertility relationship much (see columns 2, 4, and 6). As shown in columns 4 and 6, including the birth cohort fixed effects reduces the coefficients on social ranks to a small degree. A rank 7 male still had more than twice as many sons as a rank 1 male had.

The reason for lower rank 5 coefficients in all models lies in the fact that all the rank 5 males were in a difficult situation. Of the 224 males in rank 5, 119 of them were prospective officials, who were waiting for vacancies in the positions they were hired; 91 of them were the lowest-ranking employees in the bureaucratic system; the last 14 of them were median degree holders who failed to get an official position. Although the social status of rank 5 males was higher than that of males in ranks 3 and 4, they were tied to the bureaucratic system and did not have any additional monetary benefits for their status. In contrast, for the ranks 3 and 4 males, after they received a low-level degree, a lot of them chose not to waste more time on the highly competitive *keju* exams and changed their careers to leave government service.

Table 3 Unconditional Relationship between Social Status and Recorded Number of Sons, OLS Regression, Poisson Regression, and Negative Binomial Regression

	Dependent Variable: Number of Sons					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS		Poisson		Negative Binomial	
Rank 2	0.966***	0.757***	1.901***	1.600***	1.901***	1.625***
	(0.091)	(0.092)	[0.642]	[0.470]	[0.642]	[0.485]
			(0.045)	(0.046)	(0.045)	(0.048)
Rank 3	1.038***	0.796***	1.968***	1.611***	1.968***	1.672***
	(0.079)	(0.082)	[0.677]	[0.477]	[0.677]	[0.514]
			(0.038)	(0.041)	(0.038)	(0.043)
Rank 4	1.126***	0.990***	2.050***	1.833***	2.050***	1.901***
	(0.067)	(0.068)	[0.718]	[0.606]	[0.718]	[0.642]
			(0.031)	(0.033)	(0.031)	(0.035)
Rank 5	0.763***	0.682***	1.712***	1.594***	1.712***	1.636***
	(0.090)	(0.090)	[0.537]	[0.466]	[0.537]	[0.492]
			(0.049)	(0.050)	(0.049)	(0.052)
Rank 6	1.225***	1.090***	2.141***	1.902***	2.141***	1.939***
	(0.093)	(0.092)	[0.761]	[0.643]	[0.761]	[0.662]
			(0.041)	(0.041)	(0.041)	(0.042)
Rank 7	2.302***	1.941***	3.146***	2.377***	3.146***	2.431***
	(0.274)	(0.279)	[1.146]	[0.866]	[1.146]	[0.888]
			(0.081)	(0.085)	(0.081)	(0.096)
Controls						
Birth Cohort FE	N	Y	N	Y	N	Y
Constant	1.073***	1.599***	1.073***	1.551***	1.073***	1.578***
	(0.007)	(0.102)	[0.070]	[0.439]	[0.070]	[0.456]
			(0.007)	(0.058)	(0.007)	(0.060)
N	35,691	34,140	35,691	34,140	35,691	34,140
R^2/Pseudo R^2	0.036	0.101	0.015	0.051	0.008	0.033

Note: 1. Rank 1 is the reference group. 2. Robust standard errors are in parentheses in column (1). 3. Coefficients in column (2) are incidence rate ratios (IRR) for the negative binomial model. Negative binomial regression coefficients are shown in square brackets, and robust standard errors of the negative binomial regression coefficients are in parentheses in column 2. 4. *p<0.1; **p<0.05; ***p<0.01.

5.2 Status-fertility relationships conditioned on socioeconomic factors

To further examine the status-fertility relationship, I include the set of socioeconomic covariates that could also affect net reproduction into the analysis. Table 4 details the status-fertility relationships conditioned on the set of control variables. As columns 1, 4, and 5 show, if conditioned on birth cohort and lineage fixed effects, whether a male was first-born, and whether he out-migrated, the relationships are all similar to the unconditional relationship shown in Table 3.

However, controlling for the male's human capital and marriages noticeably reduces the rank effects, suggesting that both of these variables are mechanisms through which social rank affected fertility. When controlling for *zi* and *hao* ownership in columns 3 and 7, all rank gradients decline, but they remain statistically significant, and the scale of the decline is modest. A rank 7 male could still have been expected to have about twice as many sons as a rank 1 male had.

Moreover, conditioning on the number of marriages leads to a substantial decrease in all the rank coefficients, especially the coefficients on ranks 6 and 7 (columns 2 and 6). The results in columns 1 and 2 show that, without controlling for the number of marriages and for survival to adulthood, climbing the social ladder from rank 1 to rank 7 would increase the expected number of sons by a factor of 2.844 (column 1), whereas after controlling for these two variables, moving from rank 1 to rank 7 would increase the expected number of sons by a factor of only 1.246 (column 2). Additionally, the large coefficient of survival to adulthood shows the important role that lifespan played in affecting fertility.

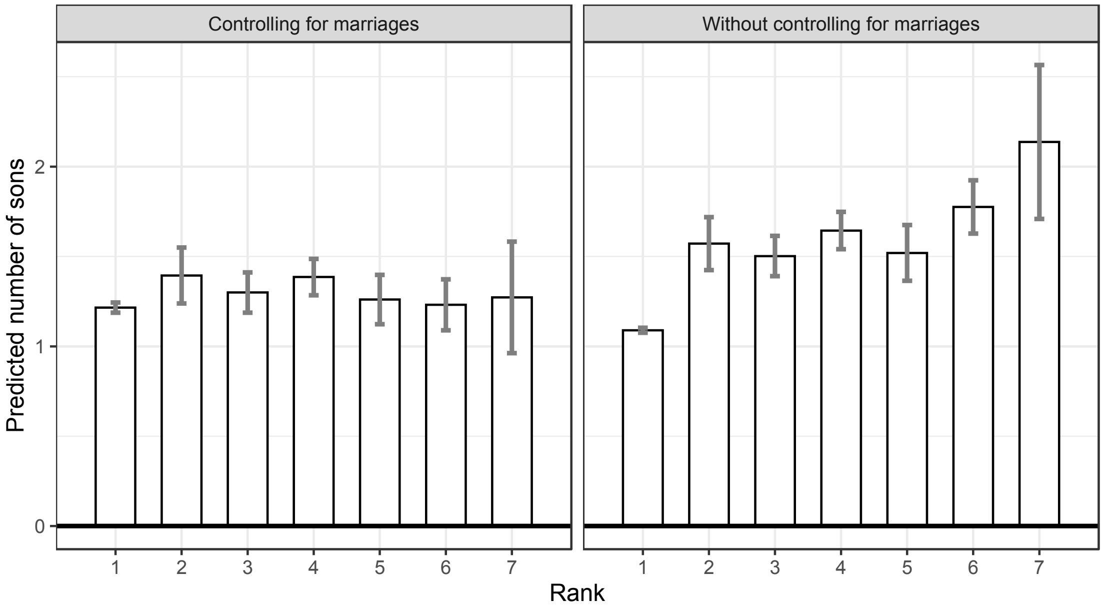
Comparing the results in column 7 and column 8 more clearly illustrates the point that the number of marriages is the key mechanism through which social status could increase the number of sons. The two figures in Figure 6 provide a stark contrast between the two sets of rank effects in the two models, first without controlling and then controlling for marriages. Before including the number of marriages in the regression (column 7), all the rank coefficients are significant and large, indicating that ranks higher than 1 were expected to increase one's number of sons by about 40 per cent to 96 per cent.

After including the number of marriages to the regression, the results in column 8 indicate that only ranks 2 and 4 still hold statistical significance and positive effects on the number of sons, yet these ranks would have increased the expected number of sons by only about 15 per cent and 14 per cent respectively. The statistically significant coefficients indicate that a near-gentry male or a lower degree holder would produce more surviving sons per marriage than a non-gentry male would. Nevertheless, the overly wide confidence intervals of the coefficients on ranks 5, 6, and 7 barred us from identifying any appreciable effects of rank. Thus, the dramatic decline of rank effects in these three ranks shows that males in ranks 5 to 7 had more surviving sons than non-gentry males, but they did so primarily by having more marriages. [26]

Moreover, as previously discussed in Section 4.3, if the findings are spurious and driven by the fact that the number of commoners' sons was under-recorded, the positive feedback between social status and number of sons would not change after controlling for marriages, as the number of sons per wife of commoners should still be fewer than the equivalent of high-status males. The similar net fertility at each level of rank shown in the left plot of Figure 6 confirms that the findings are robust to this potential bias.

[26] Per Arthi and Fenske (2018), polygamy in Nigeria increased child mortality in the contemporary period, but not in the historical context. I also used my sample to test the relationship between the number of marriages of the father and the son's chance of dying before adulthood, and the positive relationship is absent. My results suggest that if the father had two or three marriages, the chance of dying before adulthood for his son was not different from that of a son whose father had only one marriage. If the father had more than three marriages, then his son would have a statistically and quantitatively significant higher probability of surviving to adulthood.

<u>Fig. 6 Conditioned Effects of Rank Before and After Conditioning on the Number of Marriages, Estimation Equation 1.</u>



Note: 1. Values are the average adjusted predictions, predicted number of sons at each level of rank, of the models shown in column (7) and column (8) of Table 4. 2. Error bars indicate 95 per cent confidence intervals.

