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

Carol H. Shiue and Wolfgang Keller†

University of Colorado, NBER, and CEPR

This Version: January 2023

Abstract

Do big shocks have permanent effects on the economic fortunes of people, or are the effects from big shocks transitory? This paper examines the responses over three centures of intergenerationally linked families to the 1644 fall of the Ming Dynasty, which cost the lives of close to 1/8 of China's population. First, 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. We also find 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 affected by the shock. Third, we find evidence for group effects in that high levels of clan human capital magnify the positive long-run human capital response to the fall of the Ming.

Keywords: Social Networks, Chinese Clans, Human Capital Externalities, Persistence

*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. For example, it has been argued that the Great Irish Famine (1845-49) had a permanent effect on Ireland by causing mass emigration, in contrast to Allied bombing of Japanese cities in World War II which had little long-run impact on the spatial structure of Japan (O' Grada and O' Rourke 1997 and Davis and Weinstein 2002, respectively).[1] Precisely because big shocks can have effects that possibly last over centuries, it is a challenge to trace out the main channels of influence because suitable information over decades or centuries is rare. This paper makes progress by considering 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, women, and their families in Central China.[2]

The fall of the Ming Dynasty yields a uniquely powerful natural experiment. First, in the following period China was a relatively stable, pre-industrial economy with no major subsequent shock for around two centuries.[3] If the fall of Ming shock is not overlaid by other major changes, it becomes more feasible to identify the shock's long-term effects. Second, 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 great importance of such kinship relationships in many countries. Third, employing longitudinal micro data from clan histories on five consecutive generations enhances the possibility to trace out long-run effects and helps to interpret the 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 the

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

[2] Population decline from 99.9 million to 88.5 million over the period 1626-1646, see Lee and Zhang (2013). The Ming Dynasty was followed by the Qing Dynasty (1644-1911).

[3] Change came in the mid-19th century. The year 1842–end of First Opium War–initiates an era of Western colonial intervention in China, and the Taiping Rebellion of 1850-64 ranks among the world's largest civil wars.

Fall of the Ming, moving the family can yield an environment more suitable to raising children. At the same time, migration is costly (transport, food, time), and it also typically means that the family's relation to property that cannot be moved, in particular land, becomes more tenable. The model predicts that both 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 has the relatively high productivity in a given period.

The fall of the Ming is examined in terms of the behavior 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 roughly three hundred years. The fall of the Ming had a regionally diverse impact in China; in Tongcheng it was severe, including death and destruction through military campaigns as well as famines. In our sample, death rates almost tripled while birth rates fell by one third. Relative to the trend growth in the sample, the fall of the Ming reduced the size of the seven clans on which our data draws 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 by the turmoil of the fall of the Ming. Some regions, in particular mountainous areas, were less affected by the shock than others. For each subsequent generation, second to fifth, we then ask whether the behavior of the descendants of the treatment generation couples differs systematically from that of descendants of other couples. This estimates the length of time for which the shock exerted an impact, thereby providing new information on whether big shocks lead to transitory changes or not.

First, in the treatment generation, the fall of the Ming reduced 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 impact of the shock on human capital 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 fall of the Ming. One explanation that finds support in the data is that while human capital is highly 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 positive out-migration of the affected areas. This migration is mostly over relatively short distances, far enough to escape the localized destruction through the shock. Moreover, the fall of the Ming shock 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. Our analysis suggests that 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 in the case of migration, the fall of the Ming increases fertility levels of the descendants of affected couples in the treatment generation 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 and status despite the turmoil are more likely to out-migrate than other couples.

Third, the adjustment behavior provides evidence for clan effects 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 face-to-face interaction, which we proxy by individuals 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 of the clan of the in-marrying wives.

Fourth, we find that the fall of the Ming has also 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 et al. (2021) which studies *in utero* effects of the Bhopal Gas accident, while other researchers show that job loss has inter-generational effects (Oreopoulos et al. 2008, Hilger 2016). 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 US (Feigenbaum 2015) or the role of mechanization of 20th century US agriculture on outcomes of the farmer's 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 economic impact and performance (e.g., Pamuk 2007, Jedwab, Johnson, and Koyama 2022 on the Black Death, and Nunn 2020 for 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 we show below using various balance checks that there are no differential pre-trends between treatment and control observations. Our analysis is most closely related to work focusing on the mechanisms through which historical interventions exert their influence centuries later (Nunn 2008, Dell 2010, and the subsequent literature). Our approach pivots to employing linked longitudinal data on *people* instead of relying on cross-sectional data on *regions* at different points in time. To the best of our knowledge, this is one of the first papers that traces out the long-run impact of a historical intervention using a multi-generational cohort approach.

We also contribute to a sizable literature on adjustment behavior to major historical shocks. Work on 19th century US by Bleakley and Ferrie (2016) shows that a positive wealth shock does not lead to higher human capital investments for the following generation, in contrast to our finding of a positive long run human capital response to a negative shock; the difference may be due to the sign of the shock or other factors. Migration as an adjustment mechanism to bad shocks is well-established in the literature (O'Grada and O'Rourke 1997, Hornbeck 2012, Boustan et al. 2012, and Feigenbaum 2015). In addition

to employing more disaggregated data for an earlier time, our analysis highlights the importance of social effects for adjustment. Chinese clans are of interest from a comparative perspective with European guilds (De La Croix, Doepke, and Mokyr 2018). We complement analysis comparing the effectiveness of kinship relationships versus formal market institutions (Kinnan and Townsend 2012, Townsend 1994) by providing information on the importance of networks based on blood relationships 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 it requires investments that for a given parent income reduce their consumption. The parents' budget

[4]See Shiue (2017) for an analysis of the child quantity-quality decision during this time; also, Keller and Shiue (2022) analyze marriage decisions of both sons and daughters in Ming-Qing China.

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, residence, and land.

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

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

where $\sigma > 0$ 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 $(\gamma + \kappa) < 1$. 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 rising in the parameter κ. As noted earlier, 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 the child's skill acquisition would come from the child's grandfather or uncle, we would expect that $\mu > 0$. 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 optimal choice of skill investment, s_p^*, and migration investment, m_p^*, satisfies

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

and

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

These first-order conditions yield the relationship between the optimal 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

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

and

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

Discussion The optimal skill and migration investments are (1) rising in parents income and (2) rising in the weight parents place on child income (α). 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' optimal 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). 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 "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

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

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 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

[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.

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.

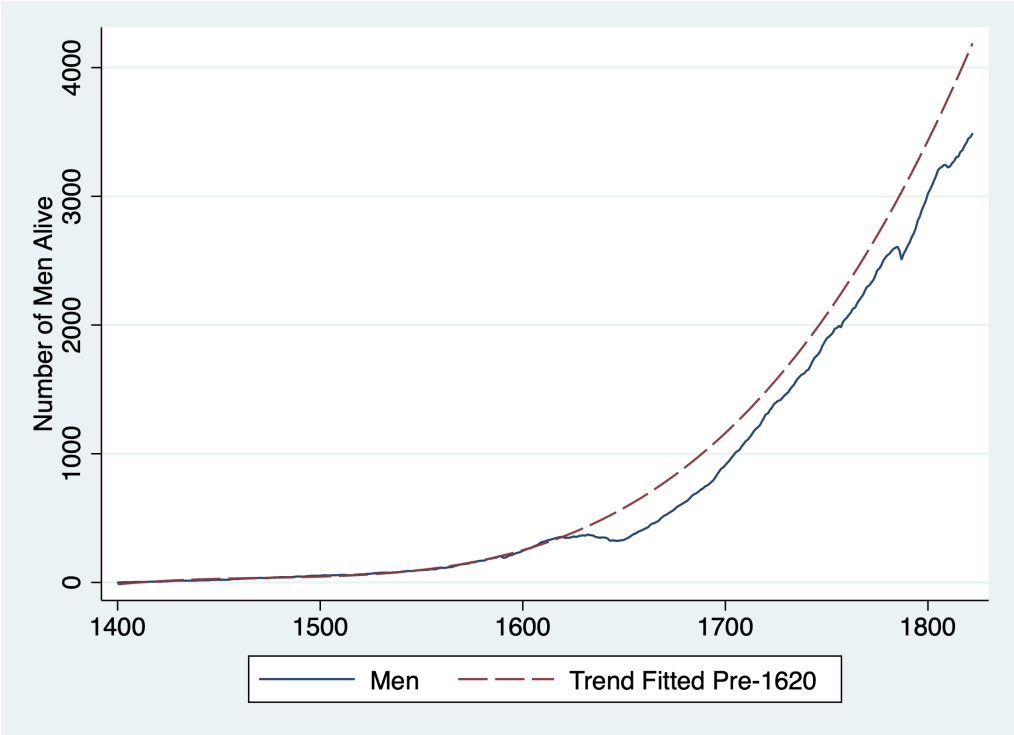
First of all, property rights turn on information recorded in genealogies, because they establish and sustain village settlement rights for specific clans. Second, genealogies are critical as a means of defense, including war, because by determining who is member of the clan and who is not it defines 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, 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]

[8] Just as with other historical data, it is useful to be aware of key characteristics of genealogical data; see Shiue (2016) for a discussion.

