Journal of Comparative Economics 52 (2024) 361–382

Contents lists available at ScienceDirect

Journal of Comparative Economics

journal homepage: www.elsevier.com/locate/jce

Hedging desperation: How kinship networks reduced cannibalism in historical China☆

Zhiwu Chen [a,*], Zhan Lin [b], Xiaoming Zhang [c]

[a] Faculty of Business and Economics (HKU Business School), University of Hong Kong, Pokfulam Road, Hong Kong, China
[b] Institute of Qing History, Renmin University of China, Beijing, China
[c] Department of Sociology, Zhejiang University, Hang Zhou, China

ARTICLE INFO

JEL classifications:
N35
O17
Z13
G20

Keywords:
Kinship networks
Confucianism
Cannibalism
Violence
Risk mitigation
Resource pooling

ABSTRACT

Survival cannibalism persisted across human societies until recently. What drove the decline in cannibalism and other forms of violence? Using data from the 1470–1910 period, this paper documents that in historical China, the Confucian clan—an institutionalized kinship network—acted as an informal internal market to facilitate intra-clan resource pooling and risk-sharing, thus reducing the need for cannibalism during times of drought-related famine. The risk mitigation role of the clan remains robust after controlling for economic development and other factors and ruling out alternative channels. Thus, kinship networks and their associated culture contributed to human civilizational development before the advent of formal markets.

1. Introduction

Preindustrial societies did not have access to well-developed markets, especially financial markets, to help residents cope with adverse shocks. The literature on development economics shows that when humans did not have tools to mitigate the impact of natural disasters, either *ex ante* or *ex post*, it often resulted in inter-personal and even inter-group violence (e.g., Miguel, 2005; Bai and Kung, 2011; Jia, 2014a; Burke et al., 2015; Chen et al., 2017; Dix-Carneiro et al., 2018). This partly explains why residents in hunter–gatherer and agrarian societies frequently lived in misery. However, another strand of research shows that various forms of human violence (e.g., homicide, war and ordinary conflicts) had been in persistent decline for centuries before the advent of the Industrial Revolution (Pinker, 2011), suggesting developmental progress that improved human resilience in the face of risk events even before modern formal markets were fully developed. One example of such progress is the development of kinship networks, which are known to play a

☆ We thank Yaohui Hu, Sijie Hu, James Kung, Jin Li, Nan Li, Chicheng Ma, Kaixiang Peng, Andrew Sinclair, Zhigang Tao, Wei Xiong, Jing Zhang and the participants at the 2022 ASREC Conference at Chapman University, the Economic Development and Thoughts Evolution seminar at Xiamen University, and the History and Economics seminar at Heilongjiang University for their helpful comments and suggestions. Comments and suggestions from Hongbin Li (JCE editor) and an anonymous referee helped to improve the paper substantially. We thank Mukun Ge for her excellent research assistance. The work described in this paper was substantially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project Reference Number: AoE/B-704/22-R). Any remaining errors are ours.

* Corresponding author.
E-mail address: zhiwu.chen@hku.hk (Z. Chen).

https://doi.org/10.1016/j.jce.2024.01.003
Received 21 August 2022; Received in revised form 17 January 2024; Accepted 29 January 2024
Available online 12 April 2024

key role in smoothing consumption (e.g., Rosenzweig, 1988; Rosenzweig and Stark, 1989; Townsend, 1993), stabilizing investments (Kinnan and Townsend, 2012) and facilitating collective action (Cao et al., 2022) in the rural villages of underdeveloped economies. Still, a link between kinship organizational development and declines in violence remains to be established.

Using the Confucian clan, the predominant lineage organization in historical China, this paper studies how kinship networks helped to reduce violence, particularly cannibalism, via risk mitigation. Before the Song dynasty (960–1279 CE), kinship networks were not yet formally developed to bring agnatic families together and institutionalize their rights and obligations to each other (Ebrey, 1991). The consequent lack of intra-lineage cohesion led to limited resource pooling and risk-sharing among agnates. However, lineage organization in China underwent a series of institutional innovations during the Song, resulting in conversion to a clan structure that was organized according to Confucian principles and that served as the most important internal financial market and raised intra-clan resource pooling and risk-sharing to new levels. The innovations introduced and propagated by Confucian sages include the compilation of genealogy to map the patrilineal tree and codify clan rules and norms; the construction of ancestral hall to provide a physical place for kinsmen to gather for ancestor worship, festivals and other regularized rituals; and the formation of lineage estates that held land and other property to offer material relief to disaster-hit and otherwise less fortunate members (e.g., Baker, 1979, chapters 3–4; Ebrey, 1991). These Song-era reforms not only formally institutionalized the Confucian clan (or, the Chinese clan) and distinguished it from kinship networks in other societies (Enke, 2019; Moscona et al., 2020) but also transformed Confucianism from a loose collection of norms and values into a physical existence that organized daily life and facilitated the trust needed to maintain intertemporal commitments and coordinate cooperation within the clan. For example, the problems of adverse selection and moral hazards resulting from clan-based resource pooling were made less severe by enforcement of the rules included in the genealogy book and regular gatherings at the ancestral hall that reduced informational asymmetry. Consequently, although China did not develop formal financial markets until the late 19th century (Chen et al., 2022), the clan served as the predominant medium of interpersonal cooperation (Greif and Tabellini, 2017).

Still, adherence to Confucianism and adoption of the clan organization varied widely by region. This variation provides us with an appropriate setting to study the impact of improved risk mitigation through resource pooling on socioeconomic outcomes. In this paper, we focus on cannibalism, an atrocious form of social violence; we hypothesize that regions with a stronger clan presence were better equipped to mitigate the negative shocks of risk events, such as drought and other natural disasters, and thus experienced fewer instances of cannibalism during times of hardship.

We choose cannibalism as the outcome variable to investigate based on two considerations. First, while systematic data on general violence in historical China are not available, records on extreme forms of violence, such as cannibalism, are better kept although they may be subject to underreporting bias (we address this shortly). Second, the frequency of cannibalistic acts can be treated as a proxy for the overall level of violence in a given region, assuming that these two variables are strongly correlated. Although cannibalism is now regarded as a morally and legally unacceptable act—and a taboo topic—in civilized societies, this practice has a long history (Degusta, 1999; Gráda, 2015; Martin, 2017). Why did cannibalism occur at all? According to Diamond (2000), cannibalism can be classified as survival-driven (e.g., famine-induced desperation) or customary (i.e., intentional consumption of human flesh in the context of superstitious rituals). Based on the post-1600 CE history of cannibalism in many countries, Gráda (2015) claims that survival cannibalism was often caused by famines that brought humans to the brink of survival; hence, cannibalistic acts can be avoided by mitigating desperation through interpersonal resource pooling and risk-sharing.[1] In historical China, the official documents of the imperial court recorded instances of survival cannibalism in connection with severe natural disasters; even in the 20th century, cannibalism occurred during the Great Famine of 1958–1961 CE (Dikötter, 2010; Zhou, 2012; Meng et al., 2015).

For this study, we construct a unique panel dataset on cannibalism that covers the Ming (1368–1644 CE) and Qing (1644–1911 CE) dynasties by manually searching all available official archives (e.g., the *Veritable Records of the Ming Dynasty* and the *Veritable Records of the Qing Dynasty*) and county gazetteers from across China. The dataset contains 1810 recorded instances of cannibalism that took place across the 267 prefectures (based on the 1820 administrative zoning) during the 1368–1911 CE period. Although the total number of prefecture–year observations is large, only a fraction of prefecture-years have a non-zero number of instances of cannibalism over the studied period. Therefore, we use a decade as the basic unit of time and the resulting prefecture–decade panel data for our empirical analysis. As the earliest available prefectural weather data start in 1470 CE, the sample period for our main analyses is 1470–1910 CE. To explain cross-prefectural variation in survival cannibalism, we use each prefecture's genealogy density—the number of genealogy books compiled in the prefecture prior to a given decade and normalized by its population—as a proxy for the strength of clan presence (and of intra-clan risk mitigation).[2] We find a significantly lower frequency of cannibalism in regions with a stronger clan presence during periods of weather shocks. On average, an exceptional drought year increases the frequency of cannibalism in a region by 111 %. However, a 10 % increase in clan density reduces the frequency of severe drought-induced cannibalism by 4.78 %. This result is robust to the inclusion of various controls, including New World crops, economic prosperity (proximity to treaty ports and concessions), church influence, government disaster relief and prefectural fixed effects, and is upheld under different specifications and robustness checks. Starting with the Ming dynasty in 1368 CE, Chinese emperors increasingly strengthened the promotion of clan formation to the grassroots, resulting in a steady increase in the country's clan density in the ensuing centuries (see also the time-series trends documented in Greif and Tabellini (2017) and Chen et al. (2022). This increase in clan density, together with our findings in this paper, at least partly explains the long-term decline in cannibalism in China. Thus, improved risk mitigation through highly developed kinship networks appears to reduce violence.

[1] Here the consumption of even dead human corpses is viewed as a form of violence against humanity.

[2] See Chen et al. (2022) and Chen and Ma (2021) for similar research designs.

There may exist endogeneity issues as natural disasters may have incentivized some lineage groups to structure and solidify more formally. To address this and the possibility of omitted variables, we use an instrumental variable (IV) approach. As mentioned earlier, the Chinese clan underwent a series of institutional changes introduced by Confucian sages during the Song dynasty. Zhu Xi (1130–1200 CE, also known as Chu Hsi) is a prominent representative of these sages (Bol, 2008). Therefore, we use his social network, measured by the number of locals in a prefecture who corresponded or interacted with him, as our IV to proxy for his influence.[3] Zhu Xi's social network is arguably orthogonal to and not influenced by cannibalism that occurred much later (e.g., during the Ming and Qing dynasties), except for its effect through the strength of clan presence. Our evidence suggests that Zhu Xi's influence in a given prefecture during the Song dynasty was orthogonal to a host of covariates, such as the prefecture's war frequency, openness and other social organizations, of the Ming and Qing. Using two-stage least squares (2SLS) regression, we obtain results similar to those from our baseline ordinary least squares (OLS) regressions, which show significant attenuating effects of the Confucian clan on cannibalism; specifically, each 10 % increase in clan density is associated with a 7.43 % decline in the frequency of drought-induced cannibalism.