Table 4 Estimating the Recorded Number of Sons, Negative Binomial Regression

	Dependent Variable:							
	Number of sons							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank 2	1.823***	1.281***	1.447***	1.825***	1.823***	1.283***	1.442***	1.147**
	(0.090)	(0.074)	(0.073)	(0.090)	(0.090)	(0.074)	(0.070)	(0.066)
Rank 3	1.812***	1.218***	1.391***	1.808***	1.805***	1.214***	1.379***	1.069
	(0.072)	(0.055)	(0.056)	(0.072)	(0.072)	(0.055)	(0.054)	(0.048)
Rank 4	2.009***	1.290***	1.551***	2.012***	2.005***	1.290***	1.509***	1.140***
	(0.066)	(0.048)	(0.053)	(0.066)	(0.066)	(0.048)	(0.050)	(0.044)
Rank 5	1.909***	1.175***	1.471***	1.906***	1.906***	1.173***	1.395***	1.037
	(0.102)	(0.066)	(0.080)	(0.102)	(0.101)	(0.066)	(0.073)	(0.059)
Rank 6	2.268***	1.163**	1.690***	2.274***	2.260***	1.164***	1.630***	1.013
	(0.095)	(0.068)	(0.075)	(0.096)	(0.095)	(0.068)	(0.071)	(0.060)
Rank 7	2.844***	1.246*	2.015***	2.834***	2.836***	1.242*	1.961***	1.047
	(0.280)	(0.152)	(0.220)	(0.277)	(0.279)	(0.151)	(0.201)	(0.130)
Marriages		2.252***				2.244***		2.174***
		(0.033)				(0.033)		(0.032)
Zi			1.502***				1.390***	1.235***
			(0.022)				(0.020)	(0.018)
Hao			1.361***				1.351***	1.191***
			(0.032)				(0.031)	(0.029)
Firstborn				1.045***		1.027**	1.048***	1.033**
				(0.013)		(0.012)	(0.013)	(0.012)
Out-migration					0.351***	0.480***	0.374***	0.492***
					(0.063)	(0.079)	(0.065)	(0.080)
Survival		43.103***				43.203***	80.425***	42.684***
		(7.063)				(7.205)	(13.528)	(7.113)

Controls								
Birth cohort FE	Y	Y	Y	Y	Y	Y	Y	Y
Lineage FE	Y	Y	Y	Y	Y	Y	Y	Y
Constant	1.413***	0.016***	1.135*	1.382***	1.413***	0.016***	0.015***	0.015***
	(0.107)	(0.003)	(0.084)	(0.105)	(0.107)	(0.003)	(0.003)	(0.003)
N	34,140	34,140	34,140	34,140	34,140	34,140	34,140	34,140
Pseudo R^2	0.041	0.146	0.051	0.042	0.042	0.147	0.093	0.150

Note: 1. Rank 1 is the reference group. 2. The coefficients in the table are incidence rate ratios (IRR) for the negative binomial model. 3. Robust standard errors are in parentheses. 4. *p<0.1; **p<0.05; ***p<0.01.

5.3 Social gradients in fertility by sub-period

I then examine the social gradients in net fertility over time. Although the consistent *keju* system and similar state bureaucratic structures make the social stratification mostly static and stable in the Ming and Qing dynasties, it cannot be taken for granted that the social status effect of each rank on fertility is constant over time. Hence, I estimate Equation 1 by four sub-periods, with results listed in Tables 5a and 5b. Because only four rank 7 males were born during the nineteenth century, I combined rank 6 and rank 7 in the period 1800-1900.

Both of the two tables show the strong positive effects of human capital on net reproduction over the five centuries. However, the larger coefficients on *zi* and *hao* in columns 3 and 4 than in columns 1 and 2 suggest that the ownership of *zi* and *hao* had a stronger effect before 1700 than after 1700.

As Table 5a shows, before conditioning on the number of marriages, a rise in social ranks would have significantly increased the number of sons a male could expect to produce throughout the period. However, the positive rank effects on fertility were much stronger after 1600 than before it, and they were the strongest in the latter half of the Qing dynasty (1800-1900).

After I included the number of marriages, most of the positive effects disappeared, whereas the coefficients on ranks 3 to 6 (and 7) remained statistically significant in the nineteenth century (see Table 5b). The results show that in the period 1400-1800, males of ranks higher than 1 still produced more sons primarily by having more marriages. For males born in 1800-1900, high social rank still brought them more marriages and thus higher net reproduction, but except for this, the "pure" effects of rank also played a significant part in determining fertility.

The rank coefficients in 1800-1900 are higher than those in 1400-1800, due to the low net fertility of rank 1 males in the nineteenth century. Owing to the Taiping Rebellion (1851-1864), a massive civil war in the late Qing period, the Lower Yangzi Region experienced a dramatic population loss in the late 1850s and early

1860s.[27] In the six lineages, the Gu and Zhuang lineages suffered the most in these conflicts. Of all the Gu and Zhuang males with death year records, 845 died in 1860-1863, 810 of them being commoners. Figure 7 shows the marked increase of deaths in 1860-70 in the two lineages. The conflict shortened the average length of men's lives and thus decreased the average number of sons they produced. The large coefficient on the number of marriages in the period 1800-1900 can also be explained by this population lost.

The status-fertility relationship in the five centuries presented in this section is somewhat different from the story told by Shiue (2017). She finds a Beckerian child quantity-quality trade-off in the early Qing dynasty (1644-1800) because of the high return in human capital during this period. Toward the end of the Qing dynasty (after 1800), the decline in the return to education led to the disappearance of the negative child quantity-quality relationship. The results in the present paper indicate that the high-status males at least did not sacrifice the quantity of sons.[28] The positive relationship for the six lineages which persisted throughout the entire Qing dynasty also suggests that future studies should look more deeply into the quantity-quality trade-off in pre-modern China in future studies.[29]

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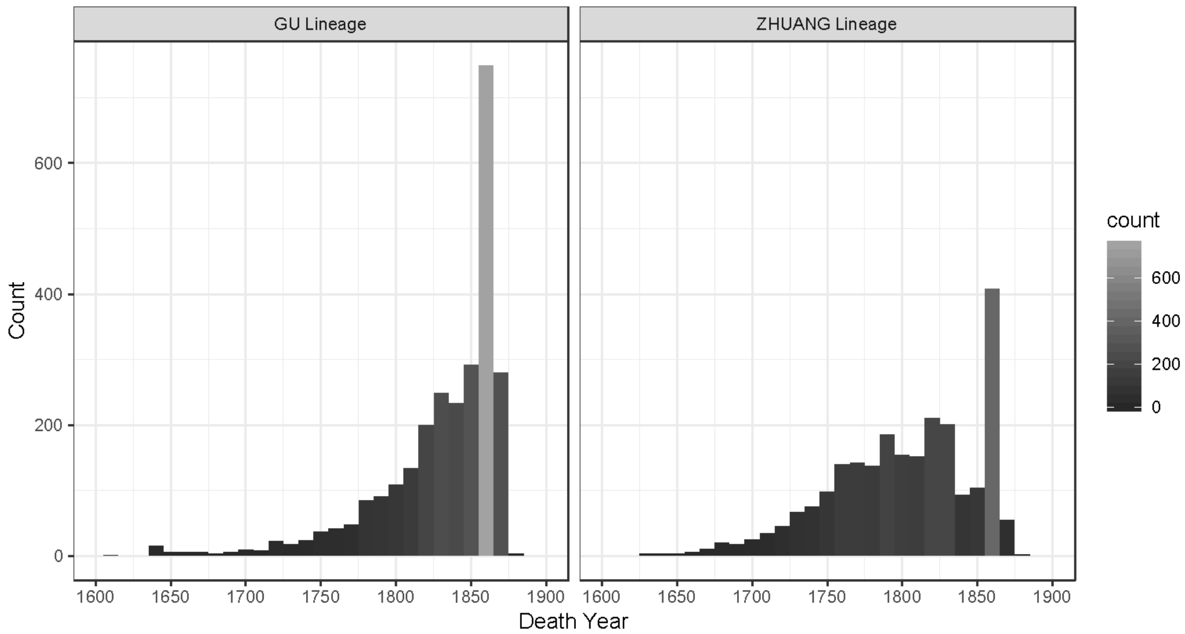
[27] Estimates suggest that the total population lost in China could have been more than 70 million (Li and Lin 2015).

[28] See Appendix B.2 for a robustness check by controlling for the father effects in the model, namely the number of brothers and ranks of fathers.

[29] Recent scholars suggest that we should use the occurrence of twin births, an unexpected and exogenous shock to the family size, to examine these trade-off effects (Clark and Cummins 2018; Clark, Cummins and Curtis 2019). After using the incidence of twin births, the previously observed negative relationship between child quantity and quality in many pre-modern Western European societies disappears.

.Fig 7 Frequency of Death Year in the Gu and Zhuang Lineages, 1600-1900.



Note: The figure plots only males whose death year is recorded.
Source: The lineage sample.