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.

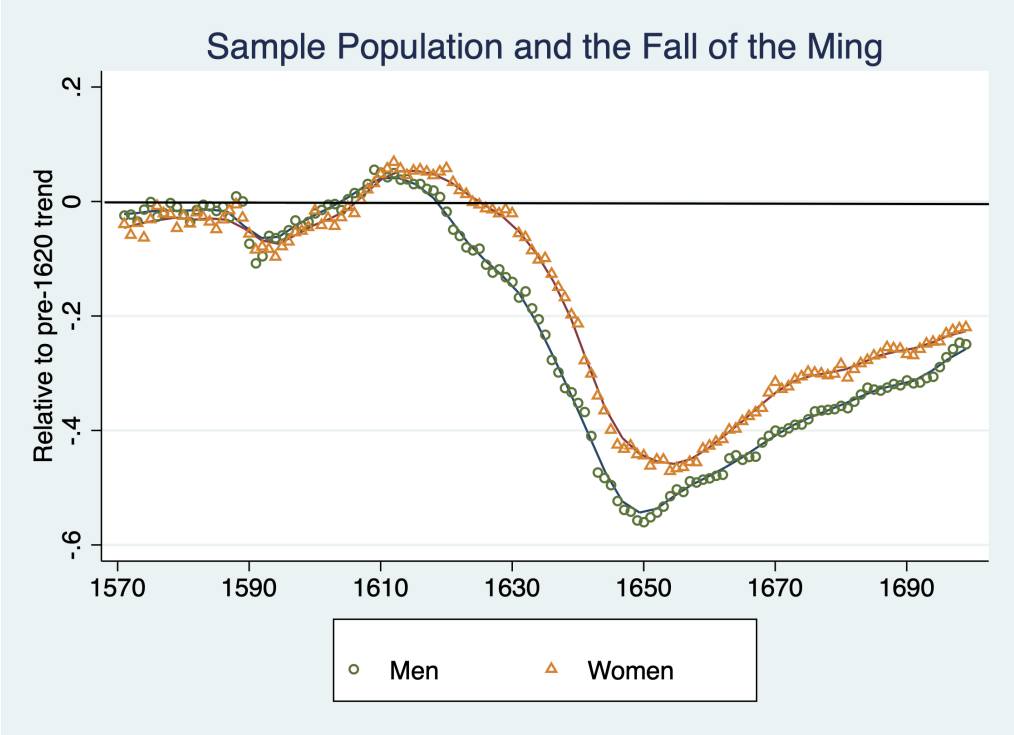
Figure 1 shows that while the number of men belonging to the seven clans in the sample has generally grown over time, starting in the early 1600s the sample falls below trend growth, and eventually the number of clan men drops in absolute terms as the Ming dynasty comes to a close (in 1644).[9] The development 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 line at least until the 1820s. Care should be taken to not overinterpret this because specifics of how the trend is calculated matter to some extent, however, the evidence presented in Figure 1 is clearly consistent with the hypothesis that the impact of the Fall of the Ming has an effect lasting for several generations of

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

descendants of the treatment generation couples.

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.

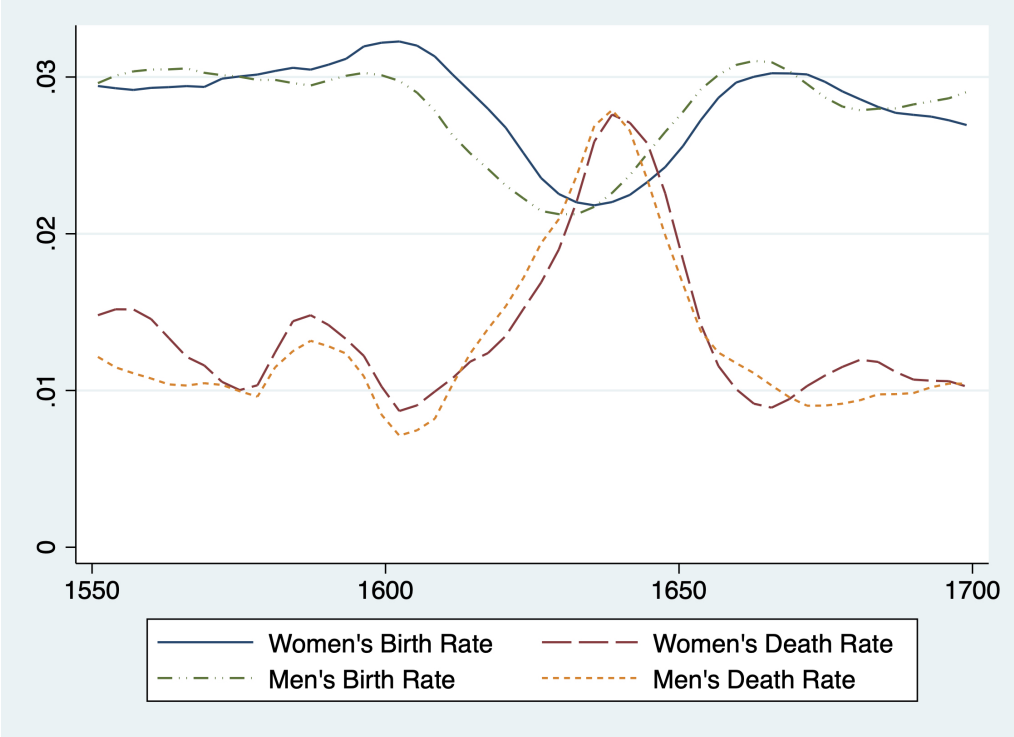
Figure 2: Fall of the Ming and Tongcheng Sample by Gender



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, both the number of men and women are at least 20% below the trend by the end of the 17th century. 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 food crises or war activity 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 only 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.

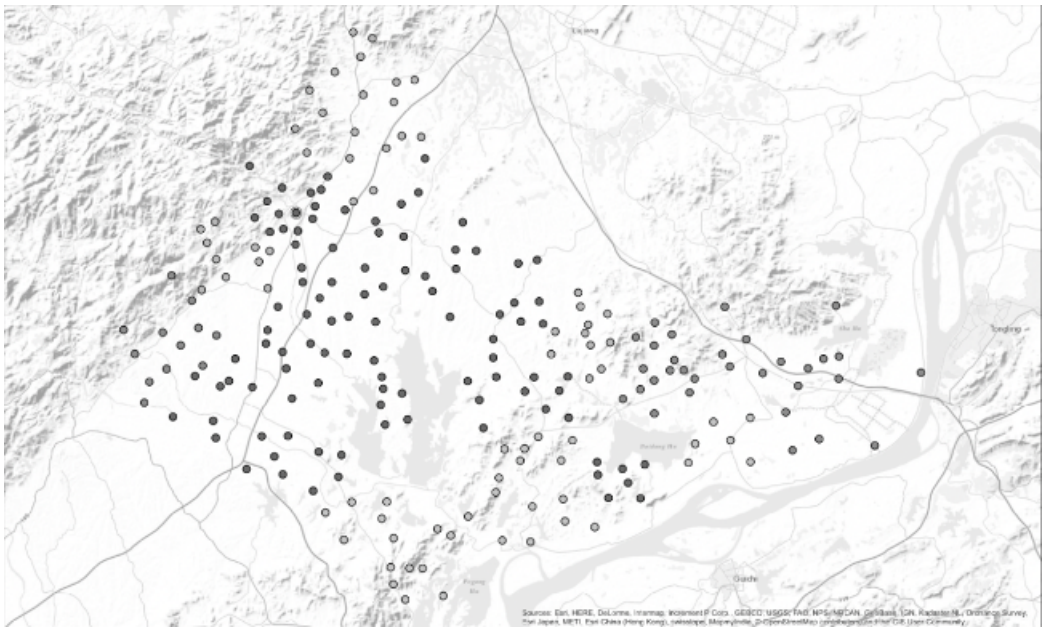
This study examines the well-being of those that were directly affected by the fall of the Ming as well as their descendants in the next four generations. We refer to the former as the treatment generation, defined to be those couples in which the husband was born in the range of 1590 to 1644. Heavy destruction is noted in Tongcheng county for the final ten years of the Ming dynasty (1634-44) or more (Beattie 1979), 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 (business insider). The treatment window of 1590-1644 covers husbands (and their wives) that were 44 years old or younger at the onset of 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 these life-cycle differences the analysis below will include birth year effects.[10] Under this treatment window assumption, the size of our treatment generation is 511 couples.[11]

4.3 Treatment Definition

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.

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



Notes: Figure shows location of historical villages in Tongcheng country, Anhui province. Destruction during the fall of the Ming is increasing in the darkness of the shading. Source: Telford (1992).

[10]The results are robust to other reasonable assumptions on the timing of the treatment window.

[11]Some of the husbands in these couples are present in multiple couples. The main reason for this is that the husband'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 husbands.