After establishing the causal link from clan strength to a reduction in cannibalism, we still need to establish that intra-clan insurance is the main mechanism supporting this link. As discussed in the sections to follow, survival cannibalism can be avoided when the outcomes of desperation can be hedged through either *ex ante* mitigation efforts (e.g., formation of a clan estate, pooling of resources to start and grow business or to invest in children's education, so as to better prepare for rainy days) or *ex post* resource sharing after adverse events occur. Indeed, Chen and Ma (2021) find that during 976–1850 CE, intra-clan food sharing allowed prefectures with more clans to suffer lower population losses during natural disasters and have fewer premature deaths of sons; Chen et al. (2022) show that in the early 20th century, the share of intra-clan loans (among all recorded interpersonal loans) was significantly higher and average lending interest rates were markedly lower in prefectures with a strong clan presence, signaling the Confucian clan acting to facilitate resource pooling at times good and bad. While data limitations do not allow us to examine all the detailed mechanisms, we investigate one particular mechanism – clan landownership, for which purpose we collect information on landownership by clans and other collectives from county gazetteers and compute the share of arable land owned or managed by clans in each prefecture. The ownership of land and other property made the clan's risk mitigation function substantial. We find that prefectures with a higher share of clan density had a larger share of clan landownership, resulting in significantly less cannibalism in these regions during adverse shocks. Thus, landownership and estate assets represented an important mechanism linking kinship organizational development to a reduction in violence. Through this role, institutionalized kinship networks have contributed to long-term declines in human violence, even before the advent of the Industrial Revolution. In this regard, our work extends beyond the consumption-smoothing functions of primordial social organizations (e.g., Rosenzweig, 1988; Rosenzweig and Stark, 1989; Townsend, 1993; Fafchamps and Lund, 2003; Mobarak and Rosenzweig, 2013). Although our empirical exercise does not directly include formal financial markets, our paper adds to the limited literature on the social value of finance (Zingales, 2015) and its mitigating effects on crime, violence and human misery during risk shocks (Morse, 2011; Burgess et al., 2017; Braggion et al., 2020), at least to the extent that both finance and kinship networks offer resource pooling and risk mitigation services.

There may have been additional mechanisms, such as Confucian conservativism and human capital accumulation, through which clan development helped reduce violence. For example, the Confucian clan is like what Greif (1993) called "a coalition" whose successful organization and functioning required the establishment and enforcement of a set of norms and rules supported by a collective punishment system. As a conservative cultural system, Confucianism, on which the Chinese clan was structured, promoted social norms against cannibalism, the violation of which led to severe repercussions. Thus, it may have been Confucian conservatism, not the clan's risk-mitigation role, that resulted in lower cannibalism in regions with strong clans. Likewise, it is possible that these regions had more elite scholars (i.e., more *jinshi* in the *keju* system; more on this point later) who promoted anti-cannibalistic culture heavily and successfully, leading to lower cannibalism in these prefectures. However, these mechanisms are ruled out by our exercise.

This paper also contributes to the general literature on the history and causes of human conflict (e.g., Pinker, 2011; Voigtländer and Voth, 2012; Chen et al., 2017; Iyigun et al., 2017). Many studies examine the forces that drive violence, such as economic shocks (Miguel, 2005; Dix-Carneiro et al., 2018), weather shocks (Bai and Kung, 2011; Burke et al., 2015; Jia, 2014a; Anderson et al., 2017), government policies (Nunn and Qian, 2014) and kinship networks (Moscona et al., 2020). However, little attention is given to the history of human cannibalism, with studies by Gráda (2015) and Lee (2019) among the exceptions.[4] Our contribution to this line of scholarship is two-fold: we construct a quantitative history of cannibalism in China during the 1368–1911 CE period, and we offer evidence of the factors contributing to a decrease in this atrocious form of violence. In a recent study, Chen et al. (2017) document the puzzling finding that, before the 19th century CE, ordinary people in China faced a lower risk of homicide and led more secure lives than their counterparts in northwestern Europe.[5] This finding is even more puzzling when one considers both the recurrent climatic shocks resulting from ever-changing monsoon patterns and the lower per-capita income in preindustrial China (vs. Europe) (Baten et al., 2010). Our results show that Confucianism in general, and the clan in particular, may have had a pacifying effect by encouraging moderation and securing intra-clan resource pooling and risk-sharing.

[3] Specifically, we construct the instrumental variable by interacting Zhu Xi's social network with a linear time trend, based on the assumption that his impact on Confucian clan formation increased over time.

[4] Ó Gráda (2015) presents a thorough study of several cases of historical cannibalism around the world but does not offer a systematic quantitative study based on a large set of observations.

[5] According to Chen et al. (2017), homicide rates in both China and northwestern Europe converged to below 2 cases per year per 100,000 population during the first half of the 19th century CE. However, the homicide rate was lower in China than in Europe during the 17th and 18th centuries CE.

The remainder of the paper proceeds as follows. Section 2 addresses the historical background of Confucianism, especially its institutionalization of kinship networks, and cannibalism in China. Section 3 introduces the data and provides descriptive evidence. Section 4 examines the attenuating effect of the clan on cannibalistic behavior, and Section 5 establishes the causality of this relationship using an IV approach. Section 6 focuses on the possible mechanisms driving this relationship. Section 7 concludes the paper.

2. Historical background

According to Gráda (2015), "Cannibalism is … the ultimate measure of the resilience or otherwise of civilizational processes to extreme conditions." In this sense, if innovations in lineage organization improve risk mitigation, they should significantly reduce the frequency of cannibalism.

2.1. Cannibalism in history

Cannibalism is a controversial topic among historians. However, it has been practiced by no fewer than 1500 animal species, including humans (Schutt, 2017). Archaeologists continue to debate when humans first began cannibalism (Diamond, 2000), although it is believed to have been a widespread practice by our prehistoric ancestors (Stoneking, 2003). Gráda (2015) cites numerous instances of cannibalism in Europe, Asia, Africa and the Americas from ancient to modern times, due to war, famine, desperation following a typhoon-caused shipwreck, enemy siege or superstition. A story in the Old Testament shows that desperate residents in ancient Israel resorted to cannibalism:

> Then the king asked her, "What is the matter?" And she answered, "This woman said to me, 'Give up your son, that we may eat him, and tomorrow we will eat my son.' So we boiled my son and ate him, and the next day I said to her, 'Give up your son, that we may eat him.' ..." (2 Kings 6:28–29)

And,

> You shall eat the fruit of your own body, the flesh of your sons and your daughters … in the siege and desperate straits in which your enemy shall distress you. The sensitive and very refined man among you …, refusing to share with any of them the flesh of his children he will eat because he has nothing left in the siege and distress that your enemy will inflict on you within all your gates. (Deuteronomy 28:53–55)

In China, the history of cannibalism can be traced as far back as the Paleolithic and as recently as the 20th century (Zheng, 1994). One frequently repeated myth concerns Zhou Wenwang, father of the founding emperor of the Zhou dynasty (1046–221 BCE):

> When Zhou Wenwang was imprisoned by the last emperor of the Shang dynasty (1600–1046 BC), his elderly son was serving as a slave in the Shang imperial court. Then, the Shang emperor killed Zhou's son, made soup from the flesh and bones, and delivered it to Zhou, saying "real noble men do not eat meat soup made from their son's flesh"; Zhou still ate it. (authors' translation from *Chronology of Emperors* (*diwang shiji*), written by Huangpu Mi of the West Jin dynasty, 265–317 CE).

Philosopher Mozi (476–390 BCE) writes of the Zhou dynasty: "South of the Chu state, there is a kingdom where people are eaten. When a first son is born in that kingdom, he is dismembered and eaten; this is considered propitious for the younger sons."[6] Similar historical accounts of the intervening dynasties are omitted here but extensively addressed in Zheng (1994).

For the Ming and Qing periods studied here, we rely on instances of cannibalism recorded in official archives and local gazetteers. In one example, "Due to continuing famine, Wang Jin and others in Wugong county, Shaanxi, murdered the travelers who stopped to rest at his home and consumed their flesh. His wife assisted in the murder with knives and sticks. They even killed a family of three for just a few liters of grain".[7] Our collection includes 1810 recorded instances of cannibalism over the period 1368–1910, where each recorded event of cannibalism is counted as one instance regardless of the actual number of bodies involved.

During the late Qing period, the Governor-General of Jiangsu, Zeng Guofan, wrote in his diary that in April 1859, "Cannibalism is pervasive in southern Anhui. Human flesh initially sold for 30 copper cash per catty, but I have recently heard that it has increased to 120 copper cash per catty" (1 catty equals 0.6 kg). Furthermore, "During the Taiping Rebellion, human flesh in Jiangsu sold for 90 copper cash per catty initially, but later for 130 copper cash" (quoted from Zheng, 1994, p. 117). The severity of famine clearly caused extreme desperation and crime.

2.2. The rise and functions of the Confucian clan

China's search for a solution to the risk mitigation challenge lasted a long time. During the era of Confucius (551–479 BCE), there were at times more than 100 kingdoms across the landmass of today's China and they were engaged in constant conflict. Confucius considered the lack of a clear and rigid social structure to be its root cause and hence sought a social rather than a market-based solution to the challenge. Specifically, he prescribed that to achieve harmony, society must rectify every name and title, enabling everyone to know his or her place in the social hierarchy and act accordingly in terms of their responsibility and obligations to others:

[6] Unless indicated otherwise, the examples cited in this paragraph are selected and translated by the authors from Zheng (1994).
[7] *Veritable Records of the Ming Dynasty: Emperor Xianzong*, volume 282; September 13, 1486.

"[T]he father must act like a father, and the son like a son" (Zhao, 2015, p. 180). Because every man must be someone's son, all men would behave "properly" and fulfill their obligations if each acted according to his place in the stratified order; furthermore, if every woman followed the Confucian principle of "obeying her father before marriage, her husband during marriage and her son in widowhood," then everyone in society would know his or her place, resulting in a rigid but orderly structure of bilateral relations with clearly specified rights and obligations. Enforced by supportive Confucian norms, this rigid system of interpersonal obligations provided a reliable morality-based solution to the problem of risk mitigation as it made interpersonal resource pooling and risk-sharing more secure. After the Han dynasty made Confucianism the state orthodoxy in the 2nd century BCE, Confucian rules and norms continued to be refined and perfected in the ensuing millennia. In this morality-based interpersonal exchange, an individual's position in the social hierarchy, and the obligations to others associated with that position, remained unchanged throughout life, and this constancy made morality-based intertemporal commitments more secure than free will-based market exchange.

