Human Capital Strategies for Big Shocks: The Case of the Fall of the Ming*

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June 30, 2023

Abstract

Do big shocks have long-lasting effects on economic fortunes, or are they short-lived? Studying the 1644 fall of the Ming Dynasty, which cost the lives of 1/7 of China's population, we revisit this question by using micro data on seven linked generations to trace out the impact of the shock in a sample from Central China. Comparing families subject to the shock with others that were not, the paper shows that the fall of the Ming significantly impacted human capital acquisition over more than 300 years by reducing it on impact while raising it in the long run. This reversal of human capital emerges due to a greater preference for human capital of those who experienced the shock, and this change in attitude is transmitted from one to the next of their future generations. In support of this explanation we present evidence that relative to before the shock, intergenerational upward human capital mobility rises and downward mobility falls for historically treated family lines. Much of the long-run human capital response is accounted for by the behavior of family lines; in contrast, whether a family currently lives in a historically treated region or not plays a negligible role. Group effects at the clan level reinforce this shift towards greater human capital preference, which is also supported by the families' migration and fertility responses.

Keywords: Intergenerational Response, Persistence, Chinese Clans, Kin-based Externalities

*Thanks to David Autor, Lee Branstetter, Richard von Glahn, Jack Goldstone, Marco Tabellini, and participants at the CEPR-Manchester China conference, Hong Kong University China and the Global Economy conference, the NBER China Spring conference, the New Economic History of China Northwestern conference, the Gevena CEPR Economic History Symposium, and the Warwick CAGE Summer school for comments and suggestions. Matt Butner's contribution to this work at an early stage is appreciated. Shiue acknowledges support from the National Institutes of Health (NICHD) through Award HD 042731-01 "Intergenerational and Interfamily Economic Links".

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1 Introduction

Do big shocks have persistent effects, or are the effects from big shocks transitory? While later-day outcomes can often be related to events in the distant past, in other cases big shocks have only temporary effects. Different development paths following the Black Death, for example, explain the persistent advantage of northwestern over southern Europe (Pamuk 2007), in contrast to the atomic bombing of Hiroshima and Nagasaki which did not produce a lasting change to Japan's city size distribution after 1945 (Davis and Weinstein 2002). A key challenge for understanding how big shocks impact an economy is that available data over the relevant horizon–potentially centuries– is rare. This paper makes progress by distinguishing the impact on people from the impact on regions through utilizing intergenerationally linked family data over three-hundred years after the transition from the Ming to the Qing, a shock that cost the life of 36 million people, one in every seven Chinese (see Figure A.1).

We examine the impact of the Ming shock on human capital acquisition and other population responses. Employing linked data on seven generations improves our understanding of a shock's impact on regions versus its impact on people because those who move from one location to another can be accounted for in the unique dataset that we analyze in this paper. The setting provides information not only on individuals but also the roles of couples and extended families, or clan, which is significant given the importance of kinship relationships in many parts of the world. The fall of the Ming is also a suitable natural experiment because in its aftermath China was a relatively stable, pre-industrial economy with no major subsequent shock for two centuries.[1]

The fall of the Ming is examined in terms of 490 couples of Tongcheng, a county of China's province of Anhui, as well as the couples formed by all of their male descendants of the next four generations (great-great-grandfather to son). The sample has about 16,000 observations on individuals from seven clans, spanning more than three hundred years.[2] The fall of the Ming had a regionally diverse impact in China. In Tongcheng, it was severe, including death and destruction through military campaigns as well as famines. In the sample, death rates roughly tripled while birth rates fell by one third, and the fall of the Ming reduced the size of the sample by about 50% over the period 1625 to 1650 relative to pre-1620 trend growth.

[1] Major change came in the middle of the 19th century. The First Opium War (1839-42) initiated an era of colonial intervention in China, and the Taiping Rebellion of 1850-64 ranks high among the largest civil wars in world history.

[2] Chinese clans are also referred to as lineages and common descent groups.

Employing a difference-in-differences approach, we begin by comparing the behavior of couples living in heavily destroyed regions during the shock with the behavior of couples living in less destroyed regions. This familiar analysis of impact by region is then combined with a less common analysis of treatment by person, where all descendants of those living in historically destroyed regions are defined to be treated persons, while all descendants of those in historically not destroyed regions are not treated (or, control) persons. The analysis plausibly estimates causal impacts over five generations. The shock was arguably exogenous and random from the point of view of those living in Tongcheng at the time, and an analysis of the two generations living before the fall of the Ming finds no evidence for significant differences between treated and control groups in the pre-shock period. The time horizon of the impact of the shock is temporary or persistent depending on whether its impact on a specific post-shock generation, one to five, is significant or not. In addition to human capital acquisition as the main outcome we are particularly interested in the families' migration response to the fall of Ming destruction. A formal framework in which parents can invest into the human capital of their child in the form of foregone consumption and outmigration is presented in section B.

We find that the shock has a negative impact on the human capital acquisition in the first generation (also referred to as treatment generation). Men living in towns and villages destroyed by the fall of the Ming find it difficult to acquire human capital compared to those in not destroyed areas. This is consistent with historical evidence on military activity, destruction, and famines slowing down the acquisition of human capital. Moreover, the impact is sizable. For every three men acquiring human capital in the not destroyed areas, only two do so in the destroyed areas. However, the negative impact on human capital does not persist. Instead, by the third generation (the treatment couples' grandsons), those with ancestors that lived in historically destroyed areas acquire more human capital than those with ancestors in historically not destroyed areas. Furthermore, this positive human capital impact persists to the fifth generation, which includes individuals living 250 years after the fall of Ming. In this case, the long-run impact of the shock is quite different from a faded version of its short-run impact.

The human capital reversal finding is robust to accounting for secular changes over centuries, as well as to controlling for heterogeneity across clans, such as that some men are from richer clans than others, and also have wives that in-marry from a different set of clans than other men. Furthermore, the human capital response over generations is confirmed for subsets of the sample in which individuals are in key dimensions, such as residence in the treatment generation, clan membership, and lifetime, more similar to each other compared to individuals in the overall sample. We also find similar results for alternative definitions of human capital, and the analysis accounts family lines that are cut off because the shock led disproportionately to early childhood death and non-marriage–hence, no intergenerational link–among the descendants of treated couples.

To explain the reversal in human capital, we postulate that the destruction of arable land has led to a greater preference for human capital for those first-hand affected by the fall of the Ming, and that these families have transmitted this change in norms from one generation to the next. Two sets of evidence are presented in support of this hypothesis. First, in the post-shock era, descendants of treated couples exhibit both a higher rate of intergenerational upward mobility and a lower rate of downward mobility than descendants of control couples. Moreover, among descendants of treated couples, sons' human capital acquisition benefits from both father and grandfather human capital, while descendant sons of control couples do not. Both of these findings are consistent with a greater emphasis on human capital for descendants of treated couples. Furthermore, the intergenerational transmission within the nuclear family is supported at the level of the clan which provides positive externalities for human capital acquisition as well as movements between villages.

Second, the shock's impact on human capital over any time horizon is almost entirely accounted for by the impact on treated couples and their descendants. Results on human capital are virtually unchanged when we distinguish those that currently live in historically destroyed regions from those that have moved to historically not destroyed regions. This is what one would expect if a change in norms is transmitted among people from one generation to the next, irrespective of where families currently live. We also explore the possibility that the fall of Ming shock has affected other norms in the same way that it did for human capital. However, there is no evidence for similarly large differences between treatment and control descendants using measures related to income, health, and attitudes towards risk.

This paper connects to several literatures. First, it is part of a large literature studying the impact of historical interventions for important questions of long-run economic impact. It has been shown, for example, that the Great Potato Famine (1845-52) has caused a permanent effect on Ireland's economy related to outmigration to the United States (O' Grada and O'Rourke 1997), and that environmental catastrophe of the 1930s American Dust Bowl has caused long-run population impacts across the Plains during the 20th century (Hornbeck 2012).[3] By connecting the distant past with periods much later using longitudinal data at the individual level, this study complements existing studies using cross-sectional analysis at different points in time with evidence that has been rarely employed to date. The present paper also contributes to the literature by studying the impact of civil war in a smaller area of a large country on which still relatively little is known.

Second, this paper relates to a large and growing literature showing that later-day outcomes are driven by events in the distant past–a literature commonly referred to as persistence studies (including Dell 2010, Nunn and Wantchekon 2011, and Voigtländer and Voth 2012).[4] Our human capital results parallel recent work by Becker, Grosfeld, Grosjean, Voigtlaender, and Zhuravskaya (2020) who show that uprootedness leads to investment in human capital among Poles that were resettled after WWII. It is also related to Lowes, Nunn, Robinson, and Weigel's (2017) analysis of migrants to infer the impact of the norms of Central Africa's Kuba kingdom on the behavior of its descendants. By employing intergenerational data on historical human capital, the present paper strengthens the evidence on the intergenerational transmission of changed norms following a shock by documenting that treatment descendant generations exhibit more upward and less downward mobility than others in the post-shock era. Moreover, information on migration allows us to assess the importance of impact by region versus impact by person, which is important because virtually all persistence studies exploit cross-sectional differences across regions as the main source of variation.[5]

Third, this paper contributes to a sizable literature in fields including labor, education, health, and public finance that uses intergenerational data to study important questions.[6] It is most closely related to research based on inter-generational analysis in historical settings, such as the intergenerational mobility of children of immigrants since 1880 in the United States (Abramitzky, Boustan, Jácome, and Pérez 2021) or the role of mechanization of 20th century U.S. agriculture on outcomes of farm children (French 2022). Most intergenerational analysis relies on official data, such as the surveys from metropolitan Malmo (Sweden; Lindahl, Palme, Sandgren-Massih, and Sjogren 2014) or US census records. Instead of official (state) data, which is not systematically available for China during the sample period, this paper

[3]Nunn (2020) provides an overview.

[4]For a review, see Voth (2020).

[5]See also Hornbeck (2012) and Boustan, Khan, and Rhode (2012) on migration responses to shocks.

[6]Oreopoulos, Page, and Stevens (2008) and Hilger (2016) study the inter-generational effects of parental job loss, McCord, Bharadwaj, McDougal, Kaushik, and Raj (2021) examine *in utero* health effects of the Bhopal Gas accident, and Chetty, Hendren, Kline, and Saez (2014) investigate the geography of intergenerational mobility in the United States, for example.

employs a trove of information in genealogies, a privately-held source of socio-economic data in China. Our approach parallels in this respect recent work on intergenerational mobility in the 20th century US that relies on self-reported family data (Jácome, Kuziemko, and Naidu 2022).[7] This study shifts the focus from two generations (Shiue 2017, 2023) to the causal impact of a big shock over more generations.[8] Representativeness is always a concern with relatively small samples, and in the present study they are addressed in part using variation across seven quite different clans. Genealogical data also allows to quantify the role of clans in the response to big shocks, which is important from a comparative perspective with European guilds (De La Croix, Doepke, and Mokyr 2018).

The remainder of the paper is as follows. Section 2 provides an historical overview on the fall of the Ming and how it has affected China as a whole as well as the area of study, Tongcheng county. Section 3 introduces our data by laying out population dynamics in the sample, as well as presenting our approach of comparing families living in destroyed versus less destroyed villages. Section 4 shows results on the impact of the fall of the Ming in the long-run in a sample with six linked generations, and also quantifies the impact of the shock on the length of family lines. Section 5 presents evidence on the proposed mechanism for the main result, that the fall of Ming shock has increased the preference for human capital acquisition in those affected as well as their descendants, and discusses other potential explanations. Section 6 summarizes our findings and presents some preliminary conclusions. The Appendix presents a simple model of parental investments into their children to help interpreting the results, and it provides more information on the data as well as supplementary empirical results.

2 The Fall of the Ming: Background

Several factors contributed to the collapse of the Ming dynasty in the mid-17th century. They include a decline in the fiscal accounts of the state that was hastened by corruption within the state and military and the increasing expenditures of the imperial court. A series of natural catastrophes in the late 1620s and 1630s increased the price of grain, leading to famine, epidemics, and crises (Brook 2010). International

[7] Lindahl, Palme, Sandgren-Massih, and Sjogren (2014) add parish data to the Malmo surveys to extend temporal coverage. Bailey, Cole, Henderson, and Massey (2020) and Abramitzky, Boustan, Eriksson, Feigenbaum, and Perez (2021) present overviews of recent work linking US censuses. Another approach is to employ pseudo intergenerational links based on surnames (Clark 2014, Güell, Rodriguez Mora, and Telmer 2015, and Barone and Mocetti 2021).

[8] Shiue (2017) examines changes in the child quantity-quality trade-off while Shiue (2023) investigates trends in intergenerational mobility during the Ming and Qing dynasties using related genealogical data.

affairs played a role as well. Prior to the 1630s and 1640s, about half of the silver mined in Japan and the New World ended up in China, but by the end of the Ming, ongoing military campaigns and an international economic depression led to a shortage of silver in China, which, according to some analysts, was associated with increased demand for taxes and economic depression in China. These downturns were compounded as banditry increased, and as Ming and Qing armies fought to win control over the empire. Finally, climatic conditions contributed to the fall of the Ming (Lee and Zhang 2013).

Throughout China's history, dynastic transition usually entailed violence and political fighting, but even by these metrics the end of the Ming Dynasty in 1644 was an exceptionally devastating interlude. Ge (1999) estimates that during the Ming-Qing transition, population dropped from 221 million in the year 1630 to 185 million in 1680 (see also Cao 2022). In the twenty years between 1626 to 1646, China experienced a reduction of more than 11% of its population (Lee and Zhang 2013). Other sources hold that the fall of the Ming Dynasty began with the campaign of the Jin khan Nurhaci against the Ming that resulted in the capture of Fushun (Liaoning province) in 1618. Irrespective of the particular source, the fall of the Ming ranks among the largest negative shocks in world history, especially among those not caused by a pandemic.

The impact of the fall of the Ming on China varied across regions. During the final decades of the Ming dynasty, Tongcheng county, in which our seven clans lived, witnessed many local uprising, including by a former serf, Chang Ju, in 1634.[9] The eventual attack on Tongcheng's capital initiated ten years of violence, bloodshed, and devastation in the county. Moreover, the new rulers, the Qing, came from the North, while the Ming Dynasty was defended from the South, so that a central region such as Tongcheng was naturally a place where the armies would meet. In particular, Tongcheng became a battleground because it lies directly in the path of the great armies of the north-west, notably that of Chang Hsien-chung, the so-called butcher of Sichuan. As a consequence, there was a "succession of sieges and battles, the comings and goings of government and rebel troops [...], famines, and plagues", and during this period almost all rich families had their property burned and plundered (Beattie 1979, p.45).

A common response to the fall of the Ming turmoil, especially by the relatively wealthy, was to flee. Taking advantage of the fact that Tongcheng is located just north of the Yangzi, as early as 1636 many of Tongcheng's residents had fled south across the river, and by 1642, more than half of Tongcheng's gentry

[9] See Beattie (1979), pp. 44-48.

was gone (Beattie 1979).[10] Another common response was to move to the capital city of Tongcheng, which was protected by a city wall since 1576 (Beattie 1979, p. 43). By 1642, the siege of this city by Chang Hsien-chung and his army meant that the city's wells were polluted, pestilence was spreading, and food was in such short supply that people were reduced to eating the flesh of corpses. When the situation further deteriorated, the people in the city were preparing to kill themselves and their wives if help did not arrive. Troops of the Manchu conquerors (the Qing) finally arrived in 1645, which stopped the situation from further deteriorating.

Though information varies, by all accounts the conditions in Tongcheng in 1645 after peace returned were desolate, with a huge loss of life and laying waste of land. The registered population of Tongcheng county fell by 57% between 1631 and 1645.[11] While there is little question on the scale of destruction during the fall of the Ming in Tongcheng, the long-run impact of the shock on the economic fortunes of Tongcheng remains unclear. Evidence is limited, but what there is suggests that conditions in Tongcheng started to improve in the 17th century. By the year 1672, the officially registered population had recovered about half way from its low in the year 1645, and it the first couple of years of the Qing dynasty about 1/3 of the land that was devastated by the destruction was being added back to the tax records, an indication that agricultural production on it might have had resumed.

Furthermore, the impact of the shock on *relative* fortunes of Tongcheng families is unclear too. Exploiting variation across Tongcheng families that were more versus less heavily affected by the shock, we will examine whether the shock had temporary or long-run effects on the economic fortunes of multiple generations of these families, and if so, what the main mechanism was.[12]

[10]Some of them went down the Yangzi river to Nanking to stay there for the duration of the turmoil, while others only took their families to safety but returned themselves to look after their interests (ibid.).

[11]Beattie (1979), page 133. Since the major population census in 1383, counts of population levels fell behind in China, however, this estimate for the population *change* in population between 1631-45 gives evidence on the order of magnitude of the shock.

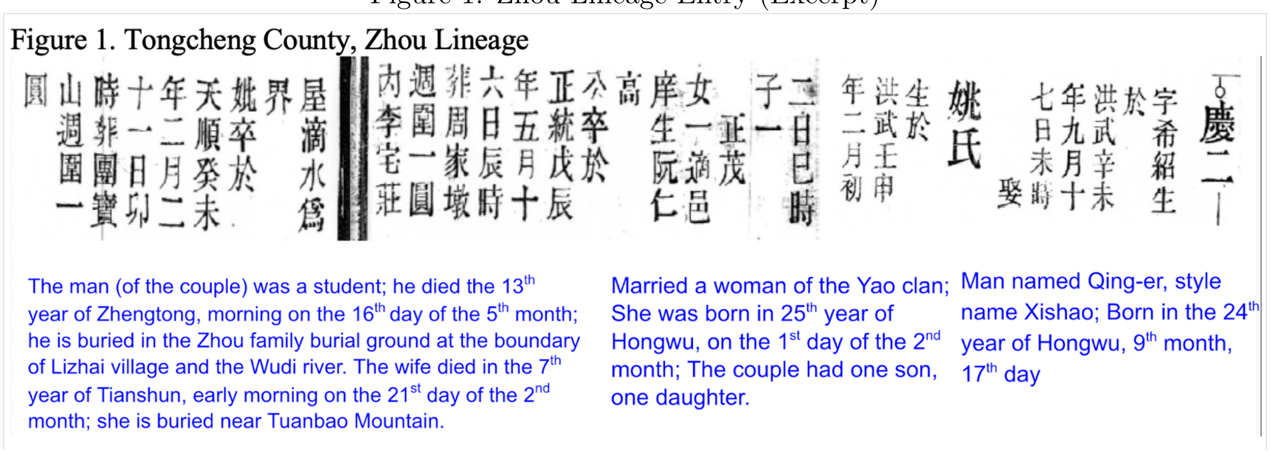
[12]Another source of heterogeneity in the impact of the shock are individual- or clan differences in resources. For example, there is anecdotal evidence that some of Tongcheng's rich who had escaped during the shock were able to reclaim their property without difficulties, and the rich may have been more able than the poor to take over the possessions of families whose houses were empty because their owners had fled or were killed (Beattie 1979, p.47, 161). We examine such heterogeneity in Tables A.8 and A.9.

3 Data

3.1 Genealogies as Data Source

This study uses genealogical data for seven male clans in Tongcheng county, part of Anhui province. Genealogies, essentially annotated family trees, are a classic source of socio-economic data for China. Recent estimates put the number of genealogies currently existing into the tens of thousands (Wang 2008), and dozens of them have been employed for Tongcheng by earlier researchers including Beattie (1979). Because documenting intergenerational links is a key purpose, genealogies are particularly useful in the present context because they yield longitudinal information on economic responses over the long term. Figure 1 shows part of the Zhou genealogy. In addition to the record of time of birth and death, as well as achievements, marriage and children, genealogies typically provide information on the location of the burial site. Since compiling a genealogy requires literacy, which is increasing in income, selection on income is a generic concern that will be discussed below.

Figure 1: Zhou Lineage Entry (Excerpt)



Notes: Authors' analysis of the genealogy of the Zhou clan.

Human capital in this analysis is an indicator that a man acquired a substantial amount of skill during his lifetime or not. This includes all men who prepared for and passed China's civil service entrance exam at either the local, provincial, or national level; in the example above, for example, the man passed the local exam and was an official "student" preparing for higher-level exams. This exam was the primary standardized form of skill acquisition during the sample period, and it was the main gateway to status and wealth in China. We also treat men who prepared for but did not pass the exam as having acquired human capital. Furthermore, men coded with human capital include those who were known to be educated or scholars independent of the civil service examination. Table A.1 provides additional information on our measure of human capital.

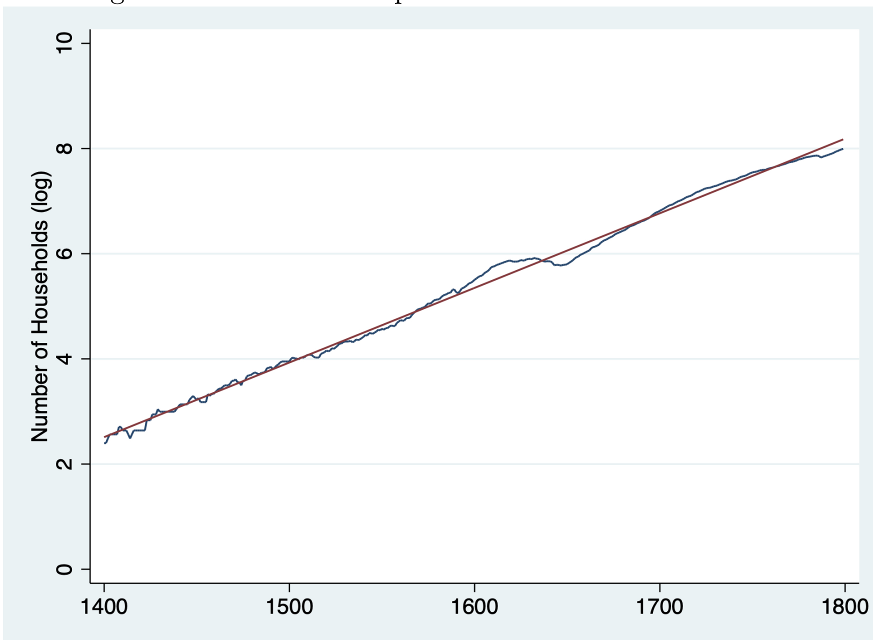
Genealogical information might, of course, be inaccurate. Specifically, the information is self-reported, and there are no penalties for misrepresentation. At the same time, Chinese genealogies served a number of important functions beyond ancestral worship that would require accurate information. First of all, property rights turn on information recorded in genealogies, because they establish and sustain village settlement rights for specific clans. Second, genealogies are critical as a means of defense, including war, because by determining who is member of the clan and who is not it defines allegiances, rights, and responsibilities in times of conflict (both versus other clans and versus the government). Third, genealogies provide information on taxation and public goods provision. On the one hand, the state delegates to local clans the right to tax as well as the responsibility to fund public works such as irrigation. On the other hand, a clan's genealogy would specify assessments (essentially taxes) on their members to found and maintain common clan property. Given these economic functions for the clan *a priori* one would expect the data to be accurate. Below the specific sample underlying this research is analyzed, including a discussion of possible bias and selection (section 4.4).

