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Clans and Calamity: How Social Capital Saved Lives during China's Great Famine

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May, 2020

Working Paper No. 1071

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First version: April 13, 2020
This version: May 21, 2020

Abstract

This paper examines the role of social capital in disaster relief during China's Great Famine of 1958-1961. We use the number of genealogies—books recording family trees—as a proxy for family clans, one of the most important vehicles of social capital in rural China. Using a county-year panel from 1954 to 1966, we employ a double-difference identification strategy that exploits the timing of the famine and the cross-sectional differences in the pre-famine measures of social capital. We find that the rise in the mortality rate over time is significantly less in counties with a higher clan density. A nationally representative household survey corroborates this finding and shows that, while individuals born before the famine are more likely to report having experienced hunger than those born after the famine, this difference is significantly smaller in regions with a higher clan density. Investigation of potential mechanisms suggests that social capital's impact on famine may have operated through enabling collective action against excessive government procurement and facilitating inter-household risk-sharing. These results indicate that social capital can reduce the damage of faulty government policies in times of crisis.

Keywords: social capital; disasters; China; family clans; the Great Famine; mortality

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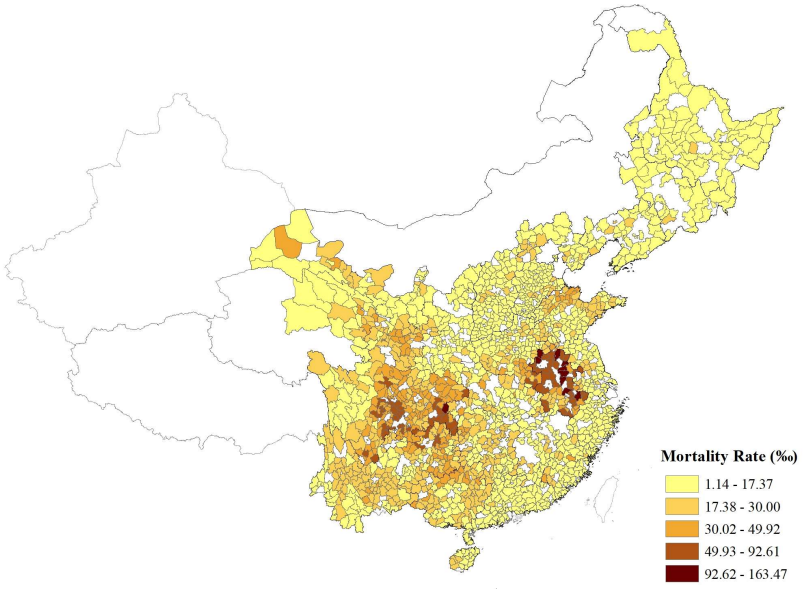
1. Introduction

An estimated 70 million people died from famines across the world in the 20th century. Among them, China's Great Famine amid Chairman Mao's Great Leap Forward (GLF) campaign was the deadliest, and probably the deadliest of all time in recorded human history. The famine extended from 1958 to 1961 and killed an estimated 16.5 to 30 million people (Coale 1981; Aird 1982; Ashton et al. 1984; Banister 1984; Peng 1987). China's official data, widely believed to be underreporting deaths from the calamity, show that the mortality rate jumped from 12.0‰ in 1958 to 25.4‰ in 1960 while the fertility rate plunged from 29.2‰ to 20.9‰ (Figure A1). Figure 1 shows the county-level average mortality from 1958 to 1961 based on data collected by the authors. In some counties in Anhui and Sichuan province, the mortality rate was over

FIGURE 1. SEVERITY OF FAMINE



Notes: County-level average mortality rate from 1958 to 1961 (deaths per thousand people). Data for regions in white are unavailable.

15%. Scholarship and official documents record multiple incidents of cannibalism in these areas (Becker 1996; Dikötter 2010). Despite the fact that the entire country suffered great loss, Figure 1 also suggests that the mortality rate varied considerably by region and within provinces. This paper provides evidence that social capital, manifested in clan organizations in rural China, can explain a good deal of the regional variation in famine severity and may have

saved millions of lives.

Natural and manufactured disasters, such as floods, earthquakes, and famines, impose severe stress on governments and communities, testing not only government effectiveness but also the robustness of norms, beliefs, and informal institutions. In such dire situations, collective action problems become extraordinarily acute. It becomes difficult for community leaders to convince members to adhere to pro-social norms, and they themselves are tempted to deviate from such norms and put personal gains before community interest. Moreover, trusting relationships, which involve risk taking (Fehr 2009), are more likely to break down in crises when the risks from trusting others become monumental—for instance, in famine a family member could die if a household shares food with another that does not return the favor.

In premodern societies across the globe, elite created social organizations to contain upheavals and maintain social order (Greif and Iyigun 2013). These organizations also provided a social safety net and coordinated local collective action. In imperial China, the most predominant form of such organizations were family clans, also called lineage groups—they were loose associations of large numbers of people connected by kinship ties who resided close to each other (Watson 1982). Although lineage groups are no longer the formal power center of grassroots politics in today's rural China, their impact persists despite the political upheaval and social change of the past century and a half. For example, Tsai (2007) contrasts rural villages with weak lineage groups with those with strong lineage groups—those that include most people in the village, where the village leaders are members of the group, and most members trust each other and share the same objective. She finds that the latter have more public goods and the lineage group is able to hold the leaders accountable for actions that affect the village. Likewise, Xu and Yao (2015) find that elected village leaders from large family clans, on average, spend more on public goods than those from small family clans, likely because they are more able to overcome the collective action problem and mobilize resources from the villagers. Based on such findings, we use the presence of strong lineage groups as a proxy for social capital in rural China and examine the role of social capital during the Great Famine.

Three main challenges arise in causally identifying the effect of social capital on famine severity. First, social capital, perhaps due to its broad definition, is notoriously difficult to

measure. Early studies that use newspaper readership, voter turnout, blood donation, and self-reported trust and civic norms to measure social capital fail to distinguish social capital from its (intermediate) outcomes (Portes 1998). We follow a more recent literature that uses historical data to construct social capital measures at the local level (e.g., Guiso and Pinotti 2013; Satyanath, Voigtlander, and Voth 2017). Specifically, we use the number of genealogies, books that record family history and trace their lineages, compiled before the founding of the People Republic of China (PRC) to measure the presence of of strong lineage groups, and use it as a proxy for social capital.

The second difficulty lies in measuring famine severity at the local level. To the best of our knowledge, systematic data on county-level mortality rate in the early years of the PRC do not exist. We manually collect county-level mortality data from local government reports, compilation of statistics, and county gazettes, and construct a panel dataset covering 1,854 counties from 1954 to 1966. To address the concern that data from official sources may be unreliable, we corroborate our main finding using data from a nationally representative household survey that directly asks the respondents about their hunger experience during the Mao era.

The third major challenge is identification. Because social capital takes a long time to build up and changes slowly over time, it is difficult to exploit its temporal variations. Hence, the main source of variations in social capital is often cross-sectional (as in this study), and identification therefore relies on a selection-on-observable assumption. To alleviate this problem, we adopt a double-difference strategy. Specifically, using the county-year panel, we compare the differences in the sudden increase in the mortality rate in the famine years compared with normal years between places with high and low levels of social capital. Similarly, with the household survey data, we compare the differences in the probability of reporting hunger experience between individuals born before and after the end of famine in communities with different levels of social capital. This identification strategy has advantages over simple cross-sectional comparisons because it controls for time-invariant confounders and common shocks by comparing changes with changes.

Our findings are striking. A one standard deviation increase in our continuous measure of social capital is associated with a reduction of 1.45-1.61 deaths per thousand people in each

year during 1958-1961, which accounts for 16-18% of the average abnormal increase in the mortality rate (8.84 deaths per thousand people) due to famine. A back-of-the-envelope calculation suggests that, had every county in our sample had half as much social capital as we measured, 1.77-1.97 million more people would have died during the famine years, an almost 10% increase in our current estimate. Using data from the household survey, we find consistently that the difference in the probability of reporting hunger experience between individuals born before and after the famine period is significantly smaller in rural communities with more social capital.

We explore several mechanisms to explain our findings. First, we test whether social capital reduces famine severity by preventing drastic drops in grain production before or during the famine years. The best micro-level data that we are able to collect does not support this theory. Second, we investigate if social capital enables peasants to organize and resist excessive grain procurement from the upper-level government at the peak of the famine. Using provincial-level data, we find that localities with more social capital handed over a significantly smaller proportion of their grain output to the state. Our third mechanism likely also played a role: We find suggestive evidence from a nationally representative survey that rural communities with more social capital are more likely to socialize with each other and engage in informal borrowing and lending, pointing to a potential risk-sharing channel. These findings suggest that the role of social capital in reducing famine severity may be primarily alleviation rather than prevention.

This paper makes two main contributions to the literature. First, it deepens our understanding of state-society relations in times of crisis, such as famines. Sen (1999) famously argues that famines only take place in non-democratic countries where a free press and mechanisms of checks-and-balances are lacking. Along this line of thought, most studies on the Great Famine, for example, focus on failures of government policies (e.g. Lin 1990; Yang 1996; Li and Yang 2005; Meng, Qian, and Yared 2015) and distorted bureaucratic incentives (e.g., Kung and Chen 2011). We complement that knowledge by studying how societal forces can moderate policy outcomes during crisis. The community-based perspective we take sheds light on the importance of local collective action and trust in resisting bad government policies and in mitigating

their consequences.

Second, this paper is among the first that quantitatively evaluates the causal effect of social capital on disaster relief, filling a gap in the social capital literature. Most studies of social capital focus on its impact on economic development (e.g., Knack and Keefer 1997; Woolcock 1998; Francois 2002; Algan and Cahuc 2009, 2010) and the quality of government (e.g., Inglehart 1988; Lipset 1994; Knack 2002; Rothstein 2003; Tsai 2007) in politics-as-usual environments—an exception is Satyanath, Voigtlander, and Voth (2017), who study the effect social capital on the probability of people joining the Nazi Party in Germany in the late 1920s to 1930s—but relatively few have quantitatively investigated whether and how social capital can mitigate or exacerbate dire consequences of large-scale disasters such as famines, which imperil the very survival of communities.

The rest of the paper proceeds as follows. Section 2 discusses the concept of social capital and its relationship to disasters. Section 3 explains the background of the study, including brief introductions to lineage organizations in China, state-peasant relations in the Mao era, and causes of the Great Famine. Section 4 describes data sources and our measurement strategy. Sections 5 and 6 introduce the identification strategy and present the empirical results, respectively. Section 7 explores the mechanisms. The last section concludes.

2. Social Capital, the State, and Disasters

Following Putnam's seminal work, we define social capital as "networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives" (Putnam 2000, pp. 664-665). Early works in the social sciences emphasize the importance of generalized trust and reciprocity among community members (e.g., Knack and Keefer 1997; Zak and Knack 2001; Paxton 1999, 2002). Recent economics literature highlights shared beliefs and the free riding/collective action problem in defining social capital.[1] In this paper, we see (1) shared beliefs and goals among the majority of community members, as well as their trusting relationships and (2) the community's ability to solve the collective action problem (to which

[1]For example, in a review of the literature, Guiso, Sapienza, and Zingales (2011) defines social capital as "persistent and shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities."

embedded leaders are crucial) as two integral components of social capital.

How can social capital interact with government policies in affecting disaster outcomes? At least three possibilities exist. First, societal forces can fill the vacuum left by the state in times of crisis. Facing a large-scale disaster, the state may lack resources, incentive, or information to act effectively. Klinenberg (1999) reports that fragmentation of government agencies and the absence of clear oversight resulted in the Chicago city government's inability to help minorities and the elderly during the 1995 Chicago heat wave while the Latino communities in the city were able to provide relief to those in need. Second, social capital and government policies may be complementary in that social capital may amplify the benefits and the harm that the government causes. Studies of natural disasters like earthquakes and hurricanes show that communities with dense social networks in Japan, India, and the United States are not only more likely to self-organize and maintain social order, but also more able to communicate their needs to the government and work with the authorities to rebuild the communities (Aldrich 2012). Finally, social capital may mitigate the effect of government policies. On the one hand, certain social groups may resist benevolent state interventions in crisis, reducing the benefits of the latter. For example, anti-vaccine groups are linked to the resurgence of measles in the United State in recent years, despite the state's continuous efforts to intervene (Benecke and DeYoung 2019). On the other hand, social capital may reduce the damage of disastrous policies, for example, by holding local leaders accountable and enabling communities' resistance to state policies.

Like most famines (Sen 1999), the Great Famine was created by policy mistakes and the government's inability to self-correct—harmful GLF policies lasted for three full years, during which voices of criticism were silenced at every level of the PRC government (Walder 2015).[2] Therefore, we expect social capital to function as a counterforce to the state's exploitative measures and to protect community members in the famine.

[2]Most prominently, at Lushan conference in 1959, Mao purged several critics of the GLF policies, including General Peng De-huai, China's Defense Minister at the time.

3. Background

3.1. Family Clans in Rural China

In China, a family clan, also known as a lineage group, is a group of descendants of a common patrilineal ancestor. Clans facilitate social exchange among members of a kinship network. Scholars have established that clans have played a predominant role in grassroots political and economic affairs in Chinese history (e.g., Fei 1946; Watson 1982). Leaders of a clan, often senior members of the lineage group, cast informal but strong authority over clan members in managing clan affairs and resolving disputes both within the clan and with outsiders (Tsai 2002, 2007). State and formal institutions sought to eliminate clans prior to the founding of the PRC and never succeeded (e.g., Fei and Liu 1982; Yu 2001).