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 historical villages in Tongcheng country, with the Yangzi river shown in the lower right of the figure. The impact of this fall of the Ming destruction is higher the darker the shading of a village is in Figure 4. Many of the villages that escaped major destruction are located in the more mountainous areas of Tongcheng, in line with the hypothesis that rugged terrain makes it more difficult to access, persecute, and destroy people (Nunn and Puga 2012). The levels of destruction captured by our village-level treatment variable are also consistent with the account of Beattie (1979) who notes that destruction in Tongcheng's east was lower than in Tongcheng's west (p.47).[12]

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 our treatment generation couples lived in villages subject to fall-of-the-Ming destruction. A value of 89% of treated villages is in line with the heavy toll that the Tongcheng area took during the Ming-Qing transition, see above. [13]

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

[12] A regression of our treatment indicator on longitude and latitude yields a coefficient of -0.22 on longitude, with robust standard error of 0.07 (N = 8,078). Also, ecological factors that vary across villages were not important in Tongcheng during the end of the Ming, and neither was overcrowding in older settlement areas or shortages of arable land (Telford 1992).

[13] We also present robustness checks on our treatment definition, see Appendix Table ...

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 yeras 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 x of the Appendix.[14] 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.[15] Furthermore, it is worth noticing that 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.[16]

Table 2 shows key summary statistics on these almost 500 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 average status of these men was about 4 on the scale between 0 and 22, and just under one quarter of the men had acquired a substantial level of human capital.[17] Migration (both of husband and of wife) is a categorical variablebased on the difference between a person's residence and their eventual burial place, which can range from < 15 *li* (< 5 miles) to > 180 *li* (more than 60 miles), and also burial outside of Anhui province. The average number of lifetime wives is above 1 mostly because of consecutive remarriage.

[14] Our main results are robust to alternative ways of defining status, such as expressed as percentiles in the status distribution, or using fewer status levels, including the binary variable no status versus any status.

[15] 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.

[16] 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.

[17] Social status is a categorical variable with 23 levels, while human capital is an indicator variable. See the Appendix for discussion of these variables.

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	9
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	9
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 information on Human Capital and Social Status variables.

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. Among the reasons for that might be worse nutrition and medical care. Information on women (and girls) in Chinese genealogies tends to be less abundant than information on men, but in the case of our Tongcheng sample we have the year of death for 96% of women, compared to 99% of men.[18]

We now turn to a series of balance tests for our treatment and control samples in the first (or treatment) generation. A variable such as the highest social status in a person's life-time, row four in Table 2, is not well-suited to examining differential pre-trends between treatment and control groups, because the highest life-time social status of a man is likely dependent on treatment. However, we also know the highest life-time social status of each man's father, as well as whether these fathers had acquired human capital; in the following balance tests we will test for differences in these and other plausibly exogenous variables, see Table 2.

In part A. of Table 3 we report results from simple tests of the equality of the mean of various variables in the treatment and control samples. There are a total of 490 couples, of which 436 are treated (89%).

[18]Vitals that are not listed in the genealogies are in part estimated based on (1) auxiliary information provided in the data–such as that a person "died when the Taipings entered Tongcheng", which must be the year 1851 or the year 1852–as well as with (2) life tables. The main results hold when we distinguish individuals with estimated and non-estimated vitals.

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.

Notice that the social status of the father of the husband in the couple is about 5.5 in both samples, with the difference not being significantly different from zero. Also, just above 30% of fathers in both treatment and control sample hold human capital, and there is no significant difference.

Husbands and wives of the first generation are potentially subject to treatment in form of the fall-of-Ming destruction, so in our balance checks we focus on variables that are pre-determined or otherwise unlikely affected by treatment. Table 3 shows results for husband's birth year, birth month, birth order, as well as death month.[19] We do not find significant differences except for birth month where the mean for the control group is five, instead of about 6.5 as one might expect. However, this is more a reminder that the sample size can be small, rather than that we believe a difference in mean birth month might indicate a performance-relevant differential pre-trend. Similarly, 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).

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

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)[20] Next, the seven male clans in our sample were established at different times in the past by their respective progenitor, with the earliest appearing in the year 1298. 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 samples in terms of which clan generation the treatment couples belong to.[21] Finally, we do not find a significant difference in relative size of the seven clans between treatment and control samples. Overall, Table 3 indicates that differential pre-trends are not present in our sample.

The couples with husbands born between 1590 and 1644 just described are the basis for our intergenerational analysis. Based on the family trees that underlie our data, we connect the 490 treatment generation couples to all descendant couples over the four following generations, yielding around 1,600 couples in the 5th generation. Furthermore, we also account for male children for whom we do not have a record of their marriage. The most important reason for such broken intergenerational links is that the male dies before reaching the age of marriage due infant and child mortality. We will analyze this in section 5.5 below.

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

Table 4: Data on Husbands by Generation

Generation	Birth Year Statistics				Death Year	Status	Migration
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	N	Mean	Min	Max	Max	Mean	Mean
1	1,669	1617.76	1590	1644	1728	4.30	1.33
2	1,663	1651.42	1608	1694	1759	4.30	1.19
3	1,634	1684.43	1625	1732	1796	3.53	1.20
4	1,609	1715.89	1643	1776	1850	2.50	1.18
5	1,515	1748.16	1662	1815	1886	2.00	1.15

Notes: Table shows statistics on all males that can be traced back to the treatment generation couples of Table 2 over five generations.

There are N = 1,669 observations on couples in the treatment generation (generation 1) that have married

[20]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.

[21]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 the very early generations of these seven clans.

male children in the fourth generation going forward–that is, they have married great-great-grandsons in the sample. Conversely, we have N = 1,515 husbands in the fifth generation whose great-great-grandparents experienced the fall of the Ming first hand; the size of the sample in the 5th generation is somewhat lower than that in the 1st generation mainly because occasionally there data on birth or death year is missing.

The first column 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, which together with the earliest birth year in the first generation of 1590 indicates that the range of calendar time that we are studying is almost three hundred years.

Over this range from 1590 to 1886, China, in contrast to some other parts of the world, remained a largely pre-industrial society, and economic opportunities declined over time in part due to the lack of industrialization. This development is reflected in the secular decline in status across generations, shown in column (6) of Table 4, and our analysis will account for that. Finally, we see that the generation subject to the fall of the Ming (generation 1) saw unusally high levels of migratory activity (Table 4, column (7). As we will see below, migration is one of the key responses to the fall of the Ming destruction.

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.

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 $hfstat_{c0}$.[22] Including a proxy of father income is a common approach in the literature (Oreopoulos et al. 2008).

Furthermore, equation (10) has a vector X of additional variables. First, it includes a fixed effect for each man's birth year. As we have seen above, 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– see Table 1– might affect the way individuals belonging to different clans respond to the fall-of-the-Ming destruction. Third, we include a fixed effect for each of the wives' clans-of-origin (about 120 different clans), denoted by f, $f = 1, ..., F$.[23] 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, and we will provide evidence on this 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 destruction 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).

[22] See Shiue (2019) on the extent of intergenerational persistence in Ming and Qing China.
[23] 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.

We see that the fall of 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. 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 that the male descendants have married 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 four generations later by employing mutually exclusive measures on the role of the wife in the husband's 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).[24] We see that the fall of the Ming has tended to reduce partnerships with a single wife and increased

[24]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 that upheld concubines' rights and obligations.

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 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 desctruction 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 acquistion 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 the individuals and couples 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 all five generations. Results in Table 6 are based on estimating equation (10); while Table 10 before reported only the coefficient β_g for g = 5 (fifth generation), Table 6 reports results for outcomes in all five generations.

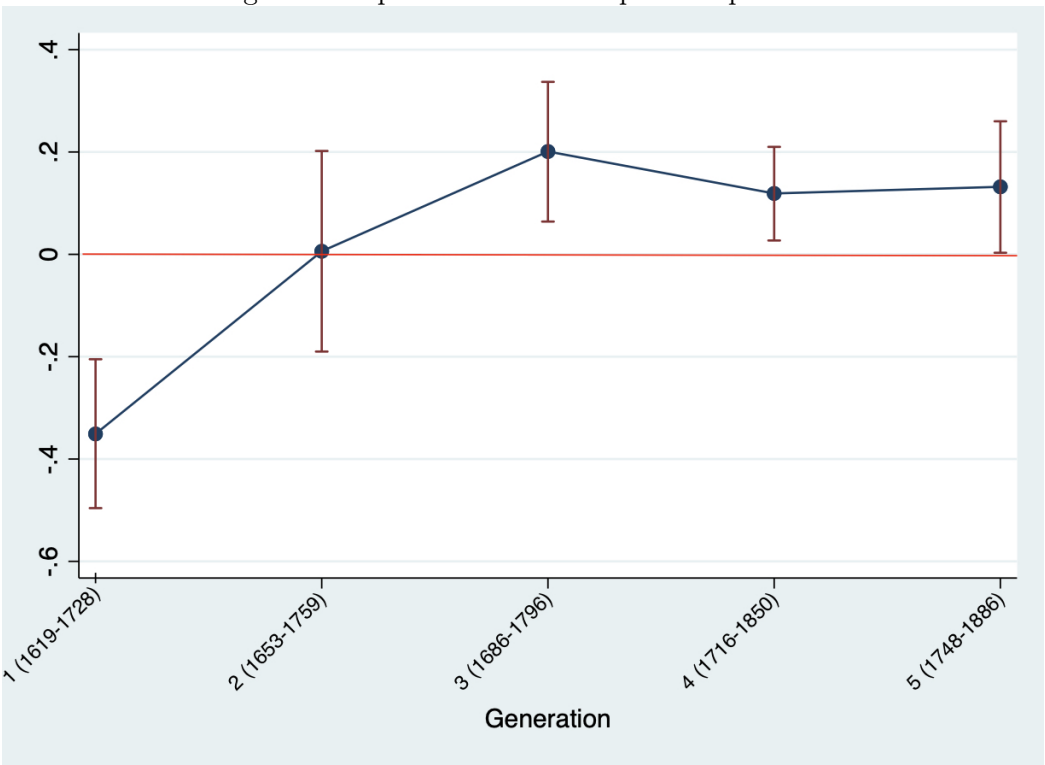
We begin with the dynamics of human capital acquisition, see column (1). Figure 5 illustrates this pattern.

