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

Carol H. Shiue and Wolfgang Keller†

University of Colorado, NBER, and CEPR

February 23, 2023

Abstract

Do big shocks have permanent effects on peoples' economic fortunes, or are they transitory? This paper proposes a multi-generational cohort approach to study individual and family responses over three centuries to the 1644 fall of the Ming Dynasty, costing the lives of close to 1/8 of China's population. Based on a sample of seven clans in Central China, our first finding is that the fall of the Ming reduced the human capital of those affected by about one third compared to individuals that were unaffected by the shock. There is also a reversal from negative to positive impact by the third generation, which persists to the fifth generation after the shock. Second, the shock induced not only out-migration of those affected during the fall of the Ming but also persistently higher migration and fertility for descendants of those that the shock affected. Third, we find that clan human capital magnifies the positive long-run human capital response to the fall of the Ming.

Keywords: Social Networks, Chinese Clans, Human Capital Externalities, Persistent Effects

*Thanks to David Autor, Jack Goldstone, Taylor Jaworski, Richard von Glahn, and audience members at the CEPR-Manchester China conference 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".

†Email: shiue@colorado.edu, kellerw@colorado.edu

1 Introduction

Do big shocks have a permanent effect on the economic fortunes of people, or are the effects from big shocks transitory? This question has vexed researchers in many settings. It has been argued, for example, that by causing mass emigration the Great Irish Famine (1845-49) had a permanent effect on Ireland, in contrast to Allied bombing of Japanese cities in World War II which had little long-run impact (O' Grada and O' Rourke 1997 and Davis and Weinstein 2002, respectively).[1] Precisely because big shocks can have effects that last over centuries, it is a challenge to trace out channels of influence because suitable information over centuries is rare. This paper considers the transition between two major dynasties of China–the Ming-Qing transition, a shock that cost nearly 1/8 of China's population--by tracing out the economic and demographic responses over three centuries in a sample of men, women, and their families in Central China.[2]

The fall of the Ming yields a uniquely powerful natural experiment because in its aftermath China was a relatively stable, pre-industrial economy with no major subsequent shock for around two centuries.[3] Given that the shock is not overlaid by other major changes, it becomes more feasible to identify long-term effects. Furthermore, our setting allows us to examine not only individual adjustment but also the role of the extended family, or clan, which is important given the significance of such kinship relationships in many countries. Finally, employing longitudinal micro data on five consecutive generations enhances the possibility to trace out long-run effects and helps to interpret empirical findings.

To guide the analysis we consider a model in which parents make investments into the human capital of their children because they care about the income of their offspring. Parents devote resources to their childrens' skill acquisition, as in Becker and Tomes (1979, 1986), through hiring teachers and in terms of the parents' own time. We extend this framework by introducing a second form of investment, which is that parents can invest by migrating their families to a new residence. In times of turbulence, such as during the Ming-Qing transition, migration away from areas of active fighting is at the most basic level

[1] Other examples of big shocks include pandemics, environmental disasters, and historical institutions. See, for example, Pamuk (2007) on the role of the Black Death (1346-53) for the economic divergence between Northern and Southern Europe, Hornbeck (2012) on the impact of the American Dust Bowl of the 1930s, and Dell (2010) on the role of the colonial mining *mita* (1573-1812) for Peru and Bolivia's 20th century economies.

[2] Population decline from 99.9 million to 88.5 million over the period 1626-1646, see Lee and Zhang (2013). Ge Jianxiong (1999, 16-25) estimates total population decline in China of 16% over the 50 years after 1630. See citation in Cao (2022).

[3] 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.

a matter of survival. Regardless of the instigating factor for outmigration, however, where to migrate is a decision that likely reflects intergenerational strategies. At the same time, migration is costly in terms of transport, food, and time, and it also typically means that the family's grasp on property that cannot be moved, in particular land, becomes more tenable. The model predicts that both skill and migration investments are increasing in parent income. Furthermore, while investment in skills and migration are complements, the family will tilt its investment towards skill building or migration depending on which form of investment is relatively productive in a given period.

The fall of the Ming is examined in terms of close to 500 couples of Tongcheng, a county of China's province of Anhui, as well as the couples formed by all of their male descendants (son to great-great-grandson). In the fifth generation, these are about 16,000 individuals, and the sample spans more than three hundred years. The fall of the Ming had a regionally diverse impact in China. In Tongcheng, the impact was severe, including death and destruction through military campaigns as well as famines. In our sample, death rates almost tripled while birth rates fell by one third. Relative to trend growth in the sample, the fall of the Ming reduced the size of the seven clans by about 50% over the period 1625 to 1650, and somewhat more for men than for women.

We estimate the impact of the shock by comparing the behavior of couples that were living in villages that were more or less destroyed–the treatment– by the turmoil of the fall of the Ming. The shock was plausibly exogenous and random, and there are no significant differences between the treated and untreated locations before the shock. By following the descendants of the two groups, we estimate the length of time and the number of generations that were impacted, thereby providing new information on how big shocks transpire across generations. We find that the descendants of the treated and control groups were still different from each other, even though they did not experience the original shock.

First, in the treatment generation, the fall of the Ming reduces the human capital of those affected by about one third compared to individuals that were unaffected. The finding is consistent with a major impact, which as a consequence of military campaigns and the resulting negative consequences for economic activity slowed down learning and the acquisition of human capital. However, the negative human capital impact does not persist. Rather, there is a reversal from negative to positive impact by the third generation, the treatment couples' grandsons. Furthermore, the positive impact of the fall of the Ming on human capital acquisition persists to the fifth generation. These individuals lived typically 160 and up to 300 years after the treatment generation. One explanation that finds support in the data is that while human capital is vulnerable to destruction in a big shock, investing into human capital is also attractive compared to other avenues of upward mobility such as land ownership because human capital is more portable than land.

Second, we show that the fall of the Ming has induced out-migration of the affected areas. This migration is mostly over relatively short distances, far enough to escape the localized destruction of the shock. Moreover, the fall of the Ming leads to a sustained increase in migration behavior which is present even among the great-great-grandsons' families of the couples that themselves lived through the turmoil of the fall of the Ming. We also find that the shock increases fertility as measured by the number of sons in a couple. This fertility increase at a time of lower human capital and overall resources–which is non-Malthuisan–can be seen as mitigating increased risk in times of crisis. As is the case for migration, the fall of the Ming increases fertility levels of the descendants of treated couples for multiple generations. Furthermore, several adjustment strategies reinforce each other. In particular, migration is effective in reducing the loss of human capital caused by the fall of the Ming in the treatment generation, and conversely, individuals that are relatively successful in acquiring human capital despite the turmoil are more likely to out-migrate than others.

Third, the adjustment behavior provides evidence for clan externalities in terms of human capital acquisition. During the fall of the Ming, men from high-human capital clans suffer a disproportionately large reduction, and in subsequent generations such men experience a disproportionately large increase in human capital compared to affected men from low human-capital clans. This evidence is consistent with positive human capital externalities at the clan level. Comparing these clan effects with potential externalities through interactions with neighbors, which we proxy by living in the same village, we find stronger evidence for kinship-based than village-based group effects. Moreover, our results indicate that not only the resources of the male clan matter but also those of the clans of the in-marrying wives.

Fourth, we find that the fall of the Ming has negatively affected the longevity of the male children of the treatment generation couples, especially once we account for the longevity of the parents. This influences the continuation of family lines because early death during childhood is a major reason why a man would not marry and have children himself. In this way, the fall of the Ming reduces the probability to have extended inter-generational lines to begin with.

A large literature examines economic well-being in terms of inter-generational effects, such as McCord, Bharadwaj, McDougal, Kaushik, and Raj (2021) who study *in utero* effects of the Bhopal Gas accident, as well as Oreopoulos, Page, and Stevens (2008) and Hilger (2016) who focus on inter-generational effects of job loss. This paper adds to work employing inter-generational analysis in historical settings, such as the impact of the Great Depression on inter-generational mobility in the U.S. (Feigenbaum 2015) or the role of mechanization of 20th century U.S. agriculture on outcomes of farm children (French 2022). Our analysis contributes a longer temporal perspective that starts earlier by employing data from family histories instead of ex-post linked census data that is increasingly available for the more recent past. Information from family histories and historical census data are increasingly seen as complementary when both are available (Price, Buckles, van Leeuwen, and Riley 2021, Bailey, Cole, Henderson, and Massey 2020, Abramitzky, Boustan, Eriksson, Feigenbaum, and Perez 2021).

This paper is also part of a growing literature that considers historical interventions to address important questions of long-run economic impact. For example, Pamuk (2007) and Jedwab, Johnson, and Koyama (2022) study the long-run consequences of the Black Death, and Nunn (2020) provides a broader overview. Historical settings are attractive both because they may provide suitable quasi-experiments and because they allow for sufficient time so that long-run effects can even be observed to begin with. The fall of the Ming is plausibly exogenous from the point of view of the individuals in our sample, and moreover, using balance checks we do not find evidence that treatment and control observations are significantly different. Our analysis is most closely related to work on the mechanisms through which historical interventions exert their influence over centuries (Nunn 2008, Dell 2010, and the subsequent literature). Our approach pivots to longitudinal data on people instead of cross-sectional data on regions at different points in time, and provides to the best of our knowledge one of the first papers tracing out the long-run impact of a historical intervention using a multi-generational cohort approach. The finding of a human capital reversal shows that while history matters, the "long shadow of history" might in fact not be that long, at least if one thought that long-run effects are generally faded versions of short-run effects.

We also contribute to a sizable literature on adjustment behavior to historical shocks. Work on 19th century U.S. by Bleakley and Ferrie (2016) shows that a positive wealth shock need not lead to higher human capital in the following generation, whereas we find that a negative shock triggers a negative short-run but positive long-run human capital response. Migration as an adjustment mechanism to bad shocks is well-established in the literature (O'Grada and O'Rourke 1997, Hornbeck 2012, Boustan, Khan, and Rhode 2012, and Feigenbaum 2015). In addition to employing more disaggregated data for an earlier time, our analysis quantifies the role of groups for adjustment. Chinese clans are of interest from a comparative perspective with European guilds (De La Croix, Doepke, and Mokyr 2018), and we complement analysis of kinship relationships versus formal market institutions (Kinnan and Townsend 2012, Townsend 1994) by studying the effectiveness of kinship networks compared to networks based on geographic vicinity.

The remainder of the paper is as follows. The following section 2 introduces a simple model of parental investments into their children as our theoretical framework to analyze the intergenerational consequences of the fall of the Ming. Section 3 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 4 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 5 shows results on the impact of the fall of the Ming in the long-run, defined as impacts in the fifth generation post treatment, while section 6 discusses our results on adjustment strategies over all five generations. Section 7 summarizes our findings and presents some preliminary conclusions. The Appendix provides more information on the data and also additional analysis of key results.

2 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.[4] Parents maximize utility according to

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

where c_i is consumption, y_i is income, and $i = p, c$ is parents or child. According to equation (1), 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

[4]The empirical analysis below allows for other "wives" including concubines. See Shiue (2017) for an analysis of the child quantity-quality decision during this time. Further, marriage behavior of both sons and daughters in Ming-Qing China is analyzed in Keller and Shiue (2022).

it requires investments that for a given parent income reduce their consumption. The parents' budget constraint is given by

$$c_p = y_p - s_p - m_p, \tag{2}$$

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 outmigrate. 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:

$$y_i = Ah_i^{\sigma}, i = p, c, \tag{3}$$

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:

$$h_c = B\, s_p^{\gamma}\, m_p^{\kappa}\, K_p^{\mu}. \tag{4}$$

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 (4), 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 (2, 3, and 4) into equation (1), the equilibrium choice of skill investment, s_p^*, and migration investment, m_p^*, satisfies

$$\frac{(1-\alpha)}{y_p - s_p^* - m_p^*} = \frac{\alpha\gamma\sigma}{s_p^*} \tag{5}$$

and

$$\frac{(1-\alpha)}{y_p - s_p^* - m_p^*} = \frac{\alpha\kappa\sigma}{m_p^*}. \tag{6}$$

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

$$\frac{s_p^*}{\gamma} = \frac{m_p^*}{\kappa}. \tag{7}$$

Equation (7) 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

$$s_p^* = \frac{\alpha\gamma\sigma}{1-\alpha(1-\sigma(\gamma+\kappa))} y_p \tag{8}$$

and

$$m_p^* = \frac{\alpha\kappa\sigma}{1-\alpha(1-\sigma(\gamma+\kappa))} y_p. \tag{9}$$

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 exact 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 (4)).

3 The Fall of the Ming: Causes and Consequences

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 treasury 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 affairs also 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. Furthermore, climatic conditions are thought to have 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 represented an exceptionally devastating interlude. In the twenty years between 1626 to 1646, China experienced an 11.4% reduction in its population (Lee and Zhang 2013). Ge (1999), using various sources, estimates that during the years spanning the Ming-Qing transition, population dropped from 221 million in the year 1630 to 185 million in 1680. Other sources take the fall of the Ming Dynasty to begin with campaign of the Jin khan Nurhaci against the Ming that resulted in the capture of Fushun (Liaoning province) in 1618. With these figures, the fall of the Ming ranks among the largest negative shocks in world history, especially those that were not caused by a pandemic.

The impact of the fall of the Ming on China varied across regions.[5] During the final decades of the Ming dynasty, Tongcheng county, in which our seven clans lived, witnessed local uprising, which began in 1634 by a former serf, Chang Ju. 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 central regions such as Tongcheng were often battleground areas. Specifically, Tongcheng lay directly in the path of the great rebel armies of the north-west, notably that of Chang Hsien-chung, the so-called butcher of Sichuan. As a consequence, there was a

[5] On the following, see Beattie (1979), pp. 44-48.

"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 was gone (Beattie 1979).[6] Another common migration 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 from different authors 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, such as that 70-80% of the cultivated land in the county had been devastated in a single year (Beattie 1979, p. 46). The registered population of Tongcheng county fell by 57% between 1631 and 1645. The fall of the Ming meant a major reset to the economic fortunes of the families of Tongcheng.[7]

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's families is unclear. Specifically, the devastation may have been followed by a swift recovery, or a slow one, or no recovery at all. Evidence on the speed of recovery is limited, but what is available suggests that conditions in Tongcheng were relatively quick to recover. The officially registered population by the year 1672 was down by 23% relative to the 1631 level, and from 1645 to 1647 alone, about 1/3 of the land that was devastated by the fall of the Ming was being added back to the tax records, an indication that agricultural production on it had resumed.

Furthermore, the impact of the fall of the Ming on *relative* fortunes of the Tongcheng families is unclear

[6] 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.).

[7] 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.

too. The shock may have diminished or even eliminated differences in opportunity that had existed before, decoupling the fates of generations before and after the fall of the Ming. Alternatively, richer families might have been better able to endure the turmoil than poorer families. In that case, rather than producing a clean slate, the fall of the Ming may have further diminished the prospects of the relatively poor to rise. The evidence on this is scant, however, some of Tongcheng's rich that had migrated away were able to reclaim their property without difficulties, and from neighboring counties where the fall of the Ming caused a comparable destruction there are reports that the rich were 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).