Chinese clans often keep a record of their family trees, known as genealogies, which link all past and present males in the kinship group and determines membership of each household in the clan (Feng 2013). At the top of family tree is the ancestor of the lineage group. A well-resourced clan also maintains an ancestral hall, in which it holds ceremonies to worship ancestors. An ancestral hall is also a place where clan leaders administer clan affairs, manage clan properties, and mobilize clan members for shared goals. In pre-modern times, the young generation of the clan often received private education funded by the clan in the hall and other charitable work might take place there (Fei 1946; Freedman 1965; Feng 2013).

Clans are important providers of local public goods (Greif and Tabellini 2010; Dincecco and Wang 2020). Clan members collaborate with each other on agricultural production and large construction projects. Those who contribute more materially to the clan and take care of the poor and the weak obtain moral standing within the clan (Madsen 1984). Beyond the ancestral hall, a clan may own land such as fields they rent out to provide income for relief of extreme poverty or worship of shared ancestors. Some clans have substantial holdings and can afford a mini-social safety net, including catastrophe relief and scholarships to children from impoverished households. Clan leaders also mobilize resources from clan members on an ad hoc basis in front of major public projects or big disasters.

Clans also serve as bridges between peasants and the state. In imperial China, the imperial government relied on clans for a variety of local functions, including tax collection, local conflict resolution, and even security. When clan members had disputes with the state, leaders of a clan often intervened, coordinating mediation and sometimes protecting clan members from state exploitation (Fei 1946; Freedman 1966; Watson 1982). In his famous report on the peasant movement in Hunan province, Mao Zedong noted that the power of lineage organizations (*zuquan*) was one of the four powers that dominated a Chinese peasant in the 1920s.[3]

Although political turmoil and social change between the late 19th century and the end of the Cultural Revolution weakened lineage organizations, clans have substantial impacts on local governance and economic activities in China's rural areas even in the reform era. For example, Martinez-Bravo et al. (2019) find that social capital—proxied by village temples—and village elections complement each other in providing local public goods. Peng (2004) shows that the strength of kinship networks has had large, positive effects on the count and workforce size of private rural enterprises as reform has gained momentum. Zhang and Zhao (2014) report that kinship networks protect peasants' property rights over land through facilitating collective action against states' coercive taking. Zhang (2020) shows that social capital, proxied by genealogies, have also facilitated entrepreneurship and development of private business in the reform era. Mattingly (2020) finds that the state may co-opt leaders of family clans to exert controls; specifically, the presence of lineage organization is associated with more land requisitions and fewer protests.

Given that clans originate with and operate based on kinship ties, the social capital they have accumulated may be primarily "bonding" instead of "bridging."[4] Many scholars see strong kinship ties as impediments to civic engagement and good governance in western societies (e.g., Putnam, Leonardi, and Nanetti 1993; Alesina and Giuliano 2010). In the context of rural China, however, researchers generally regard lineage groups as vehicles of social capital and associate them with positive outcomes. This may be because, compared with western societies,

[3]Mao Zedong, Report on an Investigation of the Peasant Movement in Hunan, 1927. Access online: https://www.marxists.org/chinese/maozedong/marxist.org-chinese-mao-192703.htm. The other three powers are: the power of the state, the power of folk deities, and the power of husbands (for women).

[4]Bonding social capital functions with a community and facilitates intra-group cooperation while bridging social capital operate between social groups and promotes inter-group associations (Putnam 2000).

Chinese villages were historically more communal and more likely to be governed by a gentry class who were members of lineage groups (Fei 1946; Greif and Iyigun 2013). In addition, as Putnam (2000) argues, bonding social capital is good for "getting by" and bridging social capital is necessary for "getting ahead," and surviving disasters like famines generally relies on "getting-by."

3.2. State-Peasant Relations in the Mao Era

For thousands of years, peasants in China have lived and worked in what anthropologists call "natural villages." After several waves of collectivization campaigns after the PRC was founded, by the end of the 1950s most natural villages had become production brigades (*sheng chan da dui*) as part of the much larger People's Communes (*ren min gong she*). A brigade consisted of several production teams (*sheng chan dui*), which was the lowest tier of commune administration. We refer to the upper-level government above the brigade as the state. The state is represented by its local agents, cadres, who were responsible for carrying out state policies. They also served as spokespersons for their own interests and those of the local community, which were often not aligned with those of the state. Commune-level cadres were the lowest level of state administration, receiving salaries from the state payroll, while brigade and team leaders were considered "local cadres" and the village office in a brigade paid their salaries. On a daily basis, in general, peasants only engaged with the production team leaders and they saw commune and brigade leaders as the "upper-levels" (Oi 1989, pp. 3-5).

At the end of each harvest, the production team owned the harvested grain and carried out procurement. However, because the state decided the procurement target prior to harvest, if the target was too high, peasants suffered. Production team leaders, therefore, had incentives to hide grain from the state. To address this, brigade-level and commune-level cadres, who had stronger career incentives to follow the state's directives, inspected the field or even peasants' homes to make sure they handed over as much grain as could to meet the procurement target (Oi 1989, p. 6). At the peak of the GLF, in addition to the collective ownership and farming of land, rural households were ordered to turn over personal possessions for communal dining halls and were no longer allowed to store and prepare their own food (Walder 2015, p. 159).

For a short period of time, Mao promoted "free food supply" and peasants were allowed to eat as much as they could in many communes from August to December of 1958 (Chen 2010).

3.3. Possible Causes of the Great Famine

The Chinese government labels 1959-1961 the "Three Years of Natural Disaster," the period with the highest mortality rate, but scholars more often count 1958 as one of the famine years because the mortality rate had already begun to increase (Ashton et al. 1984; Chang and Wen 1997b). Significant research has sought to pinpoint the causes. Drop in grain production is the most straightforward explanation, and it was certainly a factor. China's total grain output grew nearly monotonically between 1949 and 1957, but started to fall sharply in 1958 and did not recover to its 1957 level until 1965. The official explanations for the decline were a series of natural disasters and planning errors. However, several studies implicate bad government policies as the main culprit, such as the diversion of resources away from agriculture to industrialization during the GLF and weakened peasant incentives (e.g. Lin 1990; Yao 1999).

Many scholars indicate that excessive government procurement was the primary cause of famine (Kung and Lin 2003; Li and Yang 2005; Kung and Chen 2011; Meng, Qian, and Yared 2015). During the heyday of the GLF, local Communist Party officials, including commune and brigade-level cadres, had strong incentives to overreport output to advance their careers and engaged in what scholars call "mutual and ultimately self-deception" (Walder 2015, pp. 159-162). A sharp increase in state procurement based on inflated output numbers during the GLF, accompanied by a drop in grain production in 1959, caused severe food shortage in the countryside. Meng, Qian, and Yared (2015) show that nationwide aggregate grain output during the famine years could have fed the nation and it was the misallocation of food, caused by the government's excessive procurement, that led to the famine.[5]

There is only one argument we consider disproven and therefore will not consider as an explanation for the mechanisms of social capital. Scholars have argued that waste of food in public People's Communes dining halls played a major role (Chang and Wen 1997a; Yang

[5]Net grain exports in 1959 increased by over 50% and continued to increase in 1960. The amount of grain exported during 1958-1961 could have fed 16 million people a survival diet of 2,000 calories per day for almost two years (Walder 2015, p. 173).

1996). But as Chen (2010) points out, because the policy of "free food supply" was mostly abandoned by the end of 1958, this argument does not explain why deaths peaked in the winter of 1959 and the spring of 1960.

4. Data and Measurement

We discuss our main data sources and measurement strategies in this section. Statistical analyses will rely upon both a county-year panel and an individual-level household survey.

4.1. A County-Year Panel

Mortality rate and grain output. We calculate the mortality rate (death counts per thousand people) at the county-year level using data from various government reports, compilation of population statistics, and county gazettes. The resulting panel covers 1,854 counties located in 23 provinces in mainland China spanning 1954 to 1966.[6] These counties accounted for 95% of the total population in China in 1953, when the first national census took place. We also collect county-level grain output data from similar sources. Figure A3 in the appendix reports the number of counties covered in the dataset for each year. The appendix also contains details of the data sources.

Most of the data sources we use were complied in the early years of the reform when local officials responsible for famine deaths were no longer in office and people started to look for explanations for the the catastrophe.[7] While we share scholars' concern that data on that period from officials sources may not be accurate (Chen 2010; Walder 2015), there is reason to think it offers some truth. For example, our data show on average an over 20% drop in grain production from 1958 to 1959 (at the peak of the GLF campaign), consistent with most scholars' estimates (Li and Yang 2005). Moreover, based on the local mortality data we have collected, we estimate at least 19.3 millions people died from the famine nationally, well in the

[6]Three provincial-level municipalities, Beijing, Shanghai, and Tianjin, are omitted because of their unique status and the lack of district-level data. Three minority autonomous regions, Inner Mongolia, Tibet, and Xinjiang are not covered because data are unavailable.

[7]During the GLF, provincial statisticians who complained about falsehood in statistical numbers were told, "Someday the central government will ask you for the actual figures, so you must make sure to have all the real numbers and be ready to present them at any time" (Walder 2015, p. 162).

range of most independent estimates.[8] Finally, from a statistical point of view, although we cannot rule out the possibility that mortality is underreported in our data, as long as they are uncorrelated with the key outcome variable, our estimates are likely to provide a lower bound of the true effects.

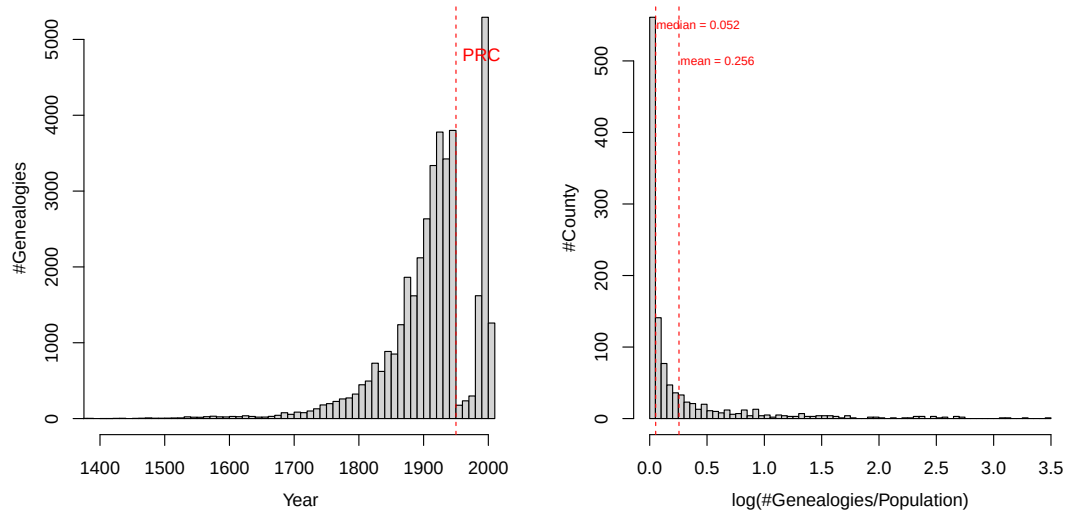
Previous studies use relative cohort size as a proxy for famine severity. This method has several drawbacks. First, it only captures deaths of infants but not adults. Second, both rise in infant mortality and drop in fertility affect cohort loss, which introduces additional measurement error. Last but not least, because cohort size during the famine years is calculated using data collected two decades later, it suffers from survival bias: those who were healthier in the earlier 1950s are more likely to show up in the census two decades later than those who were less healthy, therefore, relative cohort size may exaggerate mortality in places with poorer public health conditions and underestimate mortality in places with better conditions. For these reasons, we prefer the mortality rate to the cohort loss index as one of the primary outcome variables of this paper.

Genealogies and measures of social capital. Because compiling a genealogy and maintaining it requires continuous effort by clan members, the presence of genealogies indicates a relatively high level of clan cohesion. Therefore, we use the density of genealogies as our main measure of social capital at the local level.[9] *The General Catalog of Chinese Genealogy*, the largest collection of Chinese genealogies, provides the genealogy data. The catalog is a product of a compilation project, initiated by Shanghai Library, aiming to facilitate research on Chinese lineage and help overseas Chinese trace their family roots. It started in 2000 and completed in 2008. It consists of 52,401 Chinese genealogies compiled before the end of 2004. Most of them were stored in local archives and libraries, but some were held by individual families. For each genealogy, the catalog records its written or updated date and the clan's location. Figure 2(a)

[8] To estimate abnormal deaths during the famine years, we first calculate the average increase in the mortality rate during famine years (1958-1961) compared to normal years (1954-1957 and 1962-1966), which leads to an estimate of 8.84‰. We then estimate the national death toll by multiplying rural population size in 1957 (547 million) by 8.84‰ and obtain an estimate of 19.3 million deaths during 1959-1961. We believe that this is a conservative estimate for two reasons. First, we exclude deaths in urban areas; second, population size during famine years had the famine not occur should be larger than the population size in 1957.

[9] Several studies adopt the same strategy, e.g., Greif and Tabellini (2010, 2017); Chen, Kung, and Ma (2017); Zhang (2020).