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	# Daugth-ers	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; 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 (6) 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 5: 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 5 provides evidence on an important reversal. 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 last generation in our analysis. One reason for the loss of human capital in the first generation will be that the fall of Ming interfered with studying and other activities 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. This is consistent with human capital acquisition playing a major role for the recovery of these families.[25] 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 acquisition, we do not estimate a significantly positive impact of the fall of

[25]This analysis applies a human capital indicator variable, distinguishing those with and without a threshold level of human capital (Table A.1, column (3)). Because it may be important to account for different intensities of human capital investments, we have constructed a non-indicator variable that is increasing in human capital as evidenced by higher-level examinations passed, see Table A.1, column (4); employing this alternative variable leads to similar results as in Figure 5.

Ming shock on status in any of the five generations (see column (2)).

Second, the reversal of human capital acquistion 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 of 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, especially 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 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 are most closely 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. Of key importance 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.

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

6.2 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

[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.

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

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 $z_{ic} \times d_p$.

6.2.1 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 5). The first factor affecting human capital acquisition that we consider is male migration. Table 7 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 1 of Table 6, and also Figure 5)–, 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.

Clan Human Capital This section examines heterogeneity in the individuals' human capital response as a function of the human capital held at the level of the male clan. 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 7. 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 7, which mirrors the dynamics of

Table 7: 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.

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 rather 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) is an example of 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, however, 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 a number of 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.

6.2.2 Social Status

Migration Turning to heterogeneity in the social status response the shock, we begin by examining the role of migration. Results are shown in column (3), Table 7. 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 7).

What does the father's migration decision 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. Migration might hurt the intergenerational transfer of status 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 7). A reason for this might be 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 We now turn to the role of clan status for the adjustment behavior of men in terms of their own social status. Table 7 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, and for this reason one might see evidence for a positive group effect from clan status. 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.

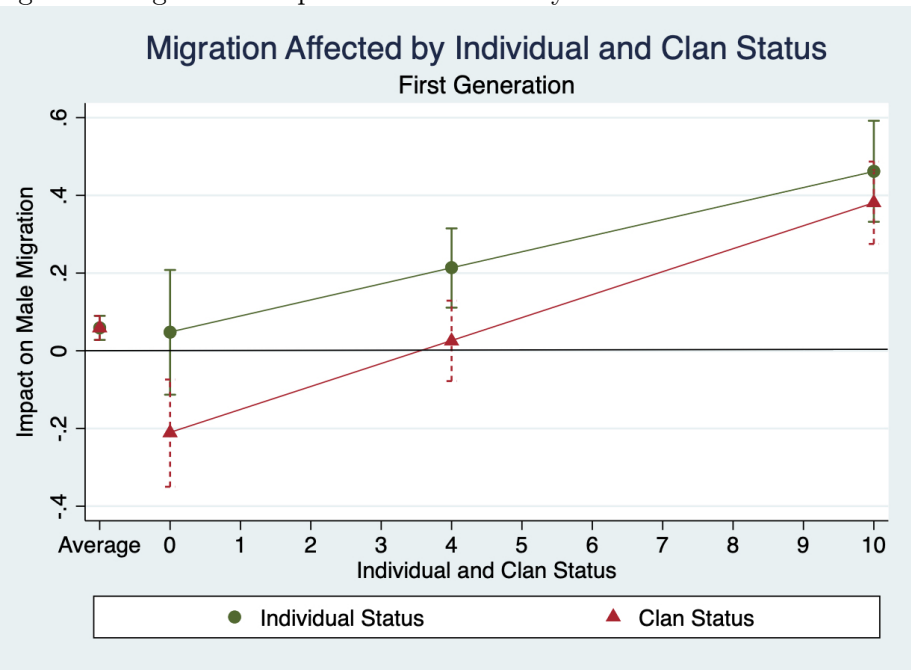
Second, the time pattern of main effect (on individual status) and interaction effect (from clan status) across generations does not match as well as it does in the case of human capital aquisition and clan human capital. For example, for the generation of the sons (second generation), the fall of the 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 7, 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 (**??**). 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.

6.2.3 Migration

This section examines the role of social status, both individual and at the clan level, for the migration response to the shock across generations. Table 7 shows that in general, the higher is individual or clan status, the larger is the migration response (column (5) and (6), respectively). Figure 6 shows marginal effects for different status levels in the first generation.

Figure 6 shows the results.

Figure 6: Migration Response Determined by Individual and Clan Status



Notes: Figure shows marginal effects and 90% confidence intervals based on Table 7, columns (5) and (6).

Notice that there are both similarities and differences in how individual versus clan status influence migration behavior. As for the former, notice that higher status–either individual or clan–tends to lead to a larger migration response in the sense that both series in Figure 6 are increasing with status. The reason for this may be in part 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, notice that the 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 social 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, we see also from Table 7 that 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 (columns (5) and (6)). Overall, the findings indicate that clan status plays a significant role for how individuals adjust to this big shock.

6.2.4 Fertility

We have seen above that, on average across all families, the fall of the Ming has caused an increase in the number of sons, not only on impact but also in future generations (Table 6, column (7)). In this section we examine how this response varies with individual and clan status. Table 7 shows these results in columns (7) and (8). Notice that 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 considerations–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.[28] Marginal effects for different status levels for generation 2 are shown in Figure A.5.

6.3 Group Effects based on 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), we have 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 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 the following Table 8, the two sets of interaction variable coefficients are shown side by side for purposes of exposition, that is, results in columns 1a and 1b are for a single regression.

Turning to the human capital results, we have seen above that clan human capital exerts an additional negative impact on individual human capital acquisition in the first generation (Table 7). Table 8 shows that this result is robust to including the village human capital variable (see 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

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

Table 8: 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.

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 8 shows that on top of the clan externalities, individual human capital acquisition is also related to externalities at the level of the village. In particular, 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 external effect from clan human capital has a positive point estimate while that from village human capital is negative, but the coefficients are not precisely estimated. For the fourth generation, results above showed a positive impact from clan human capital; Table 8 indicates that the point estimate on clan human capital remains positive upon including the village human capital average, but it is not significant anymore. However, 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.[29]

We also see from Table 8 that clan average status tends to exhibit a stronger group effect than village average status for the individual's social status (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 8, 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 benefit 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 average 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.

[29] Also, clan and village averages are correlated because some of the clan members reside in the same village as the man in question. We have considered orthogonalizing the two group variables, finding that the setting becomes too sparse. In addition, while the clan average is based on virtually all male clan members in Tongcheng, the village average does not include the human capital in the village by members of other male clans; this suggests higher measurement error for the village average, and if classical a bias towards zero.

The final specification 4 in Table 8 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.[30] Notice that group effects in terms of fertility do not begin to take effect before the second generation.

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

We have shown above evidence for sizable clan effects that influence individual-level adjustment to the fall of the Ming. So far we have proxied the strength of the clan by average human capital or by average social status, which are broad measures of resources. To better understand their nature, we present a small 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 9 shows these results in column (2), and they can be compared to employing the average clan human capital, as before, in column (1).

Notice that the pattern of coefficients across generations, as well as the estimate precision of our 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 one might hypothesize that the larger the number of in-law clans is, the easier it will be for a given man from one of the seven male clans 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 9.

[30] In the second and third generation, clan and village estimates are of opposite signs which could reflect correlation between the two group effects; such concerns do not exist however in the fourth generation.

Table 9: Clan Effects: Mechanisms

Dep. Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Human Capital			Social Status		
Factor z_{ic}	HC Average	High HC x Low Treated	In-Law Network	Status Average	High Status x Low Treated	In-Law Network
Generation 1	-0.612^{**}	-0.519^{**}	0.013^{*}	-0.213	-3.946^{*}	0.140^{+}
	(0.123)	(0.070)	(0.004)	(0.105)	(1.005)	(0.055)
Generation 2	-0.070	-0.145	0.012^{+}	0.361^{+}	2.924	0.208^{+}
	(0.218)	(0.102)	(0.005)	(0.159)	(1.466)	(0.076)
Generation 3	0.178	0.015	-0.002	0.153	0.645	0.147^{*}
	(0.139)	(0.176)	(0.005)	(0.132)	(1.235)	(0.046)
Generation 4	0.273^{*}	0.217^{*}	-0.012	0.078	0.471	-0.073
	(0.659)	(0.071)	(0.008)	(0.084)	(0.857)	(0.058)
Generation 5	0.192	0.123	-0.002	0.232^{+}	2.441^{+}	0.045
	(0.111)	(0.060)	(0.004)	(1.255)	(0.981)	(0.100)
N	8,024	8,024	8,024	8,024	8,024	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. HC stands for Human Capital. 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.