3.2 Clan Population and the Fall of the Ming

Figure 2 shows the evolution of the population based on the seven Tongcheng clan genealogies between 1400 and 1800, as measured by the number of heads-of-households. Growth of the population is relatively steady over this period, with the exception of the dip due to the Ming-Qing transition. For this period, official data by the state for Tongcheng county exists only sporadically (see Figure A.2).

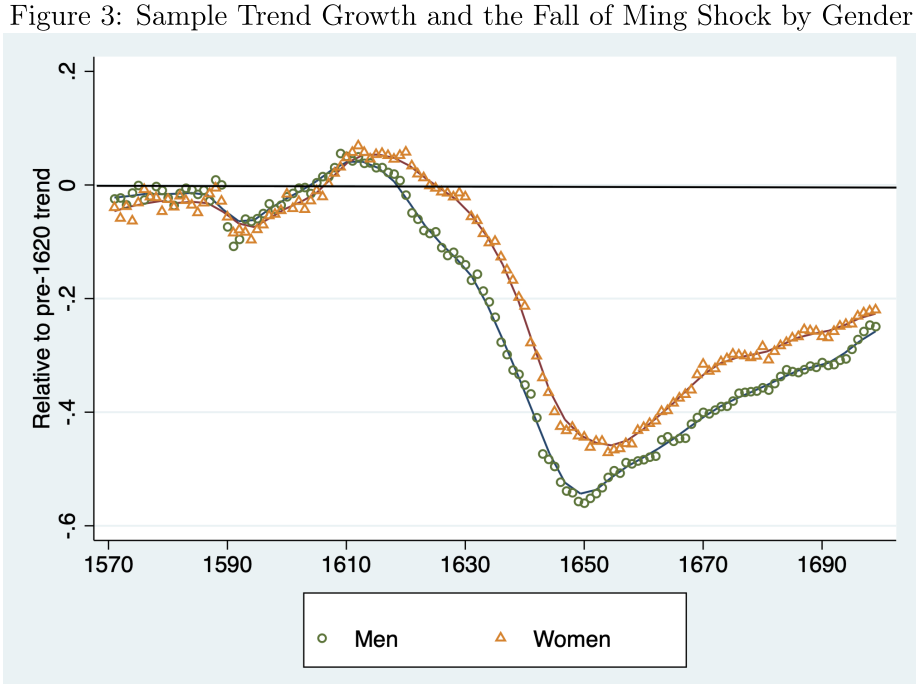
Figure 3 shows the population response around the fall of the Ming relative to the pre-1620 trend for both men and women. Growth for both gender is relatively close to the pre-shock trend until the year 1620. Between 1620 and 1650, the male population falls by more than 50% relative to pre-shock trend growth, before it slowly recovers. The onset of the female population decline is somewhat later, and its trough is with around 45% somewhat above that for men. This might be due to men being more vulnerable to war activity or food crises compared to women.

Figure 2: Seven Clan Population between 1400 and 1800



Notes: Household population, measured annually as log number of male heads-of-households in the seven clans.

Figure 3: Sample Trend Growth and the Fall of Ming Shock by Gender



Notes: Figure shows the log difference between male (female) population and its trend fitted on pre-1620 data with circles (triangles).

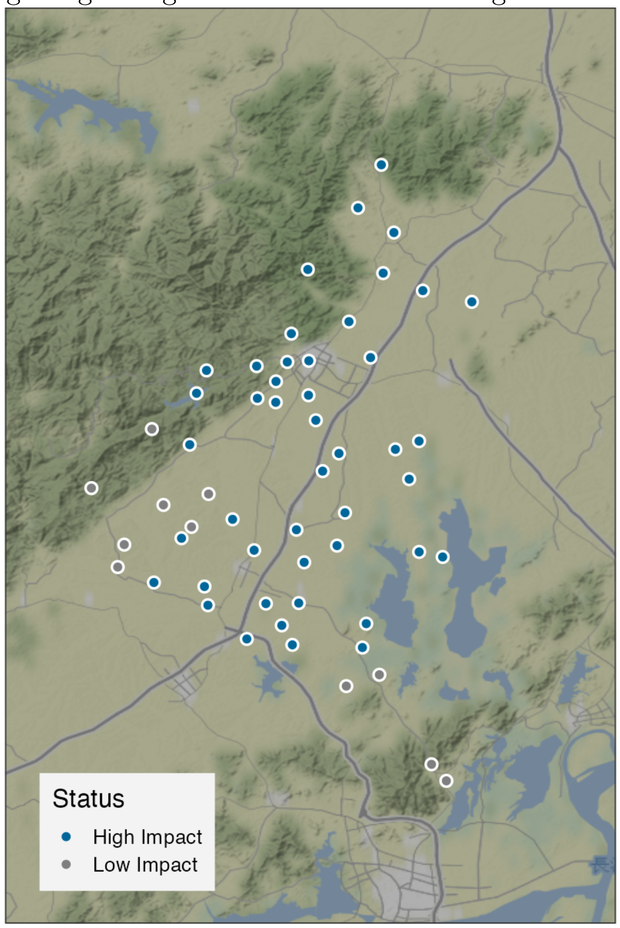
Even by the end of the 17th century the number of both men and women remains more than 20% below the trend. Figures 2 and 3 confirm that population figures from the seven male clans capture the

Ming-Qing transition as a major shock in the Tongcheng area. A relatively small number of vital statistics are estimated for both men and women, mostly based on life tables. We have verified that this estimation of data does not affect our key results (see Figures A.8, A.13).

3.3 Definition of Treatment

We define as first (or treatment) generation to be those couples in which the male was born between the years 1590 and 1644. This is motivated by historical accounts that heavy destruction took place in Tongcheng especially during the final ten years of the Ming dynasty (Beattie 1979), and it means that it covers males that were 44 years old or younger at the onset of the particularly heavy destruction starting in 1634. Thus, the lifetime of the great majority of individuals and families would have been affected by the fall of the Ming. It is shown below that the results are robust to alternative assumptions on treatment generation definition (Table 5). The size of the treatment generation is 490 couples. The couples of the treatment generation were living in the towns and villages of Tongcheng county shown in Figure 4 (the Yangzi river is shown in the lower right).

Figure 4: Tongcheng Villages and Destruction during the Fall of the Ming



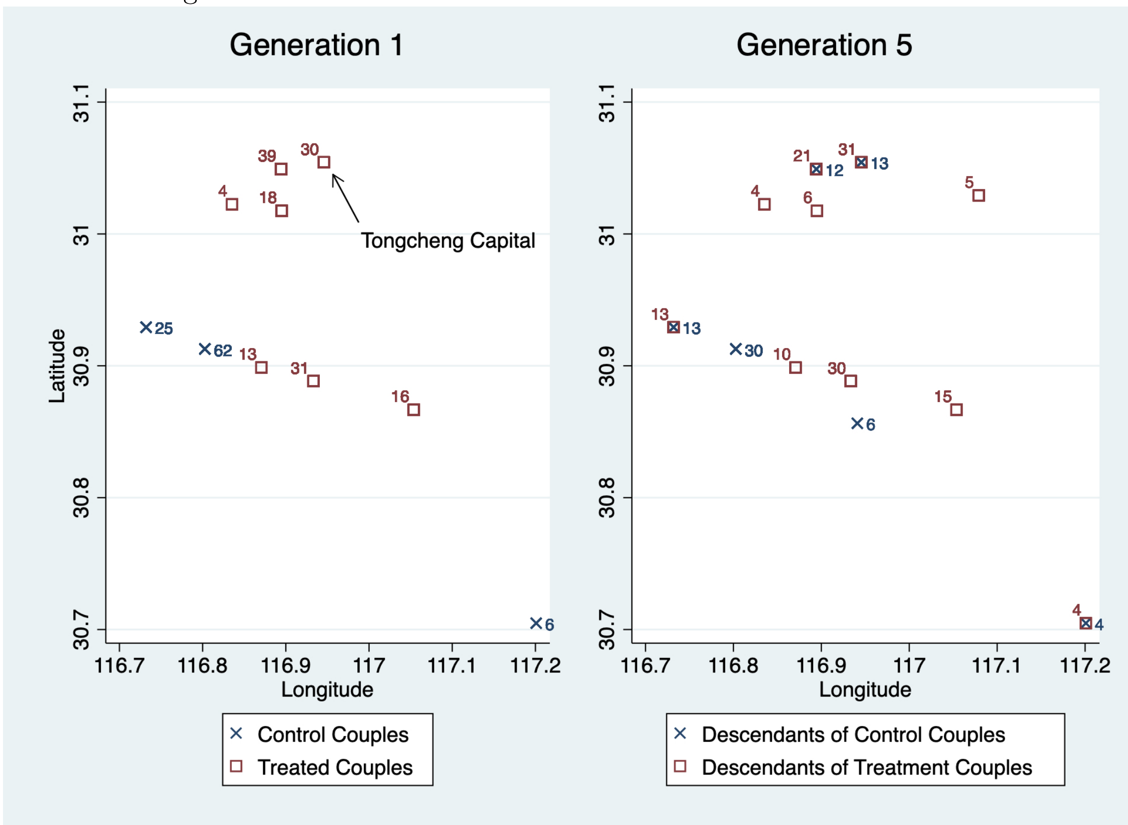
Notes: Figure shows the villages of Tongcheng country in which the treatment generation couples lived. High Impact is defined as at least moderately destroyed (treated), while Low Impact is defined as little or not destroyed (control). One village with low impact in remote eastern area not shown. Source: Telford (1992).

Spatially, treatment is defined at the level of the village in which each couple lived during the fall of the Ming. Employing data on the level of destruction of Tongcheng during the years 1635 to 1645 based on crisis mortality (Telford 1992), treatment is an indicator variable that is one if a village has been at least moderately destroyed ("High Impact" in Figure 4), and zero otherwise. About three quarters of villages were destroyed in this sense. The majority of towns and villages that escaped destruction are located in the less central and more mountainous areas of Tongcheng, in line with rugged terrain making it more difficult to persecute people (Nunn and Puga 2012).

The distinction of treatment and control locations in Figure 4 parallels that in long-run studies using cross-sectional variation across geographic space. Here, it is combined with historical information on individuals: 89% of the couples that lived through the fall of the Ming resided in towns and villages that were destroyed (436 out of 490 treatment generation couples), while 11% of couples did not. This is in line with historical accounts that the Ming-Qing transition took a heavy toll in Tongcheng. It also reflects that the population in Tongcheng, like in many other areas, tended to live in the relatively central and less rugged locations.

The couples of the fall-of-Ming generation are linked forward to the next four patrilineal generations, and the definition of treatment is extended from the first to these four following generations. Thus, in addition to the definition of treatment in a spatial sense (Figure 4), we employ a definition of treatment in terms of people, namely whether a particular individual is a descendant of a person who resided in a destroyed area during the fall-of-Ming generation. In the first generation, treatment in terms of people is identical to treatment in terms of regions, but starting in the second generation the two definitions differ due to migration. Figure 5 illustrates this using the towns and villages of the Ma clan in the first and fifth generation.

Figure 5: Locations of the Ma Clan: First and Fifth Generation



Notes: Left panel shows locations of the Ma couples in the first (treatment) generation, with squares (crosses) indicating those living in destroyed (undestroyed) locations. Right panel shows locations of the 5th generation descendants of those in the right panel, with squares indicating those descendants whose ancestors resided in generation 1 in destroyed locations. Numbers indicate the number of heads-of-households of a particular type in that location.

The left side of Figure 5 shows that the members in the Ma clan in the first generation resided in a total of ten towns and villages. The numbers give the number of males, for example, 30 Ma men of this generation resided in the capital of Tongcheng county (indicated in the upper part of Figure 5, left panel). The figure distinguishes treated from control couples, which are marked as squares and crosses, respectively. In the first generation, treatment and control couples never live in the same location. This is by construction because the distinction of treatment versus control couples is based on each location's level of destruction; as Figure 5 confirms, the level of destruction was higher in the more central towns and villages of Tongcheng than in the more peripheral areas (control villages are only in the far west and south-east of the figure).

The right panel of Figure 5 shows the locations of male Ma clan members in the fifth generation. It illustrates the migration of Ma clan members, whose ancestors were either in the treatment or control sample. For example, in the fifth generation, 13 descendants of control couples live in the capital of Tongcheng. Furthermore, 13 fifth-generation descendants of control couples reside in the western-most Ma location, which is a village that was not heavily destroyed during the fall of the Ming. There is a certain level of locational persistence from the first to the fifth generation, at the same time when there are distinct migration patterns. For example, descendants of control couples do not move into the northern part of Tongcheng county, unless it is the capital or its immediate vicinity. For the sample as a whole, families move in 19% of all transitions from one generation to the next. This migration information will allow us to estimate two types of long-run treatment effects of the fall of the Ming, the impact on those living subsequently in historically treated regions, and the effect of the shock on those that are descendants of historically treated people. Only the first of these has been analyzed frequently.

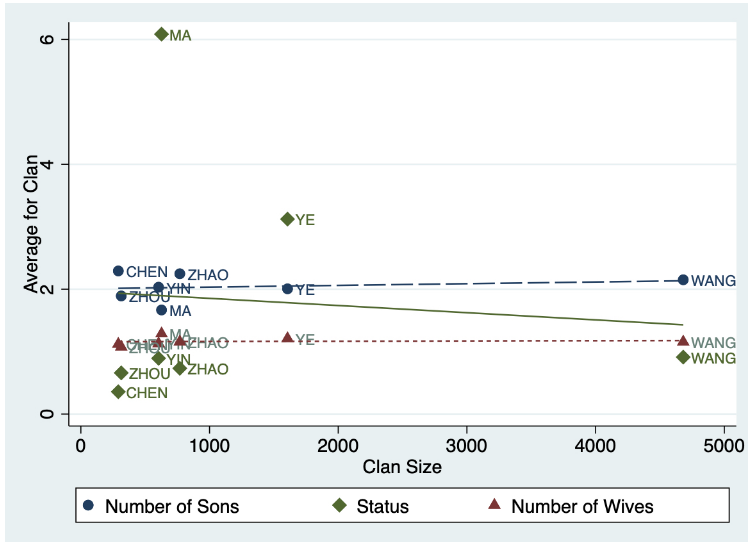
3.4 Representativeness

The sample was created using a targeted approach by considering more than three dozen genealogies from Tongcheng county and selecting a subset with the goal of generating a broadly representative sample. Seven clans have been chosen, with the following last names: Chen, Ma, Wang, Ye, Yin, Zhao, and Zhou. Given these clans' characteristics and size, we have about 20% of the sample belonging to the upper (or leisure) class as defined by Fei (1946), and the fraction of local and provincial civil service examination graduates is comparable to Chang's (1955) figure of 2%. Conditional on choosing the genealogy of a given clan, all entries of the genealogy become part of our sample.

The seven clans yield a broadly representative sample in part because the clans are quite different from each other. First, the clans differ in size. The largest clan in terms of men in the treatment generation is the Wang clan (36%), while the smallest is the Chen clan (3%).[13] Second, the clans differ in terms of the average level of human capital and status, which is closely related to human capital in this society. Based on about 30 descriptors given in the genealogies, each man's lifetime status is given by a value ranging from 0 (no status) to 22 (highest status). The descriptors give each man's highest lifetime achievements based on information such as offices held, state examinations passed, and donations made, see Table A.1. Members of two clans in the sample have relatively often high levels of human capital and high status, the Ma and the Ye, while the large majority of other clan members belong to the lowest status class.

[13] Clan size for the intergenerationally linked sample is given in Table 2.

Figure 6: Clan Size versus Status, Fertility, and Female Partners per Man



Notes: Figure shows three relationships, between average (i) number of sons, (ii) status, and (iii) number of females per man, each with the number of clan members across seven clans.

Clan differences allow us to evaluate selection due to income bias. Given that genealogies require skill and resources to produce, positive selection in the sense that richer clans report more members is a natural concern. Figure 6 indicates that there is little evidence that clan size simply reflects a clan's resources or that high-status clans systematically report more new members than lower-status clans.[14] Figure 6 considers also other observable indicators of resources. In particular, wealthier men could afford multiple wives and maintain larger families (Harrell 1985). The figure shows the relationship between clan size and the number of wives is essentially flat. Furthermore, fertility as measured by the number of male children is not strongly related to clan size either, see Figure 6. Section C.3 examines the representativeness of the sample further by considering a range of other forms of selection, including recall bias, progenitor bias, and survivor bias, finding that the sample is broadly representative of the Tongcheng area during our sample period.

3.5 Pre-Shock Analysis

The empirical analysis will compare treated with control observations in a difference-in-differences type approach. A central identification requirement is that in the absence of the shock, treatment and control observations would have followed the same trend. A well-known approach to provide evidence on the

[14]This result is unchanged when one focuses on within-clan changes using longitudinal data (Table A.2).

likelihood of this is to examine treatment and control samples in the pre-shock period. By linking the treatment generation backwards, we can compare treatment and control samples for up to two generations *before* the fall of Ming shock. Table 1 presents the results.

Table 1: Before the Shock: Evidence on Differential Pre-Trends

	Control	Treatment	Difference	p-value
	N = 54	N = 436		
A. Test of Equality of Means				
I. Generation (-1): Father				
Human Capital	0.31	0.32	-0.01	0.93
Social Status	6.00	5.18	0.82	0.37
Birth Year	1589.16	1586.90	2.26	0.37
Age at Death	55.86	53.78	2.08	0.25
II. Generation (-1): Mother				
First Wife of Several	0.11	0.12	-0.01	0.82
III. Generation (-2): Grandfather				
Human Capital	0.46	0.38	0.08	0.23
Social Status	5.22	5.62	-0.40	0.64
B. Tests of Equality of Distribution				
Generation (-1): Father Status				0.31

Notes: Test for equality of distribution is Kolmogorov-Smirnov.

Section I of Table 1 reports results from simple tests of the equality of the mean of various characteristics of the father's of the treatment generation males. As noted above, there are N = 436 treated and N = 54 control males in the treatment generation (males born between 1590 and 1644). Table 1 indicates that average human capital levels were virtually the same for fathers of treatment and control males. In both samples, about 1 in 3 men would have acquired human capital during his lifetime. Next, average status of the males in the treatment sample is 5.18–the maximum is 22, see Table A.1–, whereas it is 6.0 among the control males. Thus, father status tended to be higher for those living in locations that would not be destroyed by the fall of the Ming, although the difference is not statistically significant.

The average birth year of fathers of males in the treatment sample is around the year 1588, with the difference of about two years to the average in the control sample not statistically significant at standard levels.[15] We also report results from comparing the mean age at death among treatment and control

[15] An average birth year in the late 1580s also means that a substantial fraction of these fathers will have experienced the fall of the Ming (1644) themselves. At the same time, it would be during their old age, not during their formative years of potential human capital acquisition.

fathers. They are 56 for control and 54 for treatment samples, not a statistically significant difference at standard levels. These values are higher than the typical life expectancy in China during this period, because they are conditional on surviving to adulthood and being able to marry. Infant and childhood mortality rates were high, and a significant fraction–between 10 and 20 percent–of the males were not able to marry due to lack of resources and unfavorable sex ratios. This is further examined in section 4.2.

Section II of Table 1 shows a balance test for mothers of the treatment generation males (first pre-shock generation). Females do not acquire human capital or have social status of their own during this period in China (their participation rate in the formal labor market was virtually zero). Typically, we have information on time of birth and death as well as the number of male and female children of each female, as well as information on the role of a given female in the household. About 80% of females were the only lifetime married wife of their husband, but the data identifies also women who are the first (primary) wife in their husband's household. Table 1 shows that the share of mothers of the treatment generation males that were the first wife in their respective household was similar in the treatment and control samples; the relatively high value of 11-12% is in line with the substantial average human capital level of this generation.

Section III of Table 1 shows results on the grandfathers of the treatment generation males (second pre-shock generation). These individuals died typically in the early 1600s, well before the end of the Ming dynasty. Treatment and control grandfathers are similar both in terms of human capital and social status. Furthermore, instead of comparing only means (section B. of Table 1), also the result from comparing the entire distribution of 23 status levels among treatment and control fathers are reported. The distributions are similar, as the p-value of 0.31 indicates. It is also worth noting that human capital differences are not only small between treatment and control samples in a given generation, but they are also small from one generation to the next in the sense that human capital levels were somewhat larger among treatment fathers at the same time when they were somewhat lower among treatment grandfathers. Overall, there is no evidence for large pre-shock differences between treatment and control observations.