To put our empirical work in context, we note that before the Song dynasty (960–1279 CE), Confucianism was a way of life for aristocrats and other elites but had a limited impact on the daily lives of the grassroots. The sages of the Song not only operationalized Confucianism for the commoners but also transformed the kinship-based lineage into a cohesive clan organization[8] that epitomized Confucian ideals and ideas and offered tangible resource-pooling and risk-sharing services to its members. Accordingly, scholars generally agree that the Song marks a dramatic transformation of Chinese society (Lang, 1946; Ebrey and Watson, 1986; Ebrey, 1991; Bol, 2008) that placed the Confucian clan solidly at the center. Greif and Tabellini (2017) claim that over the past millennium, the Confucian clan was the main medium of interpersonal cooperation in Chinese society. As intra-clan cooperation was conducted through kinship obligations rather than explicit contracts, we highlight a few key aspects that made the Chinese clan robust.

First, property was owned under the name of the nuclear family, communal family (group of nuclear families in the same patrilineal line) or clan (patrilineal group of related nuclear and communal families), rather than by individuals, with the eldest male of the unit (i.e., the head) holding the title to its property and having full control over its earnings and savings (Lang, 1946). At both the communal family and clan levels, the head had considerable power to pool and allocate resources among the members. Of equal importance, the bilateral rights and obligations to share resources between any two members were determined in four dimensions: biological distance, generation, relative age and gender. In principle, the closer the biological distance, the greater the members' claims on each other's property and income and, hence, the greater the obligation to pool resources and share risks. Senior kinsmen, by generation or age, had more claim on the property and income of junior kinsmen, and the latter members had more obligations to help the former. A man held more senior entitlements than a woman (Lang, 1946; Ebrey, 1991). In historical China, each person's obligations to others were codified by a system of names and titles, thus securing intra-clan resource pooling and risk-sharing.

Second, clans owned much land and other properties, the income of which was mostly used to pay for lineage activities, wedding and funeral costs, children's education, disaster relief and charity (Leung, 1997). It was also used to provide loans or risk capital for business and other needs of members. This practice was introduced during the Song dynasty by a prominent Confucian scholar-official, Fan Chung-yen (989–1052 CE); to set up the Fan clan estate in 1050 CE, he donated 1000 acres of land as a permanent reserve for the trust and wrote a charter detailing the operational rules, emphasizing its central goal of helping poor and unfortunate members of the clan (Twitchett, 1959). Due to its success, this charitable estate was soon widely copied across the country and continued until the 20th century CE. The estate trust, together with lineage granaries (Shiue, 2004), not only gave the Confucian clan a tangible existence and elevated its risk mitigation function but also boosted clan solidarity and membership devotion.

Third, during the late Song dynasty, the ancestral hall was popularized at the grassroots level by Zhu Xi (1130–1200 CE). "To control the heart of the people needs the gathering of clan members and the promotion of good customs so that the people will not forget their origins" (Zhang Zai, quoted from Liu, 1959, p. 64). In the ancestral hall, members gathered to conduct ancestor worship rituals and hold festivities. This space for clan gatherings provided a crucial platform to address the moral hazards that might arise from intra-clan resource pooling, as it enabled members to obtain updated information about each other and monitor behavior; if free-riding was discovered, the elderly members would issue early warnings.

Fourth, by codifying a clan's rules and embodying its history, genealogy was a key device used to strengthen cohesion among members.[9] Before the Song, genealogy books were compiled only for aristocrats to prove hereditary legitimacy. In the early Song dynasty, Confucian scholars introduced a simplified genealogy template to enable commoner clans to track their patrilineal lines and put a face to each ancestor they were supposed to worship. However, the adoption of the template varied greatly across regions, depending on local preferences. After its founding in 1368 CE, the Ming dynasty actively promoted this practice, expanding the genealogy to include clan rules for rewards and punishment (Liu, 1959). "If there is no genealogy, the families do not know their origins and cannot be kept together very long. Without control among the kin, even sentiment between parents and their children tends to be weak" (Liu, 1959, p. 64).

Of course, Confucian norms and innovations were created not just to be sentimentally pleasing but also to serve economic functions, such as helping members to avoid desperation in the face of disasters. In addition to the intra-clan resource pooling and risk-sharing achieved through clan-owned property and estate assets, the enhanced cohesion and solidarity resulting from genealogy compilation and rituals increased trust among the members, who were hence more likely to help each other directly. Thus, risk

[8] For a general study on cooperative kinship organizations in other traditional societies, see Enke (2019).

[9] Dennerline (1986) shows how two clans near Wuxi, Jiangsu used clan-building devices—marriage, estate trust, clan granary, ancestral hall, rituals, genealogy and clan schools—to maintain solidarity and influence from the Song to the Qing dynasties. By helping to keep the clans tightly organized, these devices allowed each clan to navigate both good and bad times. These cases clearly demonstrate how the clan acted as an institution of resource pooling and risk mitigation.

mitigation via the clan is not only both precautionary (before risk events) and reactive (after risk events) but also at multiple levels.

The literature offers substantial evidence to support this observation. For example, using private lending data from 1911 to 1936 CE, Chen et al. (2022) show that the share of intra-clan loans (among all recorded interpersonal loans) was significantly higher and average lending interest rates were markedly lower in prefectures with a strong clan presence than in other prefectures, implying that the Confucian clan indeed acted as an informal internal financial market. Chen and Ma (2021) find that during 976–1850 CE, population losses due to natural disasters and the premature deaths of sons were significantly lower in prefectures with more clans; as a result, these prefectures generally had higher population densities. According to Zelin (2005), intra-clan capital pooling enabled Zigong, Sichuan to become a boom town full of enterprising salt businesses in the 18th and 19th centuries CE; even the corporate entities were often named after the founder's ancestral hall, signaling the crucial role of the kinship organization. Even in today's China, the importance of intra-clan capital to business startups is unmistakable (Zhang, 2020). Through *ex ante* efforts (e.g., estate trusts, business ventures) and *ex post* inter-member sharing, the clan improved its members' ability to cope with risk.

While the existing evidence establishes the Confucian clan as an internal market, this paper aims to examine the meaning of this role in terms of helping members avoid desperation and violence. Our main hypothesis is that regional variation in Confucian influence, especially clan prevalence, played a crucial role in historical China, such that regions with more clans were better equipped to survive risk shocks and hence experienced less cannibalism in the face of disasters.

3. Historical data and descriptive evidence

Our empirical work is based on a panel dataset covering 267 prefectures in China Proper[10] over the 1470–1910 period. In this setting, a prefecture is a mid-level administrative unit between province and county, as determined in 1820 CE.

3.1. Cannibalism and natural disasters

Our data on cannibalism come from two sources. The first is the multiple volumes of the "*Comprehensive Compilation of Weather Records for the Last Three Millennia of China*" (Zhang, 2004), a collection of pertinent information on weather events and social conflicts compiled from thousands of local gazetteers (see an example in Fig. A2). The second major source is the *Veritable Records of the Ming Dynasty* and *Veritable Records of the Qing Dynasty*. We manually search for and collect records of cannibalistic instances in any county, year by year, and aggregate the occurrences into a prefecture–year panel.[11] Altogether, these sources yield 1810 instances of cannibalism that occurred during 1368–1911 CE (543 years).[12] Compared with the Qing dynasty (420 instances), more instances of cannibalism occurred in the Ming dynasty (1390 instances). On average, the frequency of cannibalism in the Ming (4.7 instances per year) was 3 times as high as that in the Qing (1.6 per year). However, as shown in Fig. 1, the temporal distribution of such events was highly uneven within each dynasty.

The incidence of cannibalism peaked at 242 instances in 1640 CE, during the disastrous period of 1639–1642 CE (2 years before the collapse of the Ming).[13] This peak was a result of widespread drought in northern China and raging civil wars across the country. The 16th and 17th centuries also marked an abnormal climatological period known as the "Little Ice Age," during which the prolonged absence of sunspots and a dramatic increase in volcanic activity reduced global temperatures and precipitation levels (Parker, 2013), causing long-lasting catastrophic drought and plague events in the Northern Hemisphere that helped end the Ming dynasty.

To document the link between risk events and cannibalism, we use the weather data compiled by the Chinese Academy of Meteorological Science (1981). This compendium provides annual prefecture-level precipitation data dating back to 1470[14] and ranks the weather condition of each prefecture–year on a 5-point scale, with 1 representing "exceptional flood"; 2, "limited flood"; 3,

[10] The 267 prefectures are chosen based on the administrative zoning of 1820 CE (please refer to Appendix Fig. A1 to find the full map of Qing China in 1820 CE), partly due to data availability as county-level data on population and climate during the Ming dynasty are not available. These prefectures in hinterland China accounted for more than 90% of the total population during the studied period. This choice is also consistent with the literature (Chen and Kung, 2016; Chen et al., 2022).

[11] One concern is the possible underreporting of cannibalism, as locals might have been unwilling to record such atrocious acts. Note that cannibalism was normally recorded in the "disasters" section of local gazetteers, as most such events occurred in times of extreme distress. As the compilers tended to use cannibalism to illustrate the severity of a disaster and win sympathy, they were more incentivized to avoid omitting such occurrences. As an encyclopedia of local socioeconomic events, each gazetteer was compiled by a host of local distinguished scholars and gentry, whose reputation was at stake and who were either direct witnesses to events or able to interview first-hand witnesses (Xiao and Yan, 2019). In addition, we verify the local gazetteers' records of cannibalism by comparing them with the *Veritable Records of the Ming and Qing Dynasties* (the imperial chronology of all major political, social, economic and military events in the country). Official historians responsible for writing these chronologies were mindful that history books were intended to provide lessons for future governors and other officials, such that the "bad" events of the past would serve as warnings (Edgerton-Tarpley, 2008); thus, they were incentivized to make the records complete. Historically, prosperous regions tended to keep local gazetteers and other records more diligently than poor regions. That is, poor prefectures were more likely to underreport on cannibalism than rich prefectures. To the extent that regions with a stronger clan presence tended to be richer and better developed (Chen et al., 2020; Chen et al., 2022), a greater degree of underreporting on cannibalism in poor vs. rich regions would work against our main hypothesis.

[12] Note that of the 1,810 records of cannibalism, 87 cases do not contain location information and are hence excluded from our empirical analyses.

[13] During the Qing dynasty, the drought in 1877 CE led to the highest instances of cannibalism. See Edgerton-Tarpley (2008) for more coverage of this episode.