4 Data

4.1 Genealogical Data

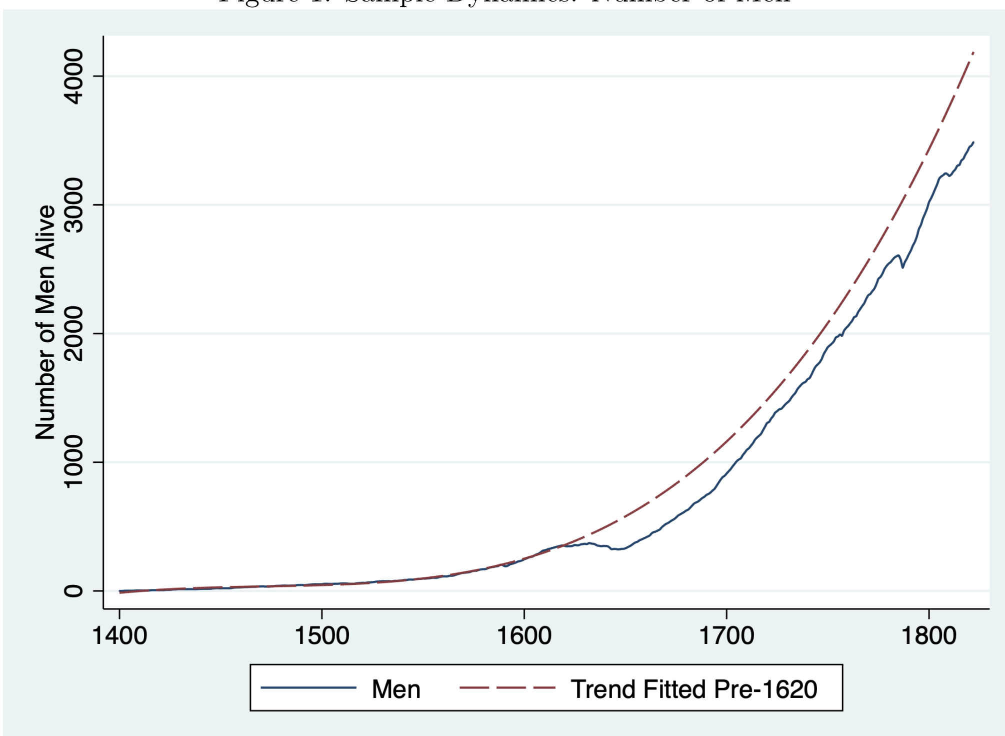
This study examines the transition from the Ming (1368-1644) to the Qing dynasty (1644-1911) using genealogical data for seven male clans (or lineages) in Tongcheng county, Anhui province. In terms of comprehensiveness and accuracy, this data cannot be compared with modern, administrative data, however, as is often the case for historical settings as early as the 16th century, such data is not available. And yet, genealogies in China served a number of important functions 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 as well as that maintaining genealogies is costly, there is little reason to expect that the information contained in these documents is not reliable. Section A in the Appendix provides more information on the data employed in this paper, including a discussion of possible bias and selection.[8]

4.2 The Fall of the Ming and Sample Population

This section begins by presenting evidence on the extent that the fall of the Ming is reflected in this data before turning to characteristics of the dataset and our empirical approach. Figure 1 shows evidence on the evolution of the seven clans in our data set between 1400 and the early 1800s.

Figure 1: Sample Dynamics: Number of Men



Notes: Figure shows the male sample population (solid line), as well as its trend using data until 1620 followed by extrapolation (dashed line). Year given is birth year.

Figure 1 shows that while the number of men belonging to the seven clans in the sample has generally grown over time, starting in the early 1600s the sample falls below trend growth, and eventually the number of clan men drops in absolute terms as the Ming dynasty comes to a close (in 1644).[9] The development in terms of population shown in Figure 1 is consistent with a sizable impact of the fall-of-the-Ming shock on the individuals and families in our sample. Furthermore, notice that our Tongcheng clan population does not appear to fully recover from the shock, in the sense that the solid line remains below the dashed

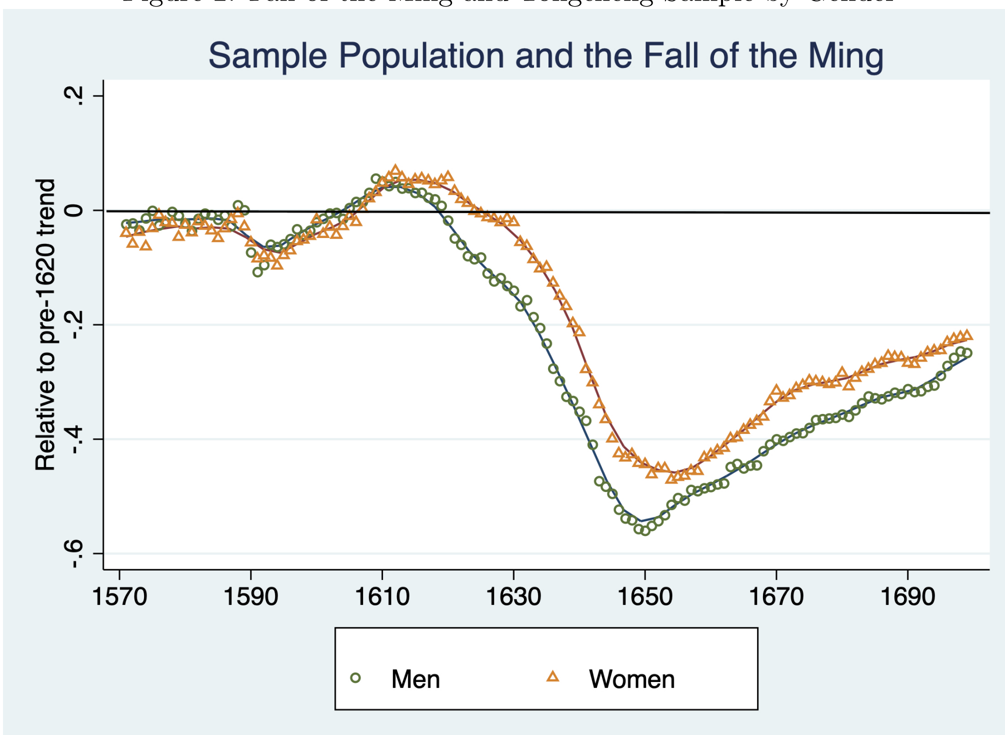
[8]Key characteristics of Chinese genealogical data are also discussed in Shiue (2016).

[9]In the late 1790s, the seven clans account for about 1.5% of the total population of Tongcheng county.

line at least until the 1820s. The evidence in Figure 1 is consistent with the hypothesis that the Fall of the Ming had an effect lasting for several generations.

Figure 2 shows the sample population response around the fall of the Ming for both men and women. We see that the sample population is relatively similar to the pre-1620 trend (see also Figure 1) until around 1620, before the sample size in terms of men and women falls until around 1650, and then recovers.

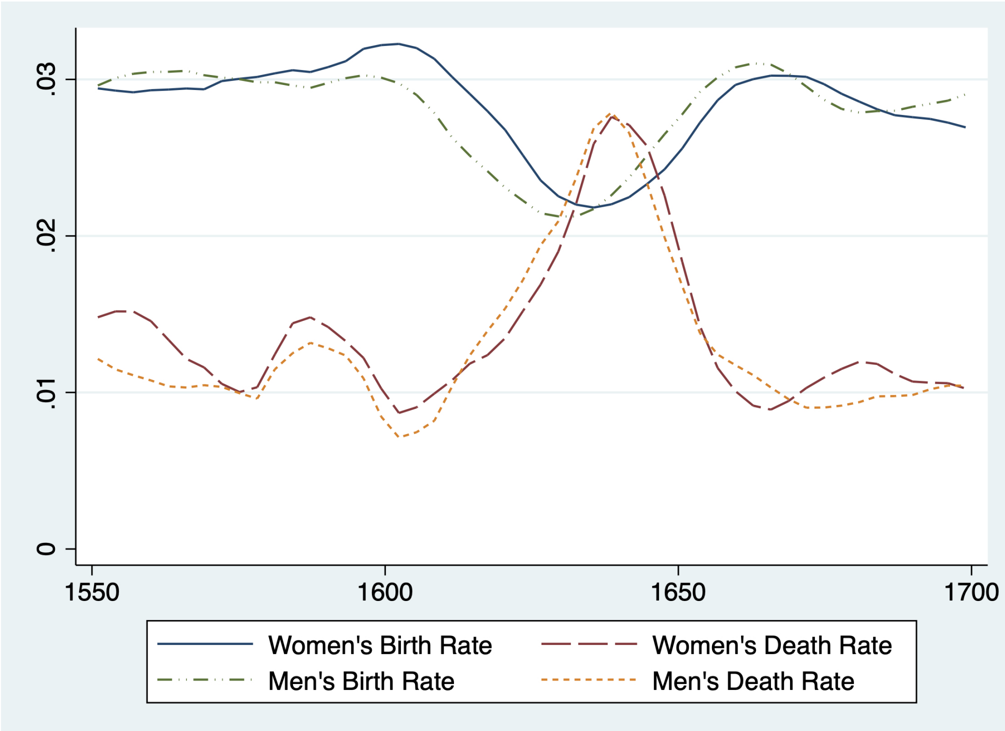
Figure 2: Fall of the Ming and Tongcheng Sample by Gender



Notes: Figure shows the log difference between male population and its trend fitted on pre-1620 data (circles); analogously, for female sample population (triangles). Year given is birth year.

There is also evidence that men are somewhat harder hit than women. The men's sample size falls to a trough of about 55% below the trend, whereas the number of women at the lowest point is about 43% below the trend. At the same time, even by the end of the 17th century the number of both men and women are at least 20% below the trend. That the trends by gender are similar is to some extent not surprising because our data is on couples. However, it is noteworthy that the men's series starts to decline by about a decade before the women's series (around 1615 instead of 1625). This might be due to a number of factors, including that men are more vulnerable to war activity or food crises compared to women.

Figure 3: Birth and Death Rates in the Sample by Gender



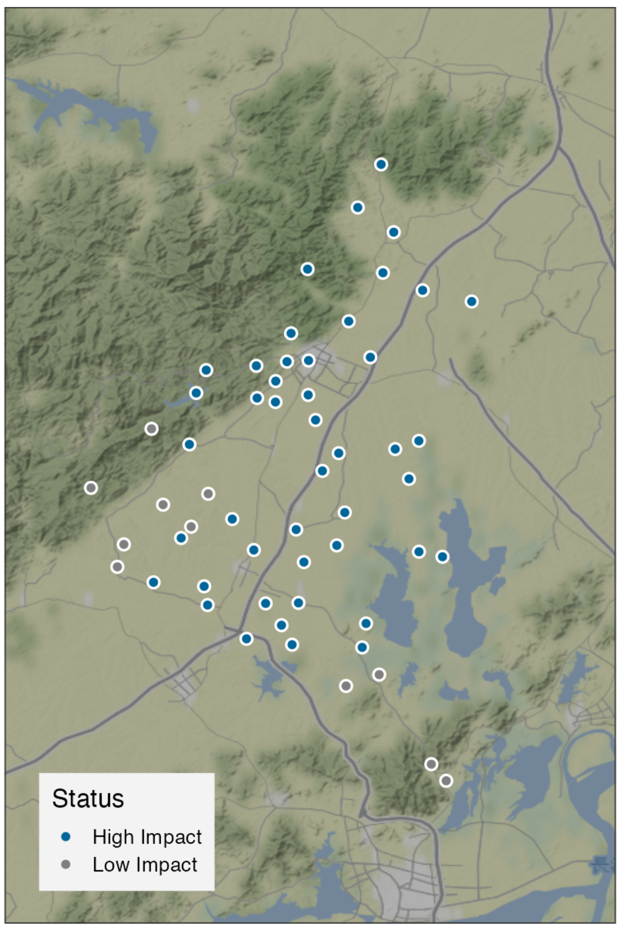
Notes: Figure shows birth (death) rates, computed as numbers born (died) in a given year relative to population living in that year, both for males and females. Year given is birth year.

Figure 3 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). Notice that the decline in population is more strongly related to an 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 attributing this to the fall of the Ming because violence, military action, and famines would arguably affect death rates more than birth rates. Figure 3 also reveals that the earlier fall of men's population, compared to women's population seen in Figure 2 is more due to an earlier fall in birth rates than to an earlier rise in death rates.

4.3 Treatment Definition

This study examines the well-being of those that were directly affected by the fall of the Ming as well as their descendants in the next four generations. We refer to the former as the treatment generation, defined to be those couples in which the husband was born in the range of 1590 to 1644. Heavy destruction is noted in Tongcheng county for the final ten years of the Ming dynasty (1634-44), and researchers believe the period during which parts of China were affected by the fall of the Ming to start in the year 1618 or even earlier (Beattie 1979). The treatment window of 1590-1644 covers husbands that were 44 years old or younger at the onset of particularly heavy destruction in Tongcheng county (1634). Given life expectancy at the time, our treatment assumption overlaps with the lifetime of the great majority of individuals and families that would have been affected by the fall of the Ming. Furthermore, to account for life-cycle differences the analysis below will include birth year effects. Under this treatment window assumption, the size of our treatment generation is 511 couples.[10]

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



Notes: Figure shows sample villages in Tongcheng country, Anhui province. One village with low impact in remote area east not shown. Source: Telford (1992).

[10]Some of the men in these couples are present in multiple couples. The main reason for this is that the man's first wife died, however, there are also some cases of polygamy (multiple married women at the same time) and concubines (a non-married woman is part of the household). The 511 first-generation couples are formed by 418 distinct men.

Treatment is defined as the level of destruction in the village in which the couples lived. This information, which is based on historical research on the ground in the Tongcheng area, is an indicator variable equal to one if destruction of the village was at least moderately strong, and zero otherwise; see Figure 4. We employ Telford's (1992) analysis of the level of destruction during the fall of the Ming based on crisis mortality during the ten-year period from 1635 to 1645. In that period, Tongcheng experienced nearly continuous warfare, siege, peasant uprising, crop failure, and famine, and the end of the Ming saw the Tongcheng area devastated as various rebel, Ming loyalist, and finally Manchu (Qing) armies marched through the county in one military campaign after another (Telford 1992). Figure 4 shows the location of the historical villages in Tongcheng country that are in the sample, with the Yangzi river shown in the lower right of the figure. The majority of villages that escaped major destruction are located in the less central and more mountainous areas of Tongcheng, in line with the hypothesis that rugged terrain makes it more difficult to persecute people (Nunn and Puga 2012).

This village-level information on the level of destruction during the fall of the Ming is available for 490 couples in our treatment generation. According to this variable, 89% of the treatment generation couples lived in villages subject to fall-of-the-Ming destruction. Eighty-nine percent of villages subject to substantial destruction is in line with the above described heavy toll that the Tongcheng area took during the Ming-Qing transition.

In addition to individual and family characteristics that might affect the impact of the shock as well as subsequent recovery, we are interested in the role of families for the patterns as well as the speed of recovery from the fall-of-Ming shock. One dimension here are the seven male clans to whom each of the males in our sample belongs. As Table 1 shows, the seven clans are represented in the treatment generation to a varying degree, with the Wang and the Ye clans being relatively large.

Across the seven clans, the fraction of members in the treatment generation that lived in affected versus unaffected areas is ranging from just under 77% (Zhao clan) to 100% (Chen clan). As a consequence, members of the Chen clan will not aid with the identification of a clan role in how individuals adjust to the fall-of-the-Ming shock. In addition to clan size, Table 1 reports the average level of each clans' male members' social status. Status is a categorical variable ranging from 0 (no status) to 22 (highest status). It gives a measure of each male's highest level of social status achieved during his lifetime based

Table 1: Clan Size and Status by Treatment in the First Generation

		Chen	Ma	Wang	Ye	Yin	Zhao	Zhou	All
Treated	N	16	55	164	136	29	20	16	436
	Status	0.00	7.36	2.12	6.54	1.79	0.45	2.34	3.99
Control	N	n/a	16	12	15	4	6	1	54
	Status		4.88	0.67	10.87	0.00	0.00	3.00	4.67
Total	N	16	71	176	151	33	26	17	490

Notes: Status gives average of all male clan members in the treatment generation, with husband's birth years between 1590 and 1644.

on information such as offices held, state examinations passed, donations made, and a number of other descriptors in the data. More details on these different levels of social status are given section A.1 of the Appendix. Notice that there is a substantial amount of variation in average clan status, with the Ye and the Ma clans on top and the Zhao and Chen clans at the bottom of the distribution.[11] Furthermore, there are differences in whether average status is relatively high or low by treatment within a given clan. For example, in the Ye clan average status is relatively high for those living in the unaffected (control) areas, while for the Wang clan the opposite is true.[12]

Table 2 shows summary statistics on these couples of the treatment generation, in which the husband was born between 1590 and 1644. The first two variables are husband's birth and death year; birth year is what defines the sample, by construction between 1590 and 1644. As indicated, those men died between 1612 and 1730, with a mean age at death of 50 years (1667 – 1617).