FIGURE 2. DISTRIBUTION OF COMPILED GENEALOGIES



(a) By Year of Compilation

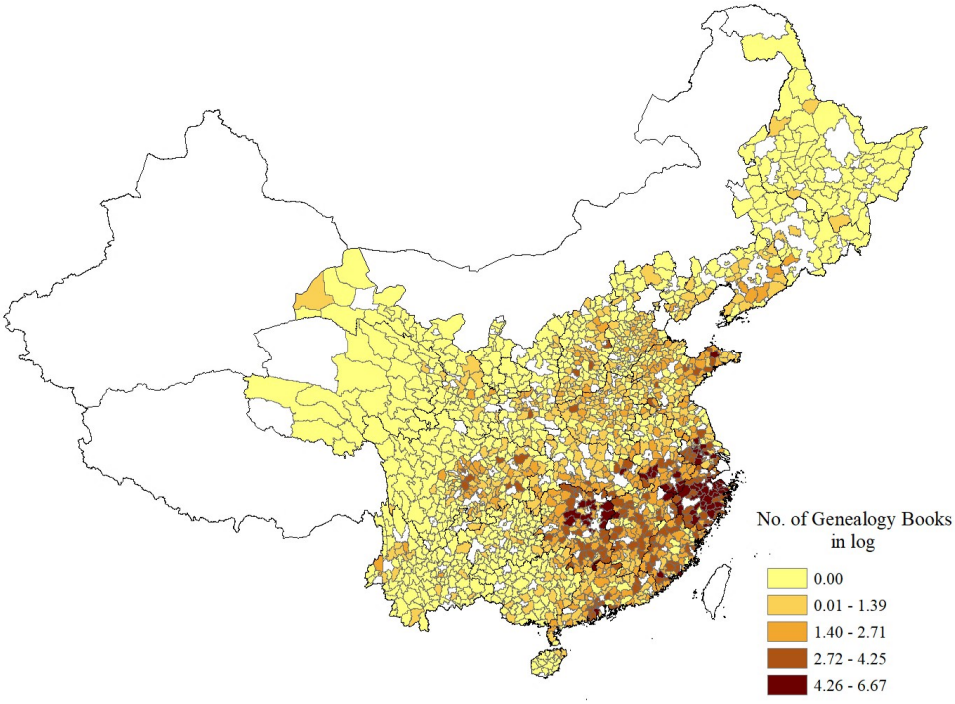
(b) By County

displays the distribution of compilation dates of genealogies. There are obviously two peaks in the time when genealogies were compiled: just prior to the founding of the PRC in 1949, and in the early reform era of the 1990s. A large number of genealogies were compiled after 1980, suggesting a resurgence of clan culture in post-reform China as people become richer and the social pressure to abandon lineage organizations dissipated. To avoid potential endogeneity issues, we restrict our focus to genealogies compiled before the founding of the PRC.

We construct two measures of social capital at the county level based on the number of genealogies: (1) the logarithmic number of genealogies compiled before 1950 in a county plus one, normalized by its population size in 1953 (i.e., the number of genealogies per 10,000 people);[10] and (2) a dummy variable indicating whether the first measure is above or below the national mean. We use the second measure because of the concern that the distribution of the first measure is severely left skewed, even after log transformation (Figure 2(b)). Figure 3 shows the geographic distribution of social capital using the first measure. Regions in white and yellow are places where we lack data describing the mortality rate during the investigated time span and counties where no genealogy book compiled before 1950 is preserved to date. Our main findings remain substantively unchanged when we remove counties with zero genealogy books from the sample.

[10]Specifically, SocialCap = log((#Genealogies + 1)/Population). County-level population data in 1953 come from China's first national population census conducted in 1953.

FIGURE 3. GEOGRAPHIC DISTRIBUTION OF SOCIAL CAPITAL



The strength of family clan is persistent. As shown in Figure A2(a) in the appendix, there is a strong positive relationship between the numbers of genealogies compiled before 1950 and those after 1980 across China. It is possible that our measure suffers from survival bias, if for example, more genealogies were destroyed during the 1960s in places with more prevalent persistent political radicalism. However, Figure A2(b) shows that splitting the sample based on the intensity of Cultural Revolution violence produces very similar correlation coefficient in each subgroup. Given that radicalism in the Mao era does not predict the numbers of genealogies compiled in the reform era, it is unlikely survival bias affects our results.

Another caveat is worth noting. When a community has more than two clans who are competing for influence and power, the lack of bridging social capital may lead to failure of collective action (e.g., Tsai 2007), or even cause disruption of social order due to a persistent power struggle (O'Brien and Han 2009). This means that our measurement and identification strategies may result in an under-estimation, instead of exaggeration, of the effect of social capital in villages that have a dominant clan consisting of the vast majority of the villagers.

4.2. China Family Panel Studies (CFPS)

We also take advantage of data from a household survey, China Family Panel Studies (CFPS), to corroborate our findings from the county-year panel. CFPS is a biennial survey and is designed to be a Chinese equivalent of the US Panel Study of Income Dynamics. We use the first national wave, which was gathered during April-August, 2010. This nationally representative sample covers 14,960 households and 33,600 adults (aged 16 years old or older). All respondents born before 1977 were asked whether they have experienced persistent hunger for at least one week. Because hunger experience in the pre-reform era does not carry a stigma, such data are unlikely to be subject to intentional misreporting or data manipulation. Underreporting due to memory loss, if uncorrelated to hunger experience, will lead to a more conservative estimate of the true effect.

At the household level, CFPS records whether a family keeps a genealogy book; at the community level, it records whether a community maintains an ancestral hall related to a large family clan. Because ancestral halls are an important, and probably more salient, marker of social interactions within a clan, than the genealogy book, we also use the presence of ancestral halls as an alternative measure. We construct three measures of social capital using these data: (1) the share of households in a community, meaning a rural village or an urban neighborhood, keeping a genealogy book (it is possible for multiple families to share the same one); (2) a dummy variable indicating whether the share of households keeping a genealogy is above or below the national mean; and (3) a dummy variable indicating whether a community has an ancestral hall. In CFPS, approximately 23% of the households have access to a genealogy book and 14% of the communities maintain an ancestral hall, respectively.[11] One limitation of these social capital measures is that they are contemporaneous, which may leave the door open for reverse causality. However, we believe that the chances that hunger experience leads to more or fewer counts of genealogies or ancestral halls are low.

[11] Beijing, Tianjin, and Shanghai are excluded from the sample.

5. Identification Strategies

We adopt a double-difference strategy for causal identification. First, when investigating the relationship between social capital and mortality during the Great Famine using the county-year panel, we exploit the timing of the famine as well as the cross-sectional differences in the pre-famine measures of social capital. Specifically, we estimate the following linear two-way fixed effects model:

$$Deathrate_{ct} = \beta SocialCap_c * Famine_t + \gamma X_c * Famine_t + \delta_c + \lambda_t + u_{ct} \quad (1)$$

in which $Deathrate_{ct}$ denotes the death counts per thousand people in county c and year t; $Famine_t$ is a dummy variable indicating the famine years (1958-1961); $SocialCap_c$ is a proxy for county-level social capital; X_c is a vector of pre-famine covariates of country c; δ_c and λ_t are counties and year fixed effects, respectively; and u_{ct} represents idiosyncratic errors. The coefficient in front of the interaction term $SocialCap_c * Famine_t$, β, is the quantity of interest. We can interpret $(-\beta)$ as the average amount of reduction in the mortality rate during the famine years, using averages in normal years as a benchmark, in places with a higher level of social capital than in places with a lower level of social capital. In other words, β captures the differential responses to the Great Famine in places with different levels of social capital.

Although the fixed effects control for time-invariant county-specific confounders and common time shocks, this estimation strategy may suffer from biases from two sources. This first is the presence of unobserved time-varying confounders—variables that change over time and potentially correlate with both the outcome and the key interaction term. For example, crop production cycles may be different in places with different densities of family clans and correlated with the mortality rate during the famine years. The second source of biases comes from cross-sectional variables that correlate with our measures of social capital and contribute to the differential responses to the catastrophe, in the form of $W_c * Famine_t$, in which W_c is a vector of unobserved time-invariant characteristics of county c. Strictly speaking, the second source of biases is a special case of the first one because we can define $W_c * Famine_t$ as a time-varying

confounder. We discuss them separately to highlight the fact that our design differs from a classical difference-in-differences design in which one group is not or only partially exposed to the treatment; in our case, the great famine affects all counties and the treatment, social capital, varies only cross-sectionally.

The crucial difference between our design and a difference-in-differences design poses additional challenges to our identification strategy because observing close-to-perfect parallel trends in non-famine years—though helpful in ruling out potential slow-moving or trending time-varying confounders—is insufficient to establish a causal relationship between social capital and a lower mortality rate. This is because there may be other factors that drive the differential response to the Great Famine and are correlated with our measures of social capital. In other words, to establish such a causal linkage, we need to rely on a selection-on-observable assumption similar to what one makes in a cross-sectional setting with observational data. That is, when we control for the interactions of all observed pre-famine covariates and time dummies (captured by $X_c * Famine_t$), $SocialCap_c * Famine_t$ has an independent effect on the mortality rate. To address this concern, we will conduct several robustness checks after reporting the main results in the next section.

In order to rule out the first source of biases, we will also estimate the following model that produces dynamic treatment effect estimates:

$$Deathrate_{ct} = \sum_{yr=1954}^{1966} \beta_{yr} SocialCap_c * D_{yr,t} + \gamma X_c * Famine_t + \delta_c + \lambda_t + u_{ct} \qquad (2)$$

in which $D_{yr,t}$ represents a series of dummy variables indicating a specific year from 1954 to 1966. By using a more flexible functional form, we can check whether β_{yr} for non-famine years are close to zero, which is implied by the assumption that there are no time-varying confounders.

The identification strategy with the CFPS data is similar. We exploit two sources of variations: As above, the first one is the cross-sectional difference in social capital in the communities individual respondents originally come from. The respondents' cohorts as defined by birth years create the second difference. Here, we take advantage of the fact that the Great Famine never affected those who were born after 1961. We estimate the following two-way

fixed effects model:

$$Hunger_{ijk} = \beta SocialCap_{ik} * PreFamine_{ij} + \gamma Z_{ijk} + \alpha_j + \sigma_k + \varepsilon_{ijk} \quad (3)$$

in which $Hunger_{ijk}$ is a dummy variable indicating whether individual i born in year j and community k experienced hunger for at least one week; $SocialCap_{ij}$ is a measure of community-level social capital; $PreFamine_{ij}$ equals 1 if individual i (who was born in year j) was born before the end of the Great Famine, i.e. $j \leq 1961$); Z_{ijk} are individual/household level control variables; α_j and σ_k are cohort and community fixed effects, respectively; and ε_{ijk} represents idiosyncratic errors for individual i in cohort j from community k. Again, we assume that the error term ε_{ijk} is orthogonal to the interaction term $SocialCap_{ik} * PreFamine_{ij}$. One testable implication of this assumption is that the average outcomes of individuals in areas of high and low levels of social capital who were born after 1961 should not differ systematically after cohort and community fixed effects are removed. We can estimate the following fixed effects model:

$$Hunger_{ijk} = \sum_{birthyr=1941}^{1977} \beta_{birthyr} SocialCap_{ik} * D_{birthyr,ij} + \gamma Z_{ijk} + \alpha_j + \sigma_k + \varepsilon_{ijk} \quad (4)$$

in which $D_{birthyr,ij}$ is a set of dummy variables indicating individual's birth-year cohort. We expect to see that $\beta_{birthyr>1961}$ are close to zero. This identification strategy is also susceptible to challenges that our measures for social capital may be proxies for other factors. However, taking evidence from the county-level and individual-level data together, we believe a causal linkage between social capital and famine relief during the Great Famine seems highly likely.

6. Main Results

In this section, we present our main empirical findings. We first show results using a panel of 1,448 Chinese counties spanning 1954–1966,[12], after which we discuss findings based on

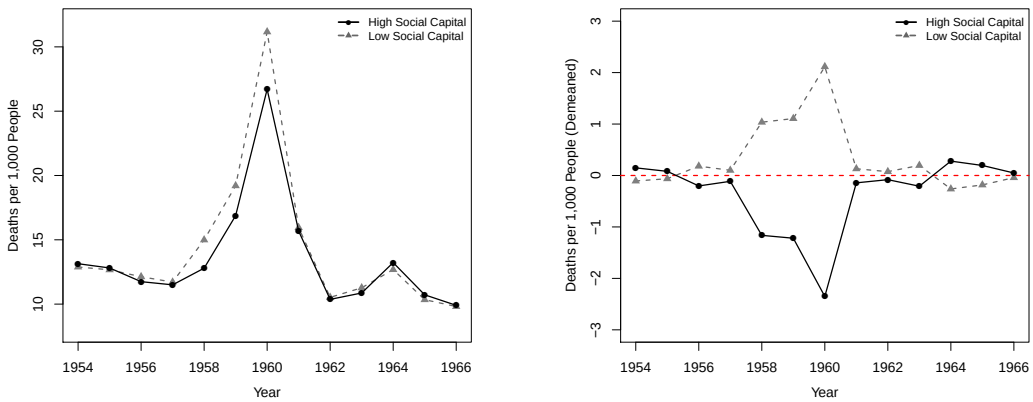
[12]Our original sample covers 1,854 counties. In order to make results across different model specifications comparable, we drop counties with missing values in control variables. We obtain very similar results when we use the full sample and include no control variables.

the CFPS. We then summarize results from a series of robustness checks, the details of which appear in the appendix due to space limitations.

6.1. Evidence from County-Level Data

Before presenting the regression results, we first plot the raw data of mortality trends in Figure 4. We divide the sample into two groups: counties with high vs. low level of social capital, based on whether the number of pre-1950 genealogies per capita is above or below the national mean. Figure 4(a) shows that, consistent with historical accounts, the mortality rate increased sharply in 1958, peaked in 1960, and declined to the 1957 level in 1962. However, while the average mortality rates before and after the famine period (i.e. 1958-1961) are close between the two groups, the increase in the mortality rate between 1958 and 1961 is smaller in regions with high social capital (solid line) than regions with low social capital (dashed line). The difference in the rise of mortality during the famine period becomes more apparent when we subtract the sample average mortality rate in each year from the raw data, as shown in Figure 4(b). Figure 4 demonstrates, in the simplest possible way, that the response to calamity across regions with different levels of social capital varies widely.