The 490 couples of Table 1 are the basis for the intergenerationally-linked analysis. Because, as a rule, all males born to clan members themselves are clan members, male children of the treatment couples will typically re-appear in the genealogy as adult head of households, which means that the family line is extended to the next generation.[16]

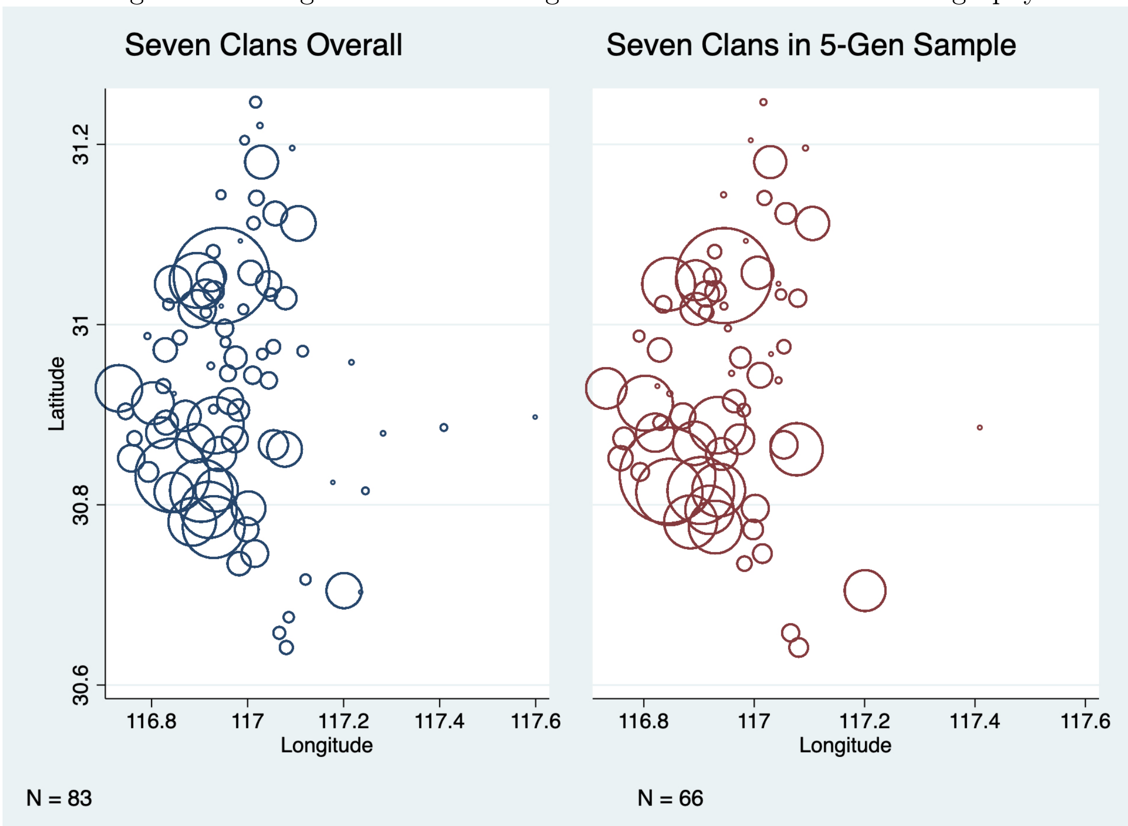
There are two main reasons why a particular family line may not extend to the next generation, so that the intergenerational sample is selected compared to the overall sample. The first reason is that a particular couple does not have a male child. Given that the genealogy is organized patrilineally, this particular branch of the family is terminated by construction. While having a male child or not is to an extent biologically determined and thus random, there is scope for selection because in the absence of a male child with a given female partner, a rich man may have another female partner whereas a poorer man may not. At the same time, there is no major difference in the number of sons for males with multiple female partners between treatment and control samples, which suggests that the influence of this for the long-run impact of the Ming-Qing transition is limited.[17]

The second reason for the termination of family lines is that even though the couple has a male child, that child not marry to form a household himself. One reason for non-marriage is that the male child dies early on in life. Clearly, child mortality is not orthogonal to parent characteristics. In particular, as we show below, the age of death of a male child depends on the health and resources of the parents. Another reason for non-marriage is that the male child lacks the resources to marry given the prevailing sex ratio. Thus, one can expect the intergenerationally linked sample to be positively selected in terms of human capital and resources. In this paper, we examine this by estimating the impact of the Ming-Qing transition on the termination of family lines, see section 4.2. For a preliminary analysis, Figure 7 shows the towns and villages of Tongcheng that the seven clans populate both for the overall and for the intergenerationally linked sample. Overall, the seven male clans reside in N = 83 towns and villages, whereas this is reduced to N = 66 locations for the five-generation linked sample (Figure 7, left and right panel, respectively). Additional analysis on selection through intergenerational linking is presented in section 4.2. Table 2 shows key summary statistics. The number of observations in the five-generation linked data set is about 8,000 (Panel A), roughly equal to $5 \times 1,600$. Given the approach of linking the first generation forward four times, the couples of the fifth generation are unique. The male in each of these couples is the great-great grandson of the treatment generation couple. Because some males in the fifth generation

[16] To facilitate the recording of data, the typical Chinese genealogy does not come in form of a grand family tree but in form of a book where information for a given individual is presented on one or more pages (see Figure 1).

[17] In the analysis below, a male who has two female partners–either consecutively or simultaneously–would form two distinct couples. For treatment generation males with more than one female partner, the ratio of total sons to number of sons with a given female partner is 1.77 in the control and 1.74 in the treatment sample (n = 15 and n = 81, respectively; p-value of 0.94).

Figure 7: Inter-generational Linking and Selection in Terms of Geography



Notes: Shown are residence locations of members of the seven male clans (1) overall on the left, and for (2) couples in the five-generation linked sample on the right. Size of circle is proportional to number of heads of household.

are brothers, the number of unique couples in the fourth generation is lower than 1,600, in the third generation even lower, and so on, until in the first generation in which there are 170 unique couples.[18] The cross-sectional unit of observation is the roughly 1,600 branches of the family tree, which in principle are observed in each of the five generations. In practice, the number of observations varies to some extent across generation, which is because identifying data on time of birth or death can be incomplete.[19]

Panel A. of Table 2 shows the typical lifetimes of sample men by generation (Figure A.9 gives an illustration). The first generation typically experienced the transition from the Ming to the Qing in 1644, while the second generation did not. Moreover, the typical lifetime of the fifth generation reached into the early 19th century, with the latest death year being 1886. The father with the earliest birth year of any of

[18]Thus, about 35% of the 490 treatment generation couples and their descendants have at least one male child that becomes a head of household over four generations.

[19]The ratio of numbers of observations in the fifth to the first generation is 91% (= 1,515/1,667). This can be compared to an estimate using current match rates for linking individuals in two U.S. censuses of the early 20th century, which is 0.07% (based on a one-link success rate of 16% (Bailey, Cole, Henderson, and Massey 2020, Abramitzky, Boustan, Eriksson, Feigenbaum, and Perez 2021), assuming independence, gives $(0.16)^4 = 0.00066$).

Table 2: Summary Statistics: Five-Generation Linked Sample

Panel A. Generation	Male									Female		
	N	Birth Year Median	Death Year Median	Death Year Max	Human Capital	Status	Migration	Sons Mean		First Wife	Sons	Daughters
1	1,667	1619	1678	1728	0.259	4.320	0.198	3.272		0.104	2.998	1.298
2	1,661	1653	1718	1759	0.264	4.320	0.276	3.667		0.092	3.517	1.704
3	1,632	1686	1743	1796	0.200	3.540	0.229	3.322		0.071	3.222	1.539
4	1,609	1716	1778	1850	0.145	2.505	0.147	3.391		0.049	3.275	1.363
5	1,515	1748	1803	1886	0.106	1.998	0.104	2.224		0.096	1.929	0.977
All	8,084				0.196	3.366	0.189	3.193		0.083	3.005	1.383

Panel B. Clan	Chen	Ma	Wang	Ye	Yin	Zhao	Zhou
N	373	903	4,527	1,175	513	531	62
Human Capital	0.064	0.581	0.146	0.288	0.018	0.049	0.032
# Wives	1.078	1.289	1.240	1.286	1.105	1.056	1.226
Total Sons	3.456	2.685	3.335	3.062	3.162	3.119	1.952

Notes: Shown are statistics for five-generation linked sample; number of observation varies to some extent by variable; value for N given in Panels A. and B. is for male birth year. Migration is equal to 1 if head of household resides in generation x in a different town or village than in generation x-1. Total Sons is number of sons of a male from all female partners; First Wife is an indicator that the female is the primary (highest-ranking) wife of all females in the household; # Sons (# Daughters) is the number of sons (daughters) born to that female.

the first generation males, which was employed in the pre-shock analysis of Table 1, was born in the year 1542. This means that the range of the data over these six generations is close to 350 years.

Our main human capital variable is an indicator variable that captures that a man has acquired a certain threshold level of skills.[20] Status is a lifetime measure of social status based on a range of descriptors in the genealogies. The variable ranges between 0 and 22, with about 70% of the men having the lowest status level of zero; see Table A.1. The decline in average human capital and status from the first to the fifth generation is due in part to the unchanging number of official positions relative to a rising population. In the analysis below, it will be captured by generation and birth year fixed effects.

Information on migration comes from the place of residence of a head-of-household; the variable is equal to one if the head of household resides in a different location compared to his father; this is the case in just under 20% of all generation-to-generation transitions. We also employ information on the number of sons a male has from all his relations, which averages at about 3.2. Women in Chinese genealogies do not have status independent from the male, however, we have information on the role the female played in the household. Table 2 shows that about 8 percent were the first (primary) wife of several in their husband's household, compared to 80% of all females who were the single lifetime wife of their husband and about 2.5% concubines (unmarried females). Females in our sample had on average close to 3 sons and 1.4 daughters, with the latter being an undercount in part due to gender preference for boys.

The lower Panel B. provides information for each of the seven male clans. The two larger clans are the Wang and the Ye, while the Zhou is the smallest clan. Clans differ substantially in terms of human capital, fertility, and general affluence, here measured as the average number of females per head of household. The Ma and the Ye have the highest average human capital levels, while the Zhao clan had the lowest.

4 The Impact of the Fall of the Ming

4.1 Main Findings

This section asks whether the fall of the Ming had a differential impact on those living in areas that were more heavily impacted, and if so, whether this differential impact was still present in any of the four

[20]We have also explored differentiating human capital further, by assigning higher levels to those passing the national compared to the provincial exam, or to those passing at any level rather than only preparing for the exam; this leads to qualitatively similar results, see Table A.5.

following descendant generations. We relate outcome variable y to the treatment indicator, d_p, the level of destruction of the village or town in which the couple resided in the first generation (see Figure 4), using the following OLS specification

$$y_{ic(p)g} = \alpha + \beta_g \left[I \left[t = g \right] \times d_p \right] + \beta_f hfstat_{c0} + \eta_g + X'\gamma + \varepsilon_{ic(p)g}, \tag{1}$$

where $y_{ic(p)g}$ is an outcome of individual i belonging to couple c in generation g who is a descendant of pair p in the treatment generation. The term $I[t = g]$ is an indicator function equal to one if the observation t belongs to generation g, and zero otherwise, and η_g are generation fixed effects. We also include the status of the father of the male in the first generation couple, denoted by $hfstat_{c0}$. Including a proxy for father income is a well-known approach to addressing omitted variables concerns (e.g., Oreopoulos, Page, and Stevens 2008), and it means that equation (1) is similar to a difference-in-differences approach.

Equation (1) includes also a vector X of additional variables, in particular a fixed effect for each man's birth year. Because lifetimes within a generation vary, including birth year fixed effects helps to account for secular changes that might affect the estimates. Furthermore, we include a fixed effect for each of the seven male clans, denoted by m, $m = 1, ..., M$. They capture time-invariant differences, for example in the level of clan resources, that may affect the response to the Ming-Qing transition. Similarly, a fixed effect for each of the wives' clan-of-origin (130 different clans) is added to equation (1), denoted by f, $f = 1, ..., F$, because characteristics of the clan from which a woman marries into the seven male clans may affect responses as well.[21] The error term $\varepsilon_{ic(p)g}$ is assumed to be mean-zero, and conditional husband's father status $hfstat_{c0}$, generation fixed effects, and the vector X, we assume that β_g gives the mean difference in $y_{ic(p)g}$ due to the fall of the Ming in generation g.

Observations are clustered by couple of the treatment generation (p) and by generation (g). The shock may trigger effects that last for more than one generation. If intergenerational adjustment strategies play any role, the behavior of members of the same family tree branch in different generations will not be independent. Allowing for dependence of observations belonging to the same generation is important because these observations will tend to be affected by the same shocks in terms of calendar time. The sample consists of all men and women that are descendant couples of the treatment generation in generation two to five, plus the individuals of the treatment generation. Results from estimating equation (1) are in

[21] We do not include the clan subscripts m and f in equation (1) to simplify the notation.

Table 3.

Table 3: The Impact of the Fall of the Ming

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Male							Female		
	Human Capital				Social Status	Migration	Sons	First Wife	Concubine	Sons
Gen 1	-0.330^{**} (0.041)	-0.305^{**} (0.040)	-0.251^{**} (0.034)	-0.351^{**} (0.069)	-2.556^{*} (0.691)	-0.173^{*} (0.057)	0.435^{+} (0.160)	-0.177^{*} (0.048)	0.029^{*} (0.010)	0.528^{*} (0.140)
Gen 2	-0.024 (0.044)	-0.053 (0.056)	-0.035 (0.068)	0.007 (0.092)	-0.424 (0.990)	-0.003 (0.054)	0.692^{*} (0.187)	0.032 (0.017)	0.053^{*} (0.018)	0.518^{*} (0.162)
Gen 3	0.254^{*} (0.062)	0.200^{**} (0.039)	0.196^{*} (0.064)	0.202^{*} (0.064)	1.322 (0.856)	0.201^{*} (0.056)	0.307 (0.184)	0.080^{+} (0.037)	0.023^{+} (0.010)	0.218 (0.158)
Gen 4	0.178^{+} (0.066)	0.132^{*} (0.044)	0.126^{+} (0.055)	0.119^{+} (0.043)	0.550 (0.662)	0.029 (0.047)	0.379^{*} (0.088)	0.032^{+} (0.013)	0.002 (0.009)	0.411^{**} (0.075)
Gen 5	0.143 (0.069)	0.111 (0.060)	0.113 (0.061)	0.132^{+} (0.060)	0.921 (0.772)	0.013 (0.047)	0.212 (0.148)	0.031 (0.015)	0.014 (0.008)	0.243 (0.141)
Father Status	0.029^{**} (0.005)	0.025^{**} (0.004)	0.018^{*} (0.004)	0.018^{**} (0.004)	0.301^{**} (0.046)	0.002 (0.004)	0.011 (0.012)	0.001 (0.003)	0.002^{+} (0.001)	-0.001 (0.010)
Fixed Effects										
Generation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Birth Year	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Male Clan	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Female Clan	N	N	N	Y	Y	Y	Y	Y	Y	Y
Mean d.p.	0.197	0.197	0.197	0.197	3.381	0.188	3.202	0.082	0.023	3.015
N	8,064	8,062	8,062	8,029	8,025	8,012	8,012	8,012	8,012	8,012

Notes: Dependent variable at the top of column; sample consists of all men and women in generations 1, 2, 3, 4, and 5 that constitute couples formed by male descendants of the treatment generation, including the treatment generation couple itself, conditional on intergenerational linking over five generations. Estimation of equation (1) by OLS. Father Status is status of the husband's father in treatment generation. Gen stands for generation, d.p. stands for dependent variable. Robust standard errors two-way clustered at the level of treatment generation couple and generation in parentheses; **/*/+ indicates significant at the 1%/5%/10% level.

We begin with the impact on human capital acquisition; column (1) has only fixed effects for each generation. The coefficient on the treatment indicator is estimated at -0.33 in the first generation. It means that for every three men in the control group that acquire human capital in the first generation, only two treated men would have because of the fall of Ming shock. The shock has made it both harder for sons of skilled fathers to acquire a comparable level of human capital and for sons of fathers without human capital to advance in terms of skills beyond their fathers, as shown in Table A.4. For the second generation, the treatment coefficient is close to zero, whereas point estimates are positive in the following generations (column (1), Table 3). The Father Status variable ($hfstat_{c0}$) enters with a positive sign, indicating that men with a high-status ancestor are more likely to acquire human capital.

Actual lifetimes of individuals in these five generations vary in terms of calendar time, so that certain events such as emperor changes might affect the men differentially. To account for that we include birth year fixed effects (results see column (2)). The following two specifications introduce male and female clan fixed effects to the specification. While the size of the negative impact in generation varies somewhat, the overall pattern, from negative in the first to positive by the third generation, is the same in columns (1) to (4), and in the specification with all four sets of fixed effects the shock's impact in the fifth generation is significant at standard levels (column (4)). Thus, compared to not affected men, the shock has initially a negative impact on human capital which turns positive in later generations.

Turning to the fall of the Ming impact on social status, it has a similar pattern as that on human capital, however, except in the first generation it is not significant. Figure A.15 illustrates that the effect on status is more muted, consistent with what we know about this society: human capital is the driver of status, and not the reverse. Regarding the migration variable, it is defined as an indicator that is equal to one if the head of household lives in a different town or village than his father, and zero otherwise. Results show that families living in villages that were heavily destroyed by the shock migrate less that families in less destroyed areas (generation 1, column (6)). Considering the mean migration rate of 19% (bottom of column (6)), the drop in migration of treated relative to control families in the first generation is sizable. Also, by the third generation, treated families migrate more than control families. The pattern of the migration response is similar to that for human capital acquisition, except that migration among treated descendants is not sustained higher until the fifth generation. Finally, the fall of Ming shock has a positive impact on the number of sons a man has, significantly so into the fourth generation (column (7)). Especially in the first generation the positive coefficient is interesting because income is lower (columns (4), (5)). One explanation for this non-Malthusian result is risk diversification: having more sons gives the family a better chance to recover. An alternative, not mutually exclusive explanation is that in times of crisis fertility control was less effectively implemented (Shiue 2017 analyzes the quantity-quality trade-off in terms of children in Tongcheng during the Ming-Qing).

Additional information on adjustment strategies of families hit by the shock comes from females, shown on the right of Table 3. First, consider the number and composition of females in the household. About 8% of the females in the sample are the first of multiple married wives. With a coefficient of -0.177, the fall of the Ming greatly reduces the chance that a given female is the first wife of several in destroyed first-generation villages, compared to less destroyed villages (column (8)). Conversely, the shock increases the probability that a female is the single married wife (not shown). Since having multiple wives reflects high income, the reduction in first-wife households is consistent with the loss of human capital in the first generation estimated in column (4).

Given that there are fewer first wives, what explains the increase in fertility found in column (7)? One reason lies in the increase in the number of sons per woman (column (10)), which is larger than the increase in the number of sons per man shown in column (7)). A second reason for the increase in fertility despite the decrease in number of first wives is an increase in concubinage, as shown in column (9). This suggests that in times of crisis, unmarried women substitute for married women to achieve fertility goals. Also, while the probability that a given female is a first wife rebalances relatively quickly in later generations, this does not occur for concubinage. The fall of Ming apparently had a long-run impact on the composition of females in Chinese households.[22]

Furthermore, in robustness checks we find also evidence for a reversal in human capital acquisition when three additional levels of human capital for those who pass the civil service examination at a relatively high level are distinguished. Also, as an alternative method of computing confidence intervals we use randomization inference. This shows that baseline standard errors based on two-way clustering tend to be relatively conservative. These results are presented in Table A.5 and Figure A.14, respectively.

To recap the key finding, even though the shock has reduced the human capital of the treatment generation, by the second generation human capital acquisition of the descendants of treatment vs control couples is comparable, and from the third generation on descendants of treatment couples acquire more human capital than descendants of control couples (Table 3, column (4)). Thus, the heavy human capital losses have not discouraged descendants of treatment couples, instead, they appear to have encouraged human capital investments in later generations. One explanation is that the shock has increased the preference for human capital, and the preferred path towards income for descendants of treated couples

[22] Additional analysis shows that the shock has increased the typical distance between residence and burial sites, see Table A.6.

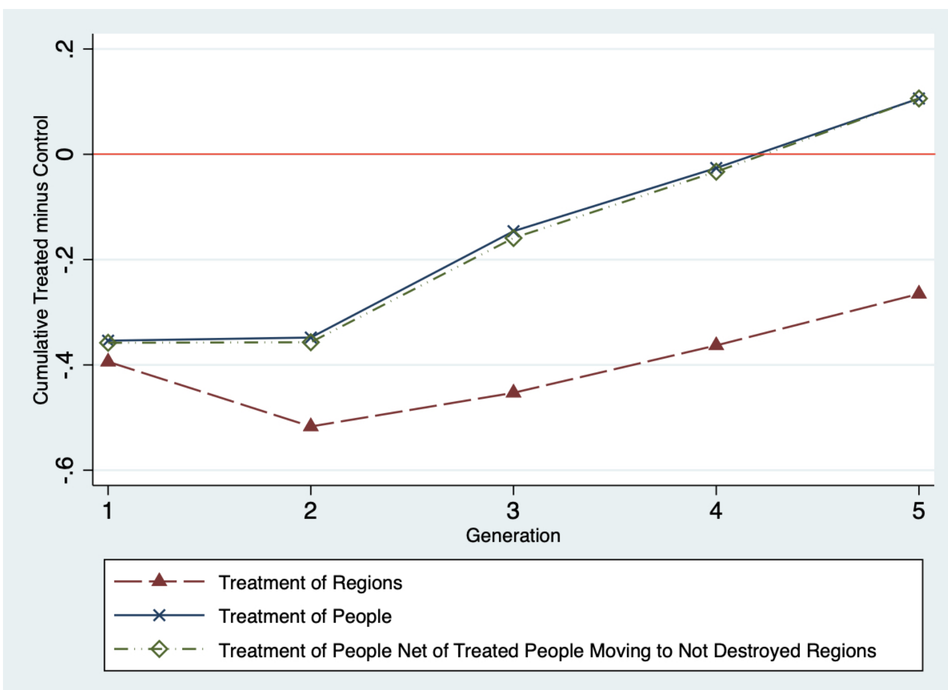
has shifted from land-based towards human capital-based wealth.

Some initial evidence on this comes from comparing findings for the descendants of those living through the fall of the Ming with those for the regions that were historically destroyed by the shock. We estimate the following by OLS:

$$y_{icg} = \alpha + \delta_g \left[I \left[t = g \right] \times I \left[r = 1 \right] \right] + \delta_f hfstat_{c0} + \eta_g + X'\gamma + \varepsilon_{icg}, \tag{2}$$

where $I[r_{ig} = 1]$ is an indicator function equal to one if individual i in generation g resides in a historically destroyed location, and zero otherwise. This exploits cross-sectional variation across regions, with one treatment coefficient δ_g per generation.[23] Figure 8 shows cumulative point estimates from applying equation (2) with human capital as the dependent variable, with full estimation results given in Table A.7, column (2).

Figure 8: Treatment of People vs Treatment of Regions



Notes: Treatment of Regions shows cumulative point estimates of column (2), Table A.7 (equation (2)); Treatment of People shows cumulative point estimates of column (1), Table A.7 (equation (1)); Treatment of People Net of Treated People Moving to Not Destroyed Regions presents cumulative point estimates $\sum_g \beta_{g1}$ of column (3) of Table A.7 (equation (3)).