The human capital variable is an indicator of whether a man acquired a substantial amount of skill during his life-time 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. The civil service entrance 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 civil service exam as having acquired human capital. Furthermore, men coded with human capital include men who were known to be educated or scholars independent of the civil service examination. In the treatment generation, just

[11]A relatively high average status for the Ma clan is consistent with Beattie (1979) who includes the Ma clan into the top five clans of Tongcheng county during the Ming and Qing.

[12]The null that the means are identical across treatment is rejected at a level <1% for the Ye clan and at a level < 12% for the Wang clan.

Table 2: Summary Statistics for the Treatment Generation

	N	Mean	Std. Dev.	Min	Max
Husband					
Birth Year	490	1616.74	15.03	1590	1644
Death Year	485	1666.60	25.21	1612	1730
Human Capital	490	0.24	0.43	0	1
Social Status	490	4.07	5.07	0	22
Father Social Status	490	5.27	6.34	0	22
Migration	490	2.67	3.10	1	5
No. of Wives	490	1.48	0.76	1	4
Wife					
Birth Year	490	1620.88	16.03	1589	1659
Death Year	472	1667.88	27.71	1610	1732
Migration	479	3.12	3.41	1	8
No. of Sons	490	1.44	1.44	0	6
No. of Daughters	490	0.68	0.96	0	4

Notes:Table shows statistics for couples in the generation that lived through the fall of the Ming (treatment generation, defined as husbands born in years 1590 to 1644); see Appendix A for additional information.

under a quarter of husbands have human capital according to this indicator variable, see Table 2. We also explore below whether distinguishing additional levels of human capital has a strong influence on the results, finding that it does not. Table A.1 provides additional information on the measures of human capital employed in this paper.

Social status of a man is measured by about 30 descriptors in the data, such as on a man's wealth, whether he set up lineage estates or made large philanthropic donations, whether he owned substantial amounts of land or was a merchant, and whether he had an official position (if so, which).[13] Status is classified into 23 groups, with about 70% of men falling into the lowest social status group (coded as status equal to 0); the living standard of these men would be close to subsistence level. The average status of men in the treatment generation was about four, see Table 2. More information on the social status groups is given in Table A.1.

Information on migration, 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. Chinese families during the sample period would typically bury their deceased close to their residences. A burial location that is a substantial distance from the original residence therefore is a sign of migration in the

[13] A comparable measure of status for women does not exist. In this society, the status of a woman would be related most closely to the status of her father (see Keller and Shiue 2022 for an analysis in the context of marriage).

sense that the person has migrated to a new residence. Distances range from burial locations within 15 *li* (5 miles) of the residence to locations 180 *li* (60 miles) or more from the residence, as well as movements outside of the province. While Table 2 shows that the average of this migration distance variable is around 3 for both husbands and wives, or about 20 miles, about 80% of all persons do not migrate in the sense of a burial distance smaller than 5 miles from the residence. We also see from Table 2 that the average number of wives a husband has is above 1; this is primarily due to remarriage after the first wife's death, but concubinage and cases of multiple simultaneous wives existed as well.

The wives of our treatment period husbands are born between 1589 and 1659 and are at the time of death 47 years old on average, slightly less than the husbands (Table 2, lower part). Among the reasons for that might be worse nutrition and medical care. Information on women (and girls) in Chinese genealogies tends to be more limited than information on men, but in the case of this sample there is information on the year of death for 96% of women, compared to 99% of men.[14]

We now turn to a series of balance tests for our treatment and control samples in the treatment generation. In order to obtain pre-shock information, we link the treatment generation backwards for one generation to obtain information on the human capital and social status of the fathers of the treatment generation husbands. These fathers provide information on potentially differential pre-trends for treatment and control observations because they were typically born around 1560 and not alive anymore at the peak of the fall of Ming destruction in 1630-45.

In the first two rows of Table 3 we report results from simple tests of the equality of the mean of these pre-shock fathers' human capital and status levels. Just above 30% of fathers in both treatment and control sample hold human capital, and there is no significant difference (p-value of 0.93). Moreover, the social status of the father of the husband in the couple is about 5.5 in both samples, with the difference not significantly different from zero (p-value of 0.37).

The next four rows of Table 3 shows results for husband's birth year, birth month, birth order, as well as death month.[15] While these measures do not all describe characteristics in the pre-shock period, they

[14]Vitals that are not listed in the genealogies are in part estimated in two ways. First, the data provides auxiliary information, such as that a person "died when the Taipings entered Tongcheng", which narrows the year down to 1851 or 1852. Second, life tables, a common method in demography, have been used to estimate vital statistics.

[15]Chinese lunar calendar dates are converted to solar months 1 to 12 following the approach of Shiue (2002).

Table 3: Balance Checks

	Control	Treatment	Difference	p-value
	N = 54	N = 436		
A. Test of Equality of Means				
Father				
Social Status	6.00	5.18	0.82	0.37
Human Capital	0.31	0.32	-0.01	0.93
Husband				
Birth Year	1619	1616	2.58	0.23
Birth Month	5.05	6.69	-1.63	< 0.01
Birth Order	1.50	1.74	-0.24	0.24
Death Month	6.19	6.55	-0.37	0.47
Wife				
Birth Year	1624	1621	3.17	0.17
Birth Month	6.20	6.56	-0.45	0.36
Death Month	6.50	6.70	-0.20	0.68
B. Tests of Equality of Distribution				
Father Social Status				0.31
Clan Generation				0.19
Male Clan Size				0.33

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

are plausibly exogenous to the shock. For example, based on the historical evidence there is no reason to believe that the fall of the Ming systematically affected the average birth year or birth order when this is calculated over the period 1590 to 1644, and the balance tests are in line with that. We do find a significant difference in birth month, although this is not the case for death month.[16] Morover, we do not find significant differences between treatment and control samples in terms of wife's birth year, birth month, or death month (see Table 3).

Part B. reports tests of equality of the entire distributions of a particular variable in treatment and control samples. We do not find a significant difference in the distribution of husband's father's social status (p-value of 0.31).[17] Next, the seven male clans in our sample were established at different times in the past by their respective progenitor. Given differences in the year of inception across clans, there could be composition effects between treatment and control samples due to life-cycle effects in the development of clans. However, Table 3 shows that there is no significant difference between treatment and control

[16]The birth month finding may reflect that with N = 54 the control sample is relatively small so that the mean of 5.05 can be relatively far from random (mean of 6.5).

[17]The husband's father's human capital level is an indicator variable, and there is no significant difference between treatment and control samples, see Part A of Table 3.

samples in terms of which clan generation the treatment couples belong to.[18] Finally, we do not find a significant difference in relative size of the seven clans between treatment and control samples. Overall, Table 3 provides evidence that differential pre-trends between treatment and control observations in the treatment generation are largely absent.[19] Going one step further, our empirical analysis below will condition on father social status–first row in Table 3– in every regression.

These couples with husbands born between 1590 and 1644 are the basis for the intergenerationally-linked analysis. Based on the genealogies, we connect the 490 treatment generation couples to all descendant couples over the following four generations. Furthermore, we also account for broken intergenerational links. In the genealogies, these broken links correspond to males who are observed as some couples' children at the same time when they are not observed as married husbands. The most important reason for such terminations of a branch of the family tree is infant mortality, that is, the male dies before reaching the age of marriage. We will analyze this in section 5.5 below.[20]

The following shows certain summary statistics for husbands that can be linked over five generations to couples in which the husband is born between 1590 and 1644.

Table 4: Data on Husbands by Generation

		Birth Year			Death Year	Human Capital	Male Migration	Single Wife	Concubine
Generation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	N	Mean	Min	Max	Max	Mean			
1	1,669	1618	1590	1644	1728	0.26	1.33	0.74	0.06
2	1,663	1651	1608	1694	1759	0.26	1.19	0.81	0.02
3	1,634	1684	1625	1732	1796	0.20	1.20	0.85	0.01
4	1,609	1716	1643	1776	1850	0.15	1.18	0.87	0.01
5	1,515	1748	1662	1815	1886	0.10	1.15	0.79	0.01

Notes: Table shows statistics on all males that can be linked forward from the treatment generation couples of Table 2 to the fifth generation (great-great-grandsons), as well as on their spouses.

There are N = 1,669 observations on couples in generation 1 that have male children four generations later. We observe these great-great-grandsons of the treatment generation together with their families.

[18]The mean clan generation is about 9 in both treatment and control samples. This also indicates that while clan population is growing (see Figure 1), our sample is not drawn from generations close to the progenitor in each of these seven clans.

[19]Comparing means for statistically significant differences is based on the assumption that treatment and control observations are drawn from there respective distributions, however, as a quasi-experiment it might be more appropriate to think of them as the universe of treatment and control observations. Below we also show results based on randomization inference which is consistent with the absence of sampling variation.

[20]Another reason for broken intergenerational links is migration to a far away location that goes unrecorded, though empirically this is not that important (see Shiue 2019).

Conversely, there are N = 1,515 husbands in the fifth generation whose great-great-grandparents experienced the fall of the Ming first hand. It may not be surprising that the rate at which five generations are linked is as high as it is (91% (= 1,515/1,669)) – after all, documenting links between different generations of a family is one of the purposes of a genealogy.

At the same time, whether a particular family has a genealogy or not is likely non-random. An alternative with in principle broad coverage is to link parents and children across censuses. However, census records as far back as the 16th century generally do not exist. Moreover, representativeness would be a concern as well because with current match rates, the sample would be reduced to a tiny fraction of its original size over several generations.[21] We discuss selection in sections A.2 to A.3. The sample is shown to be broadly representative of Chinese populations at the time, not least because it consists of observations on individuals from seven different clans.[22]

The first column of Table 4 gives the mean birth year in each generation. Comparing mean birth years across generations, we see that one generation is about 33 years long and relatively stable over time. The minimum and maximum birth year by generation indicates that the range of birth years increases with each linked generation. In the first generation, the range is 54 years by construction. In the second generation, the range of birth years is 86 years, and in the following generations the birth year range is further increasing until by the fifth generation the range is 153 years (1815 – 1662). The increase of birth year range is due to the compounding effect of multiple men in a branch of the family tree having relatively short lives, while successive men in other parts of the family tree have relatively long lives. Column (5) in Table 4 gives the latest year of death of a husband in a given generation. In the fifth generation, this maximum is 1886. By construction, the earliest birth year of the treatment generation is 1590; moreover, the regression analysis below conditions on these mens' fathers' social status, and these fathers are born as early as the middle of the 16th century. Taken together, in terms of calendar time this study covers more than three hundred years.

Over this range, China, in contrast to some other parts of the world, remained a largely pre-industrial

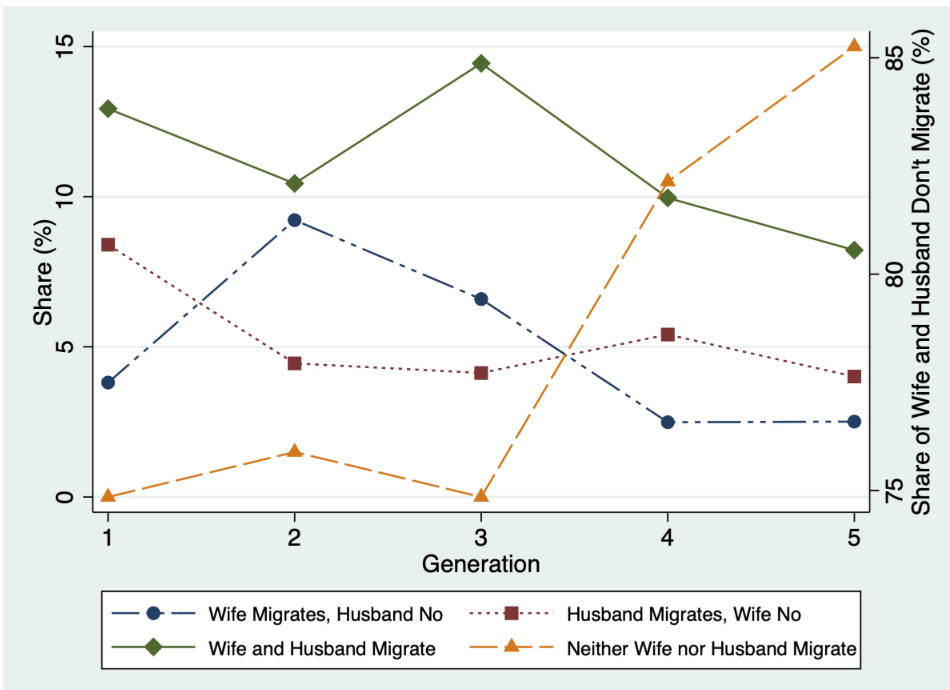
[21]Match rates for tracing individuals in U.S. censuses between 1900 and 1920, for example, are around 16% (Bailey, Cole, Henderson, and Massey 2020, as well as Abramitzky, Boustan, Eriksson, Feigenbaum, and Perez 2021 provide overviews). Under the assumption that linking parents and children across censuses is comparable in difficulty to linking the same individual across censuses, and that match rates are iid, a match rate of 16% implies that less than 0.07% of the original sample would be matched over five generations ($(0.16)^4 = 0.00066$).

[22]The match rate here is not 100% because identifying data can be incomplete.

society, and economic opportunities declined over time in part due to this lack of industrialization. This development is reflected in the secular decline in human capital levels across generations, shown in column (6) of Table 4, and our analysis will account for that. Furthermore, there is a relatively high level of male migration in the treatment generation, see Table 4, column (7). This is consistent with anecdotal evidence that families escaped the destruction during the Fall of the Ming by migrating away.

Furthermore, the data provides information on migration for both husband and wife in each generation. If we aggregate the data to a two-by-two outcome, migration or not for both husband and wife, the picture that emerges is given in Figure 5.

Figure 5: Migration by Gender and Generation



Notes: Figure shows evidence on male and female migration by generation based on indicator variables; migration equal to one if distance between burial location and residence is greater than 5 miles. Sample is all observations for which migration measure for both husband and wife is available; N = 6,999.

The evidence indicates that migration at any distance was relatively rare. Figure 5 indicates that most of the time, neither husband nor wife migrated during their lifetimes. At the same time, the Fall of the Ming increased the level of migration, in the sense that the share of not migrating husbands and wives in the first generation is only 75%, compared to 85% in the fifth generation (Figure 5). Furthermore, there is evidence consistent with the hypothesis that the shock increased migration behavior for several generations; the share of non-migrating husbands and wives remains relatively low around 75% until the third generation.

The patterns also suggest that men take the lead in terms of migration, because the share of cases where the husband migrates while the wife does not peaks before the share of cases in which the wife migrates while the husband does not (first generation, versus second generation, respectively, see Figure 5). There is also evidence consistent with the hypothesis that responses to the Fall of the Ming destruction play out over several generations, because migration by both husband and wife is highest only in the third generation.