FIGURE 4. MORTALITY TRENDS BY YEAR: HIGH AND LOW SOCIAL CAPITAL



(a) Mortality Rate in Level (b) Demeaned Mortality Rate

Notes: Regions are divided into two groups: high vs. low levels of social capital, based on whether the number of genealogies per capita is above or below the national mean.

We then estimate the regression model specified in Equation (1). Table 1 presents the results. As discussed earlier, we use two indicators to measure social capital: a dichotomous variable and a continuous variable. Columns (1)-(4), and Columns (5)-(8) are based on each

of these two indicators, respectively. Throughout the paper, unless otherwise noted, we cluster the standard errors at the county level at which social capital is measured.

TABLE 1. SOCIAL CAPITAL AND MORTALITY RATE DURING THE GREAT FAMINE

	Outcome variable: Mortality rate (‰)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable mean	13.997	13.997	13.997	13.997	13.997	13.997	13.997	13.997
High social capital x Famine period	-1.456***	-2.011***	-1.986***	-1.913***				
	(0.596)	(0.637)	(0.641))	(0.685)				
Log(#Genealogies/pop) x Famine period					-3.285***	-3.468***	-3.413***	-3.578***
					(0.398)	(0.481)	(0.491)	(0.544)
Grain output (PC) x Famine period		0.009**	0.010**	0.009**		0.010**	0.010**	0.010**
		(0.004)	(0.004)	(0.005)		(0.005)	(0.005)	(0.005)
Non-farming land ratio x Famine period		-0.117***	-0.117***	-0.121***		-0.104***	-0.104***	-0.109***
		(0.029)	(0.029)	(0.031)		(0.030)	(0.030)	(0.032)
Urbanization rate x Famine period		-0.033	-0.020	-0.018		-0.024	-0.021	-0.017
		(0.030)	(0.029)	(0.032)		(0.032)	(0.029)	(0.032)
Share of minority x Famine period		0.012	0.007	0.007		-0.007	-0.009	-0.008
		(0.013)	(0.013)	(0.014)		(0.013)	(0.013)	(0.014)
Averaged years of schooling x Famine period			-0.558	-0.643			-0.187	-0.260
			(0.394)	(0.419)			(0.399)	(0.424)
Observations	17,342	17,342	17,342	17,342	17,342	17,342	17,342	17,342
Number of counties	1,448	1,448	1,448	1,448	1,448	1,448	1,448	1,448
R-squared	0.388	0.394	0.395	0.415	0.390	0.397	0.397	0.417
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-specific time trends	No	No	No	Yes	No	No	No	Yes

Notes: In Columns (1)-(4), high social capital is a dummy variable indicating whether the number of genealogies in a county divided by the county's population size is above the national mean. In Columns (5)-(8), we use the continuous measure. Famine period is defined 1958-1961. Standard errors clustered at the county level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For easier comparisons of the coefficients, all regressions use the same sample in which data on all covariates are available.

In Column (1) of Table 1, we control for county and year fixed effects. Column (1) shows that, a higher level of social capital, on average, is associated with a reduction in the mortality rate of 1.46 deaths per thousand people each year during the famine years. The estimate is statistically significant at the 1% level. In Column (2), we further controlled for the interactions between the famine indicator and a set of pre-famine county characteristics, including grain output in 1957, ratio of non-farming land, urbanization rate, and share of minorities. We consider these factors for the following reasons. First, previous studies suggest that grain production before the famine is an important predictor of famine severity (e.g., Meng, Qian, and Yared 2015). Second, the ratio of non-farming land and the urbanization rate predict the potential for resource diversion from the agriculture/rural sector to industrialization/urban sector. Third, because policies in autonomous regions for ethnic minorities are substantively different from the rest of China and ethnic minorities have different cultural norms from the Han majority, the share of ethnic minorities may be correlated with both social capital and famine

severity. Controlling for these interactions can alleviate the concern that it is these factors, instead of social capital, that drive the differential responses to famine. The coefficient for the key interaction term becomes larger, producing a reduction of 2.01 deaths per thousand people, and is highly statistically significant. To address the concern that human capital may be driving the effect of social capital on mortality,[13] in Column (3), we include the the interaction between the county average years of schooling and the famine dummy and the key coefficient remains almost the same.[14] In Column (4), we further control for the county-specific linear time trend to mitigate the concern that trending factors drive the estimates, and, given what we observe in Figure 4, the chances are low. Not surprisingly, the estimated coefficient for the key interaction term barely changes although standard errors slightly increase.

The results are robust when we use the continuous measure of social capital. For example, Columns (5)-(8) of Table 1 show that one standard deviation increase in the logged number of genealogies per capita (0.44) is associated with a reduction of 1.44-1.57 deaths per thousand people in each year from 1958 to 1961. If we conduct a thought experiment and cut this continuous measure of social capita by half in each country, the national death toll would increase by 1.77-1.92 million people during the four-year period, a 10% increase over our current estimate at 19.3 million.[15]

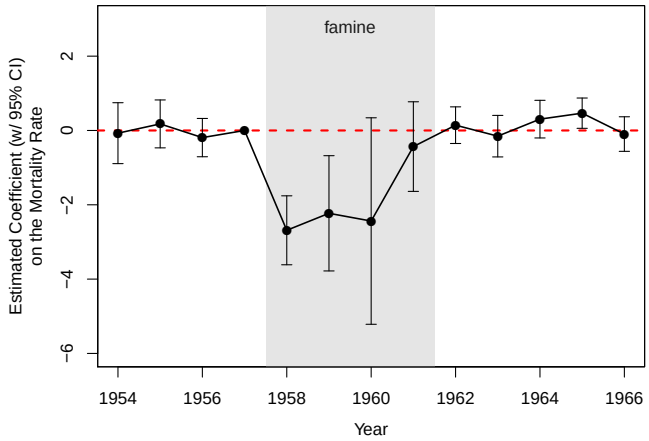
Next, we estimate the dynamic treatment effects of social capital using the regression specified in Equation (2). We plot the estimates of coefficients, β_{yr} in Figure 5, with 1957, the year just before the famine, as the baseline. Figure 5 shows that the differences in the mortality rates between regions with high and low levels of social capital are very stable in non-famine years—in fact, all the estimates are precisely estimated around zero—but diverge considerably during the famine years, that is, the rise in mortality during the famine years is much smaller in regions with a higher level of social capital.

[13] Scholars argue that human capital and social capital complement each other (Coleman 1988; Goldin and Katz 1999).

[14] Because precise data on educational attainment during the famine are unavailable, we use averaged years of schooling of people who are older than 40 year s old in 1982 based on the 1982 Census as a proxy for human capital.

[15] Specially, we use the following formula: $\Delta Mortality = \sum_i Population_i * \Delta SocialCap_i * \beta$, in which $Population_i$ is county i's population size in 1957.

FIGURE 5. EFFECTS OF SOCIAL CAPITAL ON MORTALITY BY YEAR



Notes: Coefficients of the interaction terms between social capital and year dummies are plotted. Year 1957 is set as the reference group. Specifically, we estimate the following equation: $Deathrate_{ct} = \sum_{yr=1954}^{1966} \beta_{yr} SocialCap_c * D_{yr,t} + \gamma X_c * Famine_t + \delta_c + \lambda_t + u_{ct}$.

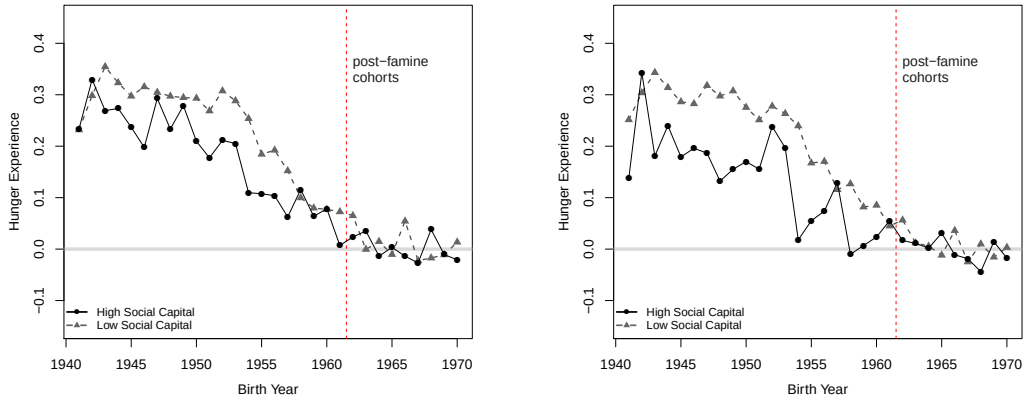
6.2. Evidence from the Household Survey

We now turn to analyses using the CFPS data. In the CFPS sample, among respondents who were born between 1941 and 1977, approximately 14% report that they had experienced persistent hunger (longer than one week). Because hunger experience in pre-reform years is neither politically sensitive nor stigmatizing for the respondents, we do not expect its reporting to suffer from the kind of measurement errors that may affect county-level data. Most of those who experienced persistent hunger say that it occurred during the Great Famine (see Figure A5 in the appendix).

Figure 6 presents the probability of reporting hunger experience by social capital and birth year subtracted by the baseline probability of the 1971 cohort. The probabilities of reporting hunger experience are stable among those born after the Great Famine across different communities, but increase significantly among those born before the famine. More importantly, the increase in the probability of reporting hunger experience among those born before the famine compared to those born after the famine is smaller in communities with a higher level of social capital. This pattern strongly suggests that social capital may have reduced famine severity during the Great Famine.

We now turn to regression analyses. We compare the differences in personal hunger experience between individuals who were born before and after the end of the famine between

FIGURE 6. HUNGER EXPERIENCE BY SOCIAL CAPITAL AND BIRTH YEAR



(a) Measuring Social Capital using Genealogies (b) Measuring Social Capital using Ancestral Halls

Notes: The probabilities of reporting hunger experience in communities of high and low social capital for birth year cohorts 1940-1970, subtracted by their respective baseline probabilities of the 1971 birth year cohort, are plotted. Social capital is measured using the share of households having access to a genealogy in a community in Subfigure (a) or whether a community maintains an ancestral hall in Subfigure (b). Results are based on rural respondents only.

communities with different levels of social capital by estimating Equation (3) with standard errors clustered at the community level. Panels A and B of Table 2 show the results using community-level genealogies as proxies for social capital; Panel C uses the presence of ancestral halls instead. In Panel A, social capital is proxied by the share of households having access to a genealogy in the community. In Panel B, we use a dummy variable indicating whether the share is above the sample mean. In Panel C, the social capital measure is the presence of at least one ancestral hall. The results show that, for example, in communities with ancestral halls, the difference in the probability of reporting hunger experience between pre-famine cohorts (older people) and post-famine cohorts (younger people) is 7.8 percentage points smaller than that in communities without them, which translates to 55% of the outcome variable mean. The estimate slightly increases to 7.9 percentage points after a set of individual characteristics are controlled for (Panel C Column (2)). Because the government prioritized food supplies in urban areas, most people who died by starvation lived in rural areas (Kung and Lin 2003). We divide the sample into rural and urban and reestimate Equation (3) using two subsamples separately. Columns (3) and (4) of Table 2 show that, as expected, the impact of the social capital on hunger experience was more pronounced in rural areas.

Next, we estimate the dynamic treatment effect using the model specified in Equation (4). We plot the estimated coefficients $\beta_{birthyr}$ and their 95% confidence intervals in Figure 7. It

TABLE 2. SOCIAL CAPITAL AND HUNGER EXPERIENCE

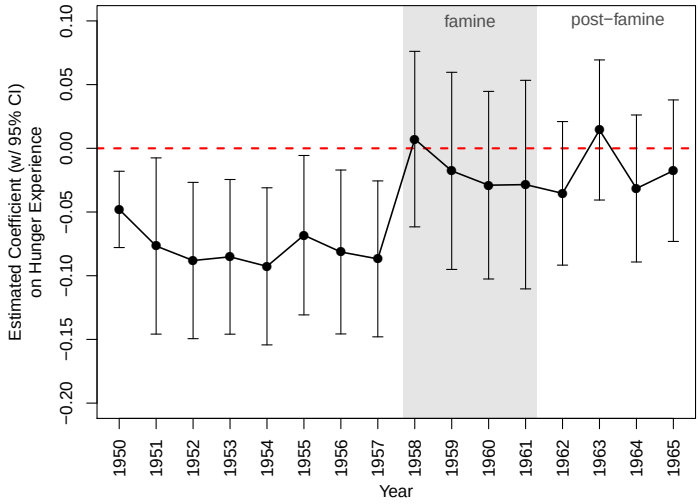
	Outcome variable: Experienced hunger (=1, yes)			
	All	All	Rural	Urban
	(1)	(2)	(3)	(4)
Outcome variable mean	0.143	0.144	0.165	0.114
Panel A				
Share of households having a genealogy	-0.075**	-0.084**	-0.121**	-0.011
x Pre-famine cohorts	(0.036)	(0.036)	(0.046)	(0.055)
Control variables	No	Yes	Yes	Yes
Observations	18972	18720	10985	7735
Number of communities	576	563	313	250
R-squared	0.273	0.280	0.305	0.229
Panel B				
High genealogy share x Pre-famine cohorts	-0.032*	-0.036*	-0.060**	0.001
	(0.019)	(0.019)	(0.026)	(0.028)
Control variables	No	Yes	Yes	Yes
Observations	18972	18720	10985	7735
Number of communities	576	563	313	250
R-squared	0.273	0.280	0.305	0.229
Panel C				
Ancestral hall x Pre-famine cohorts	-0.078***	-0.079***	-0.092***	-0.068**
	(0.025)	(0.025)	(0.034)	0.030)
Control variables	No	Yes	Yes	Yes
Observations	18972	18720	10985	7735
Number of communities	576	563	313	250
R-squared	0.274	0.280	0.305	0.230

Notes: Data are from CFPS 2010. Control variables include dummies for gender, ethnicity, household registration status, and education, and number of siblings. All regressions include dummies for birth year and community (village or neighborhood). Standard errors clustered at the community level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

shows that for respondents who were born after 1958, the difference in the probability of reporting hunger experience between respondents from communities with high and low levels of social capital is stable and close to zero. However, for those who were born before 1958, respondents from communities with more social capital have a significantly lower probability of reporting hunger experience than respondents from communities with less social capital. The fact that there are no systematic differences in hunger memory for cohorts who were born between 1958 and 1961 is reassuring because (1) adults rarely have any memory of events that took places when they were 0-3 years old; and (2) it shows that it is unlikely that differences in intentional misreporting across different regions or other community-specific time-varying confounders drive the observed differences in hunger experience.