Figure 8 shows the cumulative impact of the fall of the Ming on regions as the lowest of the three

[23] Equation (2) is estimated on the same inter-generationally linked sample as that underlying equation (1) and Table 3.

series, while the solid-line series is the cumulative impact of treatment of people based on Table 3, column (4). The impact on regions tends to be more negative than the impact on people, both because there is an incremental negative impact on regions in generation 2 and because the recovery of human capital acquisition in generations 3, 4, and 5 is slower. Overall, the cumulative difference-in-differences impact on regions in the fifth generation is -0.27, compared to 0.11 for the impact on people.[24]

By necessity, the difference between the impact on regions and the impact on people is explained by the families' migration behavior. Figure 8 indicates that given the residence of people in destroyed versus not destroyed locations in generation 1, men who moved into one of the destroyed location acquired less human capital in generation 2 than those that left the destroyed locations.[25]

Additional evidence on the role of migration comes from augmenting equation (1) in the following way:

$$hc_{ic(p)g} = \alpha + \beta_{g1}\left[I\left[t=g\right] \times d_p\right] + \beta_{g2}\left[I\left[t=g\right] \times d_p \times I\left[r_{ig}=0\right]\right] + \beta_f hfstat_{c0} + \eta_g + X'\gamma + \varepsilon_{ic(p)g}, \quad (3)$$

where $I\left[r_{ig}=0\right]$ is an indicator function returning one if the individual in that generation is residing in a historically undestroyed region, and 0 otherwise. Thus, the coefficients β_{g2} capture the impact on human capital acquisition of treated men–i.e., a descendant of a treated couple in the first generation–that move in a later generation to historically not destroyed areas. How often do these movements occur? By the fifth generation, 7.1% of the treated descendants have relocated to historically not destroyed areas.[26] If the destruction of a particular region is what matters, one would expect that accounting for the migration of seven percent of families from destroyed to not destroyed locations has a substantial impact on the estimates. Conversely, if the treatment of people is of primary importance, the migration into historically undestroyed regions will not greatly affect the estimates.

Figure 8 shows the cumulative impact on human capital net of movements to control regions (that is, it shows $\sum_g \hat{\beta}_{g1}, \forall g$). Notice that the cumulative impact on treated families is virtually identical whether one accounts for movements to historically undestroyed regions or not (in generation 5 it is identical). It

[24] The small difference between impact on region and the impact on people in generation 1 is due to constraining the birth year, and clan fixed effects to be the same across generations to economize on degrees of freedom; if instead we estimate generation by generation, as shown in Table A.5, coefficients for impact on regions and impact on people are identical in generation 1.

[25] Stayers–those family lines that stay for generation 2 in their generation 1 location–cannot explain the difference between treatment of regions and treatment of people in generation 2.

[26] The overall rate of relocation from one generation to the next is close to 19% (Table 2), however, this includes movements within the sets of historically destroyed and not destroyed locations.

does not greatly matter for the long-run human capital impact of the fall of the Ming that some of those with exposed ancestors move to historically undestroyed regions. Rather, it is as if the descendants of the treated couples take their treatment with them to the historically undestroyed regions.[27] Before we turn to an analysis of mechanisms, the following section examines the impact of the shock on the continuation of family lines.

4.2 Impact on the Continuation of Family Lines

Selection is present in intergenerational analysis if being able to make intergenerational links is not orthogonal to the outcome of interest. Here, the existence of an intergnerational link depends on a male child being able to marry, which could, e.g., be influenced by parent resources.[28] Because there is consistent information on male children in our sample, it is possible to analyze major margins of selection by using information on male children together with that on males that we know have married.

One determinant of whether a given male would marry later in life is clearly whether he would survive childhood to reach a marriageable age. We therefore begin with an examination of the impact of the fall of the Ming on longevity (age at death). The specification is given by

$$age_{i(p)2} = \alpha + \beta d_{i(p)} + \beta_f hfstat_{i0} + \eta_g + X\gamma + \varepsilon_{i(p)}, \tag{4}$$

where $age_{i(p)2}$ is longevity, measured as death year minus birth year, of individual i in generation 2 who is descending of pair p, the variable $hfstat_{i0}$ denotes the social status of individual i's pre-shock grandfather, and the vector X are male and female clan fixed effects. Table 4 shows the results.

The coefficient for $d_{i(p)}$ is estimated at about -4.5 (column (1)). This indicates that on average, the shock tends to reduce age at death by more than four years (not significant). Adding fixed effects for each of the seven male clans as well as the clans of the in-marrying mothers (68 fixed effects) does not change the point estimate much (column (2)). The impact of the shock on the son's length of life might depend on family characteristics. Introducing the interaction of the shock with some variable $z_{i(p)}$, denoted by

[27] Full estimation results are given in Table A.7, column (3). Focusing on significant coefficients instead of point estimates leads to qualitatively similar results.

[28] Factors such as race, ethnicity, or surname play less of a role here, because all individuals in the sample share the same race and ethnicity, and given information in the genealogies, intergenerational links are established with virtual certainty.

Table 4: Impact on Longevity and Marriage Probability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. var.	Longevity					Marriage	
Variable z_i			Human Capital	Longevity Father	Longevity Mother	Human Capital	Mother Longevity
Fall of Ming Shock	-4.514 (3.114)	-4.249 (3.527)	-9.959^{*} (4.315)	-39.896^{**} (13.274)	-37.610^{**} (10.538)	-0.061 (0.087)	-0.467^{**} (0.176)
Ming Shock x z_i			16.524^{**} (6.022)	0.617^{**} (0.229)	0.574^{**} (0.179)	-0.031 (0.113)	0.006^{*} (0.003)
z_i			-8.803 (5.664)	-0.217 (0.218)	-0.084 (0.218)	0.187^{+} (0.100)	-0.000 (0.003)
Father Status	0.336^{*} (0.169)	0.934^{**} (0.247)	0.109 (0.219)	0.361^{*} (0.177)	0.336^{*} (0.162)	-0.002 (0.004)	0.005 (0.004)
Birth Year FE	Y	Y	Y	Y	Y	Y	Y
Husband Clan FE	N	Y	N	N	N	N	N
Wife Clan FE	N	Y	N	N	N	N	N
N	774	761	774	774	767	801	789

Notes: Dependent variable is age at death (longevity) of male descendant of treatment generation couple in columns (1) to (5), and marriage indicator in columns (6) to (8); estimation of equation (4) by OLS. Robust standard errors clustered at the level of the treatment generation couple; **/*/+ indicates significant at the 1%/5%/10% level.

$z_{i(p)} \times d_{i(p)}$, the specification becomes

$$age_{i(p)1} = \alpha + \beta_1 d_{i(p)} + \beta_2 \left(z_{i(p)} \times d_{i(p)} \right) + \beta_3 z_{i(p)} + \beta_f hfstat_{i0} + \eta_g + \varepsilon_{i(p)}, \tag{5}$$

where $z_{i(p)}$ a characteristic of the treatment generation couple, *p,* is also included linearly. Results are shown in Table 4. In the first of these specifications, variable $z_{i(p)}$ is the human capital of the father (man in first generation). Having a human capital holding father switches the shock impact on son's life time from negative to positive (-10 + 16.5 = 6.5), at the same time when sons of fathers with human capital in this generation generally tend to have a shorter life time (coefficient on $z_{i(p)}$ is -8.8, not significant). Son lifetime is not only related to the family's resource endowment but also to its genetic endowment. In the remaining two specifications, the longevity of father and mother is employed as measures of health (genetic endowment). Results show that controlling for health, the impact of the Ming-Qing shock on son longevity is significantly negative (columns (4) and (5)).

Turning to the impact of the Ming-Qing transition shock on marriage, Table 4 shows the results on the right side. On average, sons of fathers with human capital have a roughly 19% higher chance to marry (column (6)). The fall of Ming shock tends to reduce the marriage probability by about 6 percent, and by about 9 percent if the father has human capital (not significant). Generally, the probability to marry is more closely related to the mother than to the father. Controlling for mother longevity, the shock leads to a significant reduction in the marriage probability, while for every ten years of mother longevity the probability to marry increases on average by a six percentage points ((column (7)). An analysis of the distribution of longevity by marriage status confirms that child mortality is a major channel through which the shock has cut off family lines (see Figure A.16).

This section has shown that the Ming-Qing transition shock has cut off family lines by shortening the life time of males and their ability to marry. The overall impact of the shock is composed of this shortening of family lines together with the effects on descendants that succeeded to have four generations, as examined above.

4.3 Sharpening Inference: More Similar People

Individuals and families vary in their characteristics which might make them subject to different shocks. This section performs analyses on subsamples that are more similar to sharpen identification. The idea behind it is the same as in a treatment of regions analysis that applies a spatial RDD approach around the 'border'. Three dimensions along which samples become more similar are considered, the clan, the individual, and the temporal dimension. Human capital acquisition is the dependent variable in all specifications, with only the sample changing. Table 5 gives the results. Results with the full sample are given again for convenience in column (1).

Clan Dimension While there are genealogical principles that virtually all Chinese clans adhere to, some clan rules are heterogeneous for various reasons. If clan rule differences are strongly correlated with clan responses to treatment, this heterogeneity might lead to spurious results, and analyzing a subset of clans will tend to reduce this source of bias. A downside of dropping particular clans from the sample is that the degree of representativeness of the analysis might be lowered.

Clans vary in the degree to which they are exposed to the shock. To the extent that clan characteristics shape the individual responses of their clan members, the response for individuals from exposed clans might

Table 5: Impact with More Similar People

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constraint		Clan				Individual		Temporal	
Type		Treat & Control	< 95% Treated	Higher Status	Lower Status	Higher Status	Lower HC	Born by 1634	Lifetime during 17th C
Gen 1	-0.354^{**}	-0.281^{**}	-0.295^{*}	-0.362^{**}	-0.323^{**}	-0.351^{**}	-0.349^{+}	-0.419^{**}	-0.403^{*}
	(0.070)	(0.047)	(0.096)	(0.074)	(0.071)	(0.069)	(0.154)	(0.057)	(0.095)
Gen 2	0.006	0.016	-0.061	0.014	0.068	-0.004	0.132	-0.068	-0.257^{*}
	(0.093)	(0.060)	(0.066)	(0.096)	(0.116)	(0.090)	(0.094)	(0.084)	(0.077)
Gen 3	0.202^{*}	0.179^{*}	0.086^{+}	0.195^{*}	0.272^{*}	0.143^{*}	0.190^{*}	0.201^{*}	0.158
	(0.064)	(0.059)	(0.036)	(0.059)	(0.087)	(0.040)	(0.040)	(0.064)	(0.087)
Gen 4	0.119^{+}	0.106^{+}	0.126^{*}	0.127^{+}	0.102	0.123^{+}	0.091	0.117^{+}	0.082^{*}
	(0.043)	(0.038)	(0.045)	(0.046)	(0.061)	(0.052)	(0.049)	(0.045)	(0.029)
Gen 5	0.132^{+}	0.123^{+}	0.108^{+}	0.144^{+}	0.151	0.135^{+}	0.031	0.128^{+}	0.122^{+}
	(0.060)	(0.055)	(0.042)	(0.064)	(0.076)	(0.058)	(0.045)	(0.056)	(0.052)
Father Status	0.018^{**}	0.017^{**}	0.017^{**}	0.017^{**}	0.017^{*}	0.024^{**}	0.018^{*}	0.014^{**}	0.015^{*}
	(0.004)	(0.003)	(0.002)	(0.004)	(0.006)	(0.003)	(0.005)	(0.003)	(0.004)
Fixed Effects									
Generation	Y	Y	Y	Y	Y	Y	Y	Y	Y
Birth Year	Y	Y	Y	Y	Y	Y	Y	Y	Y
Male Clan	Y	Y	Y	Y	Y	Y	Y	Y	Y
Female Clan	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	8,021	7,577	3,059	7,491	7,121	4,682	6,948	7,113	4,460

Notes: Dependent variable is human capital. Estimation of equation (1) by OLS. Column (1) is for full sample; column (2) focuses on clans that have both treatment and control families (drops Chen & Zhou); column (3) focuses on clans with < 95% observations in generation 1 treated (drops Chen, Zhou, and Wang); column (4) drops clan with the lowest average father status in generation 1 (Zhao); column (5) drops clan with the highest average father status in generation 1 (Ma); column (6) drops family lines for men in generation 1 whose father has status level 0; column (7) drops family lines for men in generation 1 whose father has status level 10 or higher; column (8) defines the treatment generation to be couples in which the male was born between 1589 and 1634; column (9) defines the treatment generation to be couples in which the male was born between 1599 and 1644 and had died in 1695 or earlier. Father Status is status of the husband's father in treatment generation. Gen stands for generation, HC for human capital. Robust standard errors two-way clustered at the level of treatment generation couple and generation in parentheses; **/*/+ indicates significant at the 1%/5%/10% level.

systematically differ from that of individuals from non-exposed clans (evidence on the role of clan effects is presented in Table A.9). There are two clans in the sample that have only members in towns and villages destroyed by the shock, the Chen and the Zhao. It turns out, however, that results are broadly similar when members of the Chen and Zhao clans are dropped from the sample (column (2)). Along the same lines, among the remaining five clans is one, the Wang, whose members reside in historically destroyed locations to a far greater extent than members of the other clans. The Wang clan also matters simply due to its size, having more than three times as many members as the second-largest clan (Table 2). Dropping members of the Wang clan in addition to the Chen and Zhao leads to the results of column (3).

Irrespective of the distribution of members in treated versus control observations, clans might shape the responses of their clan members in systematic ways that affect findings. If so, focusing on clans below or above a certain threshold level of resources will make the estimation sample more similar. The next two columns of Table 5 show that dropping the poorest or the richest clan, as proxied by average pre-shock status, does not qualitatively change the pattern of the results (column (4) and column (5), respectively). We have also explored the possibility that instead of the first moment (mean) the second moment (dispersion) of clan resources matters for individual responses, finding little evidence for it.[29]

Individual Dimension Focusing on observations that are relatively similar in an individual dimension is a direct way of obtaining a more homogeneous sample. We first focus on relatively rich family lines by dropping those from the sample for which the pre-shock father is a commoner (status equal to zero). This reduces the sample to 58% of its original size, yet results are broadly similar to before (column (6)).

Next, we turn to human capital responses for family lines that are relatively poor. Clearly, a certain minimum level of heterogeneity in the sample is needed–otherwise, human capital responses to the shock cannot be estimated. Yet, about half of the human capital holders in the sample do not belong to the group of top officials holding national and provincial degrees from the civil service examination (*jinshi* and *juren*, respectively). Column (7) shows that broadly similar results are obtained when the highest levels of human capital holders including *juren* and *jinshi* are dropped from the sample.

Temporal Dimension The remaining two specifications create more homogeneous samples by varying the definition of the treatment generation (or, first generation). In the main analysis, these are couples in

[29]The clan with the highest (lowest) coefficient of variation of father status in the pre-shock generation is the Chen (Ma) clan; results that drop these clans are along the lines of column (2) and column (5), respectively.

which the male is born between the years of 1590 and 1644. First, we explore the implications of reducing the treatment generation definition to the range of birth years from 1590 to 1634. The sample becomes more homogeneous both because less weight is given conditions in Tongcheng in post-Ming (post-1644) times, and by ensuring that all treatment generation males have lived through the heavy destruction in Tongcheng during the years 1634 to 1644. Column (8) shows that the results are broadly similar.

Second, the focus is shifted to couples in which the male is born between 1600 and 1644 at the same time when his year of death is 1695 or earlier. It may be that the heavy destruction during 1634-44 has a differential impact on those aged 34 to 44, perhaps because they are too advanced in their life to still consider human capital acquisition. By shifting the start of the treatment generation definition to 1600, the oldest treated individuals are 34 years of age by the start of the most heavy destruction in 1634. Also, one may want to limit the definition of treatment to those who have completed their lifetime in the 17th century because there may be different shocks in the 18th century. Column (9) shows that one implication of this concentration of the definition of treatment generation (later start in terms of birth year, and earlier end in terms of death year) is that the impact of the shock on human capital acquisition in the second generation may still be negative, as opposed to zero as in the baseline in column (1).

Overall, while the previous analysis with more homogeneous samples has produced some differences, the broad pattern of the human capital response is common to all specifications. In particular, relative to those living in historically undestroyed locations, the fall of Ming has caused a loss in human capital for men in the first generation, and this loss reverses to a gain in human capital among their descendants in later generations, typically by the third generation.

5 Mechanisms

5.1 Greater Preference for Human Capital

An important question is why there was a human capital reversal for those whose ancestors suffered heavily through the shock. This section examines the hypothesis that the shock might have increased the preference for human capital of those affected by the shock that is transmitted from generation to generation.

The sustained emphasis on human capital acquisition of the descendants of those impacted by the fall of the Ming, to the point that they have more than made up their ancestors initial losses (Figure 8), is prima facie evidence of the increased importance of human-capital based wealth for these families. The main alternative in this economy was land-based wealth. Historical accounts emphasize that the shock had a large negative impact on agriculture. Beattie (1979), for example, reports that 70-80% of the cultivated land in Tongcheng had been devastated in a single year. Even though devastated land will become arable again after some time, the difference in portability between land and human capital in the face of a big, temporary shock increases incentives to pursue a career based on human capital.

The relative vulnerability of immovable land compared to human capital would have been observed both by those that experienced the Ming-Qing destruction first-hand and by those that did not. However, it is plausible that the destruction made a stronger impression on the former compared to the latter. First-hand exposure may help to create attitudes and beliefs that generate a persistent difference between descendants of treated versus control couples because attitudes are internalized and passed down from generation to generation.

If the destruction during the fall of the Ming has led to a greater emphasis on human capital among the descendants of treated couples, it would increase their human capital acquisition relative to the control descendants–as in see Table 3–, unless there was a sudden drop in ability among the treated descendants. Moreover, to the extent that the transmission of this attitude, from one generation to generation, is important, one expects that greater emphasis on human capital among treated descendants is reflected in the intergenerational relationship between human capital of the father and human capital of the son. To assess this, we employ the well-known framework of studies of intergenerational mobility that relates son characteristics to father characteristics using an OLS regression:

$$y_{ic(p)g} = \alpha + \omega_1 y_{ic(p)g-1} + X\psi + \epsilon_{ic(p)g}. \tag{6}$$

Here, $y_{ic(p)g}$ is human capital of the son, $y_{ic(p)g-1}$ is human capital of the father, and the vector X includes the male's father status in generation 1 and generation, birth year, and male as well female clan fixed effects. The higher is ω_1, the more is the son's level of human capital influenced by his father's human capital, so higher ω_1 means higher human capital persistence (lower human capital mobility). Equation (6) is separately estimated for the descendants of generation-1 treated couples and the descendants of generation-1 control couples. Results are shown in Table 6, columns (1) and (3).

Table 6: Post-Shock Human Capital Mobility by Treatment

	(1)	(2)	(3)	(4)
	Treated		Control	
Father Human Capital	0.258^{**}	0.223^{**}	-0.033	-0.154
	(0.033)	(0.033)	(0.143)	(0.215)
Grandfather Human Capital		0.081^{**}		0.184^{+}
		(0.028)		(0.103)
Included Generations	3, 4, 5	4, 5	3, 4, 5	4, 5
N	4,236	2,751	411	247

Notes: Dependent variable is human capital of the son. Also included are the male father's status in generation 1 as well as generation, birth year, and male as well as female clan fixed effects. Robust standard errors clustered at the level of the treatment generation couple; **/*/+ indicates significant at the 1%/5%/10% level.

For the descendants of treated couples, the parameter ω_1 is estimated at 0.26 (column 1). It means that among descendants of couples that were subject to the fall of Ming shock, the son of a father with human capital has a 26% higher chance to acquire human capital himself compared to a son whose father has no human capital. In contrast, among control descendants, there is no benefit from having a father with human capital: the coefficient ω_1 is close to zero (column 3). This differential level of human capital persistence is consistent with the hypothesis that the fall of Ming shock has increased the emphasis on human capital among the descendants of those that were affected first-hand.

The son's human capital acquisition may not only be affected by his father's human capital but by earlier generations as well (multigenerational mobility). In fact, a change in attitude towards human capital would likely involve many members of the family, including grandparents but also (grand-)uncles and (grand-)aunts. To examine some aspects of this we add the human capital of the grandfather to the specification:

$$y_{ic(p)g} = \alpha + \omega_1 y_{ic(p)g-1} + \omega_2 y_{ic(p)g-2} + X\psi + \epsilon_{ic(p)g}. \tag{7}$$

The coefficient on grandfather human capital, ω_2, is about 0.08 and indicates that an educated grandfather gives also a boost to the human capital acquisition of the son (column 2). The sum of the coefficients of father and grandfather human capital is about 0.30, which is higher than the coefficient on father human capital in column (1) alone. It means that, typically, a son from a line of human capital father *and* grandfathers has a chance of 30% to acquire human capital himself. Among the control descendants, in contrast, the sum of father and grandfather coefficients is close to zero (column 4).

Table 7: Human Capital Mobility and the Fall of Ming

Section I: After the Shock

Panel A: Control Descendants

		Father: No HC	Father: HC
Son	No HC	96.6%	75.3%
	HC	3.4%	24.7%
		100%	100%

Panel B: Treated Descendants

		Father: No HC	Father: HC
Son	No HC	92.5%	51.9%
	HC	7.5%	48.1%
		100%	100%

Section II: Before the Shock

Panel A: Control Descendants

		Father: No HC	Father: HC
Son	No HC	82.8%	52.0%
	HC	17.2%	48.0%
		100%	100%

Panel B: Treated Descendants

		Father: No HC	Father: HC
Son	No HC	81.5%	45.5%
	HC	18.5%	54.5%
		100%	100%

Notes: Table shows transition matrix for intergenerational mobility in human capital (HC). Section I. is for post-shock period using generations 3, 4, and 5. Section II. is for the pre-shock period, using the generations of the treatment generation's fathers and grandfathers (as in Table 1). Columns sum to 100 percent. Total number of observations N = 4,741 in Section I and N = 490 in Section II.