In addition to information on migration patterns, the data reveals the changing structure of households in the aftermath of the Fall of the Ming. In particular, we know whether a given woman was her husband's only wife, whether she was one of several, either consecutively or simultaneously, or whether she was a concubine.[23] Table 4 shows that most women in the sample were their husband's unique wife, although this was more rare for the Fall of the Ming (treatment) generation, compared to subsequent generations (column (8)). One reason why the share of single-wife households during the Fall of the Ming was relatively low is that there were unusually many households with concubines, see column (9). This could be, for example, because multiple-women households are necessary in times of crisis to achieve any fertility goals the household might have.

Overall, this suggests that in addition to the acquisition of human capital, the Fall of the Ming might have impacted a whole array of other dimensions such as migration and household structure. Of course, over the course of centuries the environment of these families was subject to shocks that might also explain some of the documented changes. We therefore now turn to the approach designed to estimate the Fall of the Ming's causal effects.

5 The Long-run Impact of the Fall of the Ming

The fall of the Ming dynasty occurred during the lifetimes of the couples in which the husband was born between 1590 and 1644. The following relates our treatment variable, the level of destruction of the village in which a couple lived, to a number of characteristics of their great-great-grandsons and their families.

[23]Concubinage is an interpersonal and sexual relationship between a man and a woman in which the couple does not want, or cannot enter into a full marriage. Concubinage was a formal and institutionalized practice in China until the 20th century.

We estimate by OLS the following equation stacked with five generations (g = 1,..., 5):

$$y_{ic(p)g} = \alpha + \beta_g \left[I \left[t = g \right] \times d_p \right] + \beta_f hfstat_{c0} + \eta_g + X'\gamma + \varepsilon_{ic(p)g}, \tag{10}$$

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 first, the treatment generation (husband's birth years 1590-1644). The variable d_p is an indicator which equals one if the pair from which individual i is descendant lived in a Tongcheng village which was destroyed, and zero otherwise (see Figure 4). 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. Exploiting information on intergenerational links in the sample, we include the life-time social status of the father of the husband in the couple that was subject to the fall of the Ming shock, denoted by $hfstat_{c0}$. Including a proxy of father income is a common approach even in the literature investigating intergenerational effects using administrative data of recent developed countries (Oreopoulos, Page, and Stevens 2008).

Furthermore, equation (10) has a vector X of additional variables. First, it includes a fixed effect for each man's birth year. Lifetimes in a given generation vary, and including birth year fixed effects helps to account for secular changes that might affect our estimates. Second, we include a fixed effect for each of the seven male clans, denoted by m, $m = 1, ..., M$. Differences in the level of resources of these seven clans might affect the way individuals belonging to different clans respond to the Fall of the Ming. Third, we include a fixed effect for each of the wives' clans-of-origin (130 different clans), denoted by f, $f = 1, ..., F$.[24] These are the clans from which the wives in our sample marry into the seven male clans. It might affect the way how individuals respond to the Ming destruction, as will be explored below. Our assumption is that conditional on the husband's father status, generation fixed effects and the vector X of additional variables, β_g gives the mean difference in $y_{ic(p)g}$ that is due to the Fall of the Ming in generation g.

The term $\varepsilon_{ic(p)g}$ is a mean-zero error term; we employ two-way clustering, by couple of the treatment generation and by generation. Clustering by pair p allows for arbitrary serial correlation in outcomes of individuals in different generations that go back to the same couple in the treatment period. Clustering by generation, in turn, allows for arbitrary correlatedness of observations belonging to the same generation.

Table 5 reports results for the fifth generation from estimating equation (10). We see that the Fall of

[24] We do not include the clan subscripts m and f in equation (10) to simplify the notation.

Table 5: Impact of the Fall of the Ming in the Fifth Generation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Husband				Wife		
	Human Capital	Status	Migration	One Wife	First Wife of Several	Concubine	# Sons	Migration
Fall of Ming	0.132^{+}	0.992	0.133^{*}	−0.049	0.031	0.014	0.243	0.145^{*}
	(0.060)	(0.770)	(0.039)	(0.032)	(0.015)	(0.008)	(0.141)	(0.045)
Father Status	0.018^{**}	0.301^{**}	0.014^{*}	-0.008^{+}	0.001	0.002^{+}	−0.001	0.015^{**}
	(0.004)	(0.046)	(0.003)	(0.003)	(0.003)	(0.001)	(0.010)	(0.003)
Generation FE	Y	Y	Y	Y	Y	Y	Y	Y
Birth Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Husband Clan FE	Y	Y	Y	Y	Y	Y	Y	Y
Wife Clan FE	Y	Y	Y	Y	Y	Y	Y	Y
N	8,012	8,008	7,427	8,012	8,012	8,012	8,012	7,090

Notes: Dependent variable at the top of column; outcomes are for the treatment generation couples' great-great-grandson and his wife (or wives). Sample consists of the couples formed by all male descendants of the treatment generation couples that can be linked over five generations. Estimation of equation (5) by OLS. Father Status is the status of the husband's father in the treatment generation. 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.

the Ming had a positive impact on human capital acquisition of these couples' male descendants four generations later (column 1). Their social status also tends to be higher, although this is not significant at standard levels (column 2). Table 5 also shows that the status of the treatment generation's couples' husband's father is positively correlated with the status of the husband in descendant couples four generations later. This is consistent with the hypothesis that social status is strongly intergenerationally transmitted.[25] Another important result is that the fall of the Ming had a lasting impact on migration behavior by significantly increasing male migration four generations later.

We have also information on the wives in the fifth generation (right side of Table 5). The first three columns present evidence on the impact of the Fall of the Ming on the structure of partnerships by employing mutually exclusive measures on the role of the wife in the household: whether the woman was the only life-time wife (column 4), whether she was the first wife among several (column 5), or whether the woman was a concubine (column 6). We see that the fall of the Ming has tended to reduce partnerships with a single wife and increased the prevalence of several wives or concubines, though the coefficients are not significant at standard levels. The finding that the fall of the Ming has led to an increase in the

[25]Shiue (2019) examines the extent of intergenerational persistence in Ming and Qing China.

prevalence of multi-wife households is in line with the shock's positive effect on human capital and status (columns 1 and 2), because such husbands would have the higher level of resources needed to sustain households with several wives.

We also see that couples exposed to destruction of the fall of the Ming have fifth-generation descendants that tend to have a relatively large number of sons (not significant; column 7). This could be due either because higher human capital and status provide the resources for a larger family, or because couples that are descendants of exposed couples in the fall of the Ming want to have more male children because it may provide (old-age) insurance. The final specification of Table 5 shows that wives of descendants of fall-of-Ming shock couples exhibit a higher level of migration than descendants from couples of the same generation that did not experience this level of destruction from the fall of the Ming (column 8). One reason why both male and female migration is significantly affected is likely that husband and wife would typically move from one to another location together.

Overall, our finding that the fall of the Ming shock has a significant impact in terms of human capital acquisition and migration behavior over five generations and a time span of close to three centuries provides new evidence that economic shocks can lead to long-lasting changes in economic behavior. This is consistent with findings of persistent long-run effects in the seminal contributions of Nunn (2008) and Dell (2010), as well as the subsequent literature. In the following we provide more information on how this long-run impact comes about by exploiting intergenerational- and family links between individuals in the sample.

6 Strategies for Recovery

6.1 Dynamics of Key Responses

In this section, we examine the impact of the Ming-Qing Transition shock on the behavior of individuals, couples, and families in all five generations. Figures in Table 6 are based on estimating equation (10), as before. However, while Table 5 before reported only the coefficient β_g for g = 5 (fifth generation), Table 6 reports results for outcomes in all five generations.

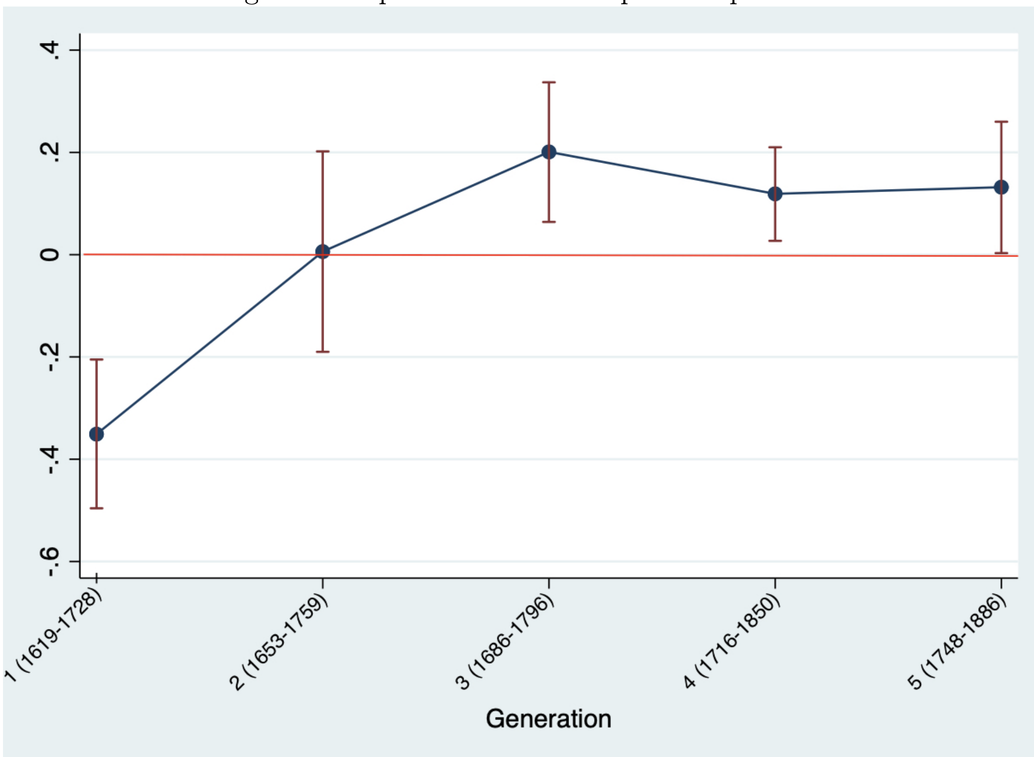
We begin with the dynamics of human capital acquisition, see column (1). Figure 6 illustrates this pattern.

Table 6: Impact of the Fall of the Ming over Five Generations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Husband			Wife					
	Human Capital	Social Status	Migration	One Wife	First Wife of Several	Concubine	# Sons	# Daugh-ters	Migration
Fall of Ming:									
Generation 1	-0.351^{**}	-2.564^{*}	0.184^{*}	0.154^{*}	-0.177^{*}	0.029^{*}	0.528^{*}	−0.080	0.055
	(0.069)	(0.687)	(0.064)	(0.046)	(0.048)	(0.010)	(0.140)	(0.204)	(0.060)
Generation 2	0.007	−0.428	−0.013	-0.103^{+}	0.032	0.053^{*}	0.518^{*}	−0.033	0.003
	(0.092)	(0.988)	(0.085)	(0.039)	(0.017)	(0.018)	(0.162)	(0.227)	(0.086)
Generation 3	0.201^{*}	1.313	0.087	−0.121	0.080^{+}	0.023^{+}	0.218	0.168	0.011
	(0.064)	(0.855)	(0.045)	(0.063)	(0.037)	(0.010)	(0.158)	(0.140)	(0.061)
Generation 4	0.119^{+}	0.540	0.188^{**}	−0.027	0.032^{+}	0.002	0.411^{**}	0.009	0.135^{**}
	(0.043)	(0.659)	(0.037)	(0.032)	(0.013)	(0.009)	(0.075)	(0.094)	(0.027)
Generation 5	0.132^{+}	0.992	0.133^{*}	−0.049	0.031	0.014	0.243	−0.094	0.145^{*}
	(0.060)	(0.770)	(0.039)	(0.032)	(0.015)	(0.008)	(0.141)	(0.093)	(0.045)
Father Status	0.018^{**}	0.301^{**}	0.014^{*}	-0.008^{+}	0.001	0.002^{+}	−0.001	0.007	0.015^{**}
	(0.004)	(0.046)	(0.003)	(0.003)	(0.003)	(0.001)	(0.010)	(0.005)	(0.003)
Fixed Effects:									
Generation	Y	Y	Y	Y	Y	Y	Y	Y	Y
Birth Year	Y	Y	Y	Y	Y	Y	Y	Y	Y
Husband Clan	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wife Clan	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	8,012	8,008	7,427	8,012	8,012	8,012	8,012	8,011	7,090

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 over five generations. Estimation of equation (10) by OLS. Father Status is the status of the husband's father in the treatment generation. 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.

Figure 6: Impact on Human Capital Acquisition



Notes: Figure shows coefficients and 90% confidence intervals from specification of column (1), Table 6. Horizontal axis shows generation as well as the range of median birth year and maximum death year in parentheses.

Figure 6 shows a reversal in human capital acquisition. Even though the shock has reduced human capital acquisition of the treatment generation on impact, the descendants of treatment couples acquire disproportionately more human capital than descendants of non-treatment couples by the third generation, and this higher acquisition of human capital is sustained until the fifth generation. One reason for the loss of human capital in the first generation will be that the fall of the Ming interfered with the ability of men to acquire human capital. Clearly, though, the loss of human capital of the treatment generation does not discourage their descendants to acquire human capital once again. Human capital acquisition plays a major role for the recovery of these families. This hypothesis is reinforced by the pattern of the coefficients for social status in column (2). Qualitatively, it is similar to human capital, which is natural because status is positively correlated with human capital; however, in contrast to human capital, we do not estimate a significantly positive impact of the fall of Ming shock on status in any of the five generations (see column (2)).

Second, the reversal of human capital acquisition caused by the fall of the Ming is accompanied by migration, both of the male descendants of the treatment couples as well as their wives (see columns (3) and (9), Table 6). We see that on impact, in the first generation, the male migration response is stronger than the female, although in the fourth and fifth generation the two are similarly strong. This confirms anecdotal evidence that individuals and families responded to the destruction caused by the Ming-Qing transition through migration (Beattie 1979). The motive for this migration could have been driven in part by the desire to simply escape from the risks to life and property. Another, not mutually exclusive possibility is that migration was a strategy designed to provide better future prospects and insurance to future generations of the family. The heterogeneity analysis performed below will provide some evidence on these issues. In any case, it is interesting to see evidence that a big shock can systematically affect migration behavior of affected versus non-affected families in the long run.

Third, the fall of the Ming has triggered a positive fertility response. The number of sons of treatment couples as well as their descendants tends to be higher than in other couples, see column (7). Trend-wise the fertility response is declining with each generation, but even in the fourth generation there still is a significantly positive coefficient. A positive fertility response is often associated with Malthus' hypothesis that an increase in resources triggers a positive fertility response until per-capita resources are back to the subsistence level. Here, the fall of the Ming reduced both the amount of arable land as well as population, there is no systematic information on which of the two was more strongly reduced, and the impact on per-capita resources is unknown.