Overall, the evidence from the household survey corroborates the finding from the county-level data that there is a strong negative association between social capital and famine severity.

FIGURE 7. EFFECT OF SOCIAL CAPITAL ON HUNGER EXPERIENCE BY BIRTH YEAR



Notes: Coefficients of the interaction terms between social capital and birth year dummies, i.e. $\beta_{birthyr}$ in Equation (4), are plotted. Respondents born after 1965 are set as the reference group.

6.3. Robustness Checks

We conduct a series of robustness checks for our main finding. Due to space limitations, we report the details in the appendix. First, we show that our main result still holds when we use the cohort loss index as the outcome (Table A3). Second, we show that neither different religious beliefs (Table A4) nor gender norms (Table A5) drive the association between social capital and mortality. Third, our finding is robust when we add the lagged outcome and spacial lagged outcome (Table A6). Last but not least, we show that the result remains substantively the same if we exclude counties that do not preserve any pre-1950 genealogies (Table A7) or if we drop any of 22 provinces from the sample (Figure A6).

7. Mechanisms

In this section, we explore potential mechanisms through which social capital can reduce famine severity. Previous historical and ethnographic studies provide four categories of potential mechanisms. First, lineage organizations managed to prevent a drastic drop in grain production. Second, clans enabled peasants to resist excessive state procurement and to conceal grain output during the peak of the famine, thus saving lives. Third, clans facilitated informal borrowing and lending among clan members and offered a last resort relief to those

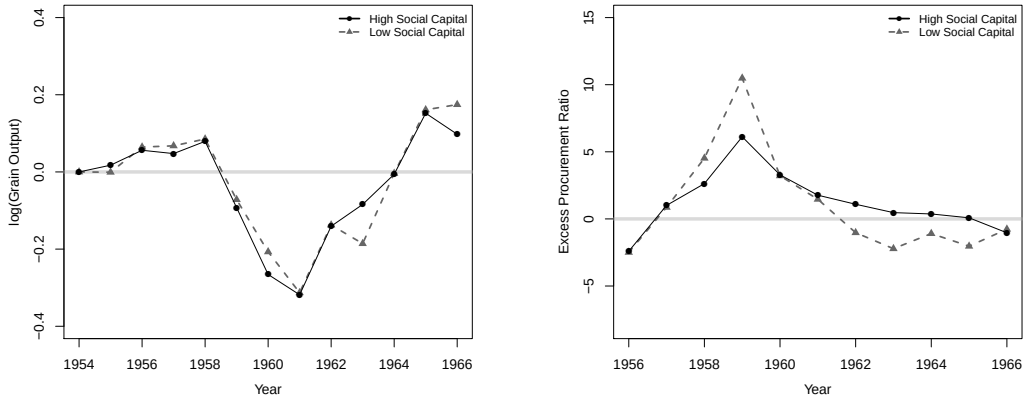
in at the greatest risk of death by starvation. Finally, lineage organizations allowed peasants to engage in survival strategies that the state prohibited—what Thaxton (2008) calls "anti-state resistance"—such as eating immature or unripe crops in the fields, stealing from the state granaries, and over-reporting headcount of peasant workers for state projects.

It is obvious that each of above channels requires some form of collective action and that local political leaders were embedded in clan networks. For example, without the help or at least acquiescence of the head of the production team and other villagers' cooperation, it would be almost impossible for individuals to steal food from state granaries, which local militiamen generally guarded. Based on oral interviews, Chen (2010) argues that clans played a key role in famine relief because "no other form of relationship—social class, friendship, comradeship, marriage, economic partnership, or political interests—could have held an *entire* village together for self-preservation and to save lives" (italics original). The subsections below provide empirical evidence, some of which are direct while others only peripheral, to shed light on the first three mechanisms. We discuss the anti-state resistance based on the existing qualitative evidence due to lack of systematic data.

7.1. Grain Output

Decline in grain production might have played a role in famine deaths. To examine whether clans helped withstand pressure from political authorities during the early years of the GLF, thus resulting a smaller drop in grain output during the famine, we manually collect county-level data on grain production from 1954 to 1966. In Figure 8(a), we plot the change in grain production over time for counties with high and low levels of social capital. Specifically, we take yearly averages of logged grain production in counties with high and low levels of social capital from 1955 to 1966 and then subtract their respective 1954 baselines (set at zero). Figure 8(a) shows that, while grain production started to decline sharply in 1959 for both groups of counties, they followed almost exactly the same trajectories throughout the famine period, almost ruling out the possibility that places with more social capital produced more crops amid the famine. We confirm this finding using the same regression model as specified in Equation (1) using both logged grain output and logged per capita grain output. Columns (1)-(4) of Table

FIGURE 8. GRAIN PRODUCTION AND EXCESS PROCUREMENT: BY SOCIAL CAPITAL



(a) Grain Production (b) Excess Government Procurement

Notes: We plot the average (logged) grain production (a) and excess procurement ratio (b) in counties with high and low social capital, subtracted their respective baseline averages. Data on excess procurement ratio come from Kung and Chen (2011), which refers to the difference between the procurement ratio during the famine period (1958-1961) and the average procurement ratio in pre-famine years (1955-1957). High or low level of social capital refers to whether the number of genealogies per capita is above or below the mean level.

3 show that there are almost no systematic differences in changes of grain output (in aggregate or per capita levels) during famine years compared to non-famine years between regions with different levels of social capital.

The only reason to doubt is that grain output numbers may be unreliable. For example, it seems possible that, expecting imminent danger of a famine in 1958, villages with high social capital produced more grain and leaders of these villages concealed a significant part of it while they actually produced more. However, the difference in grain production and concealed amount would have to be almost exactly the same. We consider the chances of such perfect data manipulation to be small. A more likely scenario, we conjecture, is that on average production declined just as much in villages with more social capital (as revealed by what we believe to be corrected data), but these villages were able to resist excessive procurement from the state when a famine was looming on the horizon, as we will discuss below.

7.2. Excessive Government Procurement

Next, we study if social capital enabled peasants to resist excessive state procurement during the apex of the famine, which was a primary cause of tens of millions of abnormal deaths (Kung and Lin 2003; Chen 2010; Kung and Chen 2011; Meng, Qian, and Yared 2015). Kung and Chen

TABLE 3. SOCIAL CAPITA, GRAIN OUTPUT AND GRAIN PROCUREMENT

	Outcome variables					
	Log grain output		Log grain output per capita		Excess grain procurement ratio	
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variable mean	10.98	10.98	-1.29	-1.29	1.06	1.06
High social capital x Famine period	0.004		0.001		-2.665*	
	(0.010)		(0.010)		(1.303)	
Log(#Genealogies/pop) x Famine period		-0.015		0.000		-3.279***
		(0.010)		(0.011)		(1.141)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	-	-
Province fixed effects	-	-	-	-	Yes	Yes
Observations	16,555	16,555	15,695	15,695	231	231
Number of clusters (counties/provinces)	1,568	1,568	1,478	1,478	21	21
R-squared	0.940	0.933	0.797	0.797	0.603	0.608

Notes: Standard errors in Columns (1)-(4) are clustered at the county level; standard errors in Columns (5)-(6) are clustered at the provincial level. *** p<0.01, ** p<0.05, * p<0.1.

(2011), in particular, show that provincial Communist Party officials who had higher incentives to impress Mao were more likely to set ambitious (and unachievable) state procurement targets during the famine years, resulting in considerably more deaths. Using provincial-level data from Kung and Chen (2011), we plot the average changes in excess grain procurement ratio, measured by the difference between the procurement ratio during the famine period (1958-1961) and the average procurement ratio from 1955 to 1957, by regions of high and low social capital, respectively. Figure 8(b) shows that the average increase in excess procurement is much smaller in regions with higher social capital than regions with low social capital. Again, we confirm this finding using regression analyses with standard errors clustered at the provincial level. The results are shown in Table 3 Columns (5) and (6). For example, Column (6) suggests that a one standard deviation increase in our continuous measure of social capital (0.44) is associated with a 1.44 percentage point cut in the excess procurement ratio compared with normal years—for example, a 4.47% jump in procurement ratio during the famine years (sample mean from 1958 to 1961) becomes a 3.03% increase.[16]

Because the state sets procurement targets ahead of each harvest season and forces pro-

[16] A potential spill-over effect seems possible in which resistance to procurement in one locality might incentivize state collectors to increase procurement effort in another one within the same administrate unit. Because procurement data we use are at the provincial level, we consider the chances of this to be low.

curement based on the targets regardless of real output, resisting excessive procurement means that formal leaders of a village, such as production brigade or production team leaders, either refused to endorse a severely inflated yield target, risking their political careers, or concealed crops when the procurement team from the upper-level government came down. The former requires village leaders to put the interests of the villagers ahead of their own while the latter also requires cooperation with the rest of the village such that no one snitches for personal gains. The cost of resistance was high. Mao personally declared the problem of "hiding grain" was "very serious" and ordered a nationwide campaign to combat "false reporting and grain hoarding;" cadres who reported starvation conditions were explicitly warned that they were expressing "right deviationist thinking" (Walder 2015, pp. 164-165). Interviews with peasants from three villages in Anhui indicate that such refusals were more likely when the political and traditional leaders of a village overlap, as the leaders and villagers shared the same goals (survival of all) and dense kinship networks bound them together (Chen 2010).

However, a puzzle remains: why did villages with strong lineage networks manage to resist excessive procurement at the peak of the famine, but fail to stand up to radical policies at the early stage of the GLF and prevent grain production from dropping? A possible explanation is that leaders of many kinship groups were winners of collectivization and lacked the incentives to resist as they gained more power (Skinner 1965; Chen 2010). Like others, they were myopic—only when the situation became so dire that deaths began to mount did they begin putting the lives of their kinfolk before their own careers.

7.3. Inter-household Relationships and Informal Borrowing

The third channel we investigate is inter-household relations and risk sharing. Note that this channel is plausible only when at least some households were able to retain and conceal crops during the direst moment of the famine. Previous studies have shown that kinship networks facilitate risk sharing and consumption smoothing in developing countries (e.g. Fafchamps and Lund 2003; Weerdt and Dercon 2006). Deeper reservoirs of social capital provide informal insurance and mutual assistance in crisis (Aldrich 2012). In the context of the Great Famine, lending others food involves a lot of risks. First, there may be no recompense, leading to hunger

for the loaning household, and second, if others learn what the loaner has, others may seek to borrow or steal one's remaining food. A major difficulty of studying this mechanism is lack of data. Survey data from the famine years are not available, nor do we have data on household lending and borrowing during that period. However, because social capital often persist over time, we may shed light on the plausibility of this potential mechanism by leveraging on the contemporaneous household survey.

TABLE 4. CLAN AND INTER-HOUSEHOLD RELATIONSHIPS

	Outcome variables							
	Relationship score				Visits during spring festival			
	With relatives		With neighbors		Visit relatives		Visit neighbors	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable mean	0.00	0.00	0.00	0.00	0.80	0.80	0.51	0.50
Panel A								
Share of households keeping genealogies	0.199**	0.197**	0.209**	0.171**	0.167***	0.144***	0.166***	0.169***
	(0.086)	(0.087)	(0.081)	(0.083)	(0.021)	(0.021)	(0.039)	(0.040)
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,795	12,145	14,795	12,145	14,697	12,076	14,652	12,038
R-squared	0.002	0.040	0.002	0.019	0.010	0.050	0.006	0.046
Panel B								
High genealogy share	0.115***	0.108***	0.092**	0.077*	0.058***	0.049***	0.072***	0.068***
	(0.041)	(0.041)	(0.039)	(0.040)	(0.014)	(0.013)	(0.018)	(0.018)
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,795	12,145	14,795	12,145	14,697	12,076	14,652	12,038
R-squared	0.003	0.041	0.002	0.019	0.005	0.047	0.005	0.044
Panel C								
Ancestral hall	0.087	0.073	0.162***	0.123*	0.102***	0.080***	0.116***	0.121***
	(0.061)	(0.062)	(0.060)	(0.064)	(0.017)	(0.017)	(0.025)	(0.026)
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,795	12,145	14,795	12,145	14,697	12,076	14,652	12,038
R-squared	0.001	0.039	0.002	0.019	0.006	0.032	0.005	0.046

Notes: Data are from CFPS 2010. Control variables include dummies for gender, ethnicity, household registration status, and education, and number of siblings. All regressions include dummies for birth year and community. Standard errors clustered at the community level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Using the CFPS data from 2010, we first examine the associations between our measures of social capital at the community level and inter-household relationships reported by the respondents. The first outcome is a relationship score based on five survey items;[17] the second outcome is a self-reported behavioral measure of visiting relatives/neighbors during the spring festival. Standard errors are clustered at the community level. Table 4 shows that in places with more social capital, respondents are much more likely to maintain a close relationship with relatives and friends; they are also more likely to visit relatives and neighbors during the spring

[17] A set of questions on interpersonal relationship in the CFPS concern the occurrence of five types of interactions over the preceding month: (1) play together; (2) share food or give gifts; (3) give help; (4) visit; (5) talk. We conduct a principal component analysis of these five variables to generate a relationship score.

festival, suggesting stronger social ties in these communities.