Table 5a Rank Effects on the Recorded Number of Sons by Sub-period, Negative Binomial Regression, without Conditioning on Marriages (1)

	Dependent Variable:			
	Number of Sons			
	(1)	(2)	(3)	(4)
Birth period	1400-1600	1600-1700	1700-1800	1800-1900
Rank 2	1.383**	1.238**	1.337***	2.048***
	(0.192)	(0.128)	(0.088)	(0.294)
Rank 3	1.065	1.145**	1.353***	1.770***
	(0.092)	(0.078)	(0.086)	(0.164)
Rank 4	1.015	1.247***	1.465***	1.920***
	(0.116)	(0.085)	(0.067)	(0.150)
Rank 5	0.931	1.254*	1.303***	2.235***
	(0.139)	(0.150)	(0.092)	(0.254)
Rank 6	1.239*	1.494***	1.509***	2.649***
	(0.139)	(0.150)	(0.094)	(0.328)
Rank 7	1.466***	1.708***	1.820***	.
	(0.217)	(0.220)	(0.314)	
Zi	1.447**	1.456***	1.348***	1.273***
	(0.072)	(0.047)	(0.029)	(0.038)
Hao	1.298***	1.265***	1.377***	1.380***
	(0.070)	(0.061)	(0.049)	(0.072)
Controls				
Firstborn	Y	Y	Y	Y
Out-migration	Y	Y	Y	Y
Lineage FE	Y	Y	Y	Y
Constant	1.424**	1.096	0.992	0.243***
	(0.122)	(0.072)	(0.053)	(0.044)
N	1,877	4,658	11,957	11,527
Pseudo R^2	0.047	0.026	0.019	0.038

Notes: 1. Males who failed to survive to adulthood (observations with *survival* = 0) were removed in this regression. 2. In the period 1800-1900, ranks 6 and 7 are combined together in column (4). 3. Coefficients are incidence rate ratios (IRR) for the negative binomial model. 4. Robust standard errors are in parentheses. 5.*p<0.1; **p<0.05; ***p<0.01.

Table 5b Rank Effects on the Recorded Number of Sons by Sub-period, Negative Binomial Regression, Conditioning on Marriages (2)

	Dependent Variable:			
	Number of Sons			
	(1)	(2)	(3)	(4)
Birth period	1400-1600	1600-1700	1700-1800	1800-1900
Rank 2	1.303*	1.089	1.143*	1.257
	(0.185)	(0.124)	(0.087)	(0.242)
Rank 3	0.951	1.006	1.136	1.177
	(0.085)	(0.064)	(0.091)	(0.139)
Rank 4	0.924	1.111	1.077	1.395***
	(0.103)	(0.078)	(0.056)	(0.122)
Rank 5	0.835	1.006	1.038	1.264**
	(0.126)	(0.129)	(0.081)	(0.135)
Rank 6	0.951	1.247*	0.829**	1.359**
	(0.157)	(0.147)	(0.069)	(0.167)
Rank 7	0.851	1.338*	0.776	.
	(0.186)	(0.236)	(0.193)	
Marriages	1.555***	1.521***	2.087***	2.986***
	(0.059)	(0.052)	(0.044)	(0.086)
Zi	1.315***	1.354***	1.186***	1.133***
	(0.065)	(0.043)	(0.025)	(0.035)
Hao	1.207***	1.174***	1.179***	1.233***
	(0.067)	(0.059)	(0.045)	(0.068)
Controls				
Firstborn	Y	Y	Y	Y
Out-migration	Y	Y	Y	Y
Lineage FE	Y	Y	Y	Y
Constant	0.951	0.798***	0.579***	0.144***
	(0.080)	(0.055)	(0.030)	(0.024)
N	1,877	4,658	11,957	11,527
Pseudo R^2	0.084	0.057	0.078	0.114

Notes: 1. Males who failed to survive to adulthood (observations with *survival* = 0) were removed in this regression. 2. In the period 1800-1900, ranks 6 and 7 were combined together in column (4). 3. Coefficients are incidence rate ratios (IRR) for the negative binomial model. 4. Robust standard errors are in parentheses. 5.*p<0.1; **p<0.05; ***p<0.01.

5.4 The excessive zero counts

As discussed in Section 4.2, because of the excess zeroes in the dependent variable, I applied the zero-inflated negative binomial regression to see if the status-fertility relationship still held. Since having a wife is the prerequisite for having a son, the number of marriages is used to predict the "always zero" in the model.

Table 6 details the results. As expected, the number of marriages is a significant predictor of the membership in the "always zero" group. If a male were to have one more wife, the odds that he would be in the "always zero" group would decrease by a factor of 31.34 in column 1 and a factor of 36.43 in column 2.

For males not in the "always zero" group, in other words, for all the married men, the number of marriages retains its significance and strong effect, but social status contributes more to increase net fertility. As column 2 shows, all the rank coefficients have strong positive effects on the number of sons. Males of a social rank higher than 1 were more likely to have more sons than rank 1 males did (about 20 per cent more for ranks 2 and 4, 15 per cent more for rank 3, 12 per cent more for rank 5, 30 per cent more for rank 6, and 60 per cent more for rank 7). Compared to the results in column 8 of Table 4 that only coefficients on ranks 2 and 4 are statistically significant, the different results here suggest that, with higher socio-economic status, the married Confucians could leave more surviving sons per marriage than the married commoners, a pattern also suggested by Clark and Hamilton (2006) for the pre-modern English society.

Table 6 Rank Effects on the Number of Sons, Zero-inflated Negative Binomial Regression

	Dependent Variable: Number of sons	
	(1)	(2)
Rank 2	1.399***	1.232***
	(0.058)	(0.053)
Rank 3	1.373***	1.147***
	(0.051)	(0.041)
Rank 4	1.430***	1.199***
	(0.043)	(0.037)
Rank 5	1.208***	1.121**
	(0.058)	(0.053)
Rank 6	1.483***	1.290***
	(0.060)	(0.052)
Rank 7	2.166***	1.574***
	(0.176)	(0.128)
Marriages		1.134***
		(0.012)
Zi		1.113***
		(0.014)
Hao		1.203***
		(0.024)
Controls		
Firstborn	N	Y
Out	N	Y
Survival	N	Y
Birth cohort FE	N	Y
Lineage FE	N	Y
Constant	1.558***	0.207***
	(0.009)	(0.035)
Inflate		
Marriages	-31.336***	-36.431***
	(0.721)	(0.711)
Constant	8.312***	7.929***
	(0.707)	(0.708)
N	35,691	34,140

Note: 1. Rank 1 is the reference group. 2. The coefficients are incidence rate ratios (IRR) for the negative binomial model. 3. Robust standard errors are in parentheses. 4. *p<0.1; **p<0.05; ***p<0.01.

5.5 The key mechanism through which social status impacted on fertility is the number of marriages

The results from the previous three sections identify the number of marriages as a key mechanism through which social ranks impacted on net fertility. This section substantiates this status-marriage relationship.

As mentioned before, only 8.46 per cent of males in the sample married more than once. According to the genealogical records, of the commoners who had more than one wife, most of them did so only when their first wife died early or failed to produce male heirs. Many more chose not to marry again and died without heirs.[30] In contrast, higher-social-class males were under less of a constraint, on average, to have more concubines, even if their first wives had already given birth to sons. As shown in Table 7 and Table 8, the proportion of remarrying and the proportion of having concubines are much higher in the high-social-class sample. In order to illustrate this positive relationship between social status and the number of marriages, I ran both OLS and Poisson regressions of this form:

$$Marriage_i = \alpha + \rho Rank_i + W_i\beta + \varepsilon_i, \qquad (2)$$

in which *Marriage* indicates the total number of marriages, and the other notations are as in Estimation equation (1).

The estimation results are shown in Table 9. Given that only two men were in rank 7 in the three common lineages, I combined rank 6 and rank 7 together in the model in column 5. The coefficients on ranks in all of the six columns demonstrate a linear correlation between social rank and the total number of marriages, with only rank 5 seeming to break the trend again. The results confirm that the number of marriages is positively correlated to social status. A male with a higher social status was more likely to have more marriages over his lifetime.

[30] This can also largely account for the universality of adoption in pre-modern China mentioned in Lee and Wang (1999, Chapter 7). Many males with no heir could not afford to marry again, so most of them would have chosen to adopt a brother's son to continue their own family lines.

For instance, the results in column 4 suggest that rank 2 males could have an average 32 per cent more marriages than rank 1 males had, and rank 7 males could be expected to have about twice as many marriages as rank 1 males had.

The results in columns 5 and 6 demonstrate the different effects of social ranks on the number of marriages in the two types of lineage. In the common lineages, high social ranks did not necessarily translate into a large number of marriages. Being in the top two ranks in the common lineages had a minimal effect on the number of marriages; males in ranks 2-5 married more times than the males in ranks 6-7. As Figure 8 also shows, in the common lineages, the rank 6 and 7 males could be predicted to have only 0.1 more marriages than the common males. Of the twenty-six ranks 6-7 males in the common lineages, only six of them had two marriages, and the other twenty of them had only one marriage over their lifetime. Although the small sample size of the top-ranking males in the common lineages is not representative enough to make a strong conclusion, the result suggests that for the bureaucrats in the common lineages, having more marriages is not the primary strategy they adopted to achieve reproductive success.