Another hypothesis is that the increase in the number of sons is a behavior towards increased levels of risk, especially given that the increase in the number of sons is stronger than that in the number of daughters. While care has to be taken to not overinterpret the gender difference because typically, information on female children is less consistent compared to information on male children in Chinese genealogies, the difference in the estimates for sons and daughters are substantial, which suggests that the fall of the Ming has led to a shift in the gender composition of children (compare columns (7) and (8)). One reason for this might be that, in times of crises, couples prefer male to female children because grown-up males will provide more old-age support and insurance than grown-up female children, because the latter become part of another family in which they marry into.[26]

Furthermore, the results show that the shock had an impact on the nature of male-female partnerships in

[26] At the same time, as we will discuss below, the links between clans established by the marriage of females might also play a role in the recovery from big shocks.

the household in the first generation. We find that the fall of the Ming has increased the likelihood that the woman in a relationship is the only (life-time) wife in a couple, while it has reduced partnerships in which the husband has a first wife among several (columns 5 and 6, respectively).[27] A likely reason is that in times of turmoil and destruction, men cannot find more than one wife that they can marry. At the same time, notice that the fall of the Ming had a positive impact on the prevalence of concubines among the exposed couples (column 6). The shift towards concubinage in times of crises might be a sign that the husband's and the family's fertility goals tend to be achieved by a partnership that is short of, and less committal, than formal marriage. Generally, the changes in male-female relationships in the household brought about by the Fall of the Ming appear to be related to the impact on fertility, see column (7).

Overall, a picture emerges in which the fall of the Ming has impacted the behavior not only of those couples that were subject to the shock themselves but also the behavior of their descendants over several generations. Key is the reversal in the human capital response. Descendants of affected couples acquire more human capital starting in the third generation after the shock has a strongly negative impact in the first generation. Increases in migration and fertility in terms of sons are important secondary responses that support the human capital strategy for recovery. The fall of the Ming shock affects both fertility and migration behavior in the long-term, into the fourth or fifth generation following the shock, although with some differences in the dynamics: the fertility response becomes weaker over generations, whereas the migration response remains high (male) or even strengthens (female) generation by generation.

6.2 Robustness

A number of robustness checks have been conducted. First, instead of stacking all five generations in a single regression, we now 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.[28] Table 7 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)).

Second, we provide results for an alternative method of inference. If one thinks of the setting of villages that

[27] Wives here includes women that live in the household while not being married (concubines).

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

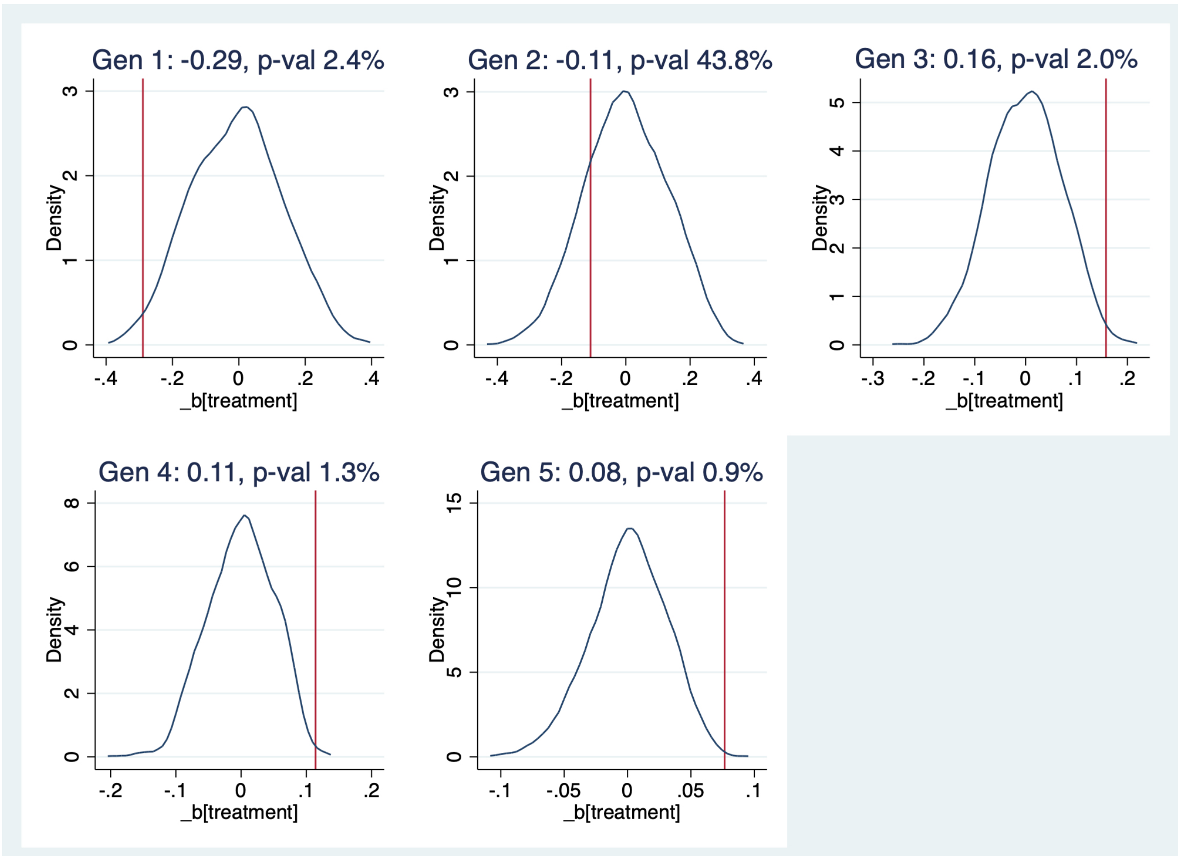
Table 7: Fall of the Ming and Different Human Capital Levels

	(1) Human Capital Indicator	(2)	(3)	(4)	(5)	(6)	(7) Four Human Capital Levels
Fall of Ming							
Gen 1	-0.351^{**}	-0.294^{**}					-0.632^{*}
	(0.068)	(0.094)					(0.148)
Gen 2	0.006		-0.105				0.082
	(0.092)		(0.114)				(0.187)
Gen 3	0.200^{*}			0.157^{**}			0.456^{*}
	(0.064)			(0.055)			(0.855)
Gen 4	0.118^{+}				0.114^{*}		0.223^{+}
	(0.043)				(0.056)		(0.090)
Gen 5	0.131^{+}					0.077	0.285^{+}
	(0.060)					(0.056)	(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 (10) 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.

were destroyed or not in the fall of the Ming as a quasi-experiment, randomization inference is a natural approach. Figure 7 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 7: 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 7); 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 7. Of particular interest are p-values, because unlike the clustered standard errors of Table 7 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.

Third, so far the analysis of human capital acquisition has been based on an indicator variable that does not distinguish between men that have passed the lowest level of the civil service exam and those that prepared but did not pass (see Table A.1, column (3)). To examine the role of this assumption, we consider an alternative human capital measure that not only distinguishes between those that passed and those that did not but also gives higher values for passing at a higher level, see Table A.1, column (4). Table 7 indicates that findings with differentiating additional levels of human capital are qualitatively similar to results with the human capital indicator variable, see columns (7) and (1), respectively.[29] We conclude that the estimated dynamics of the human capital response does not strongly depend on whether one differentiates more than two skill levels.

The following section will examine these patterns further by conducting a heterogeneity analysis.

6.3 Heterogeneity in Adjustment Strategies

This section examines whether the responses shown in Table 6 are stronger or weaker for certain sets of sub-groups. We extend equation (10) from above to include interaction terms with a particular characteristics z_{ic} in the first generation (husband birth years 1590 to 1644):

$$y_{ic(p)g} = \alpha + \beta_{gz} \left[I \left[t = g \right] \times d_p \times z_{ic} \right] + \beta_f hfstat_{c0} + \eta_g + Z'\nu + X'\gamma + \varepsilon_{ic(p)g}, \tag{11}$$

where the coefficient β_{gz} captures the extent to which the fall of the Ming impacted outcome $y_{ic(p)g}$ in a way that varied with characteristic z_{ic}. The vector Z includes all lower-order terms, including $\eta_g \times z_{ic}$ and $z_{ic} \times d_p$.

6.3.1 Human Capital Acquisition

Migration Above we have seen that the fall of the Ming reduced human capital acquisition in the first generation (on impact), while human capital acquisition of later generations whose ancestors were affected was significantly higher than that of descendants of unaffected persons (Figure 6). The first factor affecting human capital acquisition that we consider is male migration. Table 8 shows results from estimating eqation (13) in the case of z_{ic} being male migration in column (1). Notice that in the first generation, the coefficient on the interaction variable $[d_p \times z_{ic}]$ is positive, indicating that men that migrated during the fall of the Ming were subject to a lower loss of human capital than men who did not migrate. Thus, while on average there is a substantial loss of human capital–coefficient of -0.35—column

[29] Accounting for the difference in the mean of the dependent variable, one can show that the results are also quantitatively similar.

1 of Table 6, and also Figure 6)—affected men who migrate away during the fall of the Ming suffer a lower loss of human capital compared to affected men that do not migrate away. This indicates that migration was a strategy to support human capital acquisition during the fall of the Ming, even though the overall importance of migration to moderate the loss of human capital in the first generation is limited by the fact that 3 out of 4 men of the treatment generation did not migrate more than five miles from their residence. Figure A.1 in the Appendix further illustrates the marginal effects implied by the negative interaction coefficient for a number of migration levels.

Table 8: Heterogeneous Strategies for Recovery

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable	Human Capital		Social Status		Migration		Fertility	
Factor z_{ic}	Migration	Clan Human Capital	Migration	Clan Status	Status	Clan Status	Status	Clan Status
Generation 1	0.905**	−0.612**	6.846*	−0.213	0.042*	0.047**	−0.001	0.048
	(0.075)	(0.123)	(1.710)	(0.105)	(0.013)	(0.008)	(0.024)	(0.025)
Generation 2	−0.003	−0.070	−10.748**	0.361+	0.081*	0.061*	−0.028	0.077+
	(0.141)	(0.218)	(1.197)	(0.1550)	(0.018)	(0.013)	(0.025)	(0.032)
Generation 3	−0.034	0.178	−2.475	0.153	0.016	0.016+	−0.029	0.118*
	(0.100)	(0.139)	(1.425)	(0.132)	(0.010)	(0.006)	(0.032)	(0.158)
Generation 4	−0.022	0.273*	−1.024	0.078	0.017	0.017	0.027	0.083*
	(0.105)	(0.659)	(1.306)	(0.084)	(0.010)	(0.010)	(0.023)	(0.024)
Generation 5	−0.200+	0.192	−2.445	0.232+	0.000	0.021*	−0.023	−0.018
	(0.076)	(0.111)	(1.255)	(0.092)	(0.008)	(0.006)	(0.028)	(0.023)
N	7,599	8,024	7,595	8,020	7,439	7,439	8,024	8,024

Notes: Dependent variable at the top of column; outcomes are for the treatment generation couples (Generation 1), and their sons, grandsons, great-grandsons, and great-great-grandsons, as well as their respective nuclear families (in Generations 2 to 5, respectively). Sample consists of all couples formed by all male descendants of the treatment generation couples that can be linked over five generations. Estimation of equation (11) by OLS. Coefficient on father of husband in generation 1 status not reported. All 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.

Clan Human Capital Here we estimate equation (13) with factor z_{ic} being the average human capital level in the clan. Results are shown in column (2) of Table 8. Notice that the pattern of the clan human capital coefficients across generations is from negative in generation 1 to more positive coefficients for later generations, see Table 8, which mirrors the dynamics of the individual human capital acquisition coefficients. Specifically, the marginal effect of higher clan human capital is negative in generation 1, while it is positive in generation 4, the same pattern that we observed for the individual human capital coefficients in Table 6, column (1).

Clan human capital effects are a special case of social (or group) effects, which can be present for different reasons. An important distinction is between endogenous and exogenous social effects. In the former case, the propensity of an individual to behave in a certain way varies with the behavior of the group, while in the latter, the propensity of an individual to behave in a certaion way varies with the exogeneous characteristics of the group (Manski 1993). In the presence of endogenous social effects, an intervention that influences individual behavior will eventually influence group behavior because the changed individual behavior affects the average behavior of the group.

Recall the child human capital technology of equation (4) above. Equation (4) captures an endogenous social effect, because in bad times such as the fall of the Ming, the individual's human capital acquisition falls not only because individual i does not devote as many resources to human capital acquisition as usually (ie., lower s_p) but also because the group to which the individual belongs has relatively low average human capital levels (i.e., lower K_p). Thus, in the first generation there is a negative social multiplier effect. At the time when the individual would strongly benefit from the human capital of any of his clan members because the own resources he can devote 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 high levels of human capital themselves.

For subsequent generations, clan human capital turns into a positive social multiplier effect. In generation 4, the interaction variable $[d_p \times z_{ic}]$ has a positive coefficient just under 0.3, indicating that an individual who is member of a high human capital-clan acquires substantially more human capital for a given amount of own resources than a member who belongs to a low human capital clan. Figure A.2 in the Appendix illustrates marginal effects in both the first and the fourth generation for different clan human capital levels. Overall, these results indicate that clan characteristics have played an important role for the way how individuals adjusted to the fall of the Ming shock.

6.3.2 Social Status

Migration Results are shown in column (3), Table 8. We see that in the first generation, the coefficient on the interaction variable $[d_p \times z_{ic}]$ is positive for male migration's influence on social status. This means that migration is effective as adjustment strategy for men to maintain their social status, a result in line with the role of migration for human capital acquisition (compare columns (3) and (1), Table 8).

What does father migration mean for the social status of his son? In the second generation, we see that social status of the son is declining in the migration distance of his father. Thus, there is an intergenerational trade-off between father and son in terms of social status. Outmigration from the area of his ancestors benefits the status of the father at the same time when it hurts the social status of the son. The latter may be because property including land titles are more difficult to retain once a person has migrated away from the area of his ancestors. Importantly, there is no such inter-generational trade off caused by migration of the father in the case of human capital acquisition (see column (1), generations 1 and 2, Table 8). A reason for this is likely that human capital is more portable than land titles, and as a result migration does not disrupt the intergenerational transfer of human capital as much as it does the intergenerational transfer of social status. Figure A.3 in the Appendix shows marginal effects for various levels of migration in both the first and the second generation.

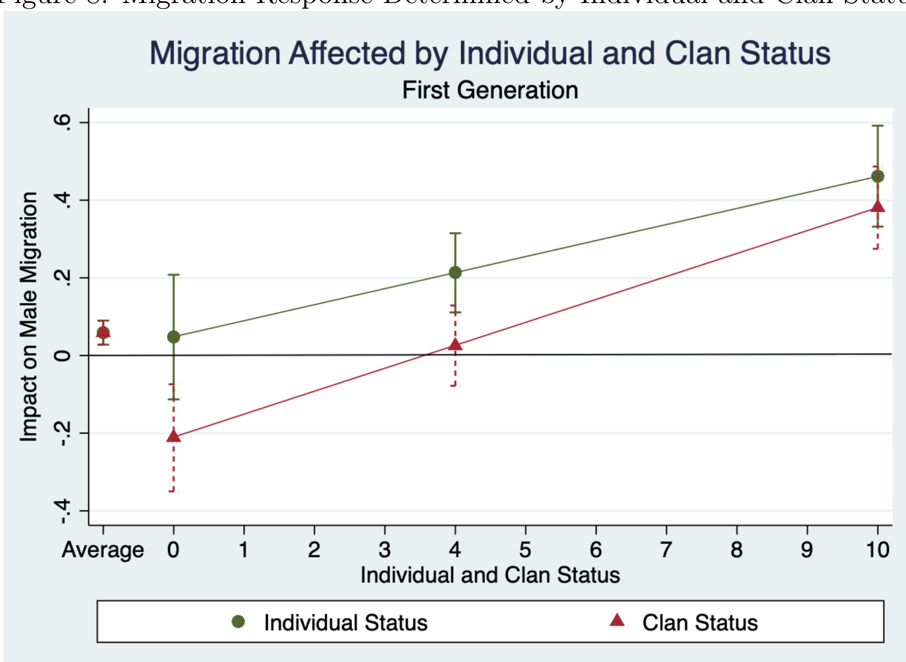
Clan Status Table 8 shows a negative interaction coefficient for generation 1 which is not significant, a positive interaction coefficient in generation 2, and also in generation 5 high clan status tends to help individuals to obtain social status (positive coefficient), see column (4). The pattern from negative to positive as the generational gap increases is somewhat similar to the role of clan human capital for individual human capital acquisition. There are two differences, however. First, the impact of clan status on individual status in response to the shock is not as precisely estimated as for clan human capital shaping the role of individual human capital acquistion. In particular, there is no significant (negative) contribution on an individual's social status from clan status in the first generation.