The previous analysis has compared relative mobility in human capital for treated and control descendants. To see whether the difference is more closely related to upward or downward mobility, we examine transition matrices that relate human capital of the son to that of his father. Table 7 shows the results in Section I. We begin with downward mobility. Notice that three quarters of sons among descendants of those couples not exposed to the shock do not retain their father's human capital, wheres among descendants of treated couples this is the case for only half on the sons. Thus, downward mobility is lower among descendants of treated couples. Another way to look at these results is in terms of human capital persistence. Close to half of sons of descendants of treated couples retain their father's human capital level, in contrast to only a quarter of the control descendant sons.

Turning to upward mobility, sons of control descendants rise at a rate of 3.4% from no human capital to having human capital (Panel A, lower left cell). In contrast, sons of treatment descendants do so at a rate of 7.5%, more than twice the rate among control descendant sons. Overall, the higher human capital persistence estimated above is due to both lower downward and higher upward mobility for descendants of fall of Ming treated couples. We cannot rule out that differences between Panels A and B are due to some (sequences of) random draws that raised ability among treatment descendants relative to control descendants, as opposed to a shift in preferences for human capital among the former. However, notice that the advantage of treatment descendants in terms of upward mobility is somewhat higher even than their advantage in terms of downward mobility. This is not what one would expect if the higher human capital persistence among treatment descendants is simply due to a big positive shock in generation 2 that comes with high genetic persistence.

Furthermore, is the higher human capital persistence among treatment descendants really a consequence of the shock, or was it perhaps present already in earlier times? Section II. of Table 7 examines human capital mobility in the first and second generation before the shock by treatment. The results show that human capital mobility was not very different among treatment and among control ancestors before the shock, certainly much smaller than after the shock. For example, the rate of upward mobility is 17.2% for control and 18.5% for treatment ancestors according to Table 7, Section II.; this a difference of about eight percent, which compares with a difference of more than 100% after the shock. This indicates that the difference in intergenerational human capital mobility found for the post-shock era is a new development.

5.2 Alternative Explanations

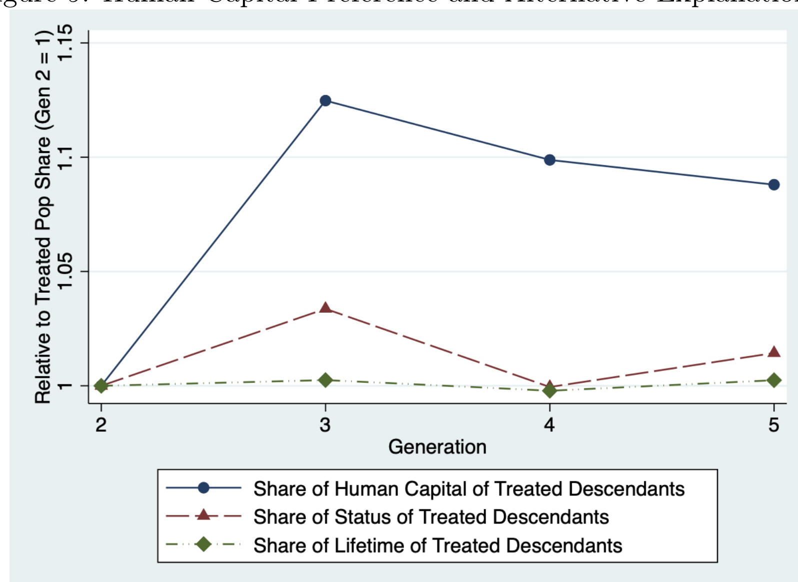
The previous section has shown evidence in support of the hypothesis that the fshock has increased the preference for human capital over several generations. However, could the patterns in the data be explained by other mechanisms? Is there something specific about human capital, or has the shock simply incentivized descendants of the historically treated couples to perform better in a number of dimensions?

The following presents evidence on a number of alternative mechanisms. First, consider sample size. For any of the five generations, the historically treated couples and their descendants account for about 90 percent of the population in the linked sample. This is not surprising, because the analysis is conditional on exit–break of family lines, see section 4.2–, and given our cohort approach there is no entry in later generations.[30] Even though the share of the treated population is approximately constant, if behavior

[30]This is different for the seven clans overall at the level of regions. As shown in Figure A.12, the share of the seven clans that lives in the historically treated regions has fallen over time.

changes as the result of the shock, the share of treated descendants in other dimensions might vary. Figure 9 shows this share for a number of variables.[31] All figures are taken relative to the share of treated descendants in the sample.

Figure 9: Human Capital Preference and Alternative Explanations



Notes: Figure shows the share of treated descendants in terms of three different variables, relative to the share of treated descendants in the sample. Lifetime is computed as death year minus birth year. Values for Generation 2 are set to equal 1.

First, consider income. One might believe that the traumatic experience of the shock with the resulting hardship and poverty might induce a greater emphasis on income. While there is no individual income data, the status variable is a good proxy of the lifetime income of different status groups. Figure 9 shows that the treated descendants' share of social status in generations 3 to 5 hovers around 1.02, that is, 2 percent higher than in the baseline period (generation 2). In contrast, the treated descendants' share of human capital is around 1.1 between generations 3 and 5, that is, five times as high.[32] This is evidence for an emphasis on human capital relative to other investment strategies to generate income.

Another hypothesis is that the shock has increased human capital acquisition because treated descendants live longer, as this gives them a better chance to obtain a high-ranking position. Longevity can also be seen as a proxy for health and attitudes towards risk. Figure 9, however, shows that the treated descendants' share of all (male) years lived virtually did not change after the shock. Thus, the increase in

[31] Generation 1 is omitted from this figure in order to focus on post-shock developments.

[32] Moreover, in this calculation the status share includes income derived from human capital; the status share of the treated net of human capital in generations 3 to 5 hardly higher than in generation 2.

human capital is not due to longer lifetimes; rather, it points to a higher investment into human capital per year of life. Overall, the pattern of human capital in the post-shock era is different from those proxying for income, health, and attitudes towards risk. This provides additional support for the hypothesis that the fall of Ming shock has led to greater preference for human capital that is transmitted from generation to generation.

6 Conclusions

Do big shocks have a permanent effect on the economic fortunes of people, or are the effects from big shocks transitory? This paper examines the fall of the Ming Dynasty (1644), a shock that cost the lives of 1/7 of China's population, and the economic responses over three centuries in a sample of men and women, as well as their children and families, in Central China. The impact of the shock is estimated by comparing the behavior of couples who were living in villages that were more or less destroyed by the turmoil of the fall of the Ming, and show that this treatment is plausibly exogenous.

We find that the shock has a negative impact on the human capital acquisition in the first generation. Moreover, the impact is sizable. For every three men acquiring human capital in the not destroyed areas, only two do so in the destroyed areas. However, the negative impact on human capital does not persist. Instead, by the third generation (the treatment couples' grandsons), those with ancestors that lived in historically destroyed areas acquire more human capital than those with ancestors in historically not destroyed areas. Furthermore, this positive human capital impact persists to the fifth generation, which includes individuals living 250 years after the fall of Ming. We also show that the human capital reversal is a robust finding.

To explain this, we evaluate the hypothesis that the shock has led to a greater preference for human capital for those first-hand affected by the fall of the Ming, and that these families have transmitted this change in norms from one generation to the next. In support of this, we find that in the post-shock era, descendants of treated couples exhibit both a higher rate of intergenerational upward mobility and a lower rate of downward mobility than descendants of control couples. Moreover, among descendants of treated couples, sons' human capital acquisition benefits from both father and grandfather human capital, while descendant sons of control couples do not. These findings are consistent with a greater emphasis on human capital for descendants of treated couples. Clan externalities support the intergenerational transmission of the focus on human capital at the level of the nuclear family.

Another important finding is that the shock's impact on human capital over any time horizon is almost entirely accounted for by the impact on treated couples and their descendants. Human capital results are virtually unchanged when we distinguish those that currently live in historically destroyed regions from those that have moved to historically not destroyed regions. This supports the hypothesis that new norms are transmitted from one generation to the next irrespective of where families currently live. Further, the shock's impact on human capital preference is unique – we do not find evidence that the shock has the same impact on other attitudes including towards income.

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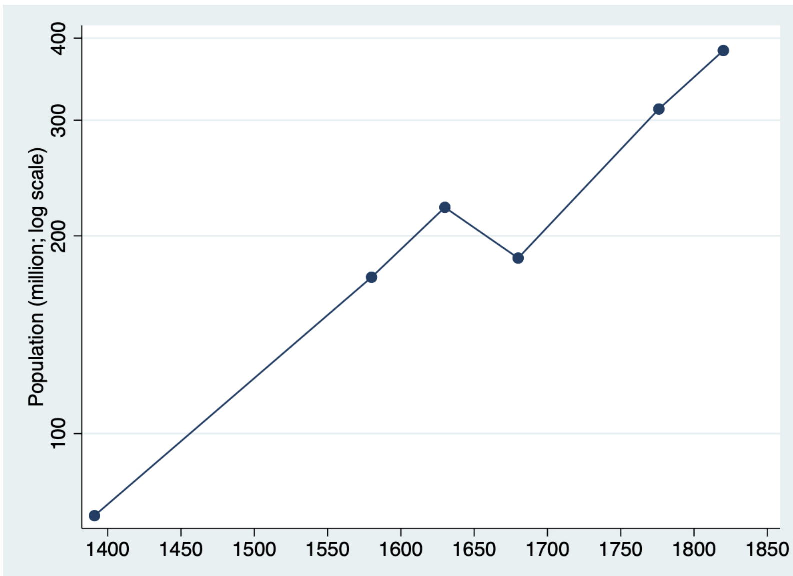
A The Fall of the Ming Shock in China

Figure A.1 shows the evolution of China's population from the late 14th to the early 19th century. In 1630, population is estimated at 221 million, compared to 185 million in the year 1680 (a 16% decline).

Figure A.1: China's Population and the Fall of the Ming



Notes: From Cao (2022), based on Ge Jianxiong (1999).

B Model

Consider a household consisting of parents and children in which parents decide how much to invest into their children. The parents are the husband and his married wife, while the child is the single son of the parents. Parents maximize utility according to

$$U_p = (1-\alpha)\, log\, c_p + \alpha log\, y_c, \tag{8}$$

where c_i is consumption, y_i is income, and $i = p, c$ is parents or child. According to equation (8), parents maximize a weighted average of their own consumption and their child's income, with the weight on the latter being governed by the parameter α,with $0 < \alpha < 1$. Raising the child's income is costly because it requires investments that for a given parent income reduce their consumption. The parents' budget constraint is given by

$$c_p = y_p - s_p - m_p, \tag{9}$$

where s_p is parent investment into the child's skills, such as the expenses to hire a teacher, while m_p are the resources spent by the parents to out-migrate. This is costly in terms of food, transport, and time that is required for migration, as well as through lower attachment to property and land.

Income in our framework depends simply on the person's human capital, h_i:

$$y_i = Ah_i^{\sigma}, i = p, c, \tag{10}$$

where $0 < \sigma < 1$ is the income elasticity of human capital, $\sigma = \frac{\partial y_i}{\partial h_i} / \frac{y_i}{h_i}$, and A is a positive constant; for simplicity, let A be equal to one. A given level of human capital translates into higher income the higher is σ. Turning to the formation of child human capital, we assume:

$$h_c = B\, s_p^{\gamma}\, m_p^{\kappa}\, K_p^{\mu}. \tag{11}$$

Here, $\gamma > 0$ and $\kappa > 0$ are the elasticities of human capital with respect to skill investment and migration, respectively, and we assume that $(\gamma + \kappa) \leqq 1$. According to equation (11), the impact of parents' skill investment on human capital of the child is rising in γ, and similarly, the effectiveness of outmigration to raise the child's human capital is increasing in the parameter κ. Outmigration benefits the human capital acquisition of the child in times of turbulence such as the Fall of the Ming, for example because it may lead to fewer disruptions in the child's training. The term K_p captures possible influences on child human capital through the clan to which p belongs. For example, if the child could be trained by an aunt of the clan, or if resources on child's skill acquisition would come from the child's grandfather or uncle, μ would be positive. Finally, B is a positive constant, and for simplicity we assume that B is equal to one.

Maximizing parent utility upon substituting equations (9, 10, and 11) into equation (8), the equilibrium choice of skill investment, s_p^*, and migration investment, m_p^*, satisfies

$$\frac{(1-\alpha)}{y_p - s_p^* - m_p^*} = \frac{\alpha\gamma\sigma}{s_p^*} \tag{12}$$

and

$$\frac{(1-\alpha)}{y_p - s_p^* - m_p^*} = \frac{\alpha\kappa\sigma}{m_p^*}. \tag{13}$$

These first-order conditions yield the relationship between the equilibrium skill and migration investments

$$\frac{s_p^*}{\gamma} = \frac{m_p^*}{\kappa}. \tag{14}$$

Equation (14) shows that parents will equalize skill and migration investments relative to the productivity of the respective investment. If the productivity of a particular investment is high, that investment will be high, and *vice versa*. Thus, while parents will invest into both skill acquisition and migration, the composition of parent investment depends on skill and migration productivity, which could vary over time.

Solving for s_p^* and m_p^*, one obtains

$$s_p^* = \frac{\alpha\gamma\sigma}{1-\alpha(1-\sigma(\gamma+\kappa))} y_p \tag{15}$$

and

$$m_p^* = \frac{\alpha\kappa\sigma}{1-\alpha(1-\sigma(\gamma+\kappa))} y_p. \tag{16}$$

Discussion The equilibrium skill and migration investments are rising in (1) parents income, (2) the weight parents place on child income (α), and the income elasticity of human capital (σ). Furthermore, skill investment is rising in the productivity of skill investment (γ), and falling in the productivity of migration investment (κ); the opposite is true for the parents' migration investment. While the specific way of these predictions depends on particulars of our framework, the notion that different investments will typically be complementary and the composition be depended on which investment is relatively productive in a given setting are more general. The empirical analysis below will provide evidence on these hypotheses, and also examine clan effects (parameter μ in equation (11)).

C Data

C.1 Human Capital and Status

This section lays out the human capital classification employed in the paper, see Table A.1. The classification draws on on work by Telford (1986, 1992) ans well as Chang (1955, 1962), Eberhard (1962), and Ho (1967). The genealogies have descriptors that summarize each man's lifetime achievements in various areas. One important aspect is whether the man ever participated in China's civil service examination, because that would require years of skill acquisition. In the baseline, our human capital variable is equal to one if a man passed the civil service examination at any level (local, provincial, and national), see column (3). Human capital is also equal to one if a man was editor or performed other high cognitive skill activities, even if the man did not pass the civil service examination. This includes the case of men who prepared but did not succeed to pass the civil service examination (group 6, column (3) of Table A.1).

To account for different levels of human capital, we explore an alternative that gives higher values to the human capital of men who passed the examinations, and at a higher level (column (4)). Distinguishing different levels of human capital does not change our qualitative findings. A concern with this human capital variable might be that given the important role of the civil service examination for coding, the human capital variable captures to a greater extent literary than scientific skills. To the extent that scientific as well as practical skills matter more for economic development than high levels of literacy, it would be the case that focusing more on literary skills has implications for growth of China's economy. While this is a question worth re-visiting, in terms of the human capital investment decision of individual men and their families, the usefulness of a certain type of human capital for industrialization and growth is not of primary importance, rather, it matters that investments into skills have a substantial return. That preparing and passing the civil service examination had such a return is well-established. For details on the income and wealth of top-level exam graduates (*jinshi*) as well as officials, see the discussions by Chang (1962). The sample includes also wealthy mean who are not also *jinshi* and top-level officials, but their number is relatively small (one percent of the sample, see column (6) for group 8). This is because status and income through official position was so high that even members of the wealthiest sought to acquire the human capital to pass the civil service exam. For example, several of the Cohong merchants engaged in the lucrative bi-lateral monopoly trading relationship with Western countries in Canton (Guangzhou) in the early 1800s sought to rise to the highest government offices requiring *jinshi* degrees, without success, so they stayed at lower level positions (Chang 1955). Passing the civil service examinations was "the ultimate source of power", as noted in the seminal work by Ho (1967).

The final two columns of Table A.1 report the size of each group in the inter-generationally linked sample. Employing the baseline definition in column (3), 19% of the men have aquired human capital during their lifetimes, while the large majority of the sample does not have human capital. That a large

Table A.1: Human Capital and Social Status Classification

(1)	(2)	(3)	(4)	(5)	(6)
Group	Description	Human Capital	Alternative HC	N	Fraction (%)
0	No title, degree, and evidence of wealth	0	0	4,399	54.5
1	Honorary or posthumous title; village head; other honors	0	0	46	0.6
2	Multiple wives in consecutive marriage (two or more not living at the same time)	0	0	434	5.4
3	Evidence of moderate wealth of 1st degree family, incl. minor and expectant official, lower level degree *(shengyuan*, *jiansheng*), and official student	0	0	1,015	12.6
4	Wealthy family member 2nd degree, incl. official, *juren*, *gongsheng*, and *jinshi*	0	0	20	0.2
5	Wealthy family member 1st degree, incl. official, *juren*, *gongsheng*, and *jinshi*	0	0	20	0.2
6	Educated, scholar, no degrees or office; editor of genealogy; refused office, or prepared but did not pass exam	1	1	273	3.4
7	Two or more wives or concubines at the same time	0	0	180	2.2
8	Substantial evidence of wealth and property; set up lineage estates, large donations, philantrophy; wealthy farmer, landowner, or merchant	0	0	79	1.0
9	Official Student (Province)	1	2	529	6.6
10	Military *shengyuan*, minor military office	0	0	0	0.0
11	Purchased *jiansheng* and/or purchased office	0	0	188	2.3
12	Student of the Imperial Academy	1	2	400	5.0
13	Civil *shengyuan*; minor civil office	1	2	199	2.5
14	Expectant official; no degrees	0	0	36	0.4
15	Expectant official one of the lower degrees	1	2	5	< 0.1
16	Military *juren*, *jinshi*; major military office	1	3	2	< 0.1
17	Civil official with no degree, minor degree, or purchased degree	0	0	68	0.8
18	*juren*, *gongsheng*, with no office	1	3	38	0.5
19	*juren*, *gongsheng*; with expectant office	1	3	53	0.7
20	*jinshi*, no office	1	3	0	0
21	*jinshi* with official provincial post or expectant official	1	3	1	< 0.1
22	*jinshi* with top-level position in Imperial bureaucracy (Hanlin Academy, Grand Secretariat, Five Boards, Prime Minister)	1	3	83	1.0
All				8,068	100.0

Notes: Table gives information on a man's human capital (HC) and social status in the six-generation linked sample. Based on Telford (1986, 1992), Chang (1955, 1962), Ho (1967), and Eberhard (1962).

majority of men does not have a substantial level of human capital is consistent with other evidence on Tongcheng and China overall during this period. At the same time, a value of 19% for human capital is higher than reported in other work on these clans of Tongcheng (Shiue 2017). The reason for this is that the sample shares in Table A.1, column (6) are for those individuals that can be intergenerationally linked over six generations. This is more likely for human capital holders than for non-holders, so the restriction on inter-generationally linked men implies positive selection. Section 4.2 in the paper is devoted to the influence of the Ming-Qing transition shock for this selection by studying the impact of the shock on the continuation of family lines.

Descriptors that determine a man's human capital and status in the genealogy are shown in column (3) of Table A.1. If there is nothing other than vital statistics in the individual's biography, and this person had no evidence of wealth, degrees, or titles, then he is coded as a member of group 0 (first line of Table A.1). These individuals would have lived close to subsistence during the sample period, and one can think of them as commoners.

Among the civil service exam degrees, *shengyuan* was the lowest degree of the recognized categories of government education, conferred upon those who had passed the local degree threshold. The *shengyuan* who were more competent were awarded with the *gongsheng*, "imperial student" title; above them in rank were the *juren* (graduate of the provincial examinations), and above the *juren* were the *jinshi* (graduate of the national metropolitan examinations). The levels are building up on each other, that is, in order to have the *jinshi* degree one must have the *juren* and the *shengyuan*, and in order to be *juren* one must have passed the *sheng-yuan* examination. There were no age requirements or limitations for advancement, but since the examinations required a high level of literacy and years of study, the earliest that one could attain the *jinshi* degree would be in the low twenties, and it was not unheard of for a man in his fifties to still be a *shengyuan*. Not all *shengyuan* advanced to the next levels, and those who didn't may have given up and turned instead to working for officials in a secretarial capacity, or, helping to manage local affairs—settling disputes, organizing local public goods projects, improving welfare and security interests, or providing education in their community (Chang 1962). In that sense, acquiring human capital by preparing for the civil service examinations had returns even for those who did not pass, let alone pass at the highest levels of the examinations.

C.2 Status and Income

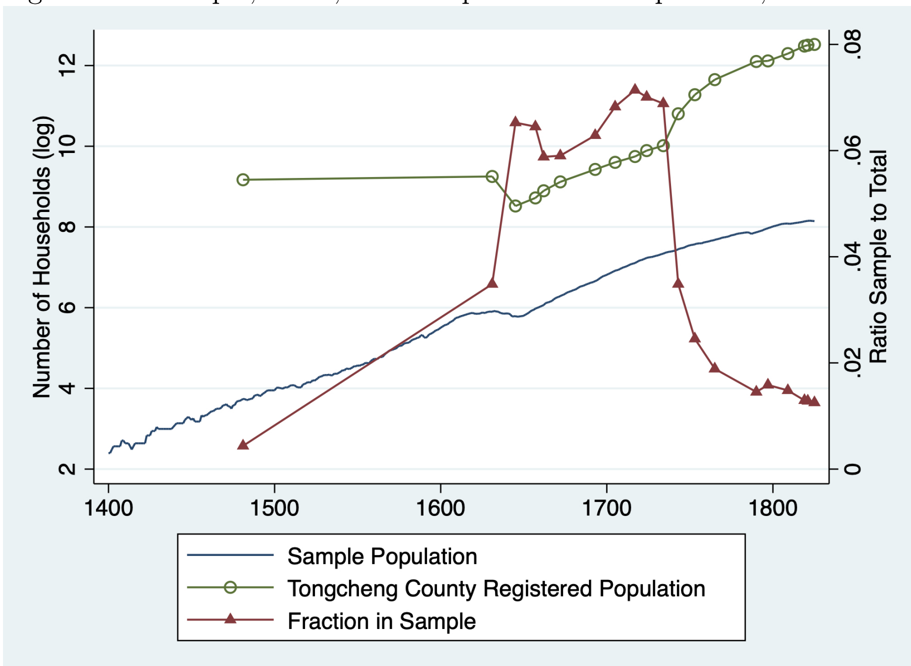
Status in society translated into income and wealth differences. There is no systematic information on the income or wealth of individual men, but having passed a certain level of degree made a person eligible for a certain level of official position. For example, there were nine levels of civil positions during the late 19th century (Chang 1962, Table 1). A district magistrate would be seventh-ranked civil official, while a provincial governor would be a second-level civil official. The mapping between degree and official position was not deterministic, however, the level of office was increasing in the degree that a man had obtained. Becoming a top-level official in the imperial bureaucracy with only a *shengyuan* (local) degree was almost impossible, and conversely, most *jinshi* had better-paid positions than being a district magistrate. The level of degree is useful because they are consistently mentioned in the data.