[14] These data are used in previous studies (e.g., Jia, 2014a; Kung and Ma, 2014).

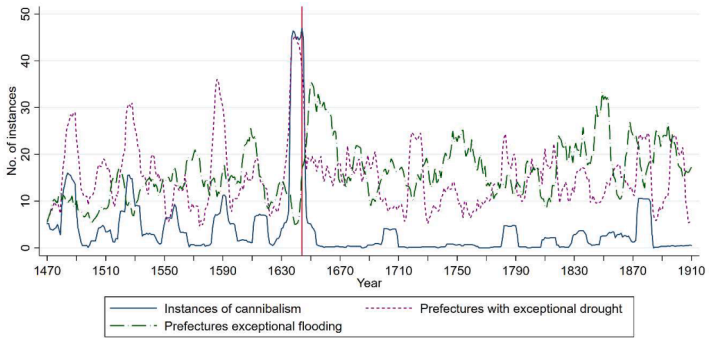


Fig. 1. Temporal distribution of cannibalism in the Ming and Qing dynasties. Notes: The red vertical line denotes the year of transition (1644 CE) from the Ming to the Qing dynasties. *Instances of cannibalism* represents the yearly number of cannibalism instances. *Prefectures with exceptional drought (flooding)* is the total number of prefectures in which an exceptional drought (flood) took place in a given year. In this figure, *Instances of cannibalism, prefectures with exceptional drought* and *prefectures with exceptional flooding* are each smoothed by taking the 10-year moving average (5 lagged, 4 forward and 1 current observation). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

"normal"; 4, "limited drought"; and 5, "exceptional drought." Fig. 1 plots together the 10-year moving averages of the annual nationwide instances of cannibalism (dark blue line), the number of prefectures with exceptional drought (red dotted line) and the number of prefectures with exceptional flood (green dashed line). The graph clearly illustrates a stronger correlation between cannibalism and exceptional drought events compared to cannibalism and flood events. This observation aligns with previous research that associates extreme hardship more closely with drought than with flooding, as droughts hinder growth and typically have expansive, long-lasting detrimental effects on human livelihood (e.g., Bai and Kung, 2011; Jia, 2014a). In contrast, during floods, farmers often have the opportunity to replant crops once the floodwaters recede.

Historical climate data at the prefecture level is only available from 1470 onwards, so our subsequent analyses focus on the sample period spanning 1470–1910 CE. During this time, there were 1670 instances of cannibalism distributed across 117,480 prefecture-years (267 × 440). Consequently, only 1.4 % of the prefecture-years in the panel have a non-zero value for our outcome variable—each prefecture's instances of cannibalism—potentially rendering our estimations unreliable.[15] To address this issue, we modify our basic unit of observation to prefecture-decade, reducing our panel to 11,481 observations.[16]

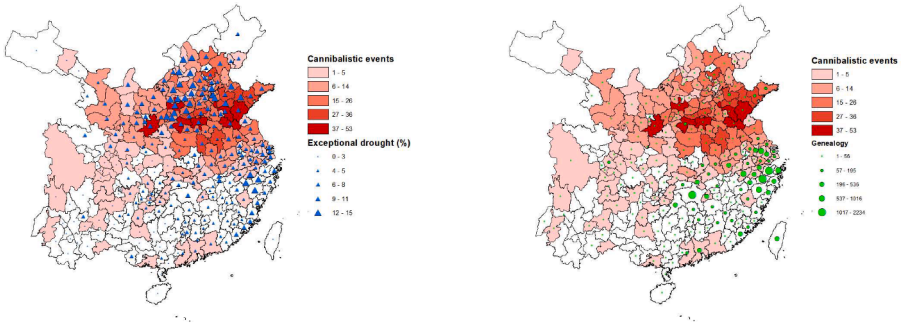
Using data from the 1470–1910 CE period, Fig. 2(a) presents the geographical distribution of cannibalism by prefecture, together with each prefecture's share of exceptional-drought years. Note that most instances of cannibalism occurred in northern China, including the provinces of Shanxi, Shaanxi, Zhili, Henan and Shandong and parts of Jiangsu, where the frequency of exceptional drought was higher (indicated by the sizes of the dark blue triangles). Jiangxi and coastal provinces (e.g., Zhejiang and Fujian) are exceptions with relatively high rates of drought but low frequencies of cannibalism; most other regions experienced low rates of both drought and cannibalism. These patterns are investigated in subsequent sections. Here, we offer two observations on northern China. First, this region was prone to drought (Fig. 2(a)) and other natural disasters during the studied period, perhaps due to its location between two climate zones, with the north better suited to nomadic or pastoral economies and the south to agricultural crop-farming (Cao, 1997). It also had higher weather volatility, with frequent instances of both drought and flooding. Second, China's most volatile rivers—the Yellow, Huai and Hai rivers—passed through much of the region, often posing challenges in the form of levee breaches to populations along their banks (Li, 2007). Breach-induced flooding often created ideal breeding grounds for locusts, leading to far greater destruction than flooding itself. In our empirical exercise, we control for these environmental and geographical factors and formally investigate the drivers of regional variation in cannibalism during the studied period.

3.2. Measurement of clan strength in a region

To explain regional variation in cannibalism, our central variable of interest is the prevalence or strength of kinship networks—the clan, as proxied by the number of genealogies per 100,000 population (i.e., genealogy density) in a prefecture. As noted in Section 2, genealogy—a defining element of a Confucian clan—played a crucial role in clan cohesion, as its physical existence facilitated members' identification and made clan rules and norms tangible. While some lineages might not have compiled genealogies, those that did displayed more serious devotion to clan formation, giving support to our treatment of a prefecture's genealogy density as a proxy

[15] Note that for the same prefectures and the 1470-1900 period, Jia's (2014a) sample has 249 peasant revolts (out of 114,810 prefecture-years), yielding a non-zero outcome value for 0.22% of the prefecture-years. Kung and Ma's (2014) study covers 107 Shandong counties over the 1644-1911 period (a total of 28,596 county-years), with a non-zero number of peasant rebellions (their outcome variable) for 0.44% of the county-years. Thus, in comparison, our data sample should be more robust than theirs. Nonetheless, we use prefecture-decade as our unit of analysis for improved robustness as in Bai and Kung (2011).

[16] We lose 267 observations because we use the lagged value of clan density (see below), leaving us with 11,481 observations.



(a) (b)

Fig. 2. Spatial distribution of cannibalism, exceptional drought and genealogy. Notes: Panel (a) shows the prefectural distribution of the total instances of cannibalism recorded during the Ming and Qing dynasties (1470–1910 CE), together with *exceptional drought*, measured by the share of exceptional drought years in each prefecture and over the entire period. Panel (b) illustrates the prefectural distribution of the total instances of cannibalism, together with the total number of genealogies compiled up to 1910 CE by prefecture. Map source: China Historical Geographic Information System (CHGIS, 2016) V6, Harvard University. https://sites.fas.harvard.edu/~chgis/data/chgis/v6/ (accessed 2022/02/09).

for both its clan density and Confucian influence intensity.[17] For the remainder of this paper, we refer to this proxy, labeled as *Clans* in the tables, interchangeably as clan density and genealogy density.

Our genealogy data are obtained from a multi-volume work, *General Catalogue of Chinese Genealogy* (*Zhongguo Jiapu Zongmu*), compiled by the Shanghai Library (2009). This is arguably the most comprehensive collection of genealogy throughout the history of China, containing information on the location and approximate time of compilation (when available) of each genealogy, which allows us to compute and analyze data by year and prefecture as needed. Altogether, the Catalogue includes 52,306 genealogies, 38.24 % (i.e., 20,003) of which were compiled before 1911 CE. The Catalogue is subject to survivorship bias, as it includes only genealogies that had survived at the time of publication. An unknown number of genealogies have been lost over the centuries due to water damage, paper decay, war, migration-forced abandonment and political movements (e.g., the Cultural Revolution of 1966–1976 CE, which forced many households to destroy genealogies). Genealogy survivorship is likely to vary across regions. To the extent that regions that adhered more seriously to the Confucian way of life were more likely to have made efforts to preserve genealogies, this survivorship bias should make each prefecture's surviving genealogy density a more informative measure of local clan influence. We use our IV to partly address the issue of potential survivorship bias.

We can roughly check whether the surviving sample is representative of the unobserved true genealogy population by comparing its spatial distribution with historical narratives. In Fig. 2(b), the number of surviving genealogies is highly uneven across the prefectures, as most are in southeast China; this is consistent with historical narratives of a strong clan presence in the southeastern provinces (Ebrey and Watson, 1986).[18] Interestingly, this pattern is almost the mirror image of the spatial distribution of cannibalism, suggesting a strong negative correlation between clan presence and the frequency of cannibalism (and violence in general), the causality direction of which will be formally tested in the next section.

Our population data are sourced from Cao (2000, 2001), who provides the most systematic estimates of historical prefectural populations based on local gazetteers. His data cover nine time points during our sample period: 1393, 1580, 1630, 1680, 1776, 1820, 1851, 1880 and 1910 CE. The populations of the in-between years for a given prefecture are linearly interpolated from his estimates for adjacent years. In what follows, we will use units of 100,000 people as the basis to arrive at prefectural population-normalized metrics.

3.3. Controls for other effects

Besides clan density, a host of other factors may affect our outcome variable, cannibalism, in each prefecture in a given decade. To remove these effects, we include various controls, of which two are explained below.

3.3.1. Population density

The clan may have affected the rate of cannibalism during our studied period through two channels: the wealth effect and the risk mitigation effect. As Zelin (2005) and Zhang (2020) demonstrate, close-knit clans pooled their resources and promoted private business development, thus enriching their prefectures and reducing their likelihood of desperation. Although this impact is hardly separable from the clan's *ex ante* risk mitigation channel (i.e., accumulating wealth to improve risk resilience), we still attribute it to the wealth effect of the clan and thus try to control for it. A large body of research demonstrates that population density is a reliable proxy for economic development in preindustrial societies for which GDP and income estimates are unavailable (e.g., Acemoglu et al., 2002): higher population density in a region means greater economic prosperity. To account for the wealth channel, we include each

[17] See Greif and Tabellini (2017), Chen et al. (2022) and Chen and Ma (2021) for the use of a similar proxy for clan strength in a region.
[18] In Section 5, we explain in more detail the historical roots of this spatial pattern.

prefecture's decadal population density as a control.