Second, the time pattern of main effect (on individual status) and interaction effect (from clan status) across generations does not match as well as it does in the case of human capital aquisition and clan human capital. For example, for the generation of the sons (second generation), the fall of the Ming tends to reduce individual status (column (2)), whereas the clan status interaction coefficient in the second generation indicates that high clan status tends to increase individual status (Table 6, column (2), and Table 8, column (4), respectively). As a result, there is less support for clan status group effects analogous to clan human capital effects as captured by equation (4). Instead, the positive coefficient for the clan status interaction variable in generation 2 more likely reflects that clans with relatively abundant resources can support the adjustment of their sons to the fall of the Ming. We illustrate the marginal impact of clan status for individual social status in Figure A.4 of the Appendix.

6.3.3 Migration

Table 8 shows that in general, the higher is individual or clan status, the larger is the migration response (column (5) and (6), respectively). Figure 8 shows marginal effects for different status levels in the first generation.

Figure 8: Migration Response Determined by Individual and Clan Status



Notes: Figure shows marginal effects and 90% confidence intervals based on Table 8, columns (5) and (6).

Figure 8 shows the results. Notice that there are both similarities and differences in how individual versus clan status influence migration behavior. As for the former, higher status–either individual or clan–tends to lead to a larger migration response in the sense that both series in Figure 8 are increasing with status. One reason for this could be that such individuals or clans have relatively more resources to cover any costs of migration. As for differences in how individual and clan status affect migration behavior, clan status series lies below the individual status series. In particular, in the case of a clan that has a low average status level, such as the Zhao clan (average of 0.75), the marginal effect of clan status on migration is negative (which is not the case for individual status). This means that belonging to a poor clan can make the decision of an individual to migrate less likely than it would be in the absence of this clan effect.

In addition, it is interesting to see that at high status levels the marginal impacts of individual and clan status are quite similar. Over generations, although the roles of both individual and clan status for the migration decision fade over time–it is lower for later generations–this is less so the case for clan status than for individual status (Table 8, columns (5) and (6)). Overall, the findings indicate that clan status plays a significant role for how individuals adjust to this big shock.

6.3.4 Fertility

Table 8 shows these results in columns (7) and (8). An individual's social status tends to have no strong or a negative influence on fertility behavior, measured as the number of sons. Most of the interaction coefficients across the five generations in column (7) are close to zero, and often with negative sign. In contrast, the number of sons tends to be increasing in clan status, and significantly so in generations 2 to 4. It is interesting to see this difference in fertility response in relation to individual versus clan status. One reason for this might be that the clan status-fertility relationship reflects broader resource availability–richer clans have the resources to have more children–whereas at the individual level, richer persons might want to restrict the number of children to some extent to focus on child quality as opposed to child quantity.[30] Marginal effects for different status levels for generation 2 are illustrated in Figure A.5.

6.4 Kin Relation versus Geographic Vicinity

In the following we compare the strength of group-based externalities for the process of recovery from the shock. Extending equation (11), there are now two sets of interaction variable coefficients, corresponding to two characteristics z_{ic}. In specification 1, these characteristics are the average of human capital of the members of the husband's clan, and the average of human capital of the inhabitants of the husband's

[30] For an analysis of the child quantity-quality trade-off in this context, see Shiue (2016b).

village. In specifications 2, 3, and 4 it is the corresponding averages of the status of the members of the husband's clan and of the husband's village, respectively. In Table 9, the two sets of interaction variable coefficients are shown side by side for purposes of exposition (results in columns 1a and 1b are for a single regression).

Table 9: Clan versus Village Externalities

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Dependent Variable	Human Capital		Social Status		Migration		Fertility	
Factor z_{ic}	Human Capital Average		Social Status Average					
Level	Clan	Village	Clan	Village	Clan	Village	Clan	Village
Generation 1	-0.653^{**}	-0.431^{*}	-0.422^{*}	-0.097	0.033^{*}	0.009	0.047	0.041
	(0.124)	(0.106)	(0.101)	(0.103)	(0.012)	(0.009)	(0.030)	(0.047)
Generation 2	0.250	-0.514^{+}	0.115	0.192	0.044^{+}	0.042^{+}	0.137^{*}	-0.092^{+}
	(0.197)	(0.186)	(0.159)	(0.118)	(0.016)	(0.016)	(0.025)	(0.035)
Generation 3	-0.381^{+}	0.469^{+}	0.070	0.026	0.020^{+}	-0.003	0.149^{*}	-0.077^{*}
	(0.167)	(0.184)	(0.122)	(0.094)	(0.008)	(0.010)	(0.032)	(0.024)
Generation 4	0.146	0.043	0.037	-0.124	0.015	-0.005	0.131^{*}	0.009
	(0.139)	(0.132)	(0.149)	(0.113)	(0.010)	(0.008)	(0.023)	(0.021)
Generation 5	0.131	-0.017	0.261^{*}	-0.136	0.024^{+}	-0.018	0.005	-0.026
	(0.137)	(0.136)	(1.255)	(0.110)	(0.009)	(0.010)	(0.023)	(0.019)
N	8,024		8,020		7,439		8,024	

Notes: Dependent variable at the top of column; outcomes are for the treatment generation couples' great-great-grandson and his wife (or wives). Sample consists of the couples formed by all male descendants of the treatment generation couples that can be linked over five generations. Estimation of equation (11) by OLS. Coefficient on father of husband in generation 1 status not reported. All 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.

Turning to human capital, we have seen above that clan human capital exerts an additional negative impact on individual human capital acquisition in the first generation (Table 8), and this result is robust to including the village human capital variable (see Table 9, Generation 1, column 1a). The negative coefficient is consistent with substantial externalities at the clan level, in the sense that in good times, individuals that acquire human capital benefit from the rising human capital levels in their clans, while in bad times, the loss of individual-level human capital is exacerbated by the simultaneous loss of human capital by members of an individual's clan.

Table 9 shows that on top of clan externalities, individual human capital acquisition is also related to externalities at the village level: the individual suffers additional losses of human capital due to the declining level of village-level human capital in the first generation. In the second generation, the clan human capital coefficient is positive that for village human capital is negative (not precisely estimated). For the fourth generation, results above showed a positive impact from clan human capital; Table 9 indicates that the point estimate on clan human capital remains positive upon including the village human capital average, but it is not significant anymore. Judging by the (absolute) size of the coefficients, our results provide evidence that clan externalities are stronger than geographic externalities based on living in the same village.[31]

Also, clan average status tends to exhibit a stronger group effect than village average status for the individual's social status (Table 9 , columns 2a and 2b, respectively). For example, while a reduction of clan social status leads to a reduction of individual-level status in the first generation, a decline in average status at the village level does not lead to a significant effect in the first generation. Similarly, by the fifth generation clan status exerts a significant positive effect on individual-level status, while the average village coefficient is insignificant.

Turning to migration, we estimate a significant positive impact from average clan status in the first generation (Table 9, column 3a). Moreover, clan status enters with positive point estimates for migration in all five generations, even if not always significantly so. The finding that social status at the clan level benefits individual migration decisions not only in generation in which the shock hits but also in future generations provides evidence that group effects play an important and long-lasting role for the pattern of individual recovery after big shocks. Except for the second generation when individual-level migration is positively affected as well by village status, the evidence for village externalities on migration is more mixed and point estimates tend to be close to zero. Overall, the strength of village-level group effects on migration is weaker than for clan-level group effects.

The final specification 4 in Table 9 provides results of heterogeneity of the fertility responses with respect to clan- and village group effects. In general, they provide evidence for positive effects from clan average status, while the evidence for village effects is more mixed. Clan estimates are also larger than village estimates in absolute value.[32] Notice that group effects in terms of fertility do not begin to take effect

[31] Also, clan and village averages are correlated because some of the clan members reside in the same village as the man in question. Future versions of this paper will go further in separating these factors.

[32] In the second and third generation, clan and village estimates are of opposite signs which could reflect correlation between

before the second generation.

6.5 Clan Group Effects: Resources, Escaping the Shock, or In-law Networks?

So far we have proxied the strength of the clan by broad measures of resources such as average human capital. To better understand their nature, we present a number of additional results based on other definitions of the clan effect. First, we define characteristic z_{ic} as an indicator variable that is equal to one if the individual comes from a clan that resides disproportionately in a Tongcheng area that has been relatively little destroyed and has a relatively large number of high-human capital men, and zero otherwise. Focusing on areas of relatively low levels of destruction captures the idea that escaping the destruction of the shock might be crucial for being able to support clan members. Furthermore, it may be that high levels of human capital, not the average, is critical to generate strong clan externalities. Table 10 shows these results in column (2), and they can be compared to employing the average clan human capital, as before, in column (1).

The pattern of coefficients across generations, as well as the estimate precision of the estimates, is similar to employing the average clan human capital (compare columns (2) and (1), respectively). This suggests that to characterize the nature of human capital group effects, the simple average human capital level at the clan level is sufficient. Another set of resources that may be accessed by an individual of clan m is those of the clans whose females marry clan-m men. We are already controlling for broad differences across these in-law clans by including wife clan fixed effects. However, in times of big shocks it might be that the larger the number of in-law clans is, the easier it is for a given man to recover from the destruction of the Fall of the Ming. Thus, we define characteristic z_{ic} as the number of distinct wife clans that the clan of a given man has in-law relationships with. Results from employing this interaction variable analogous to equation (11) are shown in column (3) of Table 10. Notice that a greater number of in-marrying wife clans raises human capital acquisition in the first and second generation before fading towards zero. This is consistent with the hypothesis that a large in-law network helps individuals to acquire human capital.

The following analysis examines the impact of the fall of the Ming on the length of family lines.

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the two group effects; such concerns do not exist however in the fourth generation.

Table 10: Clan Effects: Mechanisms

	(1)	(2)	(3)
Factor z_{ic}	HC Average	High HC x Low Treated	In-Law Network
Generation 1	-0.612^{**} (0.123)	-0.519^{**} (0.070)	0.013^{*} (0.004)
Generation 2	-0.070 (0.218)	-0.145 (0.102)	0.012^{+} (0.005)
Generation 3	0.178 (0.139)	0.015 (0.176)	-0.002 (0.005)
Generation 4	0.273^{*} (0.659)	0.217^{*} (0.071)	-0.012 (0.008)
Generation 5	0.192 (0.111)	0.123 (0.060)	-0.002 (0.004)
N	8,024	8,024	8,024

Notes: Dependent variable is human capital; outcomes are for the treatment generation couples' great-great-grandson and his wife (or wives). Sample consists of the couples formed by all male descendants of the treatment generation couples that can be linked over five generations. Estimation of equation (11) by OLS. HC stands for Human Capital. Father status of generation included, coefficient not reported; All specifications include fixed effects for 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.

6.6 The Fall of the Ming and the Continuation of Family Lines

In the analysis so far, the sample consists of all treatment generation couples that can be followed four generations forward to their great-great-grandsons and their wives. Thus, we have conditioned on continuing branches in the inter-generational relationships. However, it is plausible that the Fall of the Ming has affected the likelihood that family lines continue in the first place. One might think of this as the extensive margin effect of the fall-of-the-Ming shock. In principle, this can be studied for any of the four generations that succeed the treatment generation. The following focuses on the extensive margin from the first (treatment) to the second generation.

Of all males born to the seven clans, only a subset were able to marry later in life. This depended on a number of factors, including whether a given male child would survive through childhood to reach a marriageable age. Thus, we begin with an examination of the impact of the fall of the Ming on the age at death of male children of the treatment generation couples. The specification is given by

$$age_{i(p)1} = \alpha + \beta d_{i(p)} + \beta_f hfstat_{i0} + \eta_g + \varepsilon_{i(p)}, \tag{12}$$

where $age_{i(p)2}$ is the age at death (death year minus birth year) of individual i in generation 2 who is descending of pair p, and $hfstat_{i0}$ denotes the social status of individual i's grandfather (who lived in the generation before the treatment generation, or generation 0). Table 11 shows the results on the left side. The coefficient on fall-of-the-Ming variable $d_{i(p)}$ is estimated negative 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 precisely estimated). Upon extending equation (12) by adding fixed effects for each of the seven male clans, this changes to about seven years less (column (2)), while including in addition a fixed effect for each of the different clans of the in-marrying mothers (68 fixed effects) brings the point estimate to -4.2. Overall, there is some evidence that the Fall of the Ming shock reduced the age at death of the treatment couples' male offspring.

The analysis on the right of Table 11 allows for such variation in the impact of the shock the age-at-death. We estimate the following extension of equation (12):

$$age_{i(p)1} = \alpha + \beta_1 d_{i(p)} + \beta_2 \left(z_{i(p)} \times d_{i(p)}\right) + \beta_3 z_{i(p)} + \beta_f hfstat_{i0} + \eta_g + \varepsilon_{i(p)}, \tag{13}$$

Table 11: Impact on Longevity of First-Generation Male Children

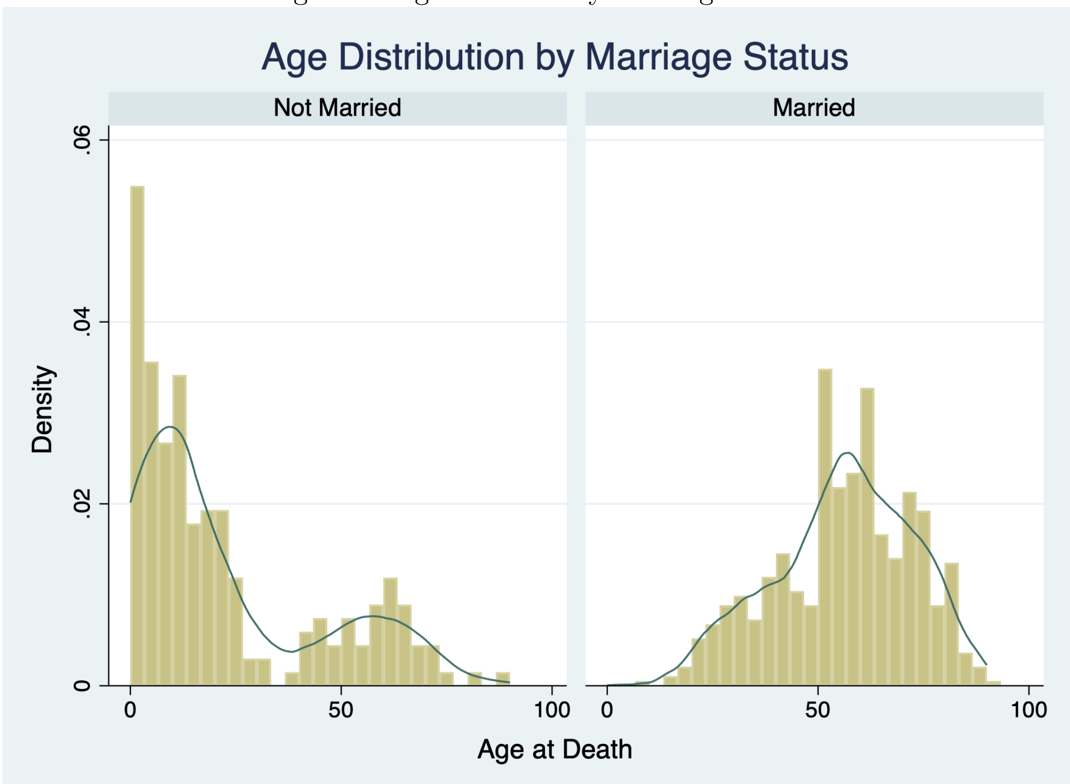
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Factor z_i				Human Capital	Social Status	Longevity Father	Mother
Fall of Ming Shock	-4.514 (3.114)	-7.102^{*} (3.225)	-4.249 (3.527)	-9.959^{*} (4.315)	-8.895^{*} (4.288)	-39.896^{**} (13.274)	-37.610^{**} (10.538)
Ming Shock x z_i				16.524^{**} (6.022)	1.057^{*} (0.528)	0.617^{**} (0.229)	0.574^{**} (0.179)
z_i				-8.803 (5.664)	-0.370 (0.552)	-0.217 (0.218)	-0.084 (0.218)
Father Status	0.336^{*} (0.169)	0.838^{**} (0.231)	0.934^{**} (0.247)	0.109 (0.219)	-0.016 (0.266)	0.361^{*} (0.177)	0.336^{*} (0.162)
Birth Year FE	Y	Y	Y	Y	Y	Y	Y
Husband Clan FE	N	Y	Y	N	N	N	N
Wife Clan FE	N	N	Y	N	N	N	N
N	774	774	761	774	774	774	767

Notes: Dependent variable is age at death (longevity) of male descendant of treatment generation couple; estimation of equation (12) by OLS. Robust standard errors clustered at the level of the treatment generation couple; **/*/+ indicates significant at the 1%/5%/10% level.

where $z_{i(p)}$ is a characteristic of the treatment generation couple, p. Once we let the shock impact depend on the father's level of human capital, the impact of the shock reduces the age of a son of a father with low human capital by on average 10 years (column (4)). In contrast, the age at death of a son of a father with high level of human capital is not negatively affected by the shock (= -10 + 16.5). A qualitatively similar result is obtained for social status: the negative impact of the fall-of-Ming shock on the male's longevity is smaller, the higher the social status of his father (column (5)). This suggests that resources of the family tend to reduce the negative impact of the shock on the length of the life of the son.