We then examine whether our measures of social capital can explain respondents' borrowing behaviors. We explore three outcomes: (1) a respondent has reportedly ever borrowed during the past year; (2) has ever borrowed through informal channels during the past year; and (3) ever borrowed through formal channels (e.g., banks) during the past year. Table 5 shows that community-level social capital is positively correlated with both borrowing and borrowing through informal channels only. The coefficients are highly statistically significant when we use ancestral halls as the measure of social capital, likely because maintaining an ancestral hall requires stronger social ties—hence, more social capital—among community members. Interestingly, more social capital is also negatively correlated with borrowing through formal channels, suggesting a substitution effect. The cumulative weight of these findings provide suggestive evidence that in places with more social capital, people tend to maintain closer relationships with each other in the community and engage in informal borrowing more regularly than in place with lower levels of social capital.

7.4. Other Potential Mechanisms

Finally, we discuss alternative channels through which social capital may mitigate famine severity. Accounts by historians demonstrate that activities the state deemed illegal played an indispensable role in saving lives during the Great Famine (Wang and Chen 2004; Chen 2010). We do not have quantitative data to systematically evaluate these channels, but we find them important enough to be considered. They are also relevant to our discussion of the effect of social capital because engaging in these activities requires either strong trusting relationships among community members or solveing difficult collective action problems, or both.

The first form of such activities is called *chi qing* (literally translated as "eat green"), which means eating immature or unripe crops in the fields. The state strictly prohibited *chi qing* because it hurt crop yields (and hence, procurement) the following year. Another survival strategy is petty theft from the state granaries, where food were often still available. During the famine, militiamen organized by the state regularly patrolled many villages to prevent such acts. Village leaders who are members of the lineage group, however, may turn a blind eye to such

TABLE 5. SOCIAL CAPITAL AND BORROWING

	Outcome variable: Ever borrowed during last year (=1, yes)					
	Ever borrowed		Through informal channels		Through formal channels	
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variable mean	0.298	0.296	0.239	0.241	0.085	0.086
Panel A						
Share of households keeping genealogies	0.047*	0.017	0.045*	0.019	-0.003	-0.016
	(0.027)	(0.028)	(0.025)	(0.025)	(0.019)	(0.019)
Control variables	No	Yes	No	Yes	No	Yes
Observations	14795	12145	14795	12145	14795	12145
Number of communities	649	649	649	649	649	649
R-squared	0.001	0.057	0.001	0.041	0.000	0.023
Panel B						
High genealogy share	0.026*	0.010	0.017	0.001	0.007	0.003
	(0.014)	(0.013)	(0.012)	(0.012)	(0.010)	(0.010)
Control variables	No	Yes	No	Yes	No	Yes
Observations	14795	12145	14795	12145	14795	12145
Number of communities	649	649	649	649	649	649
R-squared	0.001	0.057	0.000	0.041	0.000	0.022
Panel C						
Ancestral hall	0.059***	0.039*	0.080***	0.069***	-0.028**	-0.039***
	(0.021)	(0.022)	(0.020)	0.021)	(0.012)	(0.011)
Control variables	No	Yes	No	Yes	No	Yes
Observations	14795	12145	14795	12145	14795	12145
Number of communities	649	649	649	649	649	649
R-squared	0.002	0.058	0.003	0.044	0.001	0.024

Notes: Data are from CFPS 2010. Control variables include dummies for gender, ethnicity, household registration status, and education, and number of siblings. All regressions include dummies for birth year and community. Standard errors clustered at the community level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

activities and even assist villagers in achieving their goal. A third method is *chi kong xiang* (literally translated as "eat empty payroll"), which means freeloading by overreporting headcount of peasant workers who were hired for state projects. This act requires direct participation of village leaders, who inevitably take a significant personal political risk.[18] Ethnographic evidence has shown that these "illegal" yet lifesaving activities were more likely to take place in communities with a strong lineage organization and where the formal leaders belong to the group.[19]

[18] Zweig (1989) emphasizes the role of "Janus-faced" local officials who were embedded in kinship networks and protected local communities from radical central directives (p. 92). We thank Jeff Javed for pointing out this link to the literature.

[19] It is also worth noting that Xiaogang Village in Anhui province—the first village that divided the common farmland from the People's Commune in 1978 (an illegal act at that time), which kicked off China's agricultural reform—also has strong lineage organizations. In fact, those who divided the farmland mostly came from the same kinship group and the initiator was both a leader of the group and the head of the production team.

8. Conclusions

This paper examines the role of social capital in disaster relief amid the deadliest famine in recorded human history. Specifically, we study whether more social capital—in the form of clans—in a locality is associated with fewer abnormal deaths during China's Great Famine from 1958 to 1961. Our county-level analysis shows that the rise in the mortality rate during the famine years is significantly smaller in counties with a higher level of social capital, measured by the number of genealogies per capita. We corroborate this finding using individual-level survey data. We show that the difference in probabilities of reporting hunger experience between individuals who were born before and after the famine is much smaller in regions with more social capital. After conducting a series of robustness checks, we interpret these differences as the effects of social capital on famine relief.

We explore several mechanisms, including grain production, state procurement, informal lending, and unsanctioned activities. We show that grain production is unlikely to explain the observed association but find suggestive evidence for the second and third channels that social capital enabled villagers to resist excessive procurement from state and engage in informal lending. We also discuss the role of social capital in fascinating anti-state resistance that saved lives. These findings echo Amartya Sen's insight that food availability is often not the primary cause of famines; it is people's entitlements vis-à-vis the state, their ability to command food through legal means, that matters (Sen 1981, p. 433). Our results also shed light on how societal forces can mitigate the consequences of erroneous government policies that lead to disasters.

While we believe that the main finding of this paper can be extended to other contexts, it needs to be interpreted with caution. First, although social exchange in lineage organizations has a civic aspect in rural China, it has clear boundaries defined by kinship. Lineage groups are much less effective in motivating leaders and fostering collective action when multiple groups are in competition in a small geographic area (Tsai 2007). Moreover, as more people move to the city and start to enjoy an urban life style, the goal of many clan leaders may have changed in a fundamental way. Although they still command some authority over clan members, they are much more tempted to reap short-term gains at the expense of the interests of other clan

members (Mattingly 2020). Finally, as China and many other developing countries are on a fast track towards industrialization and urbanization, social capital accumulated in an agricultural society that consists of mostly relatives and acquaintance may not easily transfer to an industrial society of autonomous strangers.

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Appendix A Tables and Figures

This section presents other results mentioned in the main text.

Figure A1 presents the annual fertility and mortality rates from 1950 to 1970. It shows that the mortality rate started to increase in 1958 and peaked in 1960 and declined to the pre-famine level in 1962. The fertility rate, in contrast, declined significantly in the famine years and increased to the pre-famine level in 1962.

Figure A2(a) displays the relationship between the numbers of genealogies compiled before 1950 and after 1980. The correlation coefficient is as high as 0.64, suggesting that the clan culture is persistent and clans are still active in the post-reform era. Figure A2(b) splits the sample into two groups, localities in places with high and low Cultural Revolution violence. It shows that correlations are very similar between the two groups, suggesting that unmeasured political radicalism is not a major threat to our measurement strategy.

Figures A3 reports the number of counties covered by our county-level mortality data and grain production data.

Figure A4 presents a simple bivariate relationship between social capital and the rise in the mortality rate in famine years compared to normal years. We see a significant negative relationship with a slope of -1.7.

Figure A5 shows the distribution of the timing of reported hunger experience by respondents of the CFPS. It shows that most reported hunger experience took place during the Great Famine.

Figure A6 presents the results from estimating Equation (1) using a restricted sample with one province dropped at one time. It shows that the results remain no matter which counties in which province are dropped from the sample. We do find that some provinces, such as Sichuan and Zhejiang, have a larger weight than other provinces. Sichuan province has about 9.4 million abnormal deaths, accounting for 29% of the total abnormal deaths in China during famine years (Cao 2004).

Tables A1 and A2 present the summary statistics from the county-year panel we construct and the CFPS data, respectively.

Table A3 presents the results on the effect of social capital on famine severity measured by cohort loss index. Although the cohort loss index may not be an ideal measure of mortality, we find a consistent result that social capital mitigates famine severity.

Table A4 presents the results on the effect of other cultural norms, or more specifically, religions, on hunger experience. We find no evidence of an effect.

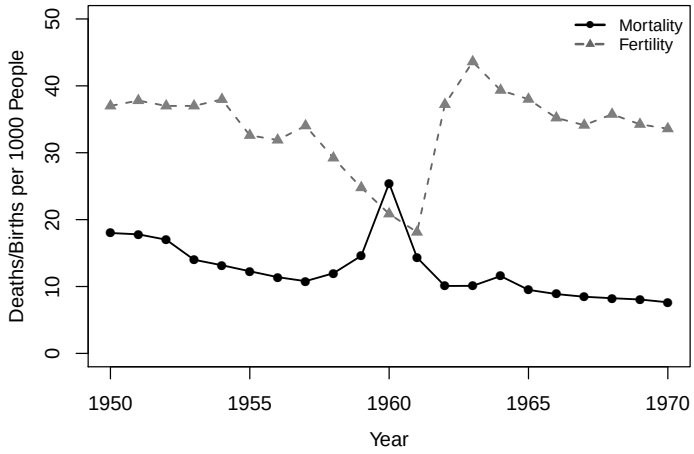
Table A5 presents the results on the effect of social capital on hunger experience by gender. We do not find much difference between males and females.

Table A6 presents the results on the effect of social capital on mortality when the lagged dependent variable and a spacial lag variable are included. The main findings remain unchanged.

Table A7 presents the results on the effect of social capital on mortality using a restricted

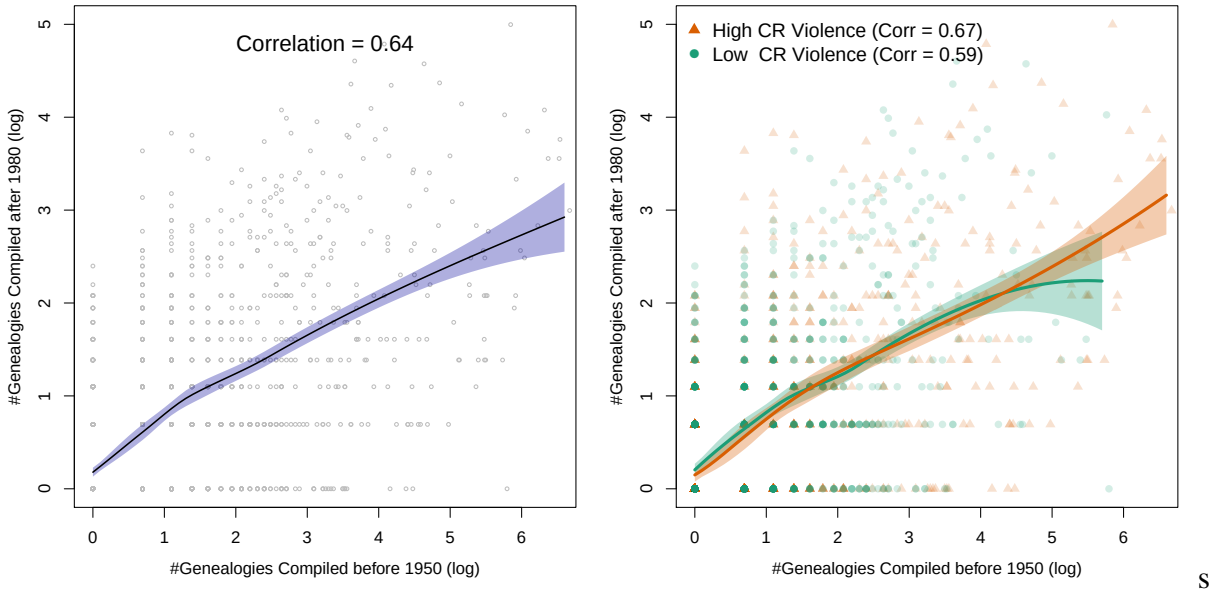
sample, which excludes all counties with no genealogies. The estimates are slightly larger than those obtained from the full sample (Table 1).

FIGURE A1. FERTILITY AND MORTALITY RATES: 1950-1970



Notes: Data are from annual statistics reported on the website of the National Bureau of Statistics of China, http://data.stats.gov.cn/english.