In contrast, the status-marriage relationship in the elite lineages is linear and much stronger. A rank 6 male, on average, could have an additional 0.6 marriages than a rank 1 male, and a rank 7 male could have an additional 0.7 more marriages. The comparison between the two types of lineage indicates that the number of marriages a male could have was affected by the lineage he came from. In general, rank 2 males in common lineages could marry more than their counterparts in the elite lineages; for males in ranks other than 2, belonging to an elite lineage brought more marriages than belonging to a common lineage did.

Table 7 Distribution of Number of Marriages by Rank

Number of total marriages	Rank 1		Ranks 2-7	
	N	%	N	%
0	10,530	31.16	36	1.90
1	20,868	61.75	1,237	65.17
2	2,109	6.24	466	24.55
>2	286	0.84	159	8.38
Total	33,793	100.00	1,898	100.00

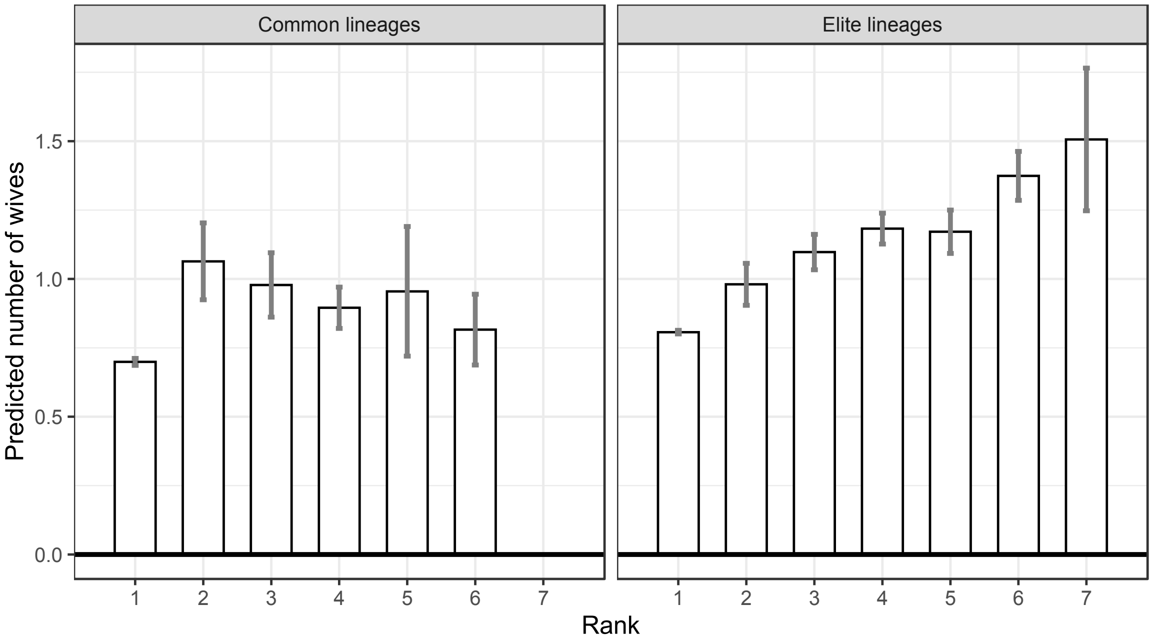
Source: The lineage sample.

Table 8 Prevalence of Remarriage and Polygamy in the Sample of Married Males

	Rank 1		Ranks 2-7	
	N	%	N	%
Number of remarriages				
0	21,068	90.56	1,413	75.89
1	1,978	8.50	368	19.76
>1	217	0.94	81	4.35
Total	23,263	100.00	1,862	100.00
Number of concubines				
0	23,003	98.88	1,620	87.00
1	241	1.04	197	10.58
>1	19	0.08	45	2.42
Total	23,263	100.00	1,862	100.00

Note: “Remarriage” means the marriage after the death of the previous wife.
Source: The sub-sample of married males.

Fig. 8 Predicted Number of Marriages, Estimation Equation 2, by Lineage Type.



Note: 1. Values are the average adjusted predictions, the predicted number of marriages at each level of rank of the models shown in column 5 (common lineages) and column 6 (elite lineages) of Table 9. 2. Error bars indicate 95 per cent confidence intervals.

Table 9 OLS and Poisson Regressions on the Number of Marriages

	Dependent Variable: Number of Marriages					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS		Poisson		Poisson	
	Full Sample		Full Sample		Common Lineages	Elite Lineages
Rank 2	0.512***	0.313***	1.667***	1.319***	1.522***	1.215***
	(0.044)	(0.044)	(0.057)	(0.046)	(0.103)	(0.048)
Rank 3	0.588***	0.354***	1.764***	1.368***	1.399***	1.360***
	(0.035)	(0.035)	(0.046)	(0.037)	(0.086)	(0.041)
Rank 4	0.602***	0.409***	1.783***	1.437***	1.281***	1.466***
	(0.027)	(0.028)	(0.036)	(0.031)	(0.056)	(0.037)
Rank 5	0.596***	0.396***	1.775***	1.424***	1.366**	1.452***
	(0.043)	(0.043)	(0.056)	(0.048)	(0.172)	(0.050)
Rank 6	0.862***	0.632***	2.121***	1.649***	1.168*	1.703***
	(0.050)	(0.050)	(0.065)	(0.053)	(0.094)	(0.057)
Rank 7	1.169***	0.829***	2.520***	1.765***	.	1.867***
	(0.163)	(0.165)	(0.213)	(0.154)		(0.164)
Controls						
Zi	N	Y	N	Y	Y	Y
Hao	N	Y	N	Y	Y	Y
Firstborn	N	Y	N	Y	Y	Y
Out-migration	N	Y	N	Y	Y	Y
Survival	N	Y	N	Y	Y	Y
Birth cohort FE	N	Y	N	Y	Y	Y
Lineage FE	N	Y	N	Y	Y	Y
Constant	0.769***	-0.023	0.769***	0.055***	0.106***	0.061***
	(0.002)	(0.025)	(0.003)	(0.005)	(0.018)	(0.008)
N	35,691	34,140	35,691	34,140	9,580	24,560
Pseudo R^2	0.058	0.251	0.011	0.077	0.049	0.089

Note: 1. Rank 1 is the reference group. 2. Coefficients in the table are incidence rate ratios (IRR) for the Poisson model. 3. As only two males were of rank 7 in the common lineages, rank 6 and 7 are combined in column 5. 4. Robust standard errors are in parentheses. 5. *p<0.1; **p<0.05; ***p<0.01.

Clark and Hamilton (2006) argued that one of the mechanisms through which wealth affected fertility in pre-modern England was that the rich produced more births per year of marriage than the poor, and the children of the rich were more likely to survive. Unfortunately, because of the nature of the probate records, the role played by marriage is not clear in the English case. However, the number of marriages does most to explain the reproductive success of the Confucian elites in Ming-Qing China: high-ranking males, especially those from elite lineages, were wealthier and thus able to marry more women to increase their number of male descendants.

Chen, He, Lin and Peng (2018, p. 263) examined 3,119 cases between 1736 and 1896 recorded in *xinke tiben* (the Qing Criminal Archive, *刑科题本*) and found that the average bride price was 19.3 silver taels. Although individual wealth was unrecorded in the genealogical books, we can still compare this bride price with wage estimates using other sources in the existing literature to see this mechanism.

Zhao (1983, pp. 55-56) estimates that a farm worker in the Yangzi Delta could earn around two to five silver taels in cash per year, and Pomeranz (2000, pp. 95) supports this estimate. Similarly, according to Chen et al. (2018, p. 265), the annual wage for a farm worker in the Qing dynasty was about three to five silver taels.[31] According to these estimates, the average farm worker in the Qing dynasty needed at least four years to save enough money to pay for a wife.

If he were a Qing bureaucrat, he could earn much more than five taels a year. For the lowest-ranking civil official, the annual income was about thirty-three silver taels, nearly ten times greater than that of a peasant worker (Chang 1962; see

[31] The two wage estimates that I cite here are estimates that exclude food allowances. The daily wage, including a food allowance, was reckoned at 0.045 taels, which was about 16 taels a year in the Yangzi Delta (Allen, Bassino, Ma, Moll-Murata, and Van Zanden 2011, pp.15-16). However, food allowances were consumed by workers daily, and besides, in the Chinese cultural tradition, a bride price cannot be exclusively composed of baskets of grains or rice, so it would be misleading to consider wages as inclusive of the food allowance here.

Table 10). Middle- and high-ranking local officials could also receive a substantial amount of "yang-lien allowance" (integrity allowance, 养廉银) every year.[32] In my rank classification, the fourth- to ninth-ranking local officials and the eighth- and ninth-ranking capital officials are included in the rank 6 group, and the first- to third-ranking local officials and the first- to seventh-ranking capital officials are all included in the rank 7 group. The high annual income guaranteed that even a low-ranking officeholder could afford more marriages.