In the remaining two specifications of Table 11, we ask whether longevity of the parents influences the impact of the shock on the longevity of their son. The positive coefficient on the interaction variables indicate that longevity of either father or mother tends to reduce the negative impact of the shock on the length of life of their son (columns (6) and (7)). One reason for this is genetic endowment. Sons from parents that are relatively healthy and reach a relatively high age at time of death are likely to be relatively healthy themselves and therefore likely to cope with the fall-of-Ming shock comparatively well.

Figure 9: 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.

Figure 9 shows the distribution of age-at-death of these males by their 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. This is due to infant mortality in this setting. 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 to marry. In comparison to the bi-modal distribution on the left, the distribution of longevity for married men is much closer to a normal distribution (Figure 9, right side).

Turning to the impact of the Fall of the Ming on the second-generation males' marriage probabilities, we estimate equations analogous to equations (12), (13) with a marriage indicator instead of age at death as the dependent variable. Table 12 shows the results.

The shock has tended to reduce the marriage probability of the next-generation male offspring, although the coefficient is insignificant when we include fixed effects for each of the clan of the in-marrying women (column 3). These results are similar to those for age-at-death in Table 11 above.

Table 12: Impact on Marriage Probability of First-Generation Male Children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Factor z_i				Human Capital	Social Status	Mother Migration	Mother Longevity
Fall of Ming Shock	-0.105^{+} (0.059)	-0.118^{+} (0.061)	-0.018 (0.072)	-0.061 (0.087)	-0.085 (0.089)	-0.150^{*} (0.068)	-0.467^{**} (0.176)
Ming Shock x z_i				-0.031 (0.113)	-0.001 (0.010)	0.038 (0.027)	0.006^{*} (0.003)
z_i				0.187^{+} (0.100)	0.021^{*} (0.010)	-0.059^{*} (0.026)	-0.000 (0.003)
Father Status	0.005 (0.004)	0.010^{*} (0.004)	0.012^{**} (0.005)	-0.002 (0.004)	-0.008^{+} (0.005)	0.005 (0.004)	0.005 (0.004)
Birth Year FE	Y	Y	Y	Y	Y	Y	Y
Husband Clan FE	N	Y	Y	N	N	N	N
Wife Clan FE	N	N	Y	N	N	N	N
N	801	801	788	801	801	797	789

Notes: Dependent variable is an indicator on whether a male descendant of treatment generation couple has married; estimation equations analogous to equations (12), (13) by OLS. Robust standard errors clustered at the level of the treatment generation couple; **/*/+ indicates significant at the 1%/5%/10% level.

However, while human capital and status of the father reduce the negative impact of the fall of the Ming on longevity of second-generation males, marriage prospects of the young male depend more on characteristics of the mother than of the father. If mothers did not migrate or had a relatively short life, the Fall of the Ming had a negative impact on their male child's marriage probability (Table 12, columns (6) and (7)). Also, the further his mother migrated or the older she got, the lower tends to be the negative impact of the shock on the second-generation male's marriage probability (significant for mother's age). The former points to longer-distance marriage networks becoming more valuable at times of crises.

7 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 almost 1/8 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. Our first result is that the fall of the Ming reduced the human capital of those affected by about one third compared to individuals that were unaffected in the treatment generation, followed by a reversal from negative to positive impact for the treatment couples' grandsons and following generations. It suggests that while human capital is vulnerable to destruction in a big shock, investing into human capital is also attractive compared to other avenues of upward mobility including land ownership.

Second, we show that the fall of the Ming has triggered certain responses that can be seen as behavior towards risk. This includes out-migration of the affected areas, but also higher fertility in terms of sons. We also have shown that several of the adjustment strategies towards the shock reinforce each other. In particular, migration is effective in reducing the loss of human capital caused by the fall of the Ming in the treatment generation, and conversely, individuals that are relatively successful in acquiring human capital and status despite the turmoil are more likely to out-migrate than other affected couples.

Third, we document new evidence for endogenous clan effects in the acquisition of human capital. During the fall of the Ming, men from high-human capital clans suffer a disproportionately large reduction, and in subsequent generations such men experience a disproportionately large increase in human capital compared to affected men from low human-capital clans, which points to positive human capital externalities at the clan level. We also found that kinship-based group effects appear to be larger than village-based group effects, and that not only the resources of the male clan but also of the clan of the in-marrying wives affect the speed of recovery to a big shock.

Our analysis so far has already shown that the impact of a big shock can last for at least five generations, or three hundred years and beyond. Furthermore, rather than a faded version of the short-run effect, the long-run impact of big shocks can be quite different from the shock's short-run effect.

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A Data

A.1 Information on Human Capital and Status for Tongcheng Clans

This section lays out the main reasons for the status classification employed in the paper. The following describes these twenty-three groups, where the classification draws on on work by Chang (1955, 1962), Eberhard (1962), Ho (1967), and especially Telford (1986, 1992). The classification is for men; women did not have social status on their own in this society. Table A.1 shows the classification in column (1). Column (2) gives a short description of the individuals' sources of status that determines their group. Column (3) shows the coding of the human capital indicator variable.

The data includes information on the major stages of each man's life, evidence of high income and wealth, various aspects of elevated status, certain functions, and specific actions such as large donations or setting up ancestral estates. There is also information on a person's education and whether he was a government official (and if so at which rank). The entry lists the man's wife (or wives) as well as each couples' children. If there is nothing other than vital statistics in the individual's biography, and this person had no titles, degrees, or evidence of wealth, then he is coded with group 0 (see Table A.1).

Table A.1: Human Capital and Social Status Classification

(1)	(2)	(3)	(4)
Group	Description	Human Capital	Alt. Human Capital
0	No title, degree, and evidence of wealth	0	0
1	Honorary or posthumous title; village head; other honors	0	0
2	Multiple wives in consecutive marriage (two or more not living at the same time)	0	0
3	Evidence of moderate wealth of 1st degree family, incl. minor and expectant official, lower level degree (*sheng-yuan*, *jian-sheng*), and official student	0	0
4	Wealthy family member 2nd degree, incl. official, *ju-ren*, *gong-sheng*, and *jin-shi*	0	0
5	Wealthy family member 1st degree, incl. official, *ju-ren*, *gong-sheng*, and *jin-shi*	0	0
6	Educated, scholar, no degrees or office; editor of genealogy; refused office, or prepared but did not pass exam	1	1
7	Two or more wives or concubines at the same time	0	0
8	Substantial evidence of wealth and property; set up lineage estates, large donations, philantrophy; wealthy farmer, landowner, or merchant	0	0
9	Official Student (Province)	1	2
10	Military *sheng-yuan*, minor military office	0	0
11	Purchased *jian-sheng* and/or purchased office	0	0
12	Student of the Imperial Academy	1	2
13	Civil *sheng-yuan*; minor civil office	1	2
14	Expectant official; no degrees	0	0
15	Expectant official one of the lower degrees	1	2
16	Military *ju-ren*, *jin-shi*; major military office	1	3
17	Civil official with no degree, minor degree, or purchased degree	0	0
18	*ju-ren*, *gong-sheng*, with no office	1	3
19	*ju-ren*, *gong-sheng*; with expectant office	1	3
20	*jin-shi*, no office	1	3
21	*jin-shi* with official provincial post or expectant official	1	3
22	*jin-shi* with top-level position in Imperial bureaucracy (Hanlin Academy, Grand Secretariat, Five Boards, Prime Minister)	1	3

Notes: Table gives information on a man's human capital and social status. Same grouping for father status and human capital. Based on Telford (1986, 1992), Chang (1955, 1962), Ho (1967), and Eberhard (1962).

Acquiring skills to pass the civil service exam is what our measure of human capital in column (3) is based on. Passing the exam was important because it was necessary to obtain a government position, the main pathway to status and income in this society. The classification reveals that higher status group in society was correlated with passing the tournament-style civil service exam. Notice that we code individuals who have studied for the civil service exam to have acquired human capital even if they did not pass the exam, because it would still have required years of focus on acquiring skills (level 6). If we distinguish additional human capital levels, depending on whether a man passed the civil service examination or not, and at what level (coding given in column (4) of Table A.1), we obtain similar results, see Table A.1

Among the civil service exam degrees, *sheng-yuan* was the lowest degree of the recognized categories of government education, conferred upon those who had passed the local (district or prefectural) degree threshold. The *sheng-yuan* who were scholastically more competent were awarded with the *gong-sheng*, "imperial student" title; above them in rank were the *ju-ren* (graduate of the provincial examinations), and above the *ju-ren* were the *jin-shi* (graduate of the national metropolitan examinations). The levels are building up on each other, that is, in order to have the *jin-shi* degree one must have the *ju-ren* and the *sheng-yuan*, and in order to be *ju-ren* 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 *jin-shi* degree would be in the low twenties, and it was not unheard of for a man in his fifties to still be a *sheng-yuan*. Not all *sheng-yuan* 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).

The role of high status not related to government office was limited. Even though there were rich landowners and merchants in Tongcheng, as elsewhere in China, they would often seek to acquire official government positions due to the additional income it would generate. 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 *jin-shi* degrees, without success, so they stayed at *ju-ren* level positions (Chang 1955).

Status and Income Status in society translated into income differences. This section provides a brief synthesis (see Chang 1955, 1962, and Ho 1967 for additional discussions). First, the income of a man is determined by two factors, the level of civil service exam he passed and the type of government office he obtained (if any). These factors were the most important determinants of where a household stood in the societal status distribution. As noted already, there were local, provincial, and national (or metropolitan) exam levels, with corresponding degrees called *sheng-yuan*, *ju-ren*, and *jin-shi*, respectively.

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 *sheng-yuan* (local) degree was almost impossible, and conversely, most *jin-shi* had better-paid positions than being a district magistrate. The level of degree is useful because there is a relatively small number of them, and they are consistently mentioned in the data.

The status groups capture the relationship between civil service examination degree and official position. Our classification is also consistent with the fact that military offices had lower status and generated lower incomes than civil offices. For example, the highest civil official had a salary of 180 *taels* per year, while the highest military office came with only 82 *taels* (see Chang (1962, Tables 1 and 2).

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. Our status categories are consistent with such clan schedules (Chang 1962 presents a number of examples).

A.2 Selection

This section sheds 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 1, 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 income over time.

In the data, there are three clans whose records begin with an educated progenitor: the Chen (progenitor born in 1298), the Wang (1358), and the Ma (1408). However, the status of these three progenitors was not more than what might be considered an intermediate level, not the highest level (*jin-shi*). For the other four clans, the highest levels of income are typically found nine generations after the inception of the dynasty. Thus, the patterns in the data do not simply reflect particularly noteworthy individuals that started the clan genealogies as progenitors. One might also be concerned that mobility is strongly affected by the number of children (or grandchildren) that that a family has. Earlier research has shown that while richer families had a larger number of children on average, they also deliberately restricted the number of children in order to raise the chance that a son would pass the civil service examination (quality-quantity trade-off; Shiue 2017).

Selection would also arise if genealogical records contain more entries of success compared to failure. A first way to check this is simply to examine whether clan size and clan status are correlated. It turns out that the correlation between clan size and average status is virtually zero. Thus, there is no evidence that on average, richer clans have included more entries in their genealogies. Second, we have checked for a temporal correlation. Perhaps periods during which a clan is successful are also those when relatively many clan members are recorded. Breaking down the overall sample period of 1300 to 1900 into twelve birth cohorts, as in the text, yields a correlation between status and the number of clan members of close to zero (and negative, -0.10).

Third, because the genealogy was compiled retrospectively one might believe that it is in times right after a clan had been relatively successful when a relatively high number of clan members would be recorded. This might happen if the appearance of a high-status individual correlates with a better memory of all the family members who were related to this locally famous individual, compared to periods when no one in the clan was particularly successful or famous. However, there is no positive relationship between the number of clan members recorded and average clan status in the recent past (the correlation is insignificant at -0.09).

Furthermore, survivor bias may be present if high-achieving clans tend to be overrepresented towards the end of the sample. If so, one would expect that clans with high income account for a relatively large share of the post-1800 observations in the Tongcheng data. Across clans, however, we do not find a strong relationship between average status and the share of post-1800 observations (insignificant correlation of 0.07).

Overall, these analyses provide evidence that these forms of selection bias are not major concerns in this data.

A.3 Representativeness

A first check of the representativeness of the data 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). 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 *sheng-yuan* 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 my sample compare with other evidence? In his classic study based on national lists of *jin-shi*, which are extremely reliable, Ho (1967) reports that during the Qing in Anhui there were 41 *jin-shi* per one million population, or, 0.0041 percent. There were regional

[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).

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

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 *jin-shi* 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 *jin-shi* in my sample than in Qing Anhui overall.

At the same time, *jin-shi* 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, *jin-shi* degree, can be compared against other lists of degree holders from Tongcheng County (Fang 2010; Cao 2016; Wang 2017). There were over 51,000 *jin-shi* 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 *jin-shi* in the sample is consistent with the information of these official lists.

In summary, employing a number of checks and comparisons the information in the Tongcheng 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.

[35]Specifically, Zhejiang and Jiangsu were among the provinces with high densities of *jin-shi*. Ho (1967) reports that a single prefecture in China could have as many as 1,004 *jin-shi* during all years of the the Qing. With typically seven counties to a prefecture, this means that there could be as many as 1,004/7 = 143 *jin-shi* per county during the Qing. Compared to this, the 14 *jin-shi* in my sample are not exceptional.