At least for certain periods, the salaries of government officials at different levels are known (see Chang 1962). However, official salaries accounted for only a small part of the total compensation of government officials; the larger portion of their income were other contributions on which there is less systematic data. At the same time, high-level officials were also expected to contribute to local public goods to a substantial degree. Arguably the best information on differences across status groups comes from assessment schedules of clans to their members who have reached higher positions. This can be thought of a tax on the clan member who has achieved a significant level of status. There is little reason to believe that the clans' assessment schedule would not be consistent with the income generated by each of these achievements. The status levels in this study are consistent with the available clan assessment schedules (see Chang 1962).

C.3 Representativeness and Selection

Representativeness Figure A.2 shows data for Tongcheng county's overall population that is available from official sources ("registered" population from tax registers). Official data is only available for 21 years between 1400 and 1825. Given this sparsity, as well as virtually unchanged levels for more than a century during a period for which genealogies indicate steady population growth suggests that official population data for this period in Tongcheng is, at a minimum, incomplete. That official data for representative samples is not consistently available during this period is not limited to Tongcheng or China but holds for many parts of the world.

Figure A.2: Sample, Total, and Sample Share of Population, 1400 - 1825



Notes: Lower series is sample household population, measured as log number of male heads-of-households (N = 426); upper series is log number of households, Beattie (1979), Table 3 (N = 21). Also shown the fraction of the sample based on these series; scale on the right.

The limited availability of reliable official data for this period means that one cannot establish the representativeness of the sample by making comparisons to official data for all of Tongcheng. Instead, we rely on broader comparisons wherever data is available, at the national or regional level, and for subsets of our sample period.

A first check is to consider mortality rates by age group. Population figures at the regional level are typically based on gazetteers (local histories about a certain place). Three county-level gazetteers about Tongcheng cover the period under analysis; they are *Tongcheng xian zhi* (1490), *Tongcheng xian zhi* (1696), *Tongcheng xuxiu xian zhi* (1827). In addition, there are official accounts for subsets of the population, such as the Qing population registers, which are the product of the Eight Banner registration system.[33] Telford (1990) compares demographic patterns in the Tongcheng genealogical data and the Eight Banner populations for 1774 to 1873, when the latter starts to become available. He finds a very similar variation in the probability of dying for different age categories across the two sources (see Telford 1990, Figure 2).

[33]These data are available for areas in China's northeast, in today's Liaoning and Heilongjiang Provinces; these lands were organized under the Imperial Household Agency and the Jilin Military Yamen, an office in the General Office of the Eight Banner Command. See https://www.icpsr.umich.edu/icpsrweb/ICPSR/series/265. For the imperial household dynasty, there are observations going back to the seventeenth century (Lee et al. 1993).

To further assess representativeness we examine top individuals, in part because much of the available estimates focuses on the upper groups. Chang (1955) takes the view that *shengyuan* holders and above were in the upper class, and estimates that they were in the top 2% of the total population in the later half Qing period. In the present analysis, the part of the population corresponding to Chang's (1955) definition account for 3.3% of the sample, which is comparable.[34] Fei (1946) presents a wider estimate of the upper income groups, at 20%. In our analysis, groups 2 to 22 in Table A.1 correspond to Fei's definition of high status—and the share of these groups in the sample is 20.2%. Both these comparisons indicate that the data is fairly representative of China's population as a whole with respect to the size of top income groups as well as the relative size of higher versus commoner groups.

Given the genealogy is a written document, if literate individuals only recorded information about themselves their and immediate kin, the percentage of top income people in the genealogy should be very high. Alternatively, if genealogies recorded extended family who were not of high income—rules of ritual say that all adult male members are eligible, regardless of income—the percentage of top income should typically be low. How does the share of top status groups in the present sample compare with other evidence? In his classic study based on national lists of *jinshi*, which are extremely reliable, Ho (1967) reports that during the Qing in Anhui there were 41 *jinshi* per one million population, or, 0.0041 percent. There were regional variations, and the province of Anhui was below the provincial average in terms of *jin-shi* per capita in Qing China (Ho 1967, p. 228). In the Tongcheng data, there were a total of 14 *jinshi* during the Qing in Shiue's (2019) study, which is about 0.045 percent of the population in the data. Thus, there are about ten times more *jinshi* in the sample than in Qing Anhui overall.

At the same time, *jinshi* were rare, and some parts of Anhui province did not produce a single *jin-shi* over centuries. Furthermore, Tongcheng was not among the areas of China where top individuals were most prevalent. Some areas had more *jin-shi* by an order of magnitude compared to Tongcheng.[35] Therefore, while the number of men in the highest status group in Tongcheng was higher than in the local surrounding area, Tongcheng was noteworthy at a local, perhaps provincial level, but it was not an unusual region in China.

Finally, the list of people who are recorded in the data to have obtained the highest status level, *jinshi* degree, can be compared against other lists of degree holders from Tongcheng County (Fang 2010; Cao

[34]In Table A.1, column (1), they are groups 13 and above.

[35]Specifically, Zhejiang and Jiangsu were among the provinces with high densities of *jinshi* (Ho 1967).

2016; Wang 2017). There were over 51,000 *jinshi* degree holders from the Yuan, Ming, and Qing dynasties. Information on top degree holders can be cross-checked for accuracy by referring to known lists of *jin-shi* degree holders from the Chinese state, which give the name, the date on which someone received his degree, and his hometown. We have verified that the information on the *jinshi* in the sample is consistent with the information of these official lists.

In summary, the information in the dataset is consistent with what we know and expect based on other sources for larger parts of China. To a significant extent this is because the dataset is based on seven genealogies that each describe rather different clans, so that combining them yields a diverse sample.

Selection Next, we shed light on a number of possible forms of selection by exploiting differences across the seven clans in the data over the sample period. As shown in Table 2, the clan's average status varies substantially. A first concern is that genealogies begin with a particularly noteworthy man, who then becomes the progenitor of the clan. Part of his noteworthiness might come from being educated, which is one of the most important signs of status and one of the consistently reported characteristics of noteworthy persons. Alternatively, perhaps later generations were more likely to *ex-post* select a particularly noteworthy progenitor. In either case, the implication would be a trend of declining status over time.

Selection would arise if the records contain more entries of success compared to failure. We have shown in the text that average clan status is virtually unrelated to size across the seven clans (6) There is no evidence that on average, richer clans have more entries in the genealogies. Here this analysis is extended by examining the temporal correlation between status and clan size across twelve birth cohorts.[36]

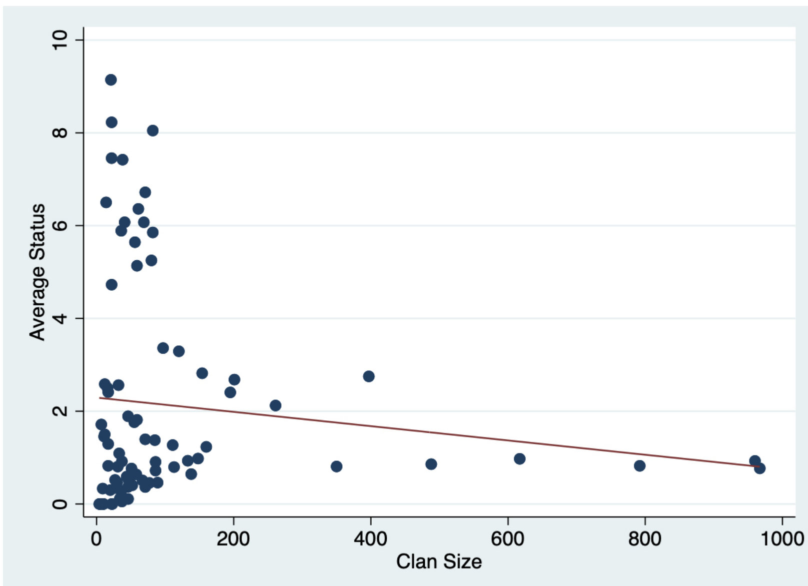
[36] The birth cohorts are 25 year periods, except (1) all years before 1575 and (2) all years after 1825; see Figure A.6.

Table A.2: Clan Size versus Status, Fertility, and Female Partners per Man

	Status			Fertility			Female Partners per Man		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Clan Size	−0.154	−0.074	−0.078	0.012	0.016	−0.019	0.005	0.001	−0.009
	(0.142)	(0.165)	(0.109)	(0.026)	(0.028)	(0.037)	(0.007)	(0.008)	(0.009)
Birth Cohort FE		Y	Y		Y	Y		Y	Y
Clan FE			Y			Y			Y
N	81	81	81	81	81	81	81	81	81

Notes: Results from OLS regressions of the variable on top of the column on the number of men born (size), both averaged by clan and by birth cohort. Clan size in 100s of men. Fertility is measured as the number of male children. FE stands for fixed effects. Standard errors in parentheses.

Figure A.3: Clan Size and Status: Birth Cohort Analysis



Notes: Shown is the size of each clan as measured by the number of men born in each of twelve birth cohorts, versus average clan status in that birth cohort; N = 81.

Figure A.3 shows that there is no strong relationship between status and clan size using information by birth cohort, and to the extent that there is a relationship it is negative. Thus, there is no simple positive selection into the sample based on status. The following extends this analysis in two ways. First, we consider the relationship between clan size and other variables. Second, the focus is placed on different parts of variation in the data by including different sets of fixed effects. See Table A.2 for the results.

Results indicate that there is no positive relationship between status and clan size, in fact there is no strong relationship of either sign. In particular, accounting for changes that are common to all clans

Table A.3: Clan Success and Recall Bias

	Clan Size		
	(1)	(2)	(3)
Clan Status (-1)	−0.098 (0.096)	−0.026 (0.098)	−0.061 (0.157)
Birth Cohort Fixed Effects		Y	Y
Clan Fixed Effects			Y
N	74	74	74

Notes: Dependent variable is clan size, measured by the number of men born in a cohort (in units of 100s). Clan Status (-1) is average clan status lagged by one birth cohort. Estimation by OLS. Standard errors in parentheses.

by including birth cohort fixed effects does not yield a significant relationship (Table A.2, column (2)). Furthermore, there is no significant within-clan relationship between status and size either, as Table A.2, column (3) indicates.

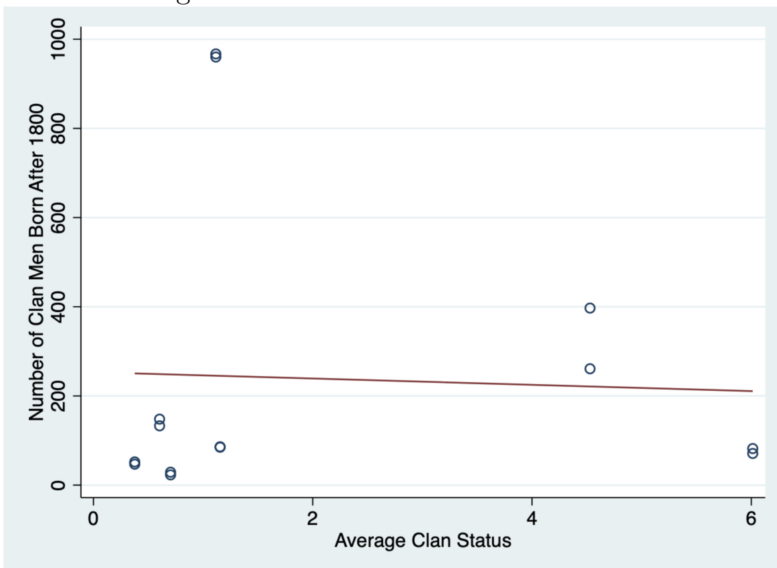
There is a positive coefficient for fertility and clan size, however, it is not significant at standard levels (Table A.2, column (4)). Moreover, the positive point estimate turns negative (still insignificant) when we account for time-invariant differences across clan size by including clan fixed effects (column (6)). Qualitatively similar results are obtained for the relationship between clan size and the number of female partners per man, see columns (7) to (9). Overall, there is little evidence that a clan's representation in the sample in terms of size is related to key economic variables.

Other concerns about selection and representativeness derive from recall bias and the retrospective nature of how genealogies are compiled. One way this bias could manifest itself is that after a clan member attains a particularly high level of status, the clan reports many new members—it could be that the clan uses its resources to confirm the significance of their achievements or ex-post, people who were not previously part of the clan might try to establish an ancestry relationship to the high status individual. Table A.3 evaluates such hypotheses of recall bias using regression analysis.

With a coefficient on lagged clan status that is negative and insignificant, there is no evidence for recall bias in the sense that recent successes for the clan translate into more clan members. This result does not change with the inclusion of birth cohort and clan fixed effects, see Table A.3, columns (2) and (3).

A related concern is survivorship bias: over time, this type of bias could result in a disproportionately fraction of high-achieving (high skill) individuals compared to low-achieving (low skill) individuals. One

Figure A.4: Evidence on Survivor Bias

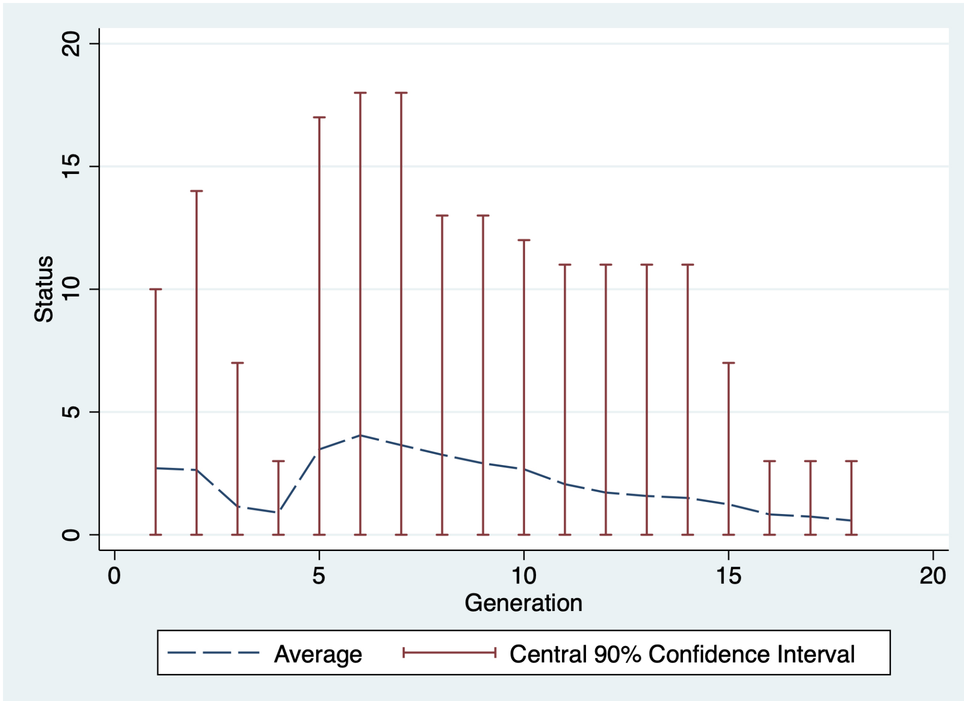


Notes: Figure shows number of clan men born in periods 1800-1825 and post-1825, both versus average clan status.

implication is that towards the end of the sample period the distribution becomes skewed towards relatively high-achieving clans. As Figure A.4 shows, however, there is little evidence that the distribution of the sample towards the end of the sample period is becomes skewed towards high-status clans.

One might also ask why the genealogy of a given clan begins in a particular year. If the genealogy of a clan is established precisely because one of the clan members had achieved extraordinarily high status, this might yield a mechanical tendency of average status falling over time, and one might be concerned that this might also affect the estimate of intergenerational mobility over time. To examine this, Figure A.5 shows average clan status by generation.

Figure A.5: Clan Status by Generation



Notes: Shown are clan average status and the central 90% confidence interval of clan status for the first to eighteenth generation.

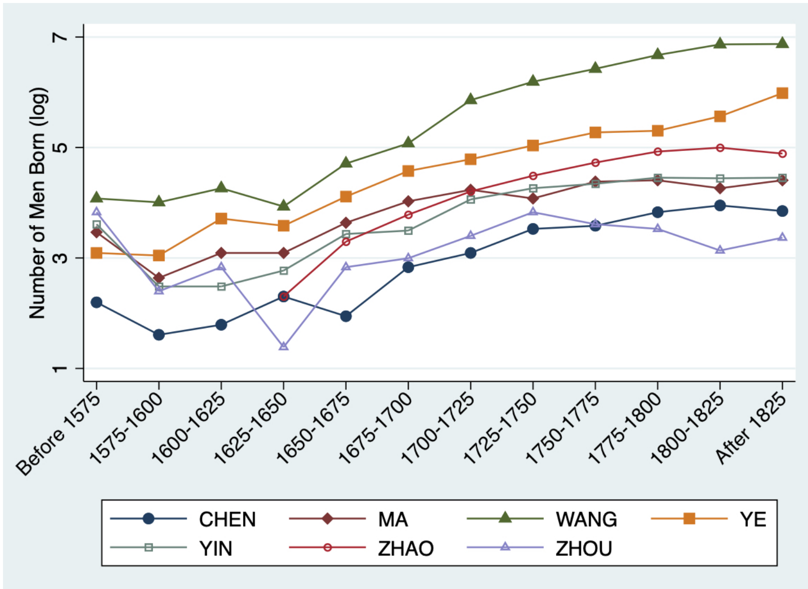
We can see that average clan status does not monotonically fall across generations. In particular, average clan status from the 5th to the 10th generation is higher than in the first generation. Thus, the dynamics of clan average status do not support the hypothesis that the sample genealogies typically begin with the life of an extraordinarily successful progenitor.

Figure A.6 shows the size of each clan in terms of the number of men born in each birth cohort. Over the sample period, all clans are present during the period from 1575 to 1825.

In general, size grows for all clans, although growth rates vary by period; for example, the growth rate is negative for three clans in the birth cohort 1625-1650, which includes the dynastic transition from the Ming to the Qing (1644). Some clans grow faster than others, however, sustained overtaking in terms of clan size is rare.

Overall, the evidence for various forms of selection bias is limited. This provides evidence that as a set, the genealogies underlying the present sample are broadly representative for Tongcheng. A different form of selection, due to intergenerational linking, is examined in section 4.2 of the paper.

Figure A.6: Sample Size over Time



Notes: Shown is the size of each clan as measured by the number of men born in each of the twelve birth cohorts shown.

C.4 Supplementary Results on Data

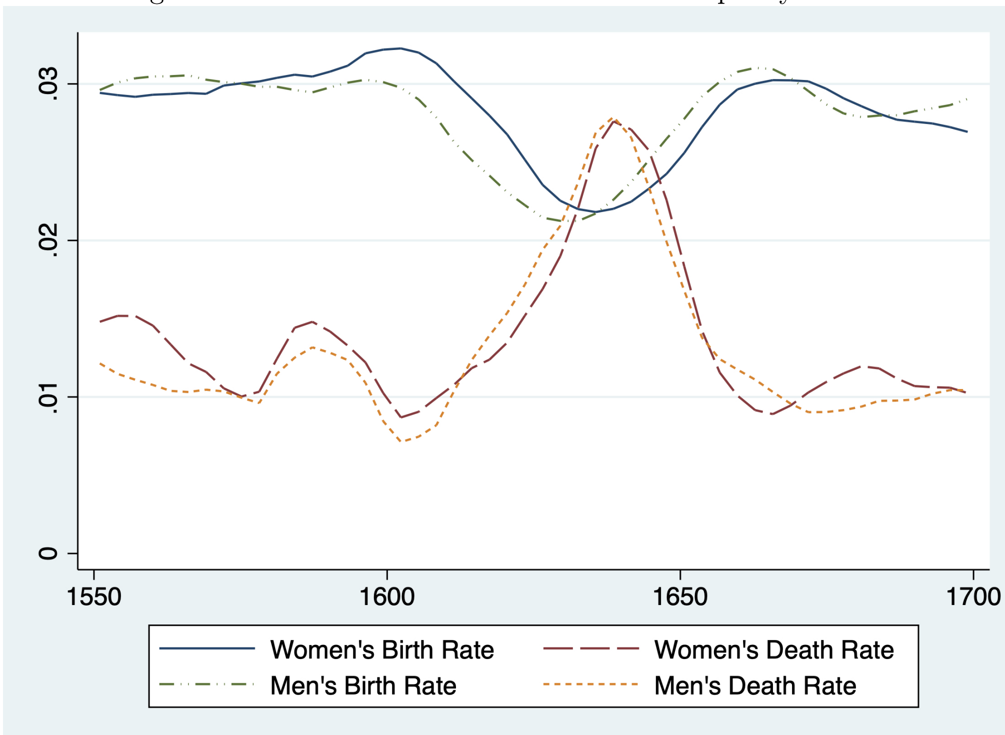
C.4.1 Ming-Qing Transition Birth and Death Rates

Figure A.7 shows birth rates and death rates by gender (the birth rate in year t is defined as the number of births in year t relative to the population alive). The decline in population is more strongly due to the increase in death rates than to a decrease in birth rates, although both of them matter. Death rates increase from around 1% to above 2.5% during the fall of the Ming, whereas birth rates dip from around 3% to around 2.2%. The relative importance of changes in death versus birth rates is consistent with violence, military action, and famine playing an important role in the fall of the Ming.