Table 10 Annual Regulated Salary of Qing Officials, by Official Rank

Official rank	Capital officials	Local officials
1	307.8	180
2	256.5	150
3	222.3	130
4	179.5	105
5	136.8	80
6	102.6	60
7	76.9	45
8	68.4	40
9	54.4	33.114

Notes: 1. Official rank 1 is the highest rank and official rank 9 is the lowest. 2. Official ranks 1 to 7 capital officials and official ranks 1 to 3 local officials belong to the Rank 7 in the sample. Official ranks 8 to 9 capital officials and official ranks 4 to 9 local officials belong to the Rank 6 in the sample.
Source: Chang (1962, pp.35-36, Table 10 and Table 11).

However, if two males were of the same rank, why the one from the elite lineages could marry more times than his common-lineage counterpart in general? This can be explained through examining the lineage fund practice. As previously mentioned, lineage was the most widespread form of social organization in Ming and Qing China. It was, for one thing, a combination of families who shared the same ancestor and the same surname, but it was also a combination of families who owned various types of property together. In addition to compiling

[32] The integrity allowance was several times greater than the regulated salary. For example, a governor of Jiangsu Province (a second-ranking local official) could receive an integrity allowance as high as 12,000 silver taels, and a seventh-ranking local official in Zhejiang Province could receive an allowance somewhere between 500 and 1,800 taels (Chang 1962, pp.12-13).

genealogical books, another common practice in the lineages was "sequestering a portion of the patrimony of each generation" as "lineage trusts" (Zelin 2009, p.626). Most of the endowments were landed estates. While most common lineages were not rich enough to own land, most elite lineages not only owned land but also used their profits from the landed estates in many other lineage activities, such as investing in the education of young boys in preparation for *keju* (Zelin 2009). Thus, males from elite lineages were able to make use of lineage wealth and also the high reputation attached to their family name to marry, something their common-lineage counterparts could never afford.

The pattern for rank 2 males is different: rank 2 males in common lineages married more times than rank 2 males in elite lineages. This is due to the different composition of rank 2 males in the two types of lineages. In general, rank 2 males are the ones who had non-*keju* related social status records in their entry. In the common lineages, most of them had donated to their lineages, where they were probably rich individuals who got their wealth from occupations other than being gentry-scholars. On the contrary, in the elite lineages, most of them were teachers in village schools or editors of genealogical books who failed the *keju* exams and were not able to engage in high-income occupations other than joining the bureaucracy.

6 Robustness

This section presents the robustness of the previous results to (1) additionally controlling for lifespan, (2) conditioning on father impacts and family background, (3) an alternative classification of social status, and (4) categorizing *Marriages* as an ordinal variable. Table B1 in Appendix B presents the summary statistics for the new variables used in this session.

6.1 Additional control: lifespan

A male's lifespan could also be a confounding factor that affected his fertility behaviour. Using a sub-sample of 11,210 males with full life records, I controlled for male's age at death, treating it as a continuous variable and also a categorical factor, and found an unaffected status-fertility relationship (Table B2 in Appendix B).

6.2 Conditioning on father impacts and family background

To account for any potential influence from his original family, I included in the regression the number of brothers that a male had and his father's social rank. As Table B3a shows, conditioning on the number of brothers and father's social rank does not affect the main results.

To further examine that if family background could be influencing the baseline results (i.e., if male net fertility is driven by the household wealth and father's social rank as opposed to their own), I also test the impacts of different ranks on individual net fertility within the same household. I use differences in net fertility between brothers to see if rank still has an effect on the number of sons despite family background. I run the following model to test the relationship between the difference in attained social ranks and the difference in net fertility between brothers:

$$Dif\_Sons_p = \alpha + \rho Dif\_Rank_p + \beta_1 \text{Father Rank}_p + \beta_2 \text{Birth Cohort}_p + \beta_3 \text{Lineage}_p + \varepsilon_p, \qquad (3)$$

where *Dif_Sons* is the variable indicating the difference in the number of sons two brothers had, and *Dif_Rank* equals the difference in the social ranks of the two brothers. p denotes the observation unit, the pair of brothers. I also control for the father's social rank, the birth cohort of the brothers, and the lineage they came from. Table B3b reports the results, and standard errors are clustered by household (defined by father).

By changing the observation units to pairs of brothers, the regression controls for the effects of family background on net fertility of the sons in the same household. The results in the three columns all indicate that the difference in the net fertility of two brothers came from the difference in their attained social ranks.

6.3 An alternative classification of social status

The significant effects of ranks 2 and 4 shown in the baseline results in Table 4 could be spurious because of a broad classification of social status. Therefore, I construct a more detailed classification containing twelve levels of status (see Table B4) to check for the robustness of the one presented in Table 2.

Table B5 reports the results of Equation (2) under a negative binomial regression using the new social status variable. The main results are robust to the new classification. Besides the unaffected relationship between status and fertility, Table B5 also shows that having more marriages was the key strategy which gentry scholars adopted to ensure reproductive success. As column 3 shows, before controlling for the number of marriages, all the statuses higher than status 1 have positive effects on net reproduction; after controlling for the number of marriages, only the coefficients on statuses 2-4 and 6 maintain to significance (column 4). The results are the same as the baseline results in columns 7 and 8 of Table 4.

6.4 Classifying *Marriages* as an ordinal variable

As the marginal effects of having one more wife for a single male and a married male could be different, I also changed *Marriages* into an ordinal variable containing four wife groups (see Table B6). By using both the OLS and negative binomial models, the coefficients on the four wife groups shown in all the columns of Table B7 suggest that the number of marriages has a linear effect on the number of sons, and the coefficients on ranks for married males are similar to the results shown in column 2 of Table 6.

7 Discussion of the results

7.1 Celibacy and Marriage Market in China

The results in this paper demonstrate an unequal Chinese society. 29.6 per cent of the males in the sample failed to marry even once, and 8.46 per cent of them married more than once. The man with the most marriages was from the Zhuang Lineage, and he married ten times in total (two wives and eight concubines).

Opposite to the English elites in the eighteenth century, who had high rates of celibacy and childlessness, the gentry class in imperial China was very likely to get married (de la Croix et al. 2019). As Table 7 shows, 31.16 per cent of the commoners never married, and for males of ranks 2 to 7, the proportion is only 1.9 per cent.

The result of about thirty per cent of the males in the sample never marrying is no surprise. Of the 32,505 males who survived to adulthood (nineteen years old), 7,572 (23.29 per cent) of them never married. According to the estimate of Lee and Campbell (1997, p. 85, Table 5.1), of 3,547 males born in 1774-1873 in rural Liaoning who survived to age 25 and age 35, 33.9 per cent and 20.4 per cent of them respectively never married. As Lee and Wang (1999, p. 64) point out, "The shortage of women, exacerbated by the practice of polygyny and the discouragement of female remarriage, prevented a significant proportion of Chinese males in the past…from ever marrying."

My results suggest that besides having concurrent marriages, which was practised by only 502 males in the sample, the more prevalent practice of having multiple marriages in sequence also exacerbated the shortage of women in the marriage market. This raises the question of how the 10,566 unmarried males found solutions for having a male heir?

A possible strategy is polyandry, in other words, renting, or buying other people's wives. Sommer (2015, p.24) found about 1,200 legal cases involved polyandry and wife-selling in *xinke tiben*, and some of them illustrated a practice called "getting a husband to support a husband". This was when a wife from a very poor family would be rented out to another male, who was usually also impoverished, to be a de facto wife in order to support her de jure husband. Because a heavy stigma was attached to polyandry, and any offspring produced by a "rented" wife was considered illegitimate, the genealogical books that I explored in this paper do not mention it.[33] Although polyandry could not be widespread, as Lee and Wang (1999 p.88) argue that "bastardy was largely non-existent in China", the number of cases recorded in criminal archives indicates that the practice was not absent. Therefore, I assume that some of the destitute unmarried commoners in my lineage sample also "rented" wives as a last resort. After all, "polyandry was the least bad option realistically available" for a "wife" to save her own family and for a "husband" to produce his own offspring (Sommer 2015, p.56).

7.2 Human capital formation in China

The paper supports one key element of the unified growth theory proposed by Galor and Moav (2002) – in the Malthusian and the Post-Malthusian regimes, higher income translated into higher population growth rates. In the meantime, as this paper argues, these high-income males in pre-modern China were also males with high educational attainments. Therefore, another critical question may be why, despite the growing representation of these high-quality individuals in the population, China still failed to make fast technological progress and thus the transition to modern economic growth, as Galor and Weil (2000) propose? Although the other end of the spectrum – the transition from a positive feedback between wealth and population growth rate to a negative one – is not examined in this paper, exploring the unique type of human capital in imperial China can already shed some light on this puzzle.