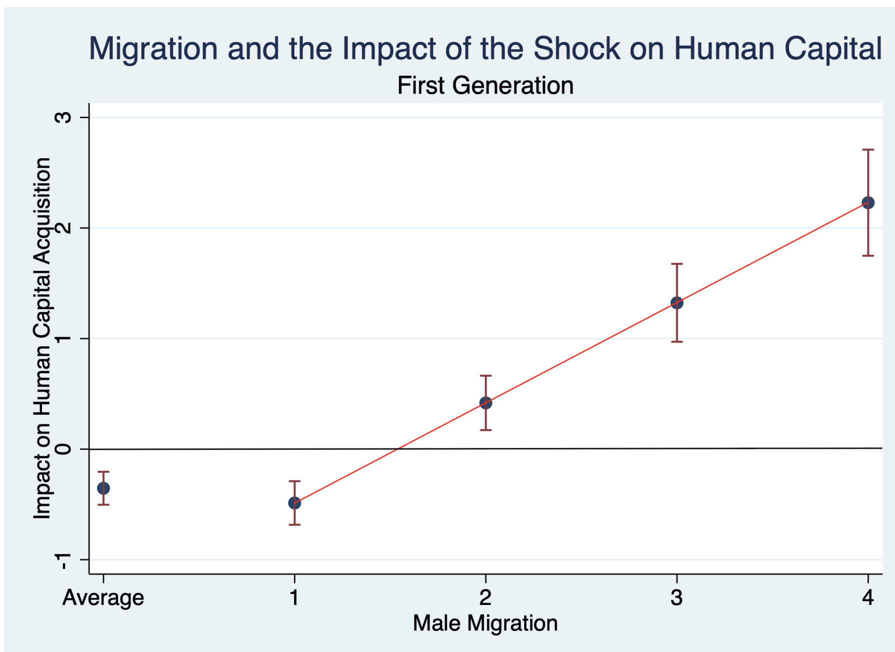
B Supplemental Empirical Analysis

B.1 Heterogeneity in Responses: Marginal Effects Analysis

B.1.1 Human Capital Acquisition

Table 8 shows that the human capital response across generations is heterogeneous in two dimensions (columns 1, 2). Figure A.1 plots marginal effects for various levels of male migration as the characteristic z_{ic} interaction in equation (11).

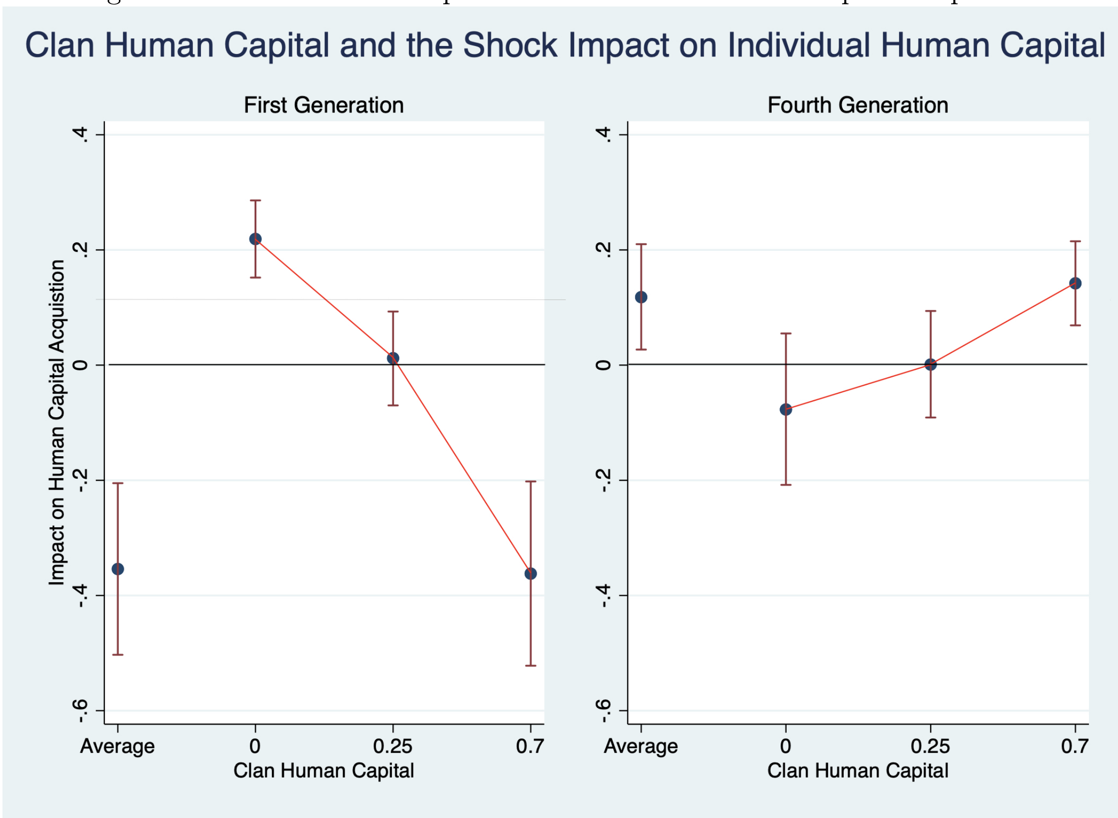
Figure A.1: Migration and Human Capital Acquisition



On the left, we see that the average impact of the fall of the Ming on human capital acquisition in the first generation, at -0.35 (see also column 1 of Table 6). That impact varies strongly with the level of migration, and as Figure A.1 shows, only men that stayed within five miles of the residence of their ancestors, which is labeled as level "1" of Male Migration in the figure, suffered a human capital loss– at the same time, these individuals were in the majority.

Figure A.2 shows marginal effects of average clan human capital for the first and fourth generation.

Figure A.2: Clan Human Capital and Individual Human Capital Acquisition



The panel on the left presents results for the first generation, while the panel on the right is for the fourth generation. In each panel on the left, we give the average impact of the shock on human capital acquisition, which is -0.35 in the first and 0.12 in the fourth generation (see Table 6, column 1). Figure A.2 shows that in the first generation, the impact of the shock on individual human capital acquisition is decreasing with the average human capital of the clan. It is particularly men from high human-capital clans that suffer the highest losses in terms of human capital. In contrast, we do not estimate losses in human capital for men that hail from low-human capital clans.

As Figure A.2 shows on the right side, by the fourth generation the relationship between individual human capital acquisition and clan human capital has turned positive: men from relatively high human-capital clans acquire significantly more human capital than men from other clans. This reversal is consistent with strong group effects, as men from high human-capital clans in the fourth generation are supported by the relatively human capital of that group.

B.1.2 Social Status

This section provides additional results on heterogeneity that shapes the impact of the fall of the Ming on social status. The first variable we consider is male migration.

Figure A.3: Migration and the Impact on Social Status

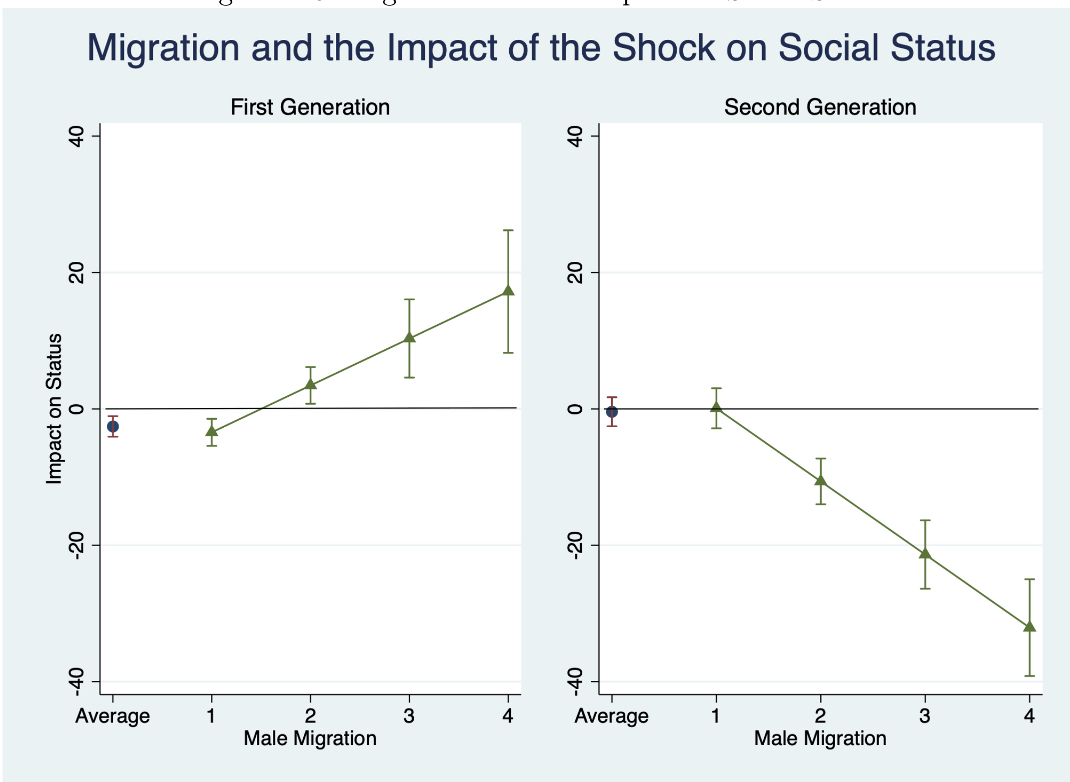
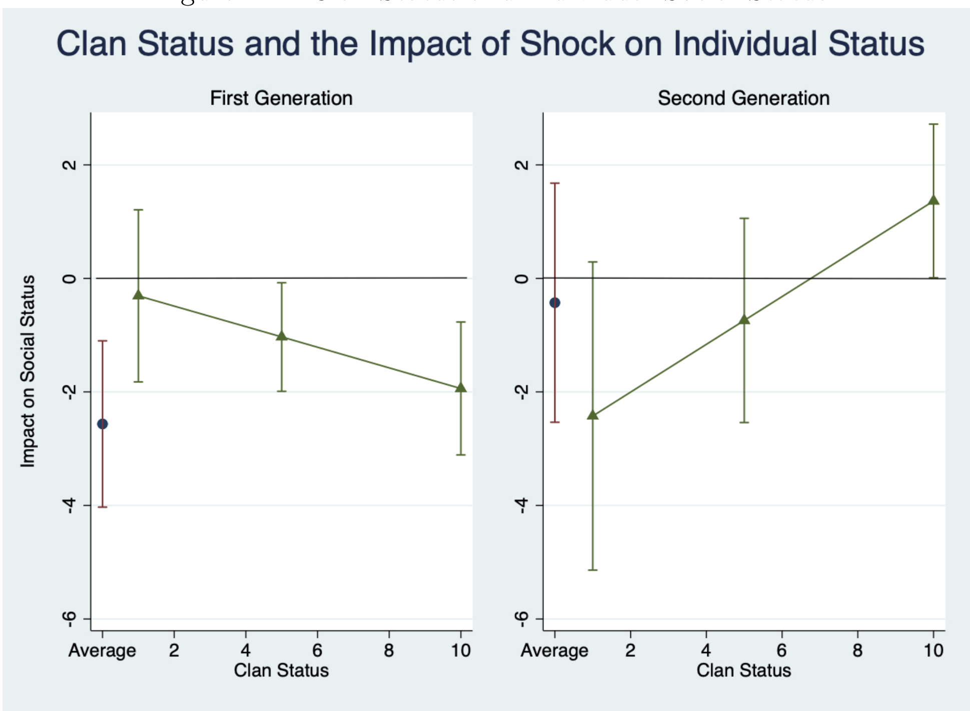


Figure A.3 shows the relationship between the impact of the fall of the Ming shock on the social status of men in the first and second generation, which means fathers and sons (left and right panel, respectively). We see that the decision of the father to migrate or not has rather different implications for his own status and the status of his son. On average, men who lived during the fall of the Ming dynasty in villages that experienced heavy destruction lost on average about 2.5 levels of status (on the very left of A.3). see also Table 2, column 2, Generation 1). However, men who migrated at least 5 miles away from the residence of their ancestors ("2" and higher in the left panel of Figure A.3) did actually not experience a reduction in social status. This illustrates that migration is effective for fathers to maintain their social status. At the same time, the right panel of Figure A.3 shows that son status is declining in the migration activity of the father. This quantifies the intergenerational trade-off between father and son in terms of social status discussed in the text.

We now turn to the role of clan status for the impact of the fall of the Ming on an individual's clan member's social status.

Figure A.4: Clan Status and Individual Social Status

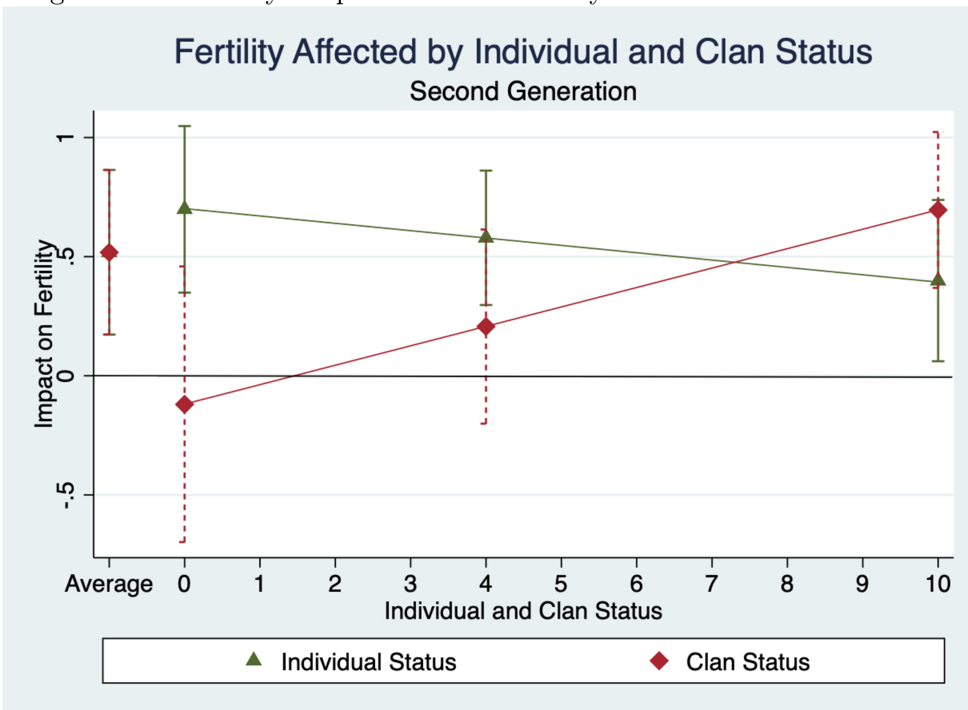


On the left of the left panel, Figure A.4 shows the average impact of the shock on social status in the first generation (-2.54, also Table 6, column (2)). This impact becomes more negative for men who are members of relatively high-status clans, although not significantly so (see Table 8, column (4)). For sons of the couples who experienced the fall of the Ming turmoil, that is, the second generation, higher clan status in the father generation tends to reduce the negative impact of the shock, as shown in the right panel of Figure A.4.

B.1.3 Fertility

The following analysis examines the way individual and clan status shape fertility responses, focusing on the second generation.

Figure A.5: Fertility Response Determined by Individual and Clan Status



As the series on the left of Figure A.5 indicates, the average fertility respons in this generation is positive at 0.518 (also see Table 6, column 7, generation 2). Notice that increases in individual status and in clan status have opposite effects on the couples' fertility choices. At the same time, only for relatively high status levels is there a significant marginal effect for both individual and clan status, and there, it has the same sign, namely positive.