C.4.2 Estimation of Vital Statistics

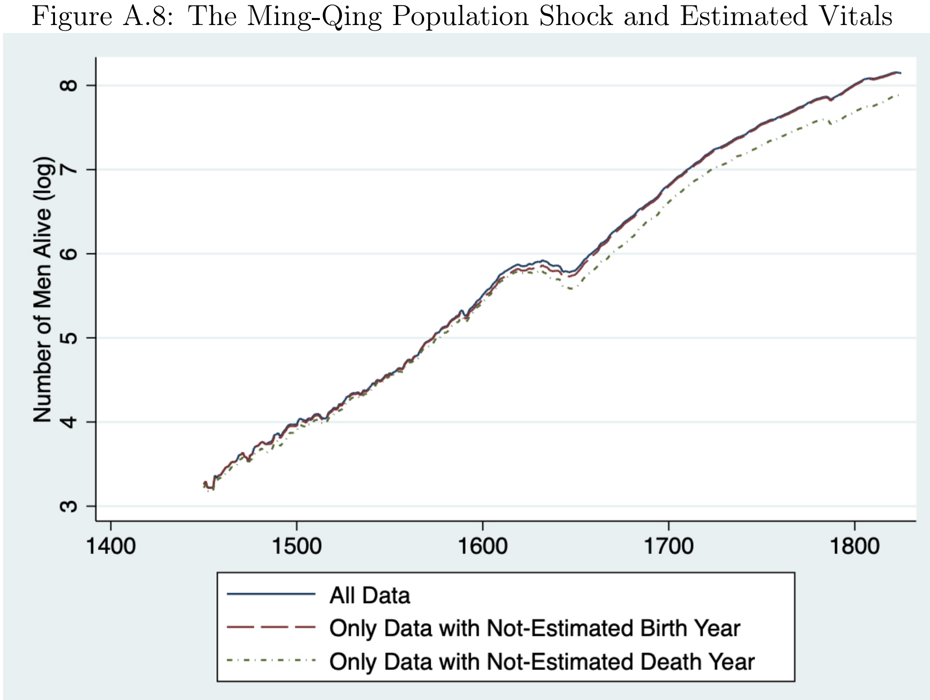
Figure A.8 shows fall of Ming population shock using the full sample as well as dropping observations with estimated vital statistics.

Figure A.7: Birth and Death Rates in the Sample by Gender



Notes: Figure shows birth (death) rates, computed as numbers born (died) in a given year relative to population living in that year, both for males and females. Year given is birth year.

Figure A.8: The Ming-Qing Population Shock and Estimated Vitals



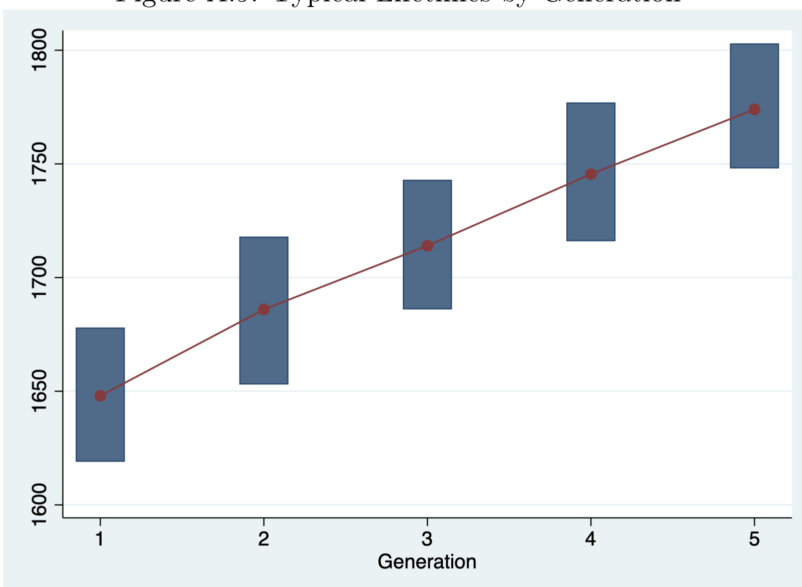
Notes: Figure shows the size of the population shock in the Ming-Qing transition using all data versus two samples that drop observations with estimated vitals.

Notice that the negative Ming-Qing transition population shock is not due to the estimation of vital statistics. If anything a focus on non-estimated data would increase the size of the shock, as one would expect if the estimation introduces classical measurement error. Moreover, it is shown below that the role of estimated vitals for key results is limited (Figure A.13).

C.4.3 Typical Lifetime of Generations

Figure A.9 shows the typical lifetime of each of the five generations.

Figure A.9: Typical Lifetimes by Generation

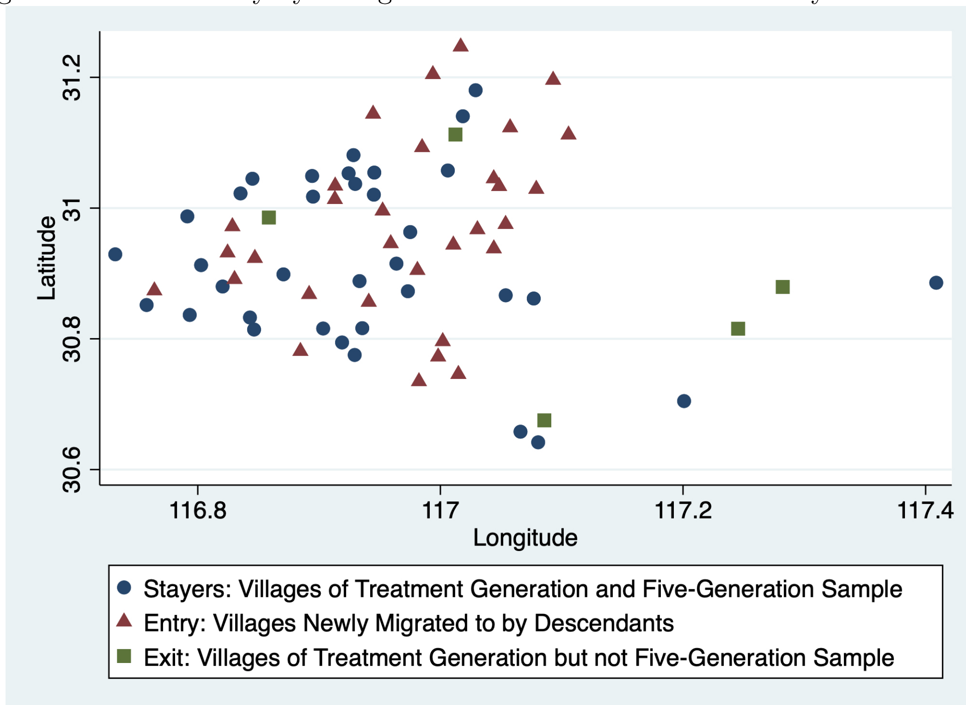


Notes: Bars show median birth and death year by generation, while the line gives the life midpoint (1/2*(birth year + death year)) on average by generation.

C.4.4 Migration

Figure A.10 shows the location of three sets of Tongcheng towns and villages: (1) those that were populated by the treatment generation couples (husband born between 1590 and 1644) and which also are populated by one of the five generations of the inter-generationally linked sample; (2) villages that are the destination of some of the descendants of the treatment generation couples but which were not among the villages of the treatment generation couples; and (3) villages that were among those populated by the treatment generation couples but which did not attract any of the descendants during the following four generations.

Figure A.10: Residency by Village in Treatment Generation and by Descendants

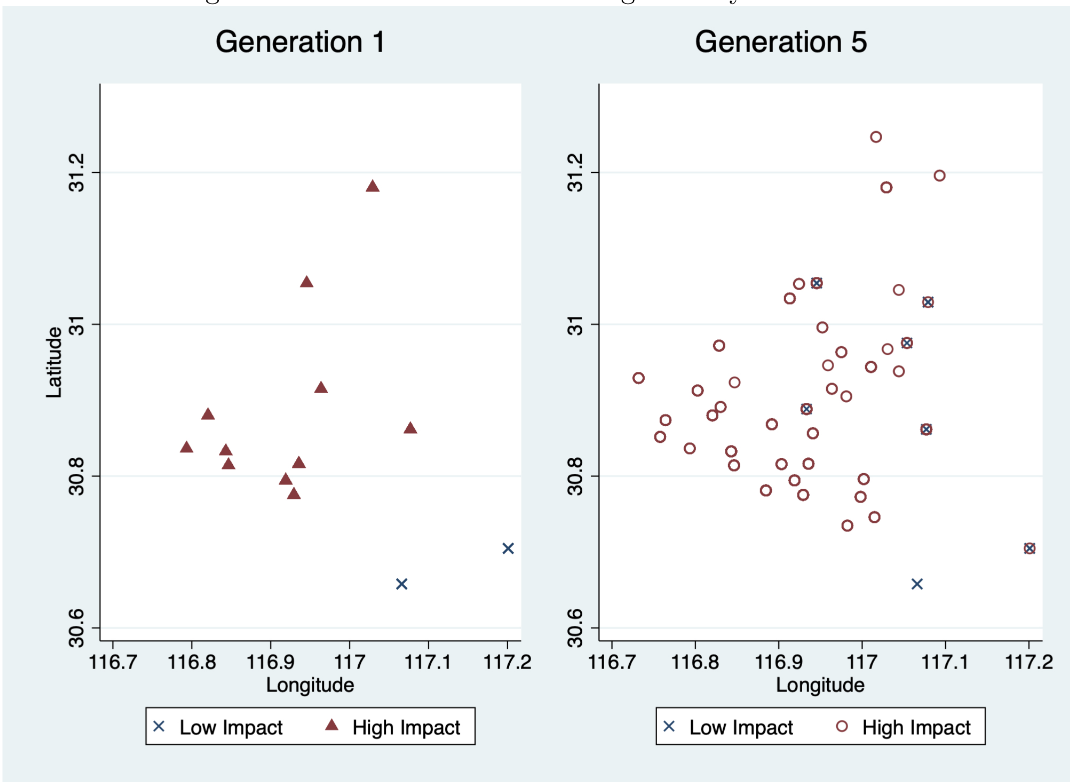


Notes: Figure shows latitude and longitude of Tongcheng villages for the three different samples given in the legend.

Figure A.10 indicates that descendants of the couples of these seven clans did not in a major way move to into the eastern parts of Tongcheng county in which there tended to not reside during the fall of the Ming. If anything, members moved towards the core areas of their clans in the western part of the county, as for example indicated by the three villages in the south-east that were among the residences of the treatment generation couples but not among the set of villages in the five-generation linked sample (green square symbol).

A closer examination of the villages in which members of the Wang clan resided in the first versus fifth generation yields the following picture (Figure A.11).

Figure A.11: Locations of the Wang Clan by Treatment



Notes: Shown are the villages in which Wang clan members lived in the first and fifth generation, by treatment.

Figure A.11 shows in the left panel the locations of Wang clan members during the fall of the Ming, in the treatment generation. For this clan, villages in the south-east experience a relatively low impact compared to villages in the center and north of Tongcheng. In the right panel we present the villages of the Wang clan in the fifth generation by whether Wang ancestors in the first generation were exposed to low or high impact from the Ming-Qing transition. While the clan members generally reside in a greater number of villages in the fifth generation, in part because clan size is growing, the number of different locations grows more for those Wang clan members whose ancestors were exposed to the fall of the Ming than for those whose ancestors were not exposed. Also, over time there is less dispersion in the population share across villages for those Wang clan members whose ancestors suffered particularly strongly from the fall of the Ming.

C.4.5 Population and Human Capital Dynamics in Treated versus Control Regions

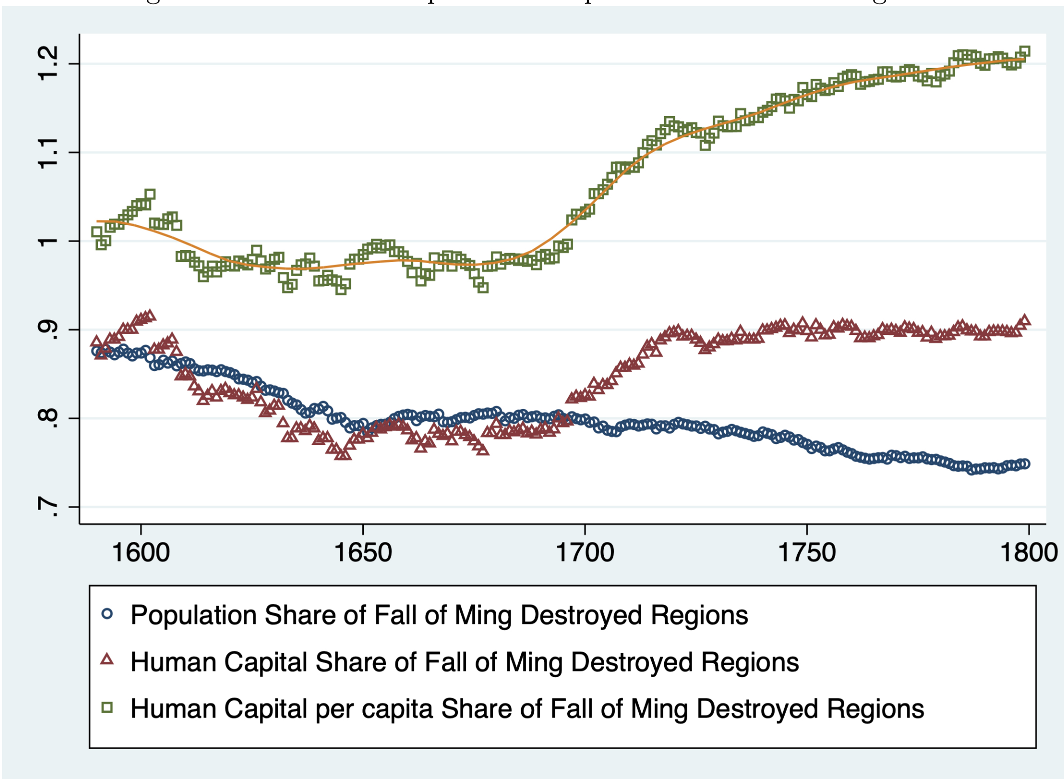
Figure A.12 shows the share of men among the seven clans that is living between 1590 and 1800 in villages suffering from historical destruction during the Ming-Qing transition (i.e., treated). The decline in the population share of treated regions in the beginning follows from the difference in mortality rates between treated and control regions, however, the decline between 1700 and 1800 provides evidence that as far as regions are concerned, the shock has induced long-term outmigration because it has made exposed regions less attractive to settle compared to regions that were historically not exposed. Figure A.12 also presents the share of all human capital held by men who reside in villages subject to fall of Ming destruction for the years 1590 to 1800 (red triangles). During the last decade of the 16th century, this human capital share is around 88%, not unlike the population share of these villages (blue circles).[37] Turning into the 17th century, not only is there a decline in the share of human capital that the treated villages account for, but this decline is stronger than the decline in population, implying that human capital holders leave the historically treated villages at a disproportionate rate. Both human capital and population shares stabilize between 1650 and 1700, before the human capital share of residents in villages that were treated during the fall of the Ming increases to just under 90%, whereas the population share resumes its decline and reaches 75% by the end of the 18th century.

The finding that the treated villages' human capital share by the year 1800 is virtually the same as it has in the late 16th century is interesting. One explanation is regional fundamentals that do not substantially change over these centuries. Human capital-technology complementarity, for example, might require that in order to productively perform their functions human capital holders have to reside in certain villages, such as the administrative capital, or central places in the network of villages characterized by the intersections of major roads. Moreover, the full recovery in the human capital share of historically treated regions parallels the human capital reversal that was estimated in a framework of treatment of people in the text.

The series at the top of Figure A.12 is the ratio of the treated regions' share of human capital and the treated regions' share of population. After falling below one in the early 1600s, human capital per male in the treated regions rises above one by about the year 1700, and reaches a value of 1.2 by the beginning of the 19th century. Thus, while the reversal of the human capital share is consistent with the persistence in

[37] The similarity of these two shares in the late 16th century is in line with the finding that there are no significant pre-trends in terms of human capital between treatment and control villages (Table 1).

Figure A.12: Human Capital and Population in Treated Regions



Notes: Shown is share of all men, and the share of all men with human capital, residing in destroyed villages of Tongcheng during the Ming-Qing transition; also shown the ratio of share of human capital to the share of men in villages treated by the fall of Ming shock.

terms of regional fundamentals, there is also evidence that the fall of Ming shock has permanently changed the human capital intensity of historically destroyed regions.

D Additional Empirical Results

D.1 Source of Human Capital Losses in First Generation

In the treatment generation, the lower level of human capital for men in treated versus control villages can be explained by both higher downward mobility and lower upward mobility, as shown in Table A.4.

In the not destroyed villages, 88.2% of fathers with human capital had sons that also acquired human capital over their lifetime, whereas the degree of intergenerational persistence in human capital in the destroyed villages is with a corresponding share of 49.3% much lower (Panel A, lower right, and Panel B, lower right, respectively). Put differently, the extent of downward mobility in human capital for treated sons is more than four times that of sons in control areas (50.7% versus 11.8%, respectively).

Table A.4: Intergenerational Mobility in Human Capital and the Ming-Qing Transition

Panel A: Not Destroyed

		Father	
		No HC	HC
Son	No HC	78.4% (29)	11.8% (2)
	HC	21.6% (8)	88.2% (15)
		100.0% (37)	100.0% (17)

Panel B: Destroyed

		Father	
		No HC	HC
Son	No HC	90.9% (269)	50.7% (71)
	HC	9.1% (27)	49.3% (69)
		100.0% (296)	100.0% (140)

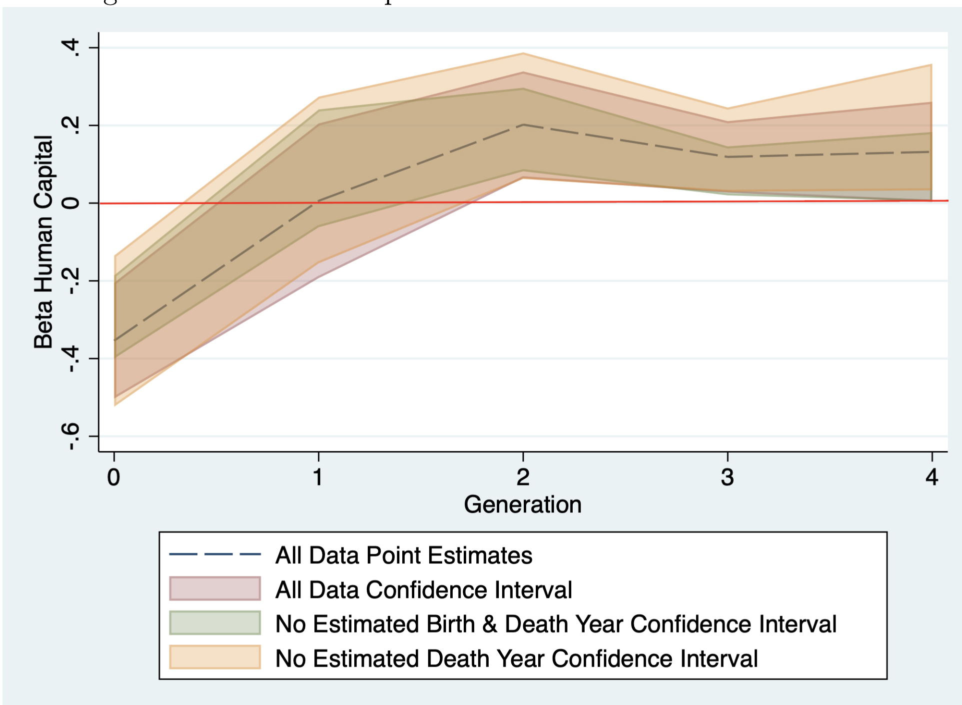
Notes: Table shows presents transition matrix for intergenerational mobility in human capital (HC) between the pre-shock generation and the first (treatment) generation by treatment. Columns sum to 100 percent; figures in parentheses are absolute numbers.

Upward mobility in treated areas is also lower than in control areas (lower left corner, Panels B and A, respectively), but quantitatively, that the Ming-Qing transition reduced the ability of sons from high-human capital families to follow in the footsteps of their fathers is of greater importance. The negative impact in generation 1 on status is consistent with the negative impact on human capital acquisition (Table 3, column (4)).

D.2 Estimated Vitals

Extending this analysis, we now compare results from the baseline human capital analysis in Table 3, column (1), with those that exclude alternative sets of data if vitals are estimated. Results are shown in Figure A.13.

Figure A.13: Human Capital Reversal and Estimation of Vitals



Notes: Figure shows the size of the population shock in the Ming-Qing transition using all data versus two samples that drop observations with estimated vitals.

Figure A.13 indicates that the estimation of vital data in the sample does not influence the finding that there was a human capital reversal.

D.3 Human Capital Impact by Generation

Instead of stacking all five generations in a single regression, here we consider the impact of the fall of the Ming generation by generation. This imposes fewer parameter restrictions, at the same time when it does not reflect the dynamics in the human capital effect across generations as much as the stacked regression.[38] Table A.5 shows that results using the generation-by-generation approach are qualitatively similar to those with five stacked generations (compare columns (2) to (6) to column (1)).

D.4 Randomization Inference

This section provides results for an alternative method of inference. If one thinks of the setting of villages that were destroyed or not in the fall of the Ming as a quasi-experiment, randomization inference is a natural

[38] Given the smaller number of observations in the generation-by-generation analysis, we drop male and female clan fixed effects from the specifications.