3.3.2. Wars

Warfare is another important factor that may contribute to cannibalism (Lee, 2019) and unevenly affect the survival of genealogy books across prefectures. We thus include each prefecture's decadal share of war years, *Wars*, as a baseline control. Data on this variable are obtained from China's Military History Editorial Committee (2003).

To avoid overwhelming the reader with our many controls and justifications, we introduce the rest in due course in later sections. Table 1 provides a short definition of each variable used in this study, together with their descriptive statistics.

4. Empirical results

Our formal tests focus on whether the role played by the clan in risk mitigation reduced the frequency of cannibalism in China during the studied period.

4.1. The empirical setup

We estimate the following specification:

$$Y_{it} = \alpha_1 Clans_{i(t-1)} * Exceptional\ drought_{it} + \alpha_2 Clans_{i(t-1)} * Limited\ drought_{it} + \alpha_3 Clans_{i(t-1)} * Exceptional\ flood_{it} + \alpha_4 Clans_{i(t-1)} * Limited\ flood_{it} + \beta_1 Exceptional\ drouht_{it} + \beta_2 Limited\ drouht_{it} + \beta_3 Exceptional\ flood_{it} + \beta_4 Limited\ flood_{it} + \gamma Clans_{i(t-1)} + \mathrm{X}_{it}\Gamma + \delta_i + \rho_t + \lambda_{it} + \varepsilon_{it}$$

where Y_{it} is the number of instances of cannibalism in prefecture i in decade t (normalized by the prefecture's average population during t in units of 100,000 people); clan density ($Clans_{i(t-1)}$) is the number of genealogies compiled prior to t, normalized by the prefecture's population (in logarithm)[19]; *Exceptional drought/flood and Limited drought/flood* are weather shock variables, each of which represents the decadal share of years in which the given type of weather event occurred; X_{it} is a vector of the baseline controls defined above; and δ_i and ρ_t are the prefectural and time fixed effects, respectively. A prefecture-specific linear time trend, λ_{it}, is added to address the cumulative nature of each prefecture's genealogies (*Clans*). Therefore, the α coefficients capture the attenuating effect of clans on violence during periods corresponding to different types of weather shocks. We cluster the standard errors at the prefectural level to address the possible serial correlation of the error term ε_{it}.

4.2. Baseline results

The baseline results are reported in Table 2. In column (1), both exceptional and limited drought events are shown to have a statistically significant and positive effect on cannibalism, whereas exceptional and limited flood events do not have a significant effect, despite yielding negative coefficients. This result holds after we add both the prefecture and period fixed effects (column (2)). This finding is in line with the literature, wherein drought is reported to be more destructive and violence-inducing than flood because drought, especially when prolonged, affects the entire food chain and threatens the survival of all living creatures; in contrast, flood damage usually can be remedied through efforts such as re-cultivation after the storm water recedes (Bai and Kung, 2011; Jia, 2014a; Kung and Ma, 2014). In particular, the coefficient for the effect of exceptional drought on cannibalism is statistically significant at the 1 % level and much larger than the coefficients corresponding to the other types of weather events. According to column (1), each additional year of exceptional drought in a typical decade, on average, leads to a 132 % increase in the number of instances of cannibalism per 100,000 population in a prefecture (relative to the mean), whereas each additional year of limited drought leads to a 20.5 % increase in cannibalism.

In column (3), we include interaction terms between a prefecture's clan density and each of the four types of weather shocks; additionally, we control for the two fixed effects and the prefecture-specific time trend. In this analysis, only two terms are statistically significant: *Exceptional drought* and its interaction with *Clans*. The coefficient of the former, 0.448, is similar to that in column (2), whereas the coefficient of the interaction term is -0.211, meaning that although exceptional drought events are associated with an increased likelihood of cannibalism in our sample, having more clans in the prefecture significantly attenuates that effect. Thus, the clan helped to reduce cannibalistic violence, particularly in regions subjected to severe drought, which supports our hypothesis.

The other three types of weather shocks did not have statistically significant effects on the incidence of cannibalism, irrespective of the strength of clan presence. Accordingly, the value of the resource-pooling and risk-mitigation functions of kinship networks is revealed only in taming the adverse impact of exceptional drought.

These results remain almost unchanged after we add two baseline controls: population density and wars. We find the risk mitigation effect by the clan to be still significant. As shown in column (4), each additional year of exceptional drought increases the incidence of cannibalism by 111 % (relative to the mean).[20] Doubling a prefecture's average clan density reduces this increase in cannibalism by

[19] To avoid reverse causality, we take the lagged value of *Clans* (i.e., genealogy books compiled by the previous decade). The results remain robust when we use the current value of *Clans* (not reported).

[20] This calculation is based on column (4) of Table 2: [(0.445 × 0.1] / 0.04) × 100 = 111.

Table 1
Summary statistics.

	Obs.	Mean	S.D.	Min	Max	Period
Dependent variables						
Instances of cannibalism	11,481	0.04	0.34	0	11.08	1470–1910
Total instances of cannibalism (Qing)	267	0.24	0.39	0	2.75	1644–1910
Independent variables						
Exceptional drought	11,481	0.06	0.09	0	0.60	1470–1910
Exceptional flood	11,481	0.06	0.09	0	0.60	1470–1910
Limited drought	11,481	0.13	0.15	0	0.80	1470–1910
Limited flood	11,481	0.16	0.16	0	0.80	1470–1910
Clans $_{(t\text{-}1)}$	11,481	0.29	0.64	0	4.79	1470–1910
Clans (alternative measure) $_{(t\text{-}1)}$	11,481	0.63	1.15	0	6.78	1470–1910
Clans (in total)	267	0.86	0.97	0	4.62	1644–1910
Control variables						
Chaste women	267	3.37	0.99	0	7.63	1644–1910
Confucian temples	267	0.80	0.43	0	2.49	1644–1910
Confucian academies	11,481	0.05	0.14	0	2.55	1470–1910
Jinshi degree holders	11,481	0.28	0.45	0	4.34	1470–1910
Population density	11,481	0.08	0.09	0	1.19	1470–1910
Sweet potato introduction	11,481	0.47	0.50	0	1.00	1470–1910
Maize introduction	11,481	0.33	0.47	0	1.00	1470–1910
Wars	11,481	0.01	0.04	0	0.70	1470–1910
Treaty ports	11,481	0.01	0.12	0	1.00	1470–1910
Concession	11,481	0.01	0.09	0	1.00	1470–1910
Churches	11,481	0.02	0.13	0	3.77	1470–1910
Government relief	11,481	1.22	1.48	0	6.19	1470–1910
Terrain ruggedness index	267	233.98	182.73	4.42	972.47	time-invariant
River density	267	51.20	23.24	0	142.43	time-invariant
Distance to the Grand Canal	267	12.90	1.65	4.87	14.55	time-invariant
Distance to the coastline	267	5.82	1.12	1.16	7.56	time-invariant
Instrumental variable						
Social networks of Zhu Xi	267	0.78	1.33	0	5.78	time-invariant
Mechanism variable						
Clan land	250	0.06	0.09	0	0.41	late Qing

Notes: *Instances of cannibalism* is the decadal number of instances of cannibalism in each prefecture, normalized by the prefecture's decadal average population (in units of 100,000; the same treatment applies to other population-based normalizations in the paper). *Total instances of cannibalism (Qing)* is the total number of instances of cannibalism occurring in a prefecture during the Qing dynasty, normalized by the prefecture's average population during the Qing dynasty. *Exceptional drought (flood)* is the prefecture's decadal share of years during which an exceptional drought (flood) took place. *Limited drought (flood)* is defined similarly. *Clans* represents the logarithm of the number of genealogy books that were compiled in the prefecture from the beginning of the Song dynasty to the decade in which the outcome variable is observed, normalized by the prefecture's decadal average population. *Clans (alternative measure)* denotes the logarithm of the accumulated number of genealogy volumes (sum of the number of volumes included in each clan's genealogy rather than counting each clan's genealogy as 1) compiled in the prefecture prior to the decade, normalized by its decadal average population. *Clans (in total)* represents the logarithm of the total number of genealogy books compiled prior to 1911 CE in the prefecture, normalized by its average population during the Qing dynasty. *Population density* is the prefecture's decadal population density (in units of 1000) per km^2 of land (in logarithm). *Wars* is the prefecture's decadal share of war years. *Sweet potato introduction* is a dummy variable indicating whether sweet potato had already been introduced in a prefecture. *Maize introduction* is a dummy variable indicating whether maize had already been introduced in a prefecture. *Treaty ports* and *Concession* are dummy variables indicating whether a prefecture was a treaty port or a concession, respectively. *Churches* is the logarithm of the decadal number of churches established in a prefecture, normalized by its decadal average population. *Government relief* is the decadal number of times that a prefecture received public relief (e.g., monetary transfer or tax exemption) (in logarithm). *Chaste women* is the logarithm of the number of chaste women documented in a prefecture's local gazetteers before 1820 CE, normalized by the prefecture's average population during the Ming and Qing dynasties. *Confucian temples* is the logarithm of the number of Confucian temples established during the Ming and Qing dynasties (prior to 1820 CE), normalized by the prefecture's average population. *Confucian academies* is the logarithm of the number of Confucian academies, normalized by the decadal average population. *Jinshi degree holders* is the logarithm of the prefecture's decadal number of *jinshi* degree holders, normalized by its decadal average population. *Terrain ruggedness index* is the difference in elevation between adjacent cells on a digital elevation grid provided by the United States Geographic Services (USGS, 1996) (https://www.usgs.gov/core-science-systems/national-geospatial-program/national-map (accessed 2022/02/09)). *River density* is the prefecture's navigable river density (km/km^2). *Distance to the Grand Canal* is the logarithm of the shortest great-circle distance to the Grand Canal (in km). *Distance to the coastline* is the logarithm of the shortest great-circle distance to the nearest coastline (in km). *Social networks* is measured as the logarithm of the number of people in a prefecture who were socially connected with Zhu Xi in the 12th century CE, based on the Qing dynasty's prefecture. *Clan land* is the share of a prefecture's total arable land that was owned or managed by clans.

Table 2
Natural shocks, cannibalism and clans: OLS estimates.