Not every type of "high quality" is conducive to the growth process. The hereditary human traits that raised social status and increased income in Ming-Qing China were unable to bring about any significant technological changes. Current literature has emphasized the crucial importance of the generation and transmission of the tacit, practical, and innovative "useful knowledge" to modern economic growth (Mokyr 2002, 2016; McCloskey 2010; Epstein 2013). Nonetheless, the mode of knowledge that has been taught and tested for centuries in China, concerned with Confucian morals and philosophy, cannot be regarded as a

[33] See Sommer (2015, Chapters 1 and 2) for more detailed accounts of wife renting cases and people's attitudes to polyandry.

scientific and technological type of knowledge in any sense and can hardly facilitate modern economic growth (Mokyr 2016; Lin 1995; Yuchtman 2017).[34]

Opposite to a "decentralized and competitive business" model that Mokyr (2016, p.292) used to describe the education industry in Europe, education in imperial China promoted intellectual obedience and uniformity, rather than innovation. In the Ming and Qing dynasties, scholars were forbidden to have academic discussions about the Sages' teachings, not to mention discussions about what should be taught in schools and tested in exams.[35]

In such a case, as McCloskey (2010, p. 162) argues, "the accumulation of human capital can be a bad idea, negative capital." Emphasizing and expanding of education during this period only imposed more severe intellectual constraints upon a larger population. The reproductive success of the Confucians amplified the diffusion of this growth-impeding education, while in the English case, the increased proportion of middle classes in society contributed to the diffusion of the "growth-promoting education" (de la Croix et al. 2019). As a result, even if the quantity-quality trade-off of children did exist in nineteenth-century China, the quality that the Chinese elites inclined towards at the time was insufficient enough to set off a process of sustained economic growth.

Nonetheless, when ideology begins to change, the accumulation of human capital turns to be a good idea. *Keju* did lead to high literacy and numeracy rates and a culture that highly values education in imperial China (Baten et al. 2010). Many studies argue that *keju* had a persistent and positive effect on Chinese economic growth in the present day (Brandt et al. 2014; Chen et al. 2018). The broad base

[34] McCloskey (2010, pp. 163) points out, "Education can make people spiritually free…without making people rich...[E]ducation without the new bourgeois rhetoric is merely a desirable human ornament, not the way to human riches." Education based on Confucian morals cannot even make people "spiritually free", let alone "rich".

[35] Per Elman (1994, p. 112), "[t]he emperor (or the bureaucracy that spoke for him), not the philosopher, had the final say on how Confucian concepts, arguments, and beliefs were put into educational practice via examinations."

of human capital generated by the legacy of *keju* laid the foundation for the phenomenal economic growth in China after the late 1970s.

7.3 Survival of Confucianism

World history has witnessed many examples of cultural persistence amid changes. Since the Emperor Wu of Han selected Confucianism as the dominant political ideology in the second century, it has also experienced its ups and downs — its dominance has several times been challenged, but it has also managed to maintain for centuries. Even today, Confucianism still plays a vital role in Chinese society, and its long persistence is worth studying.

A recent study by Giuliano and Nunn (2017) shows that the persistence of culture is associated with the stability of the living environment across generations. In a stable society, where the traditions are relevant and useful to the current generation, the traditional culture is more likely to be inherited and to persist than in a variable society. The results of this paper provide another perspective from which to examine cultural persistence, at least in the Chinese context. The reproductive success of the Confucians ensured the reproduction of the existing cultural and political system in imperial China. Descendants of the Confucians were brought up by studying Confucian classics, and they would derive much benefit from retaining the dominance of Confucianism, especially in the political and educational system. With a growing proportion of Confucians in the population over centuries, no alternative ideology could easily replace the existing one.

8 Conclusions

Using detailed genealogical records of six Chinese lineages, this paper reveals a positive relationship between net fertility and social status in China from 1400 to 1900. Overall, compared with the non-gentry class (rank 1), the near gentry class and the gentry class (ranks 2-7) were more likely to have more sons who survived infancy through having more marriages, and this Malthusian mechanism kept functioning until the end of the Qing dynasty. Since higher social status resulted in greater human capital and income in imperial China, this paper provides empirical support for “survival of the richest”, or more precisely, “survival of the Confucians” in the Chinese context. Nevertheless, remarriages and the practice of polygamy in imperial Chinese society made the primary strategy adopted by the Chinese elites for the sake of reproductive success differed from that of their Western European counterparts. The results shed light on the long-term economic stagnation in Qing China and the persistence of Confucian culture in modern China.

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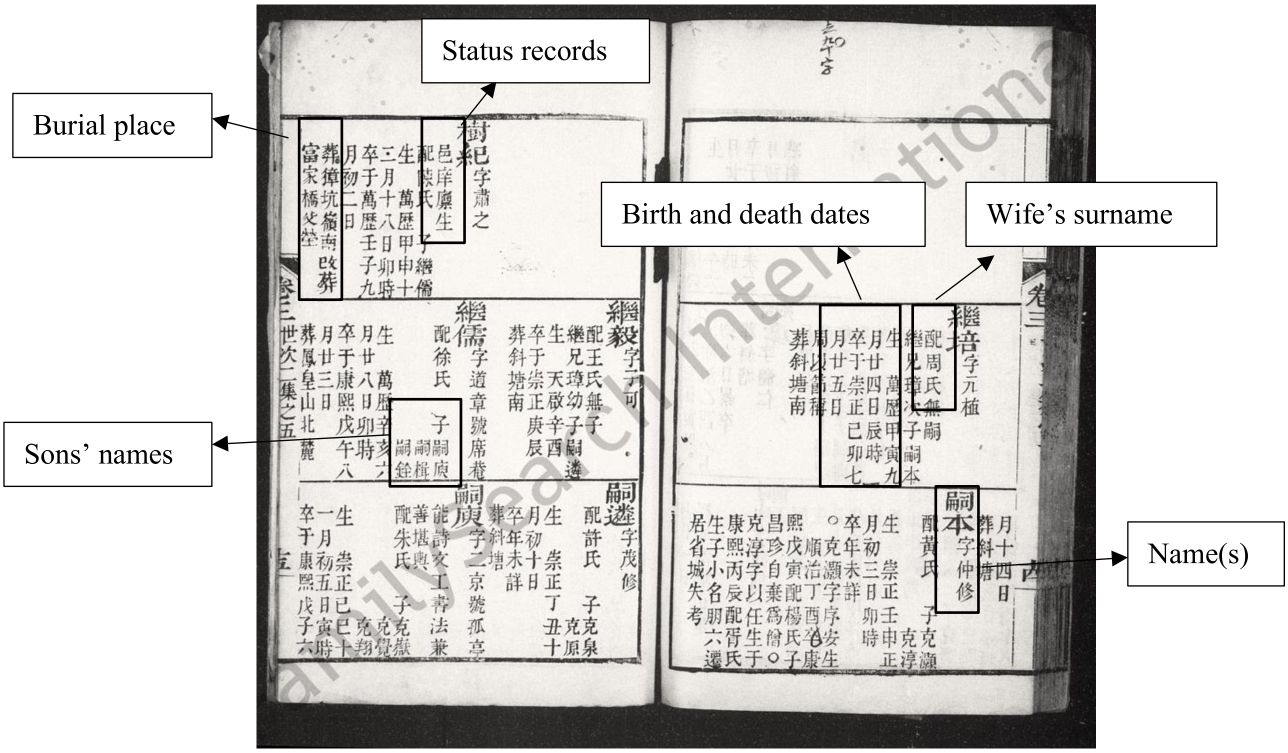
Appendix A. Extra Tables and Figures

Fig. A1 Sample pages from a Chinese Genealogical Book.



Source: Familysearch.org.

Table A1 Basic Information of Genealogies by Lineage

Lineage	Huang	Que	Zhou	Gu	Zha	Zhuang	Total
Number of volumes	4	16	4	32	24	16	96
First compilation year	1487	1664[3]	1598	1286	c.1500	1572	/
Last compilation year	1846	1928	1947	1876	1909	1875	/
Compilation times[1]	6	5	12	12	9	10	/
Average length between compilations (years)	59.8	52.8	29.1	49.2	45.4	30.3	/
Period covered[2]	c.1300-1846	c.1300-1920	c.1200-1946	c.1100-1876	1325-1905	c.1350-1875	/
Number of generations	17	25	28	22[4]	20	20	/
Male entries	1,411	8,957	1,059	16,536	5,078	4,581	37,622
Males with birth years	777	6,998	702	6,454	4,552	4,074	23,557
Individuals with birth and death years	685	4,236	679	5,087	3,260	2,340	16,287

Notes: 1. "Compilation times" refers to the recorded times of large-scale compilations recorded in the prefaces to genealogical books, not including small-scale editing.
2. The start of "Period covered" is the approximate birth year of the male in the first entry, and the end is the latest birth/death year found in the genealogical book.
3. This is the first compilation after the branches started to move to Zhejiang. Records of male family members before generation 14 are compiled on the basis of the original records in the Jiangxi Que genealogies. After the fourteenth generation, all the males recorded in the Que genealogies lived in Zhejiang.
4. Given the long history of the Gu lineage, only generations 17-38 of the Gu lineage are studied in the present paper.

Table A2 Summary Statistics

Statistics	N	Mean	Std.	Min	Max
Number of sons	35,691	1.132	1.358	0	13
Social rank	35,691	1.168	0.776	1	7
Number of marriages	35,691	0.804	0.629	0	10
Courtesy name (*zi*)	35,691	0.373	0.484	0	1
Pen name (*hao*)	35,691	0.063	0.243	0	1
Firstborn	35,691	0.511	0.500	0	1
Out-migration	35,691	0.005	0.068	0	1
Survival to adulthood	35,691	0.911	0.285	0	1
Birth cohort	34,140	5.187	0.982	1	7
Lineage	35,691	3.830	1.351	1	6

Note: 1. Number of zero counts in "Number of sons" is 15,830. 2. Number of zero counts in "Number of marriages" is 10,637. 3. Number of Brothers equals the number of father's sons, which includes the individual himself.
Source: The lineage sample.