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.

Results from analogous specifications as for human capital are shown for social status on the right side of Table 9. Employing a measure of clan status that interacts an indicator for the presence of high clan status members with a clan-level indicator of low levels of treatment yields a significantly negative coefficient for the treatment generation (see column (5), generation 1). This makes the coefficient pattern across generations somewhat more similar to that of the impact of the shock on social status (see Table 6, column (2)), which provides more evidence for positive externalities from social status similar to those for human capital. Furthermore, there is evidence that in-law networks provide resources that let individuals increase their social status in the first three generations, see column (3).

The following analysis concerns the impact of the fall of the Ming on the probability of breaks in the inter-generational relationships.

6.5 Extensive Margin: Fall of the Ming and the Continuation of Family Lines

In the analysis so far, the sample consisted of all treatment generation couples that can be followed four generations forward to their great-great-grandsons and their wives. In this sense, we have conditioned on there being no dead-end branches in the inter-generational relationships. However, it is reasonable to believe that the fall of the Ming might also have affected the likelihood that there is an inter-generational continuation of a particular branch of the family 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 inter-generational links–first to second generation, second to third,...–but for brevity the following section focuses on the extensive margin going from the treatment generation (or, generation 1) to the second generation.

An examination of the extensive margin is possible because the data provides information on the year of birth and year of death for almost all (male) children, irrespective of whether they marry later in their lives or not. Only a subset of men were able to marry in any given generation. This depended on a number of factors, and one is whether a given male child would survive through childhood to reach a marriageable

age or not. 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 10 shows the results of estimating equation (12) on the left side.

Table 10: Impact on Longevity of First-Generation Male Children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Factor z_i				Human Capital	Social Status	Longevity Father	Longevity Mother
Fall of Ming Shock	−4.514	−7.102*	−4.249	−9.959*	−8.895*	−39.896**	−37.610**
	(3.114)	(3.225)	(3.527)	(4.315)	(4.288)	(13.274)	(10.538)
Ming Shock x z_i				16.524**	1.057*	0.617**	0.574**
				(6.022)	(0.528)	(0.229)	(0.179)
z_i				−8.803	−0.370	−0.217	−0.084
				(5.664)	(0.552)	(0.218)	(0.218)
Father Status	0.336*	0.838**	0.934**	0.109	−0.016	0.361*	0.336*
	(0.169)	(0.231)	(0.247)	(0.219)	(0.266)	(0.177)	(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.

Notice that the coefficient on fall-of-the-Ming variable $d_{i(p)}$ is negative at about -4.5 (column (1)). This is evidence that on average, the shock tends to reduce age at death by almost five years, although the coefficient is 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 coefficient on

$d_{i(p)}$ to -4.2 (not significant). Overall, there is some evidence that the fall-of-the-Ming shock reduced the age at death of the treatment couples' male offspring by a sizable amount although there is substantial variation in this respect.

The analysis on the right of Table 10 allows for such variation in the impact of the shock the age-at-death. We estimate the following extension of equation (12):

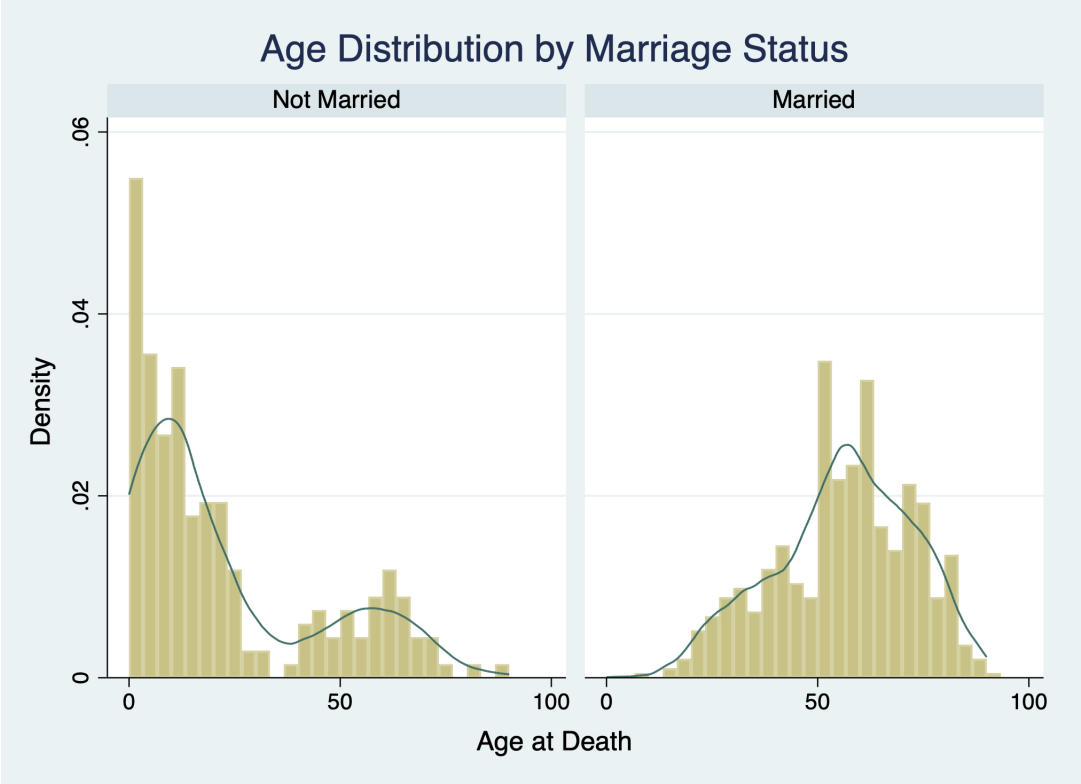
$$age_{i(p)1} = \alpha + \beta_1 d_{i(p)} + \beta_2 \left(z_{i(p)} \times d_{i(p)} \right) + \beta_3 z_{i(p)} + \beta_f hfstat_{i0} + \eta_g + \varepsilon_{i(p)}, \tag{13}$$

where $z_{i(p)}$ is a characteristic of the treatment generation couple, p. Notice that 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 indicates that education and resources of the father 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 10, 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 in columns (6) and (7) 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. One reason for this is likely genetic endowment. Sons from parents that are relatively healthy and make good choices in the sense that they reach a relatively high age at time of death are likely to make relatively good health choices themselves and therefore relatively likely to cope with the fall-of-Ming shock relatively well.

Figure 7 shows the distribution of age-at-death of these males by their marriage status.

Figure 7: 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.

We see that 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 reflecting a relatively high infant mortality in our setting, which is the single most important reason why some males do not marry. The other mode of the age distribution of those that do not marry is around 60 years. The main reason for these males to not be able to marry is likely that given the prevailing male-female sex ratio of larger than one, these men are not rich enough to marry. The distribution of married men on the right of Figure 7 is much closer to a normal distribution (median of 57 years at death).

Turning to the impact of the fall of the Ming on the second-generation males' marriage probability, we estimate equations analogous to equations (12), (13) with a marriage indicator instead of age at death as the dependent variable. Table 11 shows the results.

We see that 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 10 above.

Table 11: 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^{+}	-0.118^{+}	-0.018	-0.061	-0.085	-0.150^{*}	-0.467^{**}
	(0.059)	(0.061)	(0.072)	(0.087)	(0.089)	(0.068)	(0.176)
Ming Shock x z_i				-0.031	-0.001	0.038	0.006^{*}
				(0.113)	(0.010)	(0.027)	(0.003)
z_i				0.187^{+}	0.021^{*}	-0.059^{*}	-0.000
				(0.100)	(0.010)	(0.026)	(0.003)
Father Status	0.005	0.010^{*}	0.012^{**}	-0.002	-0.008^{+}	0.005	0.005
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(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 the human capital and status of the father reduces the negative impact of the fall of the Ming on longevity of second-generation males, for the marriage prospects of the young male characteristics of the mother matter more than characteristics of the father. As shown in Table x, for mothers who did not migrate or who had a low age at death, the fall of the Ming has a negative impact on their male child's marriage probability (columns (6) and (7)). Furthermore, 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 might be indicative of longer-distance marriage networks that become more valuable at times of crises. The latter might reflect the fact that general health that is inherited from mother to son might help to find a spouse especially in the immediate aftermath of a big shock such as the fall of the Ming.

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. We estimate the impact of the shock 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 by the generation of the treatment couples' grandsons. It suggests that while human capital is highly 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, the adjustment behavior indicates that there are endogenous clan effects 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, 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.

While preliminary, 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 in key dimensions might be qualitatively different

from the short-run effect.

References

[1] Abramitzky, R., L. Boustan, K. Eriksson, J. Feigenbaum, and S. Perez (2021), "Automated Linking of Historical Data", Journal of Economic Literature Vol. 59(3): 865-918.