	Dependent variable: instances of cannibalism			
	(1)	(2)	(3)	(4)
Exceptional drought	0.529***	0.391***	0.448***	0.445***
	(0.061)	(0.055)	(0.062)	(0.061)
Exceptional drought × $Clans_{(t-1)}$			-0.211***	-0.213***
			(0.038)	(0.038)
Limited drought	0.082***	0.058**	0.044	0.042
	(0.021)	(0.024)	(0.030)	(0.030)
Limited drought × $Clans_{(t-1)}$			-0.031	-0.032
			(0.021)	(0.021)
Exceptional flood	-0.049	-0.014	-0.035	-0.032
	(0.037)	(0.042)	(0.056)	(0.055)
Exceptional flood × $Clans_{(t-1)}$			0.037	0.038
			(0.033)	(0.033)
Limited flood	-0.002	0.048	0.046	0.046
	(0.028)	(0.029)	(0.040)	(0.040)
Limited flood × $Clans_{(t-1)}$			-0.038	-0.041
			(0.025)	(0.025)
$Clans_{(t-1)}$			0.002	-0.009
			(0.008)	(0.009)
Population density	No	No	No	Yes
Wars	No	No	No	Yes
Period FE	No	Yes	Yes	Yes
Prefecture FE	No	Yes	Yes	Yes
Prefecture-specific time trend	No	No	Yes	Yes
Observations	11,481	11,481	11,481	11,481
R-squared	0.024	0.114	0.163	0.163

Notes: The unit of observation is prefecture–decade. For variable definitions, refer to the notes to Table 1. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

47.87 %.[21]

4.3. Robustness checks

Next, we consider additional channels and specifications. Table 2 shows that after accounting for the clan effect, exceptional drought was the only type of weather shock with a significant impact on cannibalism. Hereafter, we focus exclusively on exceptional drought and adjust for the effects of other mitigation channels. The following controls are added that may have contributed to regional variation in cannibalism.

4.3.1. Introduction of new world crops

New World crops, such as sweet potato and maize, are less water-dependent than traditional Chinese crops and hence more drought-resistant. They acted like "insurance foods" to alleviate the impact of drought on people's livelihood (Jia, 2014a; Chen and Kung, 2016). Therefore, we expect the early and widespread adoption of these crops to be associated with increased resilience to drought risk in the affected regions. To correct for this channel, we include a province–decade dummy, *Sweet potato introduction*, which takes a value of 1 if the province grew sweet potatoes during a given decade and 0 otherwise; the data are obtained from Jia (2014a). The province-decade dummy, *Maize*, is similarly defined. Note that sweet potato and maize were typically introduced to a province concurrently, although the adoption times of these crops differed across provinces (Chen and Kung, 2016).

4.3.2. Trade prosperity

During the Qing dynasty, China opened its door to foreign trade after losing the 1839–1842 Opium War and some coastal territories became extralegal treaty ports or concessions where foreigners could freely reside and engage in trade, which significantly changed the socioeconomic landscape of these regions and led to rapid economic development (Jia, 2014b). We thus add two dummies, *Treaty ports* and *Concession*, to indicate respectively whether a prefecture was a treaty port or concession in a given decade (in which case the corresponding dummy takes a value of 1), based on data from Yan (1955). Note that commercially developed regions might experience less cannibalism not only because they might be richer but also because market-driven interregional goods transportation might make them more resilient to weather-caused food-supply shocks (as traders would fill the gap through interregional trade).

4.3.3. Church influence

Although we show that the presence of the Confucian clan reduced violence through its role as a risk-mitigating institution, other

[21] This calculation is based on column (4) of Table 2: [(0.2131) / 0.445] × 100 = 47.87.

social organizations, such as churches and mosques, may have played a parallel role (Chen, 2010). Bai and Kung (2015) show that the introduction of the Protestant church to China in the 19th century promoted urbanization and human capital development, which might also have increased local resilience to risk. We control for this effect by including the logarithm of the decadal number of churches in a prefecture per 100,000 people (*Churches*), based on data from Stauffer, Milton Theobald (1922).

4.3.4. Government relief

Disaster relief is a type of public good provided by a modern government and a basic performance metric of state capacity (Shiue, 2004). Clearly, abundant state-provided disaster relief can tame various forms of violence, especially cannibalism, during times of hardship. Therefore, we correct for this potential effect of state capacity by including *Government relief*, which indicates the number of times that government-provided disaster relief (e.g., monetary transfers, grain shipments and tax exemptions) was received by a prefecture in each decade (in logarithm), using data from Chen et al. (2012). Arguably, prefectures with a strong Confucian clan presence might have had better government connections than other prefectures during our studied period and hence received more official relief in times of crisis. Consequently, these prefectures would have experienced reductions in cannibalism not because of the risk mitigation effect of clans but because of the strong government connections afforded by clans.

As shown in Table 3, we gradually add these controls and find that our main result remains robust.[22] The coefficients of both *Exceptional drought* and its interaction term with *Clans* are stable and statistically significant at the 1 % level.

For our analysis, we have used genealogy density to proxy for the extent of clan influence in a prefecture; here, we give a score of 1 to each clan's genealogy (regardless of how many volumes the genealogy contains) and then sum the scores of all clan genealogies in the prefecture before normalizing the sum by its population. Arguably, a genealogy with 100 volumes signals a bigger, stronger and more tightly knit clan than a genealogy with only five volumes, and the former required more efforts and resources to compile and organize; in addition, with more members, a larger clan offered its members more resource-pooling and risk-sharing benefits. In this sense, a larger number of genealogy volumes should imply a stronger clan presence. Therefore, we use the number of volumes contained in each prefecture's genealogies (normalized by its population) as an alternative proxy for clan strength. The results reported in column (1) of Table 4 show that this alternative proxy does not affect our main conclusion.

The highly uneven spatial distribution of cannibalism shown in Fig. 2 raises a concern about whether our result is driven by regions with sparce records of cannibalism. To test this, we exclude from our analysis the three provinces (Guangxi, Fujian and Jiangxi) with the fewest records of cannibalism among the 18 provinces in our sample. This reduces the sample to 229 prefectures. The regression result is reported in column (2) of Table 4, which again confirms the robustness of our main finding.

As most of the genealogies are in regions across the southern and southeastern parts of China (Fig. 2(b)), we conduct three additional robustness checks. First, we exclude the northern provinces (Zhili, Shanxi, Shannxi, Shandong, Henan and Gansu) from our sample in column (3). Second, we include only prefectures in the coastal provinces (Zhili, Shandong, Jiangsu, Zhejiang, Fujian, and Guangdong) in column (4). Third, as noted earlier, wealth may be a crucial confounder of our main result; although we control for economic development by using both population density and trade prosperity as proxies, these controls might not be sufficient. Accordingly, we remove from our sample the traditionally most affluent provinces in the Yangtze River delta where the clan likely had a strong influence (Jiangsu, Zhejiang and Anhui), and report the results in column (5). As shown in columns (3)–(5) of Table 4, our finding that the clan helped to attenuate cannibalism is robust to these checks.

4.4. Clan, culture and human capital

Although the clan organized people's daily lives and hence epitomized Confucianism where it mattered the most, this philosophy did not account for all aspects of life. Specifically, the ability of the clan to promote Confucianism may have led to reductions in cannibalism through channels other than risk mitigation (e.g., through promoting anti-violence and anti-cannibalism social norms), and these channels may extend beyond the previously controlled effects. For instance, Kung and Ma (2014) argue that the Confucian doctrine, which emphasizes subordination and obedience, discourages people from engaging in violence; therefore, the conservative cultural norms of Confucian society, rather than the risk mitigation function, might have tamed violence during the studied period. Kung and Ma (2014) use the numbers of chaste women and of Confucian temples as separate measures of the strength of Confucian cultural influence and establish these channels as conduits reducing peasant revolts in Shandong province during the Qing dynasty.

During the Tang dynasty (618–907 CE), the imperial court promoted Confucianism by ordering counties and prefectures to build Confucian temples where people could worship Confucius and other sages. Localities exhibited varying degrees of response to these orders (Lang, 1946). Accordingly, the number of temples constructed can be taken to indicate the strength of Confucian cultural influence in a region (more Confucian temples built signals stronger devotion to Confucian culture). Following another historical trend, scholar–officials of the Song dynasty convinced the imperial court to highlight female chastity as a Confucian virtue by officially rewarding clans that nurtured chaste women; this practice continued with increased force in the Ming and Qing dynasties (Liang et al., 2021). Thus, the number of officially recognized chaste women in a region can also be treated as a proxy for the regional prevalence of Confucian culture.

We include these cultural channels, represented separately by the numbers of Confucian temples and of chaste women in each

[22] In our earlier analysis, we also include the number of levee breaches along the Yellow River in each decade as a control, as historically, levee breaches were a major source of misery along this river. However, this inclusion does not affect our result. As we include flood, drought and other variables that are strongly correlated with levee-breaching events, we remove the number of levee breaches from our analysis.

Table 3
Robustness checks with additional controls.

	Dependent variable: instances of cannibalism				
	(1)	(2)	(3)	(4)	(5)
Exceptional drought × $Clans_{(t-1)}$	-0.212***	-0.211***	-0.215***	-0.217***	-0.212***
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
Exceptional drought	0.438***	0.438***	0.438***	0.436***	0.438***
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
$Clans_{(t-1)}$	-0.016	-0.016	-0.014	-0.014	-0.016
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Population density	Yes	Yes	Yes	Yes	Yes
Wars	Yes	Yes	Yes	Yes	Yes
Sweet potato introduction	Yes	Yes	Yes	Yes	Yes
Maize introduction	Yes	Yes	Yes	Yes	Yes
Treaty ports	No	Yes	Yes	Yes	Yes
Concession	No	No	Yes	Yes	Yes
Churches	No	No	No	Yes	Yes
Government relief	No	No	No	No	Yes
Period FE	Yes	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes	Yes
Prefecture-specific time trend	Yes	Yes	Yes	Yes	Yes
Observations	11,481	11,481	11,481	11,481	11,481
R-squared	0.163	0.163	0.163	0.163	0.163

Notes: The unit of observation is the prefecture–decade. For variable definitions, refer to the notes to Table 1. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 4
Robustness checks with subsamples.