Table A3a Rank Distribution by Lineage

Rank	Huang	Que	Zhou	Gu	Zha	Zhuang	Total	Percent
1	1,477	7,092	816	15,951	4,861	3,596	33,793	94.68%
2	5	8	73	73	43	29	231	0.65%
3	2	66	22	23	156	118	387	1.08%
4	1	135	15	52	214	206	623	1.75%
5	8	6	8	38	70	114	244	0.68%
6	0	7	17	43	104	162	333	0.93%
7	0	0	2	11	22	45	80	0.22%
Total	1,493	7,314	953	16,191	5,470	4,270	35,691	100.00%

Source: The lineage sample.

Table A3b Rank Distribution by Sub-periods

Rank	Pre 1400	1400-1499	1500-1599	1600-1699	1700-1799	1800-1899	Post 1900	Total
1	102	373	1,327	4,334	11,621	13,578	922	32,257
2	12	11	20	37	117	34	0	231
3	0	4	73	125	115	67	0	384
4	1	5	14	115	331	148	0	614
5	0	5	19	32	109	78	0	243
6	10	12	11	63	156	79	0	331
7	4	9	8	30	26	3	0	80
Total	129	419	1,472	4,736	12,475	13,987	922	34,140

Note: 34,140 of 35,691 males could be identified with birth cohorts.
Source: The lineage sample.

Table A4 Lineage Distribution by Sub-periods

Lineage	Pre 1400	1400-1499	1500-1599	1600-1699	1700-1799	1800-1899	Post 1900	Total
Huang	3	32	143	301	669	313	0	1,461
Que	31	62	264	949	1952	3,110	819	7,187
Zhou	75	157	178	38	130	278	76	932
Gu	9	112	538	1,624	5,088	7,460	0	14,831
Zha	9	46	285	1,183	2,449	1,466	27	5,465
Zhuang	2	10	64	641	2,187	1,360	0	4,264
Total	129	419	1,472	4,736	12,475	13,987	922	34,140

Source: The lineage sample.

Table A5 Zero Counts of Number of Marriages and Number of Sons by Lineage

Lineage	N Total	N Unmarried males	N Heirless males	% Unmarried males	% Heirless males	% Heirless married males
Huang	1,493	677	843	45.34%	56.46%	20.34%
Que	7,314	2,698	3,283	36.89%	44.89%	12.69%
Zhou	953	334	476	35.05%	49.95%	22.94%
Gu	16,191	3,992	6,777	24.66%	41.86%	22.83%
Zha	5,470	1,563	2,494	28.57%	45.59%	23.85%
Zhuang	4,270	1,302	1,872	30.49%	43.84%	19.20%

Source: The lineage sample.

Table A6a Number of Sons by Social Rank

	N	Mean	Standard Deviation	Minimum	Maximum	% Heirless
Rank 1	33,793	1.073	1.315	0	10	45.89%
Rank 2	231	2.039	1.384	0	6	14.72%
Rank 3	387	2.111	1.546	0	8	12.40%
Rank 4	623	2.199	1.654	0	9	13.48%
Rank 5	244	1.836	1.399	0	8	15.57%
Rank 6	333	2.297	1.693	0	10	9.01%
Rank 7	80	3.375	2.467	0	13	5.00%
Total	35,691	1.132	1.358	0	13	44.11%

Table A6b Number of Marriages by Social Rank

	N	Mean	Standard Deviation	Minimum	Maximum	% Unmarried
Rank 1	33,793	0.769	0.600	0	5	31.16%
Rank 2	231	1.281	0.668	0	3	6.49%
Rank 3	387	1.357	0.681	0	4	1.29%
Rank 4	623	1.371	0.670	0	4	1.28%
Rank 5	244	1.365	0.668	0	4	2.46%
Rank 6	333	1.631	0.911	0	6	0.60%
Rank 7	80	1.938	1.470	1	10	0.00%
Total	35,691	0.804	0.631	0	10	29.60%

Note: 1. The number of marriages is the total number of marriages, including both wives and concubines. 2. The number of males also includes men who died before adulthood.

Table A7 Recorded Number of Sons by Status

	N	Mean	Standard Deviation
Huang Lineage			
Non-gentry	1,477	1.060	1.542
Near-gentry	5	2	1.871
Gentry	11	2.636	1.362
All	1,566	1.025	1.528
Que Lineage			
Non-gentry	7,092	1.304	1.613
Near-gentry	8	2.625	1.996
Gentry	214	3.121	1.811
All	7,314	1.358	1.649
Zhou Lineage			
Non-gentry	816	0.868	1.227
Near-gentry	73	2.164	1.375
Gentry	64	2.156	1.417
All	953	1.054	1.331
Gu Lineage			
Non-gentry	15,951	1.041	1.178
Near-gentry	73	2.055	1.224
Gentry	167	2.072	1.479
All	16,191	1.056	1.188
Zha Lineage			
Non-gentry	4,861	0.976	1.228
Near-gentry	43	1.674	1.507
Gentry	566	2.037	1.468
All	5,470	1.091	1.299
Zhuang Lineage			
Non-gentry	3,596	0.939	1.207
Near-gentry	29	2.069	1.334
Gentry	645	2.071	1.781
All	4,270	1.118	1.374

Note: "Non-gentry" denotes rank 1, "near-gentry" denotes rank 2, and "gentry" denotes ranks 3 to 7.
Source: The Lineage sample.

Appendix B. Robustness checks

B.1 Lifespan

Table B1 Summary Statistics of variables in Robustness checks

Statistics	N	Mean	Std.	Min	Max
Age	11,210	49.951	17.597	1	105
Age-squared	11,210	2804.715	1740.665	1	11025
Number of brothers	35,691	2.706	1.489	1	13
Father social rank	35,691	1.306	1.041	1	7
Status	35,691	1.230	1.190	1	12
Difference in sons	25,478	-0.008	1.757	-9	11
Difference in ranks	25,478	0.007	0.852	-6	6

B.2 Father impacts and family background

Table B2 Negative binomial regression of number of sons of males with age records

	Dependent Variable: Number of Sons		
	(1)	(2)	(3)
Rank 2	1.219***	1.093*	1.089*
	(0.059)	(0.055)	(0.054)
Rank 3	1.276***	1.075*	1.078*
	(0.050)	(0.043)	(0.043)
Rank 4	1.371***	1.138***	1.141***
	(0.045)	(0.039)	(0.039)
Rank 5	1.242***	1.040	1.020
	(0.072)	(0.058)	(0.056)
Rank 6	1.427***	1.057	1.055
	(0.071)	(0.055)	(0.054)
Rank 7	1.758***	1.129	1.129
	(0.160)	(0.115)	(0.112)
Age	1.103***	1.096***	
	(0.004)	(0.004)	
Age-squared	0.999***	0.999***	
	(0.000)	(0.000)	
Age group 15-19			0.174***
			(0.051)
Age group 25-29			1.988***
			(0.195)
Age group 30-34			3.074***
			(0.285)
Age group 35-39			3.959***
			(0.354)
Age group 40-44			4.219***
			(0.373)
Age group 45-49			5.231***
			(0.459)
Age group 50-54			5.194***

			(0.455)
Age group 55-59			5.608***
			(0.491)
Age group 60-64			5.509***
			(0.482)
Age group 65+			5.572***
			(0.481)
Marriages		1.304***	1.293***
		(0.021)	(0.020)
Zi		1.064***	1.065***
		(0.023)	(0.023)
Hao		1.192***	1.188***
		(0.030)	(0.030)
Controls			
Firstborn	N	Y	Y
Out-migration	N	Y	Y
Birth cohort	Y	Y	Y
Lineage	Y	Y	Y
Constant	0.120***	0.103***	0.347***
	(0.014)	(0.015)	(0.051)
N	11,210	11,210	10,976
Pseudo R^2	0.096	0.099	0.105

Note: 1. Males who died after age 15 were selected into this sub-sample. 2. Rank 1 is the reference group. Age group 20-24 is the reference group in column (3). 3. The coefficients in the table are incidence rate ratios (IRR) for the negative binomial model. 4. Robust standard errors are in parentheses. 5. Birth cohort FE in this regression is a set of 50-year intervals. 6.*p<0.1; **p<0.05; ***p<0.01.