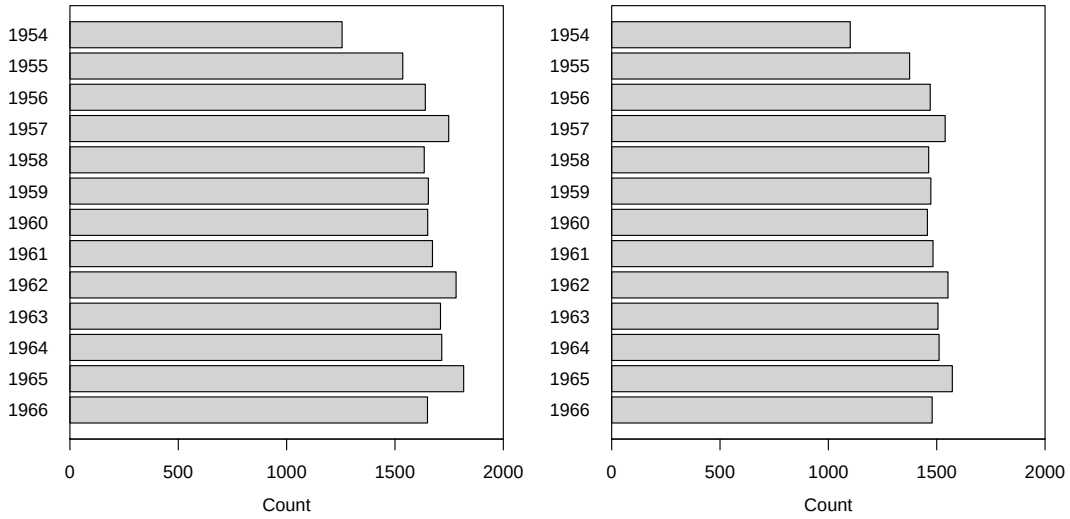
FIGURE A2. PERSISTENCE OF CLANS



(a) Full Sample (b) By Cultural Revolution Violence

Notes: The number of genealogies is in logarithmic scale. Cultural Resolution violence is measured by the number of victims in a county divided by county population based on Andrew Walder's "China Political Events Dataset, 1966-1971."

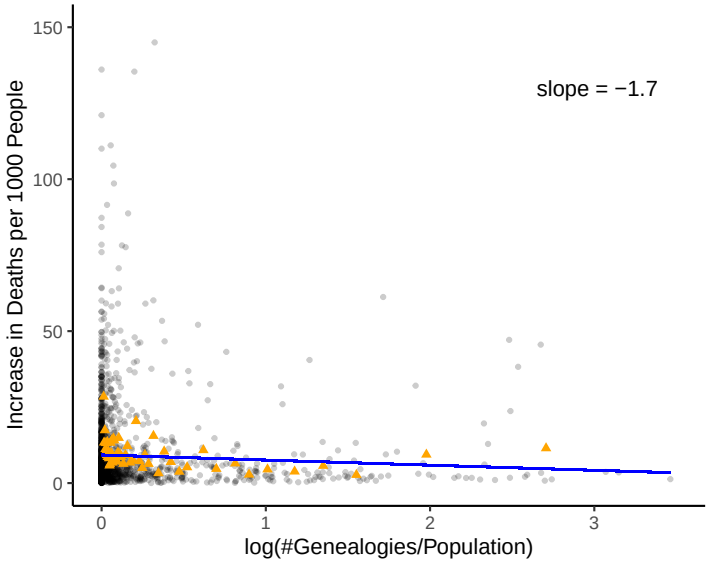
FIGURE A3. SAMPLE COVERAGE



(a) Mortality Data (b) Grain Production Data

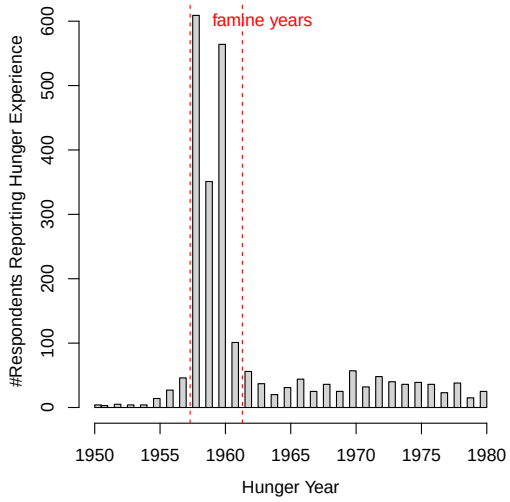
Notes: These counties are in 23 provinces of mainland China. Provinces that are not covered include three municipalities (Beijing, Shanghai, and Tianjin) and three minority autonomous regions (Inner Mongolia Autonomous Region, Tibet Autonomous Region, and Xinjiang Uyghur Autonomous Region).

FIGURE A4. SOCIAL CAPITAL AND INCREASE IN MORTALITY DURING FAMINE YEARS



Notes: The y-axis is the increase in the mortality rate in the famine years (1958-1960) compared with normal years; the x-axis is the (log) number of genealogies *per capita*. Each gray dot represents one county. Each yellow triangle represents an average of 20 counties in a close range of the x-axis. The blue line is a linear fit of all counties.

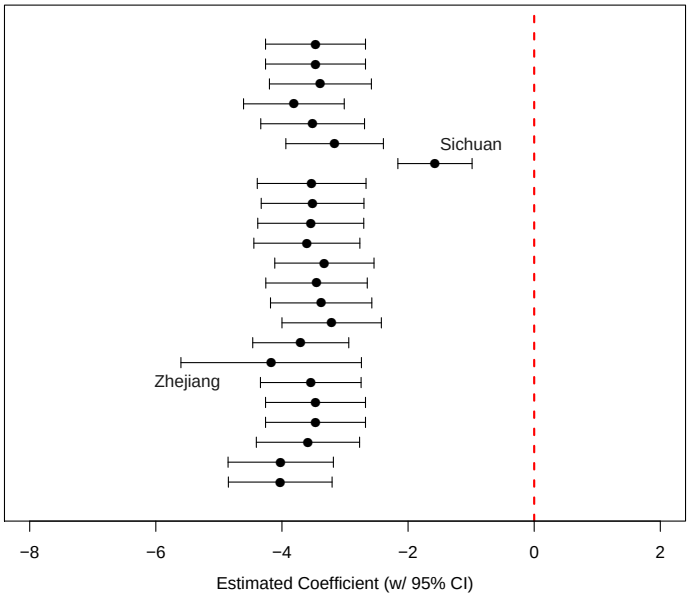
FIGURE A5. DISTRIBUTION OF HUNGRY YEARS AMONG INDIVIDUALS EXPERIENCED PERSISTENT HUNGER



Notes: Data are from CFPS 2010. The sample is restricted to respondents who reported that they had experienced hunger for at least one week between 1950 and 1980.

It is possible that having only a small number of provinces drives the results. We address this concern by a simple exercise, re-estimating Equation (1) repeatedly when dropping data from one province at a time. Figure A6 shows that the coefficients for the key interaction term remain negative and large in magnitude not matter which province is dropped.

FIGURE A6. ESTIMATES WITH ONE PROVINCE EXCLUDED AT A TIME



Notes: Coefficients of the interaction terms between social capital and a dummy indicating famine period are plotted. Each coefficient is based on a subsample of the original dataset from which one province is dropped. Sichuan province had the highest mortality rate during the Great Famine while Zhejiang province had the most variation in our measure of social capital.

TABLE A1. SUMMARY STATISTICS: COUNTY-YEAR PANEL

	Observations	Mean	Std. Dev.	Min	Max
Panel A: *County-year variables*					
Mortality rate (‰)	21,466	13.89	10.66	0.29	218.88
Ln(Grain output (*ton*))	16,576	10.98	0.91	2.38	13.45
Panel B: *Time-invariant county-level variables*					
Log(Genealogies per 10,000 people)	1,748	0.19	0.43	0.00	3.46
Grain output per capita in 1957 (*kg*)	1,568	326.45	214.64	25.96	2992.91
Farming land ratio in 1957	1,607	79.50	10.14	36.14	99.37
Urbanization rate in 1957	1,577	7.71	7.08	0.04	91.91
Share of minorities in 1982	1,810	12.32	25.38	0.00	100
Panel C: *Province-year variables*					
Excess grain procurement ratio	242	1.09	5.58	-14.60	24.92

Notes: Data on grain procurement ratio are from Kung and Chen (2011). For data sources of other variables, see Appendix B.

TABLE A2. SUMMARY STATISTICS: CFPS

	Observations	Mean	Std. Dev.	Min	Max
Panel A: Individual *level*					
Hunger experience (=1, yes)	18,720	0.14	0.35	0	1
Gender (=1, male)	18,720	0.49	0.50	0	1
Minor (=1, yes)	18,720	0.09	0.28	0	1
Urban household registration (=1, yes)	18,720	0.11	0.32	0	1
Education dummies					
Primary school	18,720	0.23	0.42	0	1
Junior middle school	18,720	0.27	0.45	0	1
High school	18,720	0.11	0.31	0	1
College or above	18,720	0.04	0.20	0	1
Number of siblings	18,720	3.41	1.86	0	13
Panel B: *Community level*					
Share of households keeping genealogies	576	0.24	0.25	0	1
Ancestral hall (=1, yes)	576	0.12	0.32	0	1
Christian/Islam church (=1, yes)	576	0.11	0.31	0	1
Buddhism/Taoism temple (=1, yes)	576	0.33	0.47	0	1

Notes: Data are from CFPS 2010.

One may worry that our results from the county-level data are driven by mis-reporting in the mortality rate. In the main text, we discussed why the mortality rate is a better and more direct measure of famine severity than cohort loss. In Table A3, we show that our main results are robust when we use the cohort loss index based on the 1982 census as the outcome variable.

We calculate cohort loss index using micro-level data from China National Population Census 1982 (1% sample) and following the formula used by Chen and Yang (2015). We collect county-level population size in 1953 from China's first population census, which was conducted in 1953.

TABLE A3. SOCIAL CAPITAL AND COHORT LOSS DURING THE GREAT FAMINE

	Outcome variable: Cohort loss index					
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variable mean	0.156	0.156	0.156	0.156	0.156	0.156
High social capital x Famine period	-0.012	-0.017**	-0.015*			
	(0.008)	(0.008)	(0.008)			
Log(#Genealogies/pop) x Famine period				-0.021***	-0.015*	-0.014*
				(0.007)	(0.008)	(0.008)
Control variables	No	Yes	Yes	No	Yes	Yes
County-specific time trends	No	No	Yes	No	No	Yes
Observations	17,342	17,342	17,342	17,342	17,342	17,342
Number of counties	1,448	1,448	1,448	1,448	1,448	1,448
R-squared	0.658	0.661	0.692	0.659	0.661	0.692

Notes: All regressions include county and year fixed effects. Control variables include interactions between indicator of famine period and grain output, share of non-farming land, share of urban population in 1957 and share of minorities in 1982. Standard errors clustered at the county level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

It is possible that our measures for social capital may in fact serve as proxies for other unobserved community-level factors. Although we cannot exhaust all potential omitted variables, variables that capture religiosity of a locality should be considered because research has shown that they affect local public goods provision and risk sharing (e.g. Dehejia, DeLeire, and Luttmer 2007; Warner et al. 2015). In Table A4, we replace the interactions between measures of social capital and pre-famine cohorts with the interactions between indicators of presence of religions, including Christianity, Islam, Buddhism, and Taoism, and pre-famine cohorts. We use the presence of churches, mosques, and Buddhist and Taoist temples to measure each of these religions, respectively. We find that none of these interaction terms can explain the difference in hunger experience between pre- and post-famine cohorts.

TABLE A4. RELIGIONS AND HUNGER EXPERIENCE

	Outcome variable: Experienced hunger			
	All	All	Rural	Urban
	(1)	(2)	(3)	(4)
Outcome variable mean	0.143	0.144	0.165	0.114
Panel A				
Christian/Islam x Pre-Famine cohorts	0.009	0.011	-0.014	0.047
	(0.031)	(0.031)	(0.045)	(0.043)
Control variables	No	Yes	Yes	Yes
Observations	18972	18720	10985	7735
Number of communities	576	576	313	263
R-squared	0.272	0.279	0.304	0.229
Panel B				
Buddhism/Taoism x Pre-Famine Cohorts	0.014	0.019	0.016	-0.001
	(0.021)	(0.022)	(0.028)	(0.035)
Control variables	No	Yes	Yes	Yes
Observations	18972	18720	10985	7735
Number of communities	576	576	313	263
R-squared	0.273	0.279	0.304	0.229
Panel C				
All religions x Pre-Famine Cohorts	0.015	0.019	0.025	-0.005
	(0.020)	(0.020)	(0.027)	0.030)
Control variables	No	Yes	Yes	Yes
Observations	18972	18720	10985	7735
Number of communities	576	576	313	263
R-squared	0.273	0.279	0.304	0.229

Notes: Data are from CFPS 2010. Control variables include dummies for gender, ethnicity, household registration status and education, and number of siblings. All regressions include dummies for birth year and community. Standard errors clustered at the community level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

We consider the regional differences in gender norms. China's clan culture is closely related to preferences for sons, and therefore affects sex ratio at birth and regions with clan density are more likely to have a larger share of males in their population (Zhang 2019). Because the mortality rates for males and females are different, it is possible that differences in gender norms confound our findings on social capital. As a robustness check, we replicate Table 2 with two subsamples of male and female respondents. Table A5 shows that our main results hold in both sub-samples and the estimates are almost the same in magnitude between men and women who lived in rural areas. Thus, it is unlikely that different gender norms and gender composition in the population drive the association between our measures of social capital and reduction in famine severity.[A1]

TABLE A5. SOCIAL CAPITAL AND HUNGER EXPERIENCE: BY GENDER

	Outcome variable: Experienced hunger					
	Men			Women		
	All	Rural	Urban	All	Rural	Urban
	(2)	(3)	(4)	(2)	(3)	(4)
Outcome variable mean	0.16	0.18	0.12	0.13	0.15	0.10
Panel A						
Share of households having genealogy x	-0.090**	-0.102**	-0.028	-0.066	-0.109**	0.005
Pre-famine cohorts	(0.040)	(0.040)	(0.065)	(0.042)	(0.053)	(0.065)
Observations	9218	5475	3743	9489	5508	3990
Number of communities	563	313	250	563	313	250
R-squared	0.297	0.321	0.250	0.302	0.329	0.255
Panel B						
High genealogy share x Pre-famine cohorts	-0.033	-0.061**	0.012	-0.039*	-0.062**	-0.008
	(0.021)	(0.028)	(0.033)	(0.021)	(0.030)	(0.030)
Observations	9218	5475	3743	9489	5508	3990
Number of communities	563	313	250	563	313	250
R-squared	0.296	0.320	0.250	0.302	0.330	0.255
Panel C						
Ancestral hall x Pre-famine cohorts	-0.075***	-0.093**	-0.053*	-0.089***	-0.103**	-0.077*
	(0.028)	(0.039)	0.029)	(0.030)	(0.040)	0.043)
Observations	9218	5475	3743	9489	5508	3990
Number of communities	563	313	250	563	313	250
R-squared	0.297	0.321	0.251	0.303	0.330	0.256

Notes: Data are from CFPS 2010. Control variables include dummies for gender, ethnicity, household registration status and education, and number of siblings. All regressions include dummies for birth year and community. Standard errors clustered at the community level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[A1] Population statistics in China show that the mortality rate for males are higher than females at almost all ages. If regions with more social capital also have more males in population, failing to correct the influence of gender composition on mortality will lead to a downward bias of the estimates.