	Dependent variable: instances of cannibalism				
	(1)	(2)	(3)	(4)	(5)
Exceptional drought × *Clans* (alternative measure) $_{(t-1)}$	-0.149***				
	(0.023)				
Clans (alternative measure) $_{(t-1)}$	-0.002				
	(0.007)				
Exceptional drought × *Clans* $_{(t-1)}$		-0.230***	-0.151***	-0.159***	-0.209***
		(0.041)	(0.042)	(0.059)	(0.080)
Exceptional drought	0.470***	0.452***	0.279***	0.283***	0.442***
	(0.063)	(0.064)	(0.074)	(0.108)	(0.064)
$Clans_{(t-1)}$		-0.024*	0.004	-0.015	-0.012
		(0.014)	(0.005)	(0.018)	(0.012)
Baseline + additional controls	Yes	Yes	Yes	Yes	Yes
Excluding sparse samples	No	Yes	No	No	No
Excluding northern China	No	No	Yes	No	No
Coastal provinces	No	No	No	Yes	No
Excluding Yangtze River Delta	No	No	No	No	Yes
Period FE	Yes	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes	Yes
Prefecture-specific time trend	Yes	Yes	Yes	Yes	Yes
Observations	11,481	9847	7783	3397	9933
R-squared	0.164	0.170	0.117	0.230	0.162

Notes: The unit of observation is the prefecture–decade. For variable definitions, refer to the notes to Table 1. The reduced subsample used in column (2) excludes prefectures in the three provinces (Guangxi, Fujian and Jiangxi) with the fewest records of cannibalism among all 18 provinces in our sample. In column (3), we exclude provinces in northern China (Zhili, Shandong, Shanxi, Shannxi, Gansu and Henan). In column (4), we include coastal provinces (Zhili, Shandong, Jiangsu, Zhejiang, Fujian, and Guangdong). In column (5), we exclude provinces in the Yangtze River Delta region (Jiangsu, Zhejiang and Anhui). The baseline controls include each prefecture's *Population density* and *Wars*. Additional controls include *Sweet potato introduction, Maize introduction, Treaty ports, Concession, Churches* and *Government relief*. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

prefecture, as a competing alternative to the risk mitigation role played by the clan in reducing violence. For both variables, the data are obtained from the *Uniform Sourcebook of the Great Qing* (*Daqing Yitong Zhi*), which was compiled in 1820 CE by the Qing government based on local gazetteers (Mu et al., 2008).

Specifically, *Chaste women* is calculated as the logarithm of the number of chaste women documented in local gazetteers during 1644–1820 CE, and *Confucian temples* is the logarithm of the number of Confucian temples established during 1368–1820 CE; both values are normalized by the prefecture's average population (in units of 100,000). These variables are included in a horse race with clan density, as shown respectively in columns (1) and (2) of Table 5. In column (1), the cultural channel captured by *Chaste women* does not have a statistically significant impact on cannibalism during times of exceptional drought, and it does not affect the

Table 5
Competing channels—clans, Confucian culture and human capital.

	Dependent variable: instances of cannibalism			
	(1)	(2)	(3)	(4)
Exceptional drought × $Clans_{(t-1)}$	-0.315***	-0.307***	-0.210***	-0.283***
	(0.059)	(0.056)	(0.037)	(0.068)
Exceptional drought × *Chaste women*	0.043			
	(0.073)			
Exceptional drought × *Confucian temples*		0.296		
		(0.192)		
Exceptional drought × *Confucian academies*			-0.542***	
			(0.195)	
Confucian academies			0.000	
			(0.009)	
Exceptional drought × *Jinshi degree holders*				0.638**
				(0.316)
Jinshi degree holders				-0.010
				(0.022)
Exceptional drought	0.316	0.228	0.455***	0.225**
	(0.267)	(0.165)	(0.064)	(0.091)
$Clans_{(t-1)}$	0.013	0.012	-0.015	-0.020
	(0.012)	(0.012)	(0.010)	(0.013)
Baseline + additional controls	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes
Prefecture-specific time trend	Yes	Yes	Yes	Yes
Observations	9345	9100	11,481	11,481
R-squared	0.172	0.173	0.164	0.170

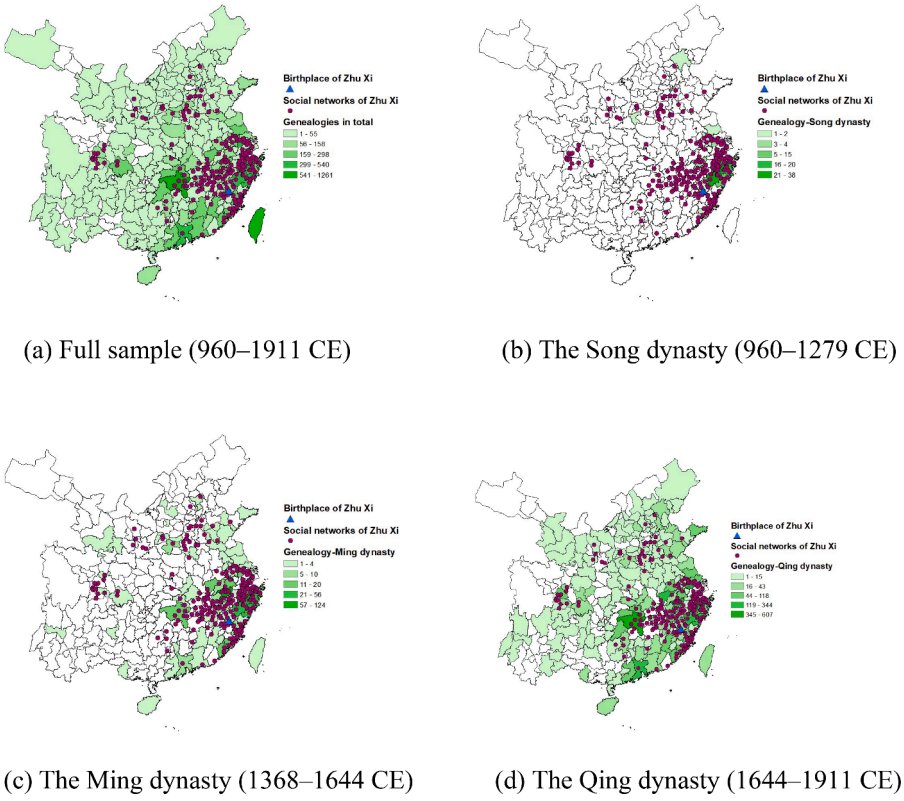
Notes: The unit of observation is the prefecture–decade. For definitions, refer to the notes to Table 1. Baseline controls include the prefecture's *Population density* and *Wars*. Additional controls include *Sweet potato introduction, Maize introduction, Treaty ports, Concession, Churches* and *Government relief*. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

significance of the risk mitigation effect of the clan. In column (2), the cultural channel captured by *Confucian temples* has a marginally statistically significant effect on cannibalism during times of severe drought, but the sign is in the wrong (i.e., positive) direction. This finding suggests that the literature may overestimate the violence-reducing role of Confucian cultural norms. Instead, Confucianism may have contributed to violence reduction only through the risk mitigation channel facilitated by the Confucian clan.

Admittedly, it is difficult to completely separate the risk mitigation channel from the cultural channel. The clan indeed held land and other property, facilitated business cooperation among members, operated estate trusts and maintained granary and charity houses, thus offering tangible pooling and sharing services both *ex ante* and *ex post*. However, the promotion of chastity and the existence of Confucian temples and related rituals helped strengthen the clan by providing a solid cultural and moral foundation; the behavioral rules and norms enshrined in Confucianism reduced the likelihood of default on obligations and thus reinforced cooperation and risk-sharing within the clan. Simultaneously, the kinsmen's faith in and loyalty to Confucianism were enhanced by the clan's tangible pooling and sharing benefits. In other words, these two channels were intertwined. Nonetheless, the results in columns (1) and (2) of Table 5 give support to our claim that the clan organization embodied and epitomized Confucianism in ways that mattered to people's lives.

Lastly, the clan effect on cannibalism may have been through a human capital channel. After the Song imperial court opened the civil examination system for selecting officials (commonly known as *keju* in Chinese) to members of lower socioeconomic classes, the sons of commoners could finally enter officialdom and become rich and powerful (Chen et al., 2022). From the late 10th century onward, this policy change incentivized local communities to send their children to schools and nurture human capital. However, it usually took many years of education for one to obtain a *jinshi* degree (the highest degree awarded to any civil examinee) (Ho, 1962); therefore, exam takers needed extensive financial support and often had to rely on their clans to pool resources. Hence, closely-knit clans were more likely than others to have *jinshi* degree holders who would in turn be appointed to powerful official positions. For this reason, it is expected that prefectures with strong clan presence would likely achieve better schooling on average and more *keju* success (more *jinshi* degree holders), accumulating better overall human capital. As a result, these regions would not only be richer (higher population density) but also have more native sons in high government offices (so as to have better access to government relief), both effects of which would help to reduce cannibalism at times of hardship.

Population density and *Government relief* in Tables 3–5 partly control for the above two effects of the human capital channel. We try to further capture this channel directly by using two additional proxies: *Jinshi degree holders*, defined as the logarithm of the prefecture's decadal number of receivers of the *jinshi* degree normalized by the decadal average population, and *Confucian academies*, defined as the logarithm of the number of academies devoted to Confucian education, normalized by the decadal average population.



(a) Full sample (960–1911 CE) (b) The Song dynasty (960–1279 CE)

(c) The Ming dynasty (1368–1644 CE) (d) The Qing dynasty (1644–1911 CE)

Fig. 3. Influence of Zhu Xi's Social Network on Genealogy Compilation. Notes: Panel (a) illustrates the influence of Zhu Xi's social network on total genealogy compilation from the Song to the Qing dynasties, while Panels (b), (c) and (d) respectively demonstrate this influence on genealogy compilation during the Song, Ming and Qing dynasties. Each red dot represents the geolocation of one person who directly communicated with Zhu Xi (e.g., his disciples, friends and relatives) during his lifetime. Green shading indicates the number of genealogies compiled in a prefecture during the given period; the darker the shade, the higher the number. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

The data on *jinshi* degree holders are obtained from the China Biographical Database Project (CBDB)[23] of Harvard University, which provides a complete list of all *jinshi* degree holders in the Ming and Qing dynasties. The data on Confucian academies are obtained from Ji (1996).

We must acknowledge the difficulty to totally separate the human capital channel from the clan channel as the two are tightly intertwined. Nonetheless, for the horse race exercise shown in Table 5, we treat the two channels as if they were independent.