[2] Acemoglu, Daron, Simon Johnson, and James A. Robinson (2001), "The Colonial Origins of Comparative Development: An Empirical Investigation", American Economic Review 91, 5: 1369-1401.

[3] Bailey, Martha J., Connor Cole, Morgan Henderson, and Catherine Massey (2020), "How Well Do Automated Linking Methods Perform? Lessons from US Historical Data", Journal of Economic Literature 58(4): 997-1044.

[4] Beattie, Hilary J. (1979), *Land and lineage in China: a study of T'ung-ch'eng County, Anhwei, in the Ming and Ch'ing dynasties*, Cambridge and New York: Cambridge University Press.

[5] Becker, Gary S., and Nigel Tomes (1986), "Human Capital and the Rise and Fall of Families", Journal of Labor Economics 4, S1-S39.

[6] Becker, Gary S., and Nigel Tomes (1979), "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility", Journal of Political Economy 87: 1153-1189.

[7] Bleakley, H., and J. Ferrie (2016), "Shocking Behavior: Random Wealth in Antebellum Georgia and Human Capital Across Generations", Quarterly Journal of Economics 131(3), pp. 1455-1495.

[8] Boustan, L. P., M. E. Kahn, and P. W. Rhode (2012), "Moving to Higher Ground: Migration Response to Natural Disasters in the Early Twentieth Century", American Economic Review P.P. 102(3): 238-244.

[9] Brook, Timothy (2010), *The Troubled Empire: China in the Yuan and Ming Dynasties*. Harvard University Press.

[10] Chang, Chung-li (1955), *The Chinese Gentry*. Seattle: University of Washington Press.

[11] Chang, Chung-li (1962), *The Income of the Chinese Gentry*. Seattle: University of Washington Press.

[12] Davis, D., and D. Weinstein (2002), "Bones, Bombs, and Break Points: The Geography of Economic Activity", American Economic Review 92(5): 1269-1289.

[13] de la Croix, David, Matthias Doepke, and Joel Mokyr. 2018, "Clans, Guilds, and Markets: Apprenticeship Institutions and Growth in the Preindustrial Economy", Quarterly Journal of Economics Vol. 133, pp. 1-70.

[14] Dell, Melissa (2010), "The Persistent Effects of Peru's Mining Mita", Econometrica 78: 1863-1903.

[15] Eberhard, Wolfram (1962*), Social Mobility in Traditional China.* Leiden: E.J. Brill.

[16] Feigenbaum, James (2015), "Intergenerational Mobility during the Great Depression", Harvard University, working paper.

[17] French, Jacob (2022), "Technological Change, Inequality, and Intergenerational Mobility: The Case of Early 20th Century Agriculture", working paper, Arizona State University, May.

[18] Hilger, N. G. (2016), "Parental Job Loss and Children's Long-Term Outcomes: Evidence from 7 Million Fathers' Layoffs", American Economic Journal: Applied Economics Vol.8(3), pp. 247-283.

[19] Ho, Ping-ti (196*2), The Ladder of Success in Imperial China: Aspects of Social Mobility (1368-1911).* New York: Columbia University Press.

[20] Hornbeck, Richard (2012), "The Enduring Impact of the American Dust Bowl: Short- and Long-Run Adjustment to Environmental Catastrophe", American Economic Review 102(4): 1477-1507.

[21] Jedwab, R., N. D. Johnson, and Mark Koyama (2022), "The Economic Impact of the Black Death", Journal of Economic Literature 60(1): 132-178.

[22] Keller, Wolfgang, and Carol H. Shiue (2022), "Marriage Matching over Five Centuries in China", NBER # 30625.

[23] Kinnan, C., and R. Townsend (2012), "Kinship and Financial Networks, Formal Financial Access, and Risk Reduction", American Economic Review P.P. 102(3), 289-293.

[24] Lee, Harry. F., and David D. Zhang (2013), "A tale of two population crises in recent Chinese history", Climatic Change 116: 285-308.

[25] Manski, Charles F. (1993), "Identification of Endogenous Social Effects: The Reflection Problem", Review of Economic Studies Vol. 60, 3: 531- 542.

[26] McCord, G. C., P. Bharadwaj, L. McDougal, A. Kaushik, and A. Raj (2021), "In Utero Exposure to Industrial Disasters: A Case Study of the Bhopal Gas Tragedy", working paper UC San Diego.

[27] Nunn, Nathan (2020), "The historical roots of economic development", Science 367, eaaz9986 (2020). DOI: 10.1126/science.aaz9986 .

[28] Nunn, Nathan (2008), "The Long Term Effects of Africa's Slave Trades", Quarterly Journal of Economics 123, 1: 139-176.

[29] Nunn, Nathan, and Diego Puga (2012), "Ruggedness: The Blessing of Bad Geography in Africa", Review of Economics and Statistics 94(1): 20-36.

[30] O' Grada, Cormac, and Kevin H. O' Rourke (1997), "Migration as disaster relief: Lessons from the Great Irish Famine", European Review of Economic History Vol.1, No.1: 3-25.

[31] Oreopoulos, P., M. Page, and A. H. Stevens (2008), "The intergenerational effects of worker displacement", Journal of Labor Economics 26(3): 455-483.

[32] Pamuk, S. (2007), "The Black Death and the origins of the 'Great Divergence' across Europe, 1300-1600", European Review of Economic History 11: 289-317.

[33] Price, J., K. Buckles, J. Van Leeuwen, and I. Riley (2021), "Combining family history and machine learning to link historical records: The Census Tree data set", Explorations in Economic History 80, April.

[34] Shiue, Carol H. (2019), "Social Mobility in the Long Run: A Temporal Analysis of China from 1300 to 1900", CEPR discussion paper # 13589.

[35] Shiue, Carol H. (2017), "Human Capital and Fertility in Chinese Clans Before Modern Growth", Journal of Economic Growth, 2017, 22(4), pp. 351-396.

[36] Shiue, Carol H. (2016), "A Culture of Kinship: Chinese Genealogies as a Source for Research in Demographic Economics", Journal of Demographic Economics Vol. 82(4): 459-482.

[37] Telford, Ted A. (1992), "Covariates of Men's Age at First Marriage: The Historical Demography of Chinese Lineages", Population Studies, Vol. 46, No. 1: 19-35.

[38] Telford, Ted A. (1986), "A survey of social demographic data in Chinese genealogies." *Late Imperial China* 7: 118-48.

[39] Townsend, R. (1994), "Risk and Insurance in Village India", Econometrica 62(3): 539-91.

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 income 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 income group 0 (see Table A.1).

Table A.1: Human Capital and Social Status Classification

(1)	(2)	(3)	(4)
Status-23	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).

The classification reveals that higher status in society was correlated with passing the tournament-style civil service exam. 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. 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 (status level 6). We obtain similar results if we distinguish additional human capital levels than the indicator variable shown in Table A.1.

There were a number of different degrees. The *sheng-yuan* degree was the lowest of the recognized cat-

egories 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 in Society and Income Status in society translated into status 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 classificaiton is also consistent with the fact that military offices 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 several of those clan schedules, see Chang (1962) for a number of examples.

A.2 Reliability

The list of people who are recorded in my 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.

These results suggest that the data has the level of accuracy necessary for quantitative analysis. Additional analyses of the Tongcheng genealogies that further confirm these checks can be found in Shiue (2016a).

A.3 Selection

This section sheds light on a number of possible forms of selection by exploiting differences across the seven clans in the Tongcheng dataset for an extended period, as discussed in Shiue (2019). As noted in the text, 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 a high level of education, 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 income 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 income are correlated. It turns out that the correlation between clan size and income 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 various forms of selection bias are not major concerns in this data.

A.4 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).[31] 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.[32] 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). Representativeness in terms of shares of population with different status levels is important for our study. We first examine top income 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

[31]Three county-level gazetteers about Tongcheng cover the period under analysis: *Tongcheng xian zhi* (1490), *Tongcheng xian zhi* (1696), *Tongcheng xuxiu xian zhi* (1827).

[32]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).

the top 2% of the total population in the later half Qing period. In my analysis, the part of the population corresponding to Chang's (1955) definition account for 3.3% of the sample, which is comparable.[33] 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 my sample is 20.2%. Both these comparisons indicate that my 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 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.[34] 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.

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

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

[34] 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.