We test the robustness of our main findings from the county-level data by adding a lagged dependent variable and a spatial lag to account for temporal correlations in the mortality rate both within a county and between a county and its neighbors in the same prefecture. The spatially lagged mortality rate for county i in year t is constructed using the average mortality rate of other counties in the prefecture where county i belongs in year $t-1$.[A2] Table A6 shows that our results are robust to including these lagged terms.

TABLE A6. SOCIAL CAPITAL AND MORTALITY DURING THE GREAT FAMINE: CONTROLLING FOR LAGGED MORTALITY RATE

	Outcome variable: Mortality rate (‰)			
	(1)	(2)	(3)	(4)
Outcome variable mean	14.04	14.06	14.04	14.06
High social capital x Famine period	-1.517***	-1.331**		
	(0.525)	(0.517)		
Log(#Genealogies/pop) x Famine period			-2.890***	-2.702***
			(0.405)	(0.391)
Lagged mortality rate	0.228***	0.118***	0.225***	0.117***
	(0.027)	(0.037)	(0.027)	(0.037)
Lagged average mortality rate in other counties in the prefecture		-0.180***		-0.177***
		(0.037)		(0.037)
Observations	15,519	15,356	15,519	15,356
Number of counties	1,375	1,361	1,375	1,361
R-squared	0.441	0.445	0.443	0.447
Control variables	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: In Columns (1)-(3), high social capital is a dummy variable indicating whether the number of genealogies in a county divided by the county's population size is above the national mean. In Columns (4)-(6), we use the continuous measure. Famine period is defined as years from 1958 to 1961. Control variables include interactions between indicator of famine period and grain output, share of non-farming land, share of urban population in 1957 and share of minorities in 1982. Standard errors clustered at the county level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[A2]The Nickell bias in this dynamic panel setting diminishes as the number of time periods grows (in our case, T= 12). Research shows that the bias is relatively small compared with finite sample biases of GMM estimates (Beck and Katz 2011).

We test the robustness of our main finding by excluding counties that preserved zero genealogies prior to 1950.

TABLE A7. EXCLUDING COUNTIES HAVING NO GENEALOGIES

	Outcome variable: Mortality rate (‰)					
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variable mean	13.997	13.997	13.997	13.997	13.997	13.997
High social capital x Famine period	-2.220***	-2.765***	-2.752***			
	(0.820)	(0.904)	(0.978)			
Lg(#Genealogies/pop) x Famine period				-4.134***	-4.276***	-4.660***
				(0.0.495)	(0.615)	(0.694)
Observations	12848	12848	12848	12848	12848	12848
Number of Counties	1083	1083	1083	1083	1083	1083
R-squared	0.397	0.405	0.425	0.401	0.408	0.429
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
County-specific time trends	No	No	Yes	No	No	Yes

Notes: The sample is restricted to counties that have at least one genealogy book. The social capital measure in panel A is a dummy variable denoting whether the number of genealogies (normalized by population size in 1953) in a county is above the mean level. The famine period is defined 1958–1960. All regressions control for interactions between indicator of famine period and grain output, share of non-farming land, share of urban population in 1957 and share of minorities in 1982. Standard errors clustered at the county level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix B Data Sources

B.1 Mortality and Population Data

Compilation of statistics, local gazettes

13 Hebei Province

13.01 Demographics of Hebei Province (1949-1984), Compilation of Important Historical Documents of the Communist Party of China, Service Center for Chinese Publications, 2010

14 Shanxi Province

14.01 Forty Years of Shanxi Population (1949-1990), edited by Bureau of Statistics of Shanxi, Public Security Department of Shanxi, and Population Census Office of Shanxi, published by China Statistics Press, 1990

21 Liaoning Province

21.01 Demographics of Liaoning Province: 1949-1984, edited by Bureau of Statistics of Liaoning, 1986

21.02 Forty Years of Liaoning Development 1949-1989, Bureau of Statistics of Liaoning, China Statistics Press, 1989

22 Jilin Province

22.01 Compilation of Sixty Years Agricultural Development of Jilin Province 1949-2009, Edited by Ren Kejun, Jilin Publishing Group, 2011

22.02 County gazettes

23 Heilongjiang Province

23.01 Heilong Jiang Demographic Yearbook 1989

32 Jiangsu Province

32.01 Compilation of Jiangsu Population Statistics, Edited by Population Census Office of Jiangsu, Public Security Department of Jiangsu, and Bureau of Statistics of Jiangsu, 1986

33 Zhejiang Province

33.01 Compilation of Zhejiang Population Statistics 1949-1985, Edited by Population Census Office of Zhejiang, 1986

33.02 Compilation of Population and Family Planning Statistics in Zhejiang Province 1949-1994

34 Anhui Province

34.01 Anhui Provincial Gazetteer, vol. 8, edited by Local gazettes Compilation Committee of Anhui Province, Published by Anhui People's Publishing House, 1995

34.02 County gazettes

35 Fujian Province

35.01 Compilation of Fujian Population Statistics 1949-1988, Edited by Bureau of Statistics of Fujian and Public Security Department of Fujian, published by China Statistics Press, 1989

36 Jiangxi Province

36.01 Fifty Years of New China: Jiangxi, Compilation Committee of Fifty Years of New China: Jiangxi, published by China Statistics Press, 1999

36.02 County gazettes

37 Shandong Province

37.01 Compilation of Shandong Population Statistics 1949-1984, Compilation of Important Historical Documents of the Communist Party of China, Service Center for Chinese Publications, 2009

41 Henan Province

41.01 Compilation of Henan Population Statistics in Forty Years, edited by Population Census Office of Henan Province, 1989

42 Hubei Province

42.01 Agricultural Statistics of Hubei Province 1949-1978, Agricultural Bureau of Hubei Province

42.02 County gazettes

43 Hunan Province

43.01 Demographics of Huan Province 1949-1991, edited by Population Census Office of Hunan Province and Bureau of Statistics of Hunan Province, 1992

44 Guangdong Province (including 46 Hainan Province)

44.01 Compilation of Guangdong Population Statistics 1949-1985, Population Census Office of Guangdong Province, 1987

45 Guangxi Province

45.01 Compilation of Demographics of Guangxi Zhuang Autonomous Region 1949-1985

51 Sichuan Province (including Chongqing Municipality)

51.01 Sichuan Population Yearbook 1950-1986

52 Guizhou Province

52.01 Compilation of Guizhou Population Statistics (1949-1984), Population Census Leading Group of Guizhou Province, Public Security Department of Guizhou Province, and Bureau of Statistics of Guizhou Province, 1986

53 Yunnan Province

53.01 Compilation of Yunnan Population Statistics 1949-1988, Yunan People's Publishing House Press, 1990

61 Shaanxi Province

61.01 Compilation of Shaanxi Population Statistics 1949-1990, Bureau of Statistics of Shaanxi Province, China Statistics Press, 1991

61.02 County gazettes

62 Gansu Province

62.01 Compilation of Gansu Population Statistics 1949-1987, Bureau of Statistics of Gansu Province, China Statistics Press, 1988

63 Qinghai Province

63.01 Compilation of Shaanxi Population Statistics 1949-1985, Bureau of Statistics of Qinghai Province, China Statistics Press, 1991

64 Ningxia

64.01 Compilation of Population Statistics of Ningxia Hu Autonomous Region 1949-1985, Bureau of Statistics of Ningxia, 1986

B.2 Agricultural Data

Government reports, compilation of statistics, county gazettes

13 Hebei Province

13.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

13.02 Forty years of Chengde

13.03 County gazettes

14 Shanxi Province

14.01 Shanxi County Economy

21 Liaoning Province

21.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

21.02 County gazettes

22 Jilin Province

22.01 Compilation of Sixty Years Agricultural Development of Jilin Province 1949-2009, Edited by Ren Kejun, Jilin Publishing Group, 2011

23 Heilongjiang Province

23.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

23.02 Forty Years of Mudanjiang, Bureau of Statistics of Mudanjiang, 1989

23.03 County gazettes

32 Jiangsu Province

32.01 Agricultural Statistics of Jiangsu Province 1949-1975, Bureau of Statistics of Jiangsu Province

33 Zhejiang Province

33.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

33.02 1949-1990 Taizhou is Forging Ahead 1949-1990, Bureau Statistics of Taizhou

33.03 County gazettes

34 Anhui Province

34.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

34.02 County gazettes

35 Fujian Province

35.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

35.02 Fifty Years of Fuzhou

35.03 County gazettes

36 Jiangxi Province

36.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

36.02 County gazettes

37 Shandong Province

37.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

37.02 Economic and Social Development of Jinan 1949-1989, Bureau of Statistics of Jinan, China Statistics Press, 1991

37.03 Forty Years of Yantai Glory, Bureau of Statistics of Yantai, China Statistics Press, 1989

37.04 County gazettes

41 Henan Province

41.01 Agricultural Statistics of Henan Province in 30 Years since the Founding of the People's Republic of China 1949-1979 Bureau of Statistics of Henan Province

42 Hubei Province

42.01 Agricultural Statistics of Hubei Province 1949-1978, Agricultural Bureau of Hubei Province

43 Hunan Province

43.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

43.02 Forty Years of Xiangtan

43.03 Xiangxi Autonomous Prefecture in half a century 1949-1999

43.04 County gazettes

44 Guangdong Province

44.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

44.02 Forty Years of Guangzhou

44.03 Basic Statistics of National Economy and Society of Heyuan City, Guangdong Province

44.03 County gazettes

45 Guangxi Province

45.01 Forty-five Years of Guangxi Agriculture, edited by Bureau of Statistics of Guangxi Zhuang Autonomous Region and Guangxi Zhuang Autonomous Region Planning Commission, published by Guangxi Nationalities Press on November 11, 1996

46 Hainan Province

46.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

46.02 County gazettes

51 Sichuan Province (including Chongqing Municipality)

51.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

51.02 Agricultural Statistics in Wenjiang, Sichuan Province 1949-1979, edited by Agriculture Bureau of Wenjiang, publisehd in 1980

51.03 Forty Years of Agriculture in Fuling

51.04 County gazettes

52 Guizhou Province

52.01 Sixty Years in Guizhou, edited by Bureau Statistics of Guizhou Province, published by China Statistics Press in 2009

53 Yunnan Province

53.01 Capitalized Yunnan: 60 Years of Glory, edited by Bureau of Statistics of Yunnan Province, published by Yunnnan People's Publishing Press in 2010

61 Shaanxi Province

61.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

61.02 County gazettes

62 Gansu Province

62.01 Sixty Years of New China: Gansu, Compilation Committee of Sixty Years of New China: Gansu, published by China Statistics Press, 2009

63 Qinghai Province

63.01 County-level Crop Database of the Ministry of Agriculture and Rural Affairs

63.02 County gazettes

64 Ningxia Hui Autonomous Region

64.01 Historical Statistics of Agriculture in Ningxia Hui Autonomous Region 1949-1988, edited by Agriculture Department of Ningxia Hui Autonomous Region, published by Ningxia People's Publishing House in 1989

B.3 China Family Panel Studies (CFPS)

CFPS is a biennial survey and is designed to be the Chinese equivalent of the US Panel Study of Income Dynamics. The first national wave was conducted in collaboration with the Institute of Social Science Survey at Peking University and the Survey Research Center at the University of Michigan from April 2010 to August 2010. The five main parts of the questionnaire include data on communities, households, and household members, including adults and children.

The survey sample was obtained by a three-stage cluster sampling with unequal probabilities. In the first stage, 16 counties were sampled from the four of the large provinces and 32 township-level units from Shanghai, and 80 counties from the other 20 provinces, with probabilities proportional to population size (PPS). In total, there were 144 counties and 32 township-level units. In the second stage, two or four administrative villages or resident committees were sampled with PPS in each county or town. Together there were 640 villages or resident committees. In the third stage, 28-42 households were sampled from each village or resident committee, and in all there were about 15,000 households. The final national representative sample covers 14,960 households and 33,600 adults (aged 16+ years).