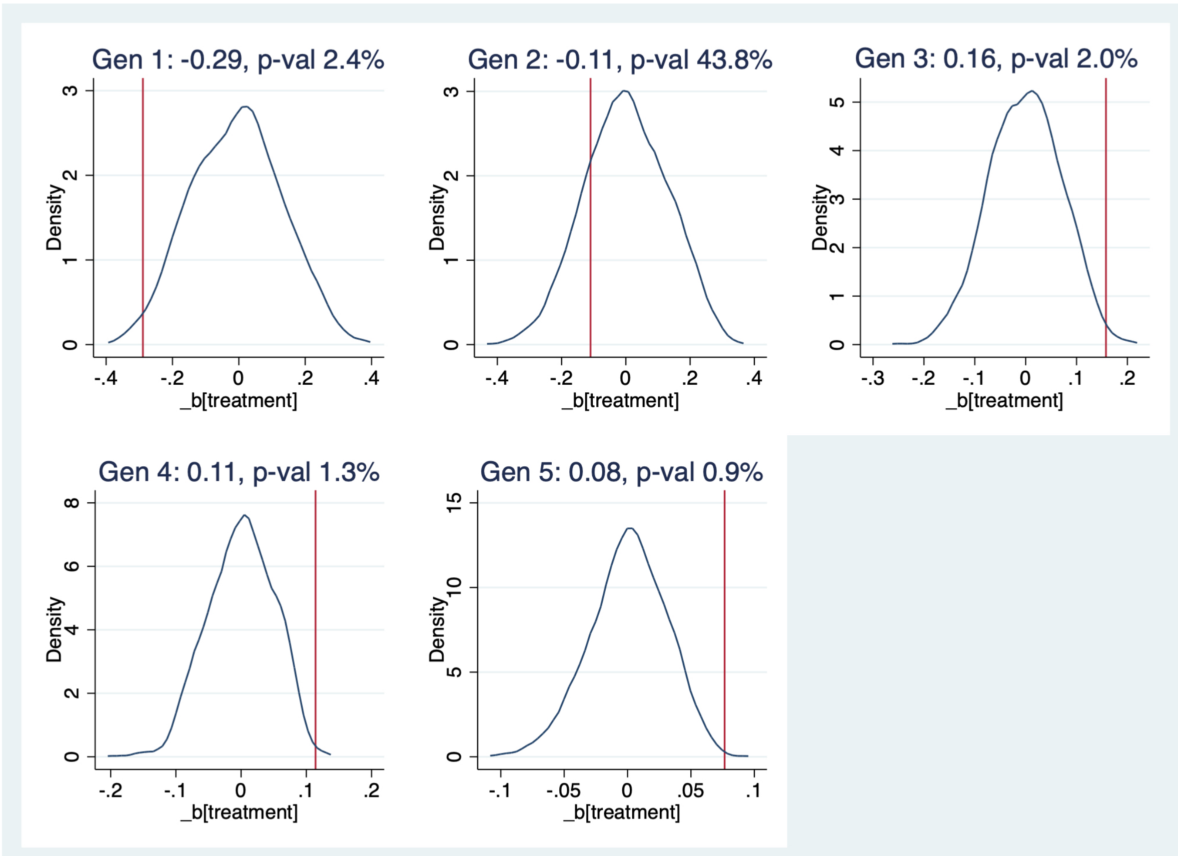
Table A.5: Fall of the Ming and Different Human Capital Levels

	(1) Human Capital Indicator	(2)	(3)	(4)	(5)	(6)	(7) Four Human Capital Levels
Fall of Ming							
Gen 1	-0.351^{**} (0.068)	-0.294^{**} (0.094)					-0.632^{*} (0.148)
Gen 2	0.006 (0.092)		-0.105 (0.114)				0.082 (0.187)
Gen 3	0.200^{*} (0.064)			0.157^{**} (0.055)			0.456^{*} (0.855)
Gen 4	0.118^{+} (0.043)				0.114^{*} (0.056)		0.223^{+} (0.090)
Gen 5	0.131^{+} (0.060)					0.077 (0.056)	0.285^{+} (0.124)
N	8,012	1,669	1,657	1,625	1,600	1,500	8,012

Notes: Dependent variable at the top of column; sample consists of the couples formed by all male descendants of the treatment generation couples that can be linked forward over five generations. Estimation of equation (1) by OLS. Gen stands for generation. Fixed effects for birth year included, in columns (1) and (7) also fixed effects for generation, husband clan, and wife clan. Also included is the status of the husband's father in the treatment generation. Robust standard errors in parentheses; clustered at treatment generation couple and in columns (1) and (7) also at the level of generation; **/*/+ indicates significant at the 1%/5%/10% level.

approach. Figure A.14 shows, for each generation 1 to 5, the results from randomly assigning treatment one thousand times and running with each simulation sample the OLS treatment effect regression.

Figure A.14: Human Capital Impact: Randomization Inference



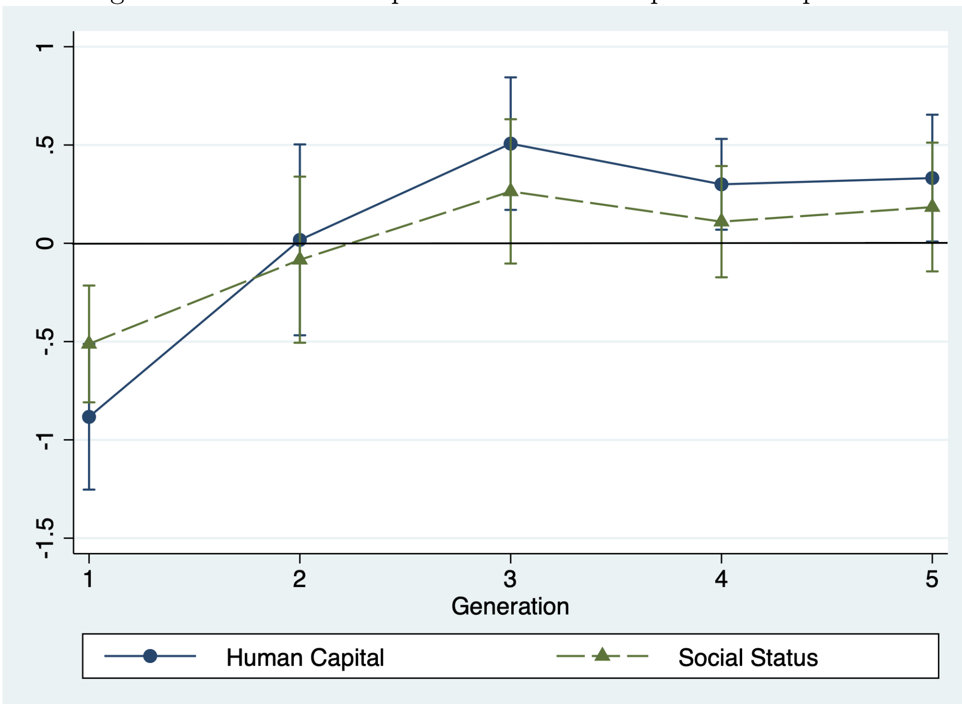
Notes: Figure shows the distribution of coefficients from estimating the impact on human capital using randomized assignment by generation, 1 to 5; red line indicates the estimate of observed assigned (columns (2) to (6), Table A.5); p-values from the empirical distribution based on 1,000 randomized assignments each. Gen stands for generation.

In each plot, the red line gives the coefficient estimated with the actual assignment, as shown in columns (2) to (6) of Table A.5. Of particular interest are p-values, because unlike the clustered standard errors of Table A.5 the randomization p-values do not rely on sample variation. While the randomization p-values can be considerably smaller than the p-values based on clustering, for example for generation 5, overall, results using different approaches to inference lead to broadly similar results.

D.5 Relation of Human Capital and Status

Figure A.15 shows estimates analogous to Table 3, columns (1) and (2) using standardized variables with mean zero and standard deviation of one.

Figure A.15: Human Capital and Status Responses Compared



Notes: Figure shows estimates and 90% confidence intervals of specifications analogous to columns (1) and (2) of Table 3 using standardized measures with mean zero and standard deviation of one.

Notice that both the loss in status in generation one and the gains in status in generations three to five are not as large as they are for human capital, and the positive coefficients in later generations are not significantly different from zero. This provides evidence that human capital is an important source of status, in contrast to high status allowing men to acquire human capital.

D.6 Distance to Burial Sites

Information on burial sites, both of husband and of wife, comes from a categorical variable ranging from 1 to 8 based on the distance between a person's residence and their eventual burial location. While Chinese families during this period typically buried their deceased close to their residences, a burial location that is a substantial distance from the residence is a likely sign of turmoil that has caused burial away from the family residence. Distances range from within 15 *li* (5 miles) of the residence to locations 180 *li* (60 miles) or more from the residence, as well as locations outside of the province. The average of the categorical burial distance variable for both males and females is about 3. Table A.6 shows the impact of the shock on the location of burial sites relative to residence. Results indicate that the shock has tended to increase the distance between residence and burial site for both gender, especially in the long run.

Table A.6: Fall of the Ming Impact on Distance to Burial Sites

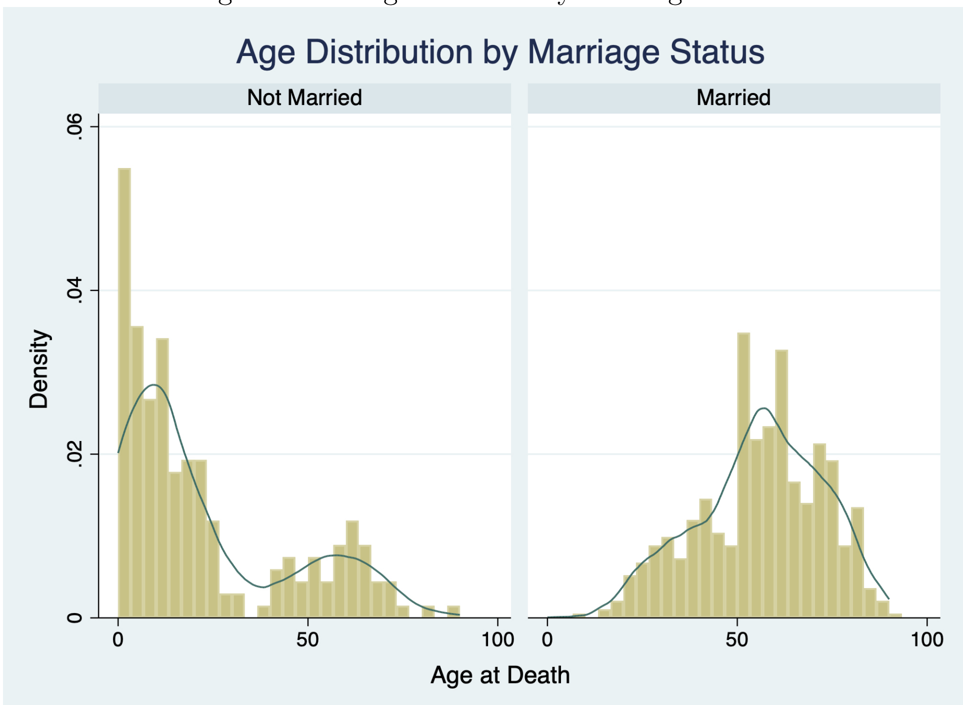
	(1)	(2)
	Male	Female
Fall of Ming:		
Generation 1	0.184^{*}	0.055
	(0.064)	(0.060)
Generation 2	-0.013	0.003
	(0.085)	(0.086)
Generation 3	0.087	0.011
	(0.045)	(0.061)
Generation 4	0.188^{**}	0.135^{**}
	(0.037)	(0.027)
Generation 5	0.133^{*}	0.145^{*}
	(0.039)	(0.045)
Father Status	0.014^{*}	0.015^{**}
	(0.003)	(0.003)
Fixed Effects:		
Generation	Y	Y
Birth Year	Y	Y
Husband Clan	Y	Y
Wife Clan	Y	Y
N	7,427	7,090

Notes: Dependent variable at the top of column; sample consists of all men and women in generations 1, 2, 3, 4, and 5 that constitute couples formed by male descendants of the treatment generation, including the treatment generation couple itself, conditional on intergenerational linking over five generations. Estimation of equation (1) by OLS. Father Status is status of the husband's father in treatment generation. Robust standard errors two-way clustered at the level of treatment generation couple and generation in parentheses; **/*/+ indicates significant at the 1%/5%/10% level.

D.7 Extensive Margin

Figure A.16 shows the distribution of the length of life time of these males by marriage status. For non-married males (left panel), the distribution of age at death is bi-modal, and the highest density of males is for those that do not live beyond three years of age. The main reason for this is infant mortality. Another, local maximum of those that do not marry is around 60 years. The main reason that these males do not marry is that given the prevailing male-female sex ratio of larger than one, these men are not rich enough

Figure A.16: Age at Death by Marriage Status



Notes: Figure shows densities of age at death of two samples, the second-generation males that were able to marry and of the sample of second-generation males that were not able to marry, right and left panel, respectively.

to marry. In comparison, the distribution of longevity for married men has a single maximum around 52 years (Figure A.16, right side).

D.8 Treatment of People versus Treatment of Regions

Table A.7 presents the estimation results underlying Figure 8 in the text.

D.9 Individual-Level Heterogeneity

This section examines whether the responses shown in Table 3 are stronger or weaker for certain sets of subgroups. We extend equation (1) from above to include interaction terms with a particular characteristics, denoted by z_{ic}^{f}. To avoid endogeneity concerns, we focus on the human capital and status of the fathers of the first generation husbands.

$$y_{ic(p)g} = \alpha + \beta_{gz} \left[I\left[t = g\right] \times d_p \times z_{ic}^{f} \right] + \beta_f hfstat_{c0} + \eta_g + Z'\nu + X'\gamma + \varepsilon_{ic(p)g}, \tag{17}$$

where the coefficient β_{gz} captures the extent to which the fall of the Ming impacts outcome $y_{ic(p)g}$ in

Table A.7: Treatment of People versus Treatment of Regions

	(1) Treatment of People	(2) Treatment of Regions	(3) Treatment of People w/ Move to Control Regions
Fall of Ming			
Gen 1	-0.354^{**} (0.070)	-0.394^{**} (0.068)	-0.358^{**} (0.068)
Gen 1 × Control Region			0
Gen 2	0.005 (0.093)	−0.122 (0.064)	−0.000 (0.093)
Gen 2 × Control Region			0.258 (0.159)
Gen 3	0.201^{*} (0.065)	0.064 (0.032)	0.197^{*} (0.065)
Gen 3 × Control Region			0.041 (0.058)
Gen 4	0.118^{+} (0.043)	0.090^{*} (0.029)	0.125^{*} (0.042)
Gen 4 × Control Region			−0.084 (0.049)
Gen 5	0.132^{+} (0.061)	0.098^{*} (0.024)	0.138^{+} (0.060)
Gen 5 × Control Region			-0.077^{+} (0.036)
N	8,024	8,024	8,024

Notes: Specification in column (1) assigns treatment to first generation couples living in destroyed towns and villages as well as to their descendants; identical to Table 3, column (4). Gen stands for generation, d.p. stands for dependent variable. Robust standard errors two-way clustered at the level of treatment generation couple and generation in parentheses; **/*/+ indicates significant at the 1%/5%/10% level.

a way that varies with characteristic z^f_{ic}. The vector Z includes all lower-order terms, including $\eta_g \times z^f_{ic}$ and $z^f_{ic} \times d_p$. Table A.8 shows the results.

Table A.8: Individual-Level Heterogeneity in Adjustment

	(1)	(2)	(3)	(4)
Dependent Variable	Human Capital	Status	# Sons	Concubine
[*Generation* 1 $\times z^f_{ic}$]	-0.292^{*} (0.087)	-0.226^{*} (0.053)	0.058^{+} (0.024)	0.042^{+} (0.019)
[*Generation* 2 $\times z^f_{ic}$]	-0.052 (0.117)	0.023 (0.114)	-0.011 (0.028)	-0.026 (0.015)
[*Generation* 3 $\times z^f_{ic}$]	0.213^{*} (0.074)	0.134 (0.071)	-0.030 (0.021)	-0.008 (0.009)
[*Generation* 4 $\times z^f_{ic}$]	0.165 (0.088)	0.010 (0.080)	0.009 (0.018)	-0.038^{+} (0.016)
[*Generation* 5 $\times z^f_{ic}$]	0.136 (0.089)	0.139 (0.088)	-0.039 (0.021)	0.017 (0.013)
Variable z^f_{ic}	Father HC	Father Status	Father Status	Father HC
N	8,038	8,034	8,038	8,038

Notes: Dependent variable at the top of column; estimation of equation (17) by OLS. Estimates of interaction coefficients β_{gz} shown; variable z^f_{ic} is human capital or status of father of treatment generation husband, as shown. Other coefficients not reported. Sample is all observations that can be forward linked from treatment to fifth generation. Specifications include fixed effects for each generation, husband birth year, husband clan, and wife clan. Robust standard errors two-way clustered at the level of the treatment generation couple and generation in parentheses; **/*/+ indicates significant at the 1%/5%/10% level.

In the first generation, sons who descend from a treated father with human capital-holding grandfather lose disproportionately, as the coefficient of -0.292 in column (1) indicates. Moreover, in later generations descendants of such a human capital holder disproportionately increase their own human capital acquisition, significantly in the third generation. Overall, human capital in the pre-shock period amplifies the overall pattern of human capital acquisition documented above (Table 3). The influence of high status in the pre-shock period follows the same pattern but is less pronounced (column (2)).

Furthermore, while couples living in highly destroyed villages during the fall of the Ming have on average more sons than those in less destroyed villages (Table 3), this is even more so in the first generation the case for couples in which the man comes from a high-status family (Table A.8, column (3)). Thus, even though many men in this generation suffer losses in terms of status and human capital, based on the family's past status and income the couple has more children. This indicates that fertility decisions are to some extent based on the permanent as opposed to the current income of the family. Finally, concubines are more common among the treated generation 1 couples if the husband has a father holding human capital (column (4)). Heterogeneity in terms of status or human capital of the ancestors does typically not matter beyond the third generation.

D.10 Group-Level Heterogeneity

This section examines the roles of clans and other groups for the results. The specification is similar to equation (17) but instead of characteristics of the generation-1 male's father, we introduce two measures of the group that individual i belongs to. They are individual i's clan, denoted by k, and individual i's village, denoted by v. Clan membership captures the importance of kin relationships, whereas belonging to the group of residents of a particular village captures the influence of geographic proximity (regular face-to-face interaction, trust building, and knowledge transmission). The specification is given by

$$y_{ic(p)g} = \alpha + \beta_{gz}\left[I\left[t = g\right] \times d_p \times z^l_{ict}\right] + \beta_f hfstat_{c0} + \eta_g + Z'\nu + X'\gamma + \varepsilon_{ic(p)g}, \tag{18}$$

where $l = k, v$,and z^l_{ict} is a measure of the share of the group l of a particular variable that individual i belongs to in period t. The main variable used to compute these shares is status, but we also employ human capital and migration activity as alternatives. For example, if observation $y_{ic(p)g}$ belongs to the Ye clan, the variable z^l_{ict} is the share of the Ye clan in all of the status in that generation when the group is clans. This share captures the importance of the Ye clan in two ways. First, for given status, it is increasing in the size of the Ye clan. Second, for two clans that have the same number of members in a given generation, the clan share is increasing in the status of the average member. We employ status of the father, in the preceding generation, to reduce the reflection problem (Manski 1993). Table A.9 shows the results.

We begin with the role of the clan for human capital acquisition. The negative impact on human capital in the first generation turns out to be increasing in clan status, while it is increasing in clan status in the second generation (column (1)). Consider the human capital technology of equation (11). This captures a group effect because during bad times such as the fall of the Ming, human capital acquisition falls not only because individual i does not devote as many resources to human capital acquisition as usually but

Table A.9: Group-Level Heterogeneity in Adjustment

	(1)	(2)	(3)	(4)
Dependent Variable	Human Capital		Fertility	
$[Generation\ 1 \times Clan]$	-0.185^{*}	-0.265^{**}	0.018	0.264
	(0.049)	(0.051)	(0.134)	(0.158)
$[Generation\ 1 \times Village]$		-0.371^{**}		1.705^{+}
		(0.074)		(0.755)
$[Generation\ 2 \times Clan]$	0.069^{+}	0.054	0.393^{+}	0.760^{*}
	(0.031)	(0.031)	(0.178)	(0.250)
$[Generation\ 2 \times Village]$		0.135		−0.050
		(0.087)		(0.242)
$[Generation\ 3 \times Clan]$	−0.039	−0.066	0.122	1.187^{**}
	(0.030)	(0.047)	(0.215)	(0.207)
$[Generation\ 3 \times Village]$		0.052		0.718^{**}
		(0.049)		(0.140)
$[Generation\ 4 \times Clan]$	−0.050	−0.060	0.176	0.265
	(0.057)	(0.053)	(0.139)	(0.166)
$[Generation\ 4 \times Village]$		0.061		−0.057
		(0.032)		(0.127)
$[Generation\ 5 \times Clan]$	0.012	−0.009	−0.098	−0.043
	(0.032)	(0.035)	(0.147)	(0.162)
$[Generation\ 5 \times Village]$		0.011		−0.051
		(0.036)		(0.108)
N	8,021	8,021	8,021	8,021

Notes: migration is for the male of the couple; fertility is measured by the number of sons. Specifications include fixed effects for each generation, husband birth year, husband clan, and wife clan. Robust standard errors two-way clustered at the level of the treatment generation couple and generation in parentheses; **/*/+ indicates significant at the 1%/5%/10% level.

also because the group to which the individual belongs has relatively low average human capital levels. At a time where the individual would particularly benefit from the resources of his clan members because own resources are relatively low, the individual cannot get that support because the destruction caused by the fall of the Ming means that also the individual's fellow clan members haven't been able to build up their levels of human capital. Thus, in the first generation there is a negative group effect. In the second generation, a positive group effect is estimated. While human capital acquistion of treated and control observations for generation 2 overall does not significantly differ (Table 3), the positive group coefficient indicates that treated men from high-status clans acquire significantly more human capital than treated men from lower-status clans (Table A.9, column (1)). This is consistent with positive clan externalities as described by equation (11) of the model.

It is also interesting to examine evidence for externalities associated with geographic proximity, as captured by the size of the village individual i resides in. We augment column (1) with an analogous set of regressors that interact treatment with the share of status in individual i's village in that generation. Both clan share and village share are normalized to have mean zero and standard deviation of one, so that coefficient differences indicate differences in economic magnitudes. Clan and village shares are not orthogonal to each other, as clan members often reside in the same village.[39] For the first generation, we find that human capital acquistion is declining due to both clan and village effects, see column (2). Furthermore, including the village group variable reduces the size of the positive clan coefficient in the second generation. Group effects are found to be more important in the first than in other generations, and generally, village effect point estimates appear to be somewhat larger than clan point estimates (in absolute value).

The final two columns of Table A.9 examine group effects in the context of fertility responses to the shock. Both clan and village effects are present in the first three generations; coefficients tend to be positive, with not a single significantly negative estimate. This is further evidence for positive group-level externalities in the individuals' responses to the fall of Ming shock.

[39]In fact, it is not unusual that all residents of a village hail from the same clan.