B.3 Alternative classification of social status

Table B3a Effects of Fathers on the Recorded Number of Sons, Negative Binomial Regression

	Dependent Variable: Number of Sons		
	(1)	(2)	(3)
Rank 2		1.735***	1.137**
		(0.087)	(0.065)
Rank 3		1.686***	1.060
		(0.070)	(0.049)
Rank 4		1.905***	1.147***
		(0.066)	(0.045)
Rank 5		1.884***	1.082
		(0.105)	(0.063)
Rank 6		2.245***	1.065
		(0.105)	(0.065)
Rank 7		2.880***	1.138
		(0.313)	(0.141)
NBrothers	1.017***	1.016***	1.013***
	(0.005)	(0.004)	(0.005)
Father			
Rank 2	1.456***	1.290***	1.044
	(0.072)	(0.065)	(0.054)
Rank 3	1.436***	1.228***	1.090**
	(0.057)	(0.050)	(0.043)
Rank 4	1.493***	1.227***	1.077**
	(0.047)	(0.041)	(0.034)
Rank 5	1.209***	0.925	0.866**
	(0.073)	(0.057)	(0.057)
Rank 6	1.272***	0.869***	0.811***
	(0.060)	(0.041)	(0.040)
Rank 7	1.850***	1.049	0.921
	(0.114)	(0.067)	(0.065)
Marriages			2.169***
			(0.032)
Zi			1.229***
			(0.018)
Hao			1.190***
			(0.029)
Controls			
Firstborn	N	N	Y
Out-migration	N	N	Y
Survival	N	N	Y
Birth cohort FE	Y	Y	Y
Lineage FE	Y	Y	Y
Constant	1.473***	1.385***	0.014***
	(0.111)	(0.105)	(0.003)
N	34,140	34,140	34,140
Pseudo R^2	0.037	0.042	0.150

Note: 1. Rank 1 is the reference group. 2. The coefficients in the table are incidence rate ratios (IRR) for the negative binomial model. 3. Robust standard errors are in parentheses. 4. *p<0.1; **p<0.05; ***p<0.01.

Table B3b Effects of Differences in Attained Social Ranks on Differences in Net Fertility between Brothers, OLS regression.

	Dependent Variable:		
	Difference in number of sons between brothers		
	(1)	(2)	(3)
Rank difference			
= -1	-0.394**	-0.369**	-0.407**
	(0.179)	(0.179)	(0.175)
= -2	-0.412**	-0.412**	-0.444***
	(0.163)	(0.165)	(0.167)
= -3	-1.049***	-1.033***	-1.066***
	(0.162)	(0.162)	(0.162)
= -4	-0.226	-0.218	-0.239
	(0.194)	(0.195)	(0.199)
= -5	-0.843***	-0.854***	-0.812***
	(0.243)	(0.247)	(0.250)
= -6	-1.351***	-1.356***	-1.533***
	(0.468)	(0.474)	(0.518)
= 1	0.499***	0.528***	0.547***
	(0.138)	(0.140)	(0.140)
= 2	0.506***	0.510***	0.519***
	(0.163)	(0.159)	(0.153)
= 3	0.964***	0.977***	0.947***
	(0.145)	(0.147)	(0.150)
= 4	0.813***	0.812***	0.793***
	(0.175)	(0.175)	(0.179)
= 5	1.609***	1.632***	1.620***
	(0.218)	(0.222)	(0.245)
= 6	2.684**	2.693**	2.689**
	(1.159)	(1.167)	(1.187)
Controls			
Father ranks	Y	N	Y
Birth cohort FE	Y	Y	Y
Lineage FE	Y	Y	Y
Constant	-0.001	-0.075	-0.058
	(0.230)	(0.261)	(0.261)
N	24,594	24,632	24,594
R-squared	0.019	0.020	0.021

Notes: 1. Rank difference=0 is the reference group. 2. The coefficients in columns 2 and 3 are incidence rate ratios (IRR) for the Poisson model and the negative binomial model. 3. Robust standard errors in parentheses, clustered on fathers (8,445 clusters). 4. *p<0.1; **p<0.05; ***p<0.01.

B.4 *Marriages* as an ordinal variable

Table B4 Alternative Classification of Social Status

Status	Count	Percent	Description
1	33,793	94.68%	No status; honoured by later generations with poems or prose discourses
2	188	0.53%	Literate and educated but without degree (teacher of the village or editor of genealogical books); lineage chief; donor to the lineage and the county
3	487	1.36%	Lower degree holder (normal *shengyuan* and civil *shengyuan*)
4	522	1.46%	Students at the Imperial Academy (lower degree)
5	34	0.10%	Intermediate/high degree holder (*juren*, *gongsheng*, *jinshi*), but no official position
6	64	0.18%	Awarded by the emperor with official titles, with no academic degree
7	119	0.33%	Prospective officials (*houbu*)
8	91	0.25%	Clerks (*wei'ruliu*); the lowest-ranking official (*cong jiupin*), with no degree
9	106	0.30%	Low-/medium-ranking local official and low-ranking court official, with no academic degree record or normal and civil *shengyuan* degree
10	128	0.36%	Low-/medium-ranking local official and low-ranking court official, with degree of studentship at the Imperial Academy
11	82	0.23%	Low-/medium-ranking local official and low-ranking court official, with intermediate/high degree
12	77	0.22%	High-ranking local official and medium/high-ranking court official

Table B5 Effects of Status on the Recorded Number of Sons, Negative Binomial Regression

	Dependent Variable:			
	Number of Sons			
	(1)	(2)	(3)	(4)
Status 2	1.899***	1.881***	1.481***	1.135**
	(0.096)	(0.106)	(0.081)	(0.073)
Status 3	1.996***	1.859***	1.398***	1.097**
	(0.068)	(0.068)	(0.050)	(0.044)
Status 4	2.039***	2.000***	1.513***	1.122***
	(0.069)	(0.070)	(0.054)	(0.047)
Status 5	1.782***	1.689***	1.323**	0.962
	(0.228)	(0.223)	(0.171)	(0.154)
Status 6	2.156***	1.971***	1.524***	1.273**
	(0.181)	(0.180)	(0.140)	(0.142)
Status 7	1.496***	1.805***	1.263***	0.952
	(0.118)	(0.149)	(0.101)	(0.073)
Status 8	1.782***	1.963***	1.464***	1.048
	(0.120)	(0.150)	(0.106)	(0.092)
Status 9	1.891***	2.014***	1.541***	1.048
	(0.152)	(0.162)	(0.118)	(0.109)
Status 10	2.483***	2.582***	1.781***	1.009
	(0.161)	(0.169)	(0.120)	(0.098)
Status 11	2.092***	2.190***	1.559***	1.048
	(0.130)	(0.152)	(0.114)	(0.107)
Status 12	3.087***	2.801***	1.927***	0.999
	(0.260)	(0.287)	(0.205)	(0.129)
Marriages				2.175***
				(0.032)
Zi			1.389***	1.234***
			(0.020)	(0.018)
Hao			1.353***	1.194***
			(0.031)	(0.029)
Controls				
Zi	N	N	Y	Y
Hao	N	N	Y	Y
Firstborn	N	N	Y	Y
Out-migration	N	N	Y	Y
Survival	N	N	Y	Y
Birth cohort	N	Y	Y	Y
Lineage	N	Y	Y	Y
Constant	1.073***	1.422***	0.015***	0.015***
	(0.007)	(0.107)	(0.003)	(0.003)
N	35,691	34,140	34,140	34,140
Pseudo R^2	0.008	0.041	0.093	0.151

Note: 1. Status 1 (commoners) is the reference group. 2. The coefficients in the table are incidence rate ratios (IRR) for the negative binomial model. 3. Robust standard errors are in parentheses. 4.*p<0.1; **p<0.05; ***p<0.01.

Table B6 Wife Groups and Distribution

Wife groups	Number of marriages	N	%
0	0	10,566	29.60
1	1	22,105	61.93
2	2	2,575	7.21
3	3	366	1.03
4	>4	79	0.22
Total		35,691	100.00

Table B7 Effects of Rank and Wife on the Recorded Number of Sons, OLS and Negative Binomial Regression

	Dependent Variable: Number of Sons		
	(1) OLS	(2) Negative Binomial	(3) Negative Binomial (Married males)
Rank 2	0.398***	1.232***	1.232***
	(0.086)	(0.053)	(0.060)
Rank 3	0.274***	1.145***	1.145***
	(0.075)	(0.041)	(0.043)
Rank 4	0.382***	1.198***	1.198***
	(0.065)	(0.037)	(0.036)
Rank 5	0.150*	1.121**	1.121**
	(0.085)	(0.053)	(0.055)
Rank 6	0.463***	1.291***	1.291***
	(0.090)	(0.053)	(0.052)
Rank 7	1.246***	1.611***	1.611***
	(0.264)	(0.132)	(0.105)
Wife Group 0	-1.454***	0.0003***	
	(0.012)	(0.000)	
Wife Group 2	0.238***	1.144***	1.144***
	(0.030)	(0.018)	(0.018)
Wife Group 3	0.499***	1.251***	1.251***
	(0.086)	(0.047)	(0.045)
Wife Group 4	1.145***	1.528***	1.528***
	(0.256)	(0.125)	(0.100)
Controls			
Zi	Y	Y	Y
Hao	Y	Y	Y
Firstborn	Y	Y	Y
Out-migration	Y	Y	Y
Survival	Y	Y	Y
Birth cohort FE	Y	Y	Y
Lineage FE	Y	Y	Y
Constant	1.910***	0.234***	0.235***
	(0.098)	(0.039)	(0.043)
N	34,140	34,140	23,884
R-squared/Pseudo R^2	0.357	0.261	0.043

Note: 1. Rank 1 and wife group 1 are the reference groups. 2. Robust standard errors are in parentheses in column. 3. The coefficients in column (2) and (3) are IRR. The coefficients in column (3) are incident rate ratios. 4. *p<0.1; **p<0.05; ***p<0.01.