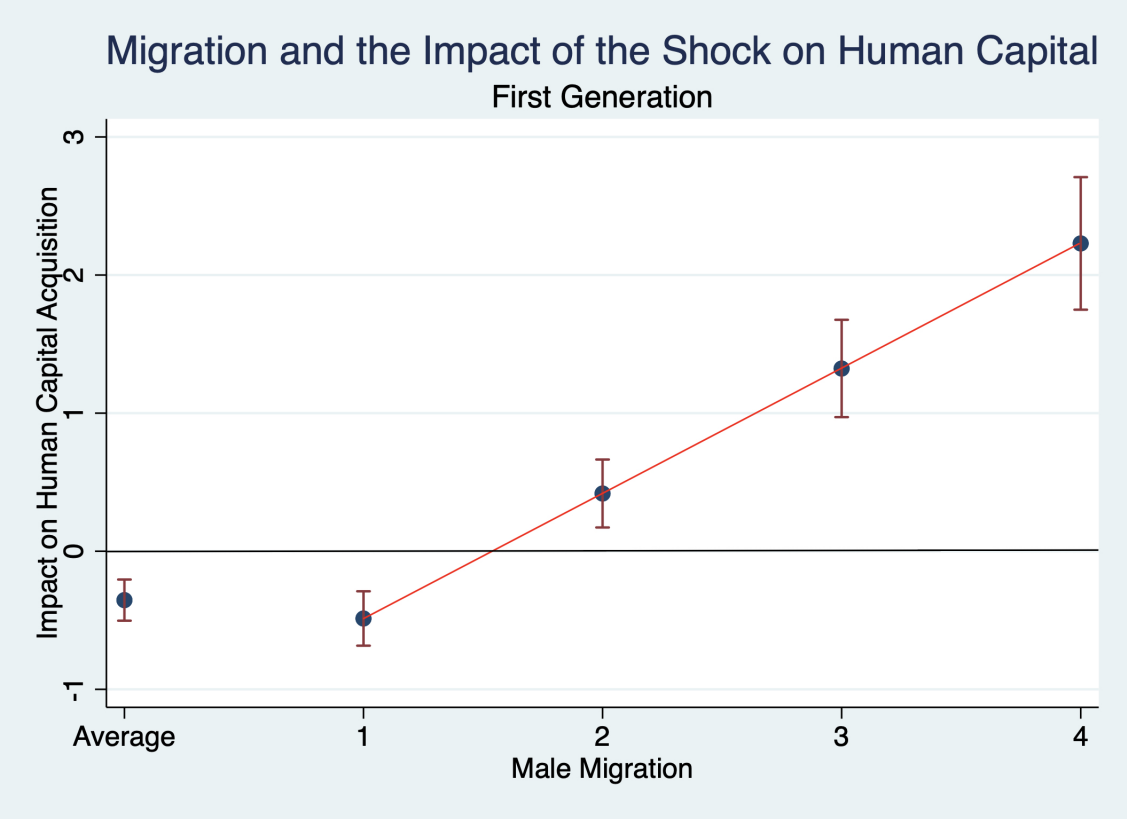
extent this is because the dataset is based on seven genealogies that each describe rather different clans, yielding a diverse sample.

B Heterogeneity in Responses: Marginal Effects Analysis

B.1 Human Capital Acquisition

Table 7 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

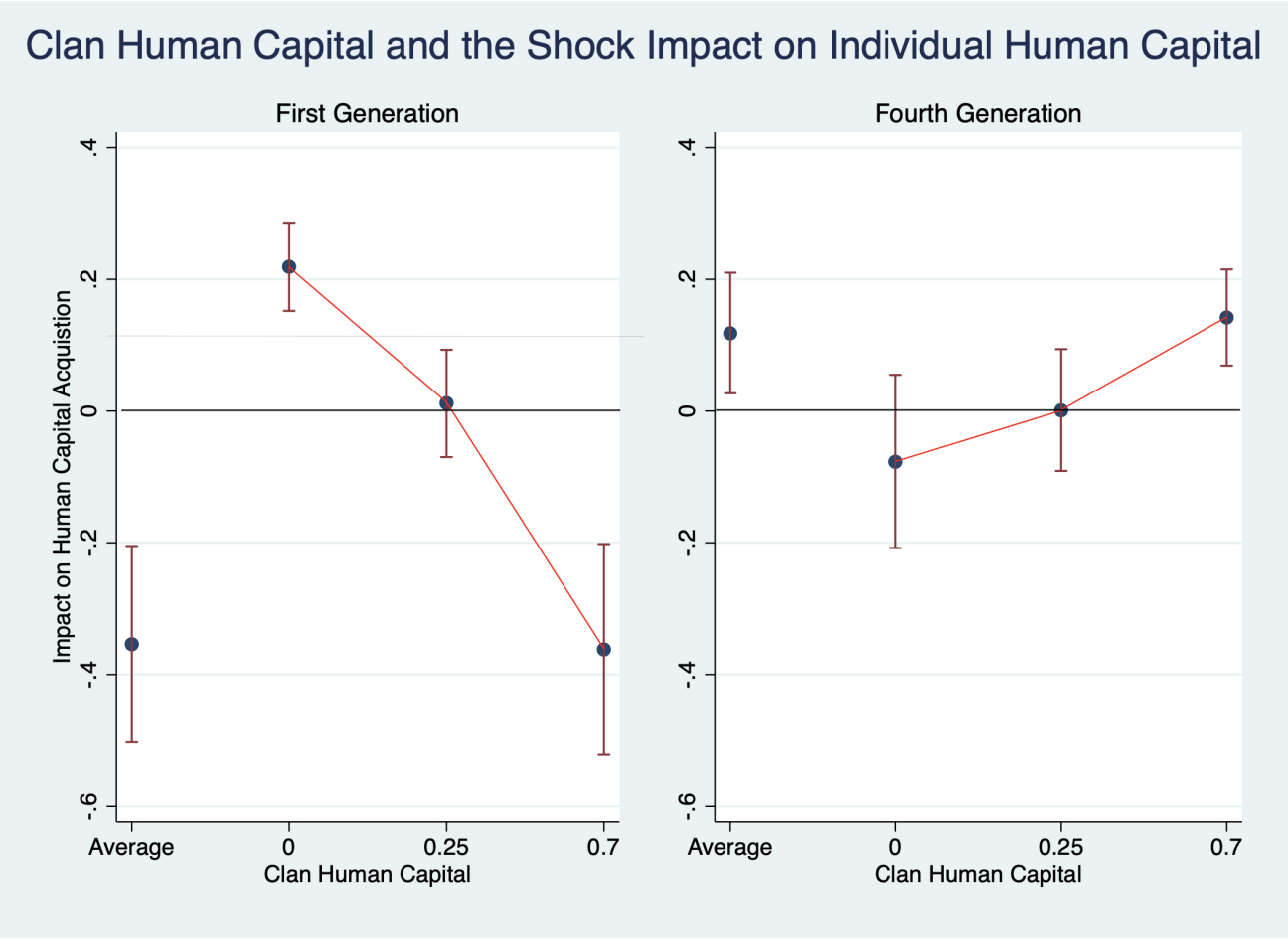


On the left, we see that the average impact of the fall of the Ming on human capital acquisition in the first generation, at -0.35 (see also column 1 of Table 6). That impact varies strongly with the level of migration, and as Figure A.1 shows, only men that stayed within five miles of the residence 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.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

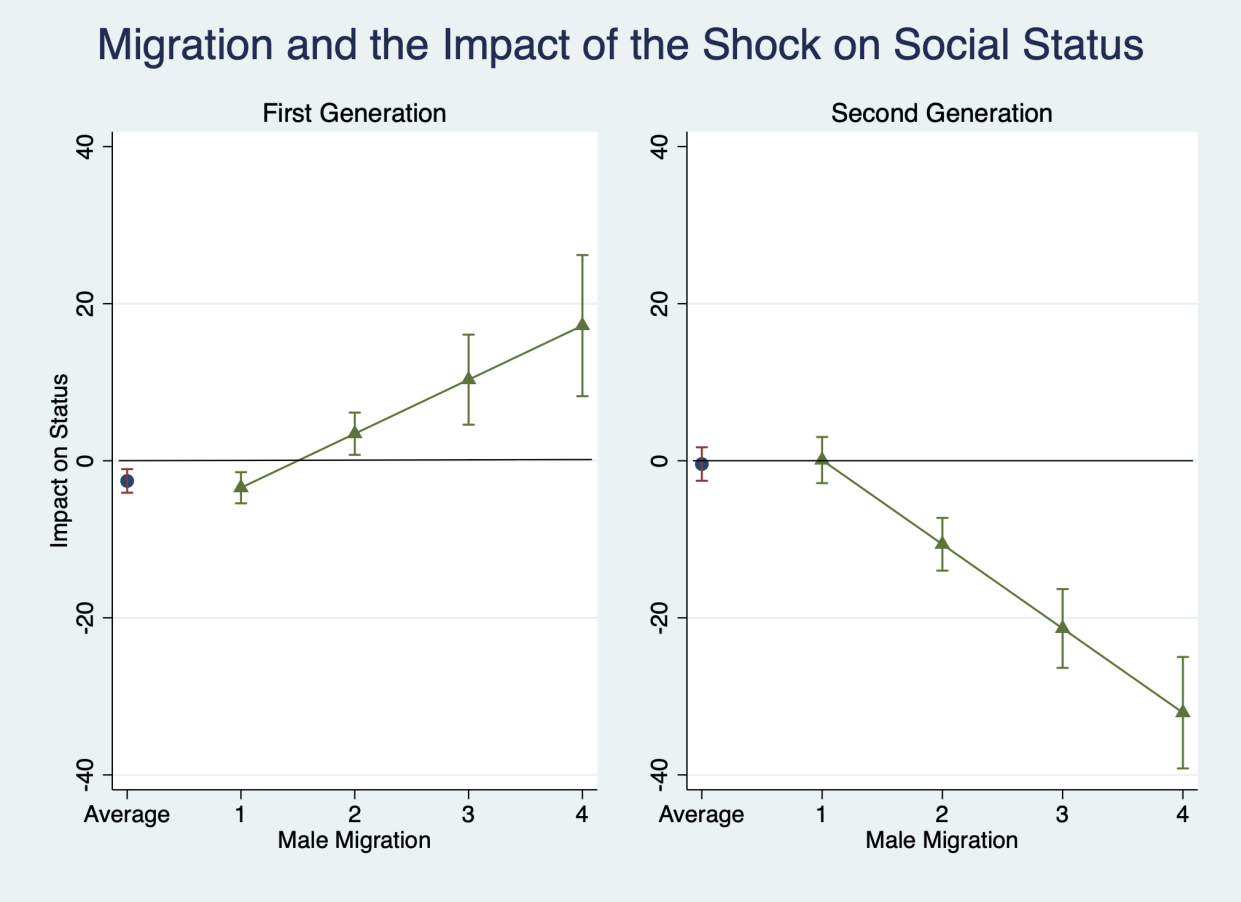
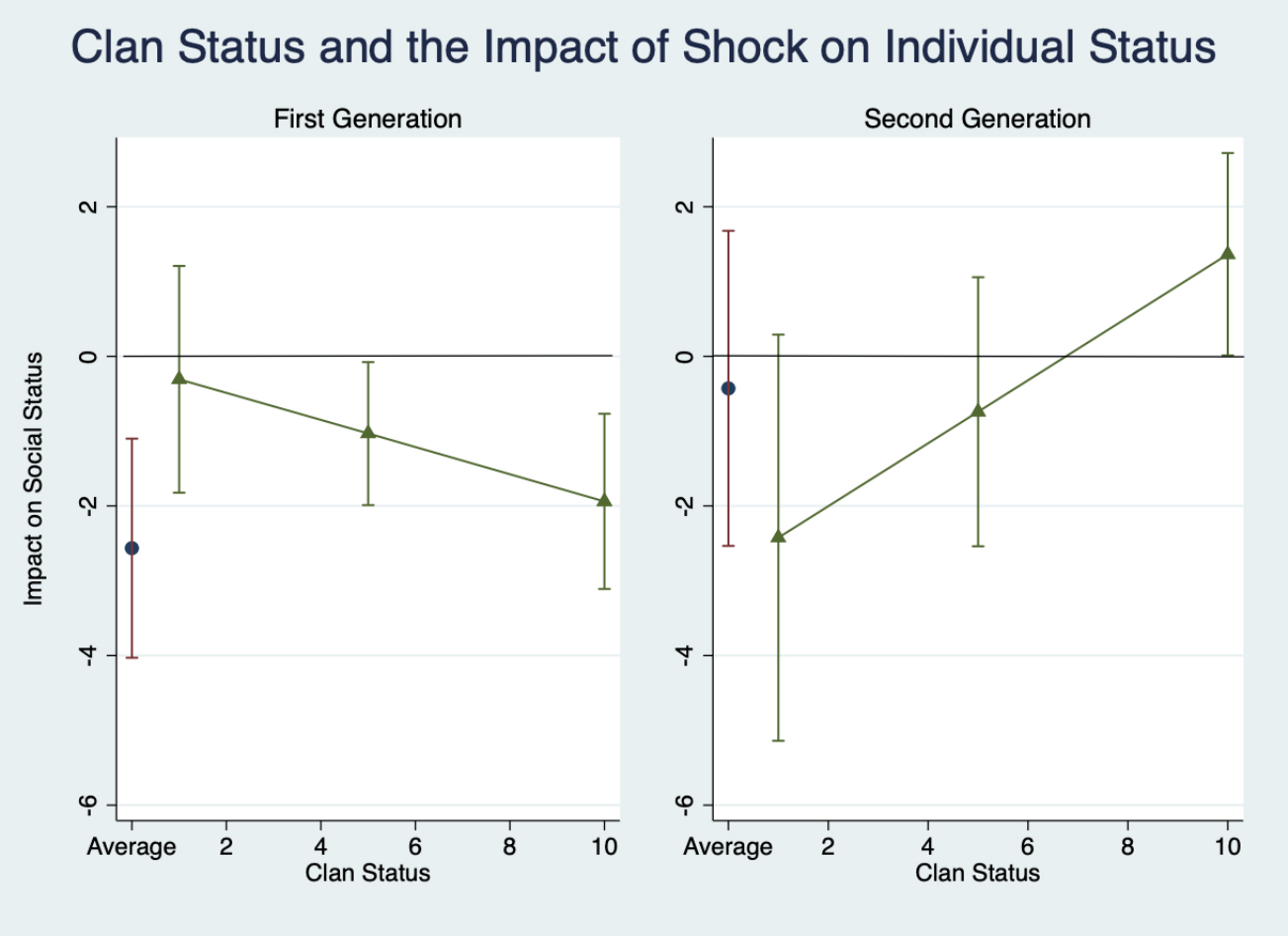


Figure A.3 shows the relationship between the impact of the fall of the Ming shock on the social status of men in the first and second generation, which means fathers and sons (left and right panel, respectively). We see that the decision of the father to migrate or not has rather different implications 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

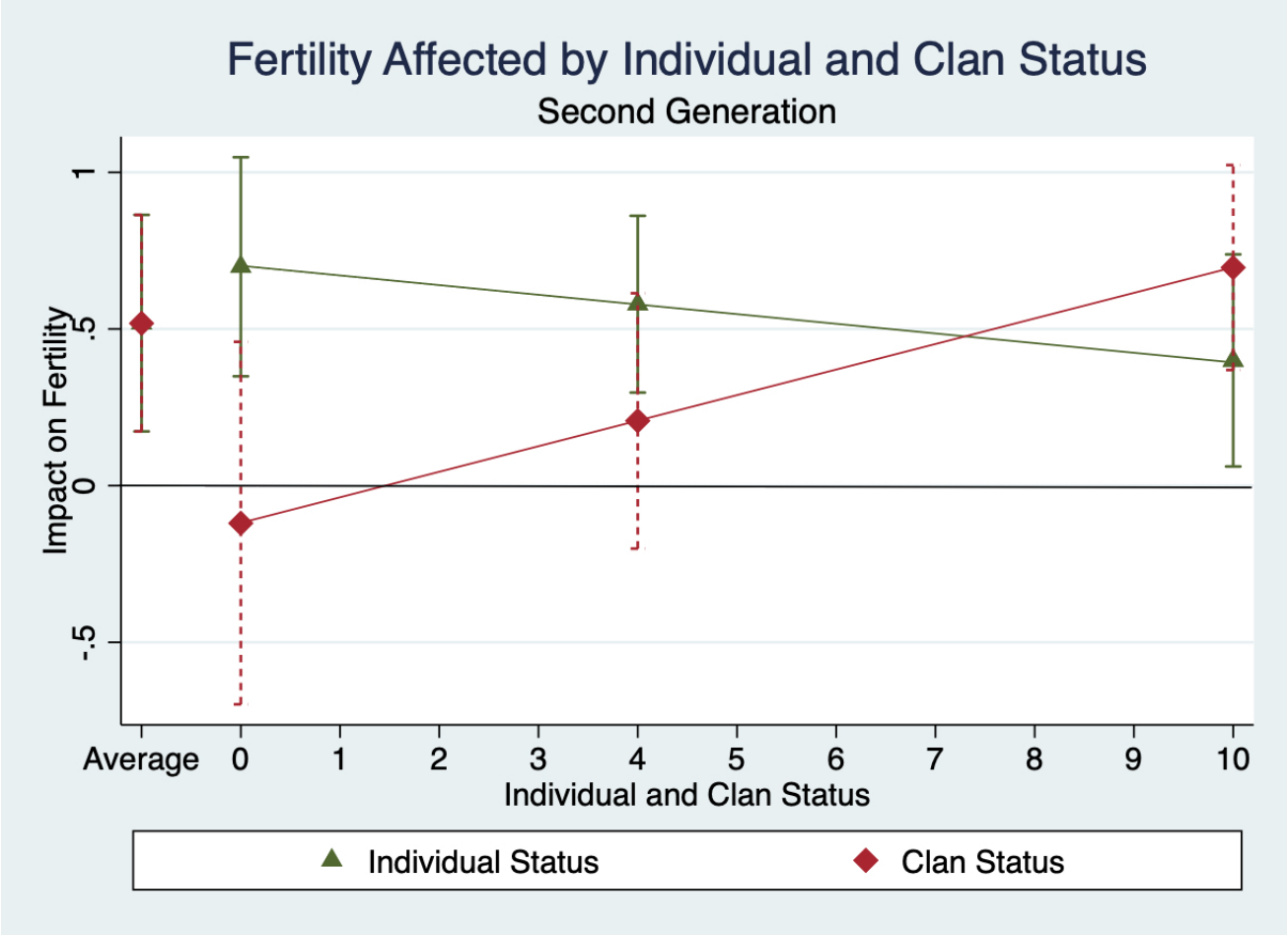


On the left of the left panel, Figure A.4 shows the average impact of the shock on social status in the first generation (-2.54, also Table 6, column (2)). This impact becomes more negative for men who are members of relatively high-status clans, although not significantly so (see Table 7, column (4)). 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.

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.