Columns (3) and (4) of Table 5 demonstrate the mixed role of the human capital channel, as reflected separately by the proxies of Confucian academies and *jinshi* degree holders, in reducing cannibalism during hard times. Although the Confucian academies channel helped to reduce cannibalism, perhaps through Confucian moderation (Kung and Ma, 2014), the coefficient of the interaction term between *jinshi* and exceptional drought has an unexpectedly positive sign, suggesting that the *jinshi* human capital channel is not a conduit for the mitigating effect of the clan on cannibalism. This "surprising" sign may be due to two reasons. First, it is possible that regions with better education or higher literacy (as proxied by more *jinshi*) documented local conditions and unusual events (e.g., cannibalism during a severe drought) more diligently than other regions, giving rise to the positive coefficient of the interaction term in column (4). Second, in 1713 CE, Emperor Kangxi issued an edict to adopt a South-North system for *jinshi* quota allocation, effectively to give northern China more *jinshi* quota (Wu, 2011). As a result, how many *jinshi* a region would get in the civil examination after 1713 would no longer be purely based on examination performance, decoupling the link between clan resource-pooling effectiveness and *jinshi* success. Since the net effect of the emperor's edict was an increase in *jinshi* quota for the north and most cannibalism instances occurred when the north experienced severe droughts (Fig. 2), it may have caused the sign for the interactive term's coefficient to be positive.

The fact that the coefficient for the interactive term between Exceptional Drought and Clans remains negative and statistically significant at the 1 % level in each of columns (1)-(4) shows that the inclusion of the competing channels (both culture and human capital) does not qualitatively affect the attenuating impact of the clan on cannibalism.

[23] https://projects.iq.harvard.edu/cbdb (accessed 2022/02/09)

Table 6
Natural shocks, clans and cannibalism—instrumented results.

	First stage Clans $_{(t-1)}$		Second stage Instances of cannibalism	
	(1)	(2)	(3)	(4)
Exceptional drought × *Clans*$_{(t-1)}$			-0.415***	-0.393***
			(0.093)	(0.088)
Social networks × time trend	0.005***	0.005***		
	(0.001)	(0.001)		
Exceptional drought	-0.159***	-0.160***	0.545***	0.529***
	(0.033)	(0.033)	(0.074)	(0.072)
Clans$_{(t-1)}$			0.118***	0.179***
			(0.039)	(0.047)
Baseline + additional controls	No	Yes	No	Yes
Period FE	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes
Observations	11,481	11,481	11,481	11,481
R-squared	0.842	0.848	0.007	0.002
Kleibergen–Paap *F* statistic			12.239	12.977

Notes: The unit of observation is the prefecture–decade. For variable definitions, refer to the notes to Table 1. Baseline controls include the prefecture's *Population density* and *Wars*. Additional controls include *Sweet potato introduction, Maize introduction, Treaty ports, Concession, Churches* and *Government relief*. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

5. IV estimation

Our results so far provide strong evidence of the attenuating effect of the clan on cannibalism. However, concerns related to omitted variables and reverse causality may exist. For example, clan formation may have been a response to omitted variables that drove drought and other natural disasters and thus led to cannibalism. To address such issues, we conduct an IV exercise.

5.1. Zhu Xi's social network as an IV

We search for an IV by returning to the origin of Confucian influence, especially the clan, on the grassroots. As mentioned in Section 2, Confucianism played a limited role in the daily lives of common people before the Song dynasty (960–1279 CE). Responding to challenges from competing ideologies and foreign religions, scholar–officials in the Song era initiated a Confucian revival movement, aiming to consolidate the metaphysical base and permeate all levels of society with Confucianism (Bol, 2008). During that social transformation, the elites switched their focus from imperial court politics to local affairs such as descent group organizing, community building and education (Hartwell, 1982; Tackett, 2014). The transformative success of the Confucian revival was due to the extensive debate and exchange of ideas among scholars.

Zhu Xi was arguably the most influential Confucian sage during the Song dynasty (Bol, 2008). Over time, scholars have considered Zhu Xi's contributions parallel to those of Confucius, given that Zhu Xi's seminal works helped operationalize and popularize the Confucian way of life. Among his celebrated books, *Rituals of the Family (Zhuzi Jiali)* provides detailed guidelines on the structure and organization of the Chinese clan (Ebrey, 1991). After its official promotion by the founding emperor of the Ming dynasty (1368–1644 CE), this book on the family became a sacred text for the clan from the 14th through the early 20th centuries. In another popular book, *Reflections on Things at Hand: The Neo-Confucian Anthology (Jin Si Lu)*, Zhu Xi and co-author Lv Zuqian interpreted daily life from the perspective of Confucian principles and thus promoted Confucianism widely. Therefore, we use Zhu Xi's social network to construct our IV.[24]

Specifically, we use the number of people in each prefecture who directly communicated with Zhu Xi (e.g., his disciples, friends and relatives) during his life, based on information included in the CBDB (Appendix Fig. A3).[25] This measure is exogenous to the events of the Ming and Qing dynasties, as Zhu Xi preceded both, and it captures the reliance of scholars on letters to exchange ideas before modern technology.

Fig. 3 illustrates the link between the social network of Zhu Xi and the adoption of Confucian practices; his social network clearly overlaps with the distribution of genealogies across the prefectures, based on both the full sample (Panel (a)) and subsamples corresponding to the Song, Ming and Qing dynasties (Panels (b), (c), and (d), respectively). Panel (b) shows that few genealogies were compiled during the Song dynasty, as this practice was just starting at the grassroots level. Genealogy compilation became much more popular during later dynasties. The maps in Fig. 3 support our use of Zhu Xi's network as the IV.

Zhu Xi's social network was not influenced by violent events that occurred in the Ming and Qing dynasties and therefore is exogenous to our main outcome variable. Still, this IV might have impacted the occurrence of cannibalism in later centuries through

[24] Research demonstrates that social networks play a crucial role in influencing and mobilizing social movements. For example, see Siegel (2009) and Becker et al. (2020).

[25] See https://projects.iq.harvard.edu/cbdb (accessed 2022/02/09).

Table 7
The clan as a risk-mitigating institution.

	First stage Clan land		Second stage Total cannibalism instances (Qing)	
	(1)	(2)	(3)	(4)
Clans (total)	0.031***	0.034***		
	(0.007)	(0.008)		
Exceptional drought (Qing) × *Clan land*			-25.975**	-25.944**
			(11.183)	(11.200)
Clan land			1.331	1.677
			(1.124)	(1.129)
Exceptional drought (Qing)	-0.095	-0.060	3.050***	3.192***
	(0.138)	(0.135)	(1.115)	(1.124)
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Observations	250	250	250	250
R-squared	0.686	0.695	0.496	0.495

Notes: The unit of observation is the prefecture. For variable definitions, refer to the notes to Table 1. Prefecture-level controls include *Population density* (in logarithm) and *Wars* during the Qing dynasty, *Terrain ruggedness index, River density, Distance to the coastline* and *Distance to the Grand Canal*. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote significance at 1 %, 5 % and 10 % levels, respectively.

other potential channels or omitted variables. To examine the exclusion restriction condition, we regress several potential channel variables on the IV. However, we find no consistently significant relationship between our IV and prosperity-related treaty ports and concession territories, churches or government relief efforts, as shown in Appendix Table A1. Nevertheless, our IV regressions include several controls to attenuate the effects of other potential channels.

5.2. IV results

The IV results are presented in Table 6. For the first-stage regressions, we interact the IV with a linear time trend based on Fig. 3, which demonstrates that Zhu Xi's influence persisted and increased over time as indicated by the continuous rise in clan formation and genealogy compilation after the Song dynasty. Columns (1) and (2) show that regions containing more people who communicated with Zhu Xi had significantly higher numbers of clans, and hence a higher clan density between 1470 and 1910 CE, than other regions. The *F*-statistic values also indicate the strength of our IV.

Columns (3) and (4) report the respective second-stage IV estimates corresponding to columns (1) and (2). Both sets of estimates demonstrate a statistically significant and negative relationship between the IV-predicted clan density and cannibalism during times of exceptional drought; here, the coefficient of the interaction term is larger than that obtained in the baseline regression. The IV results support our main hypothesis by demonstrating that an additional 10 % increase in genealogy density leads to a 7.61 % decline in cannibalism based on column (3), and a 7.43 % decline based on column (4), conditional on exceptional drought shocks.[26]

6. Resource pooling as the mechanism

Having identified a causal link between the presence of the Confucian clan and a reduction in cannibalism, we now aim to illustrate the mechanism underlying this causality by demonstrating that the clan facilitated intra-clan cooperation in resource pooling and risk-sharing. As discussed earlier, risk mitigation by the clan came in two forms: *ex ante* precautionary mitigation and *ex post* resource sharing. First, the clan prepared itself for hardship by setting up clan estates and granaries, accumulating property and collecting rental income. Additionally, intra-clan capital pooling (e.g., Zelin, 2005; Zhang, 2020) and lending–borrowing (Chen et al., 2022) enabled clan members to undertake new business, grow existing businesses or scale up agricultural production more robustly, allowing the members to amass wealth, both individually and collectively, and improve their resilience against future disasters. As another form of *ex ante* risk mitigation, the trust afforded by a strong clan enabled its members to pool their resources to build irrigation systems for drought mitigation. Thus, clan-mediated cooperation led to *ex ante* risk mitigation through both its wealth effect and various clan-facilitated devices (wealth gained via intra-clan resource pooling worked an effective defense against future risks). Second, *ex post* risk-sharing occurred in the form of resourceful members sharing with, and clan estates offering aid to, needy members after a risk event.

To further establish evidence supporting the said mechanism, we would need systematic data for each of the pooling and sharing

[26] The declines are calculated as follows: [(0.415 × 0.1) / 0.545] × 100 = 7.61; [(0.393 × 0.1) / 0.529] × 100 = 7.43.

forms mentioned above and for the 1470–1911 period, which are unfortunately difficult to obtain. Instead, we focus on one representative mechanism – clan landownership – which can be treated as a proxy for the overall level of effective intra-clan cooperation. For this purpose, we have collected data on public land (i.e., land owned or managed by clans) by searching through nearly 2500 available county and prefecture gazetteers, to find records of public land acreage for 1526 counties (in 250 prefectures), representing a cross-sectional snapshot of the conditions at the end of the Qing dynasty in 1911.[27] Note that clans owned most of the public land reported in the gazetteers, including charity land (*Yitian*, used to provide disaster relief to kinsmen), ritual land (*Jitian*, for lineage ritual expenses), and education land (*Xuetian*, to support children's education). Although a small fraction of the reported public land was owned by Buddhist temples (*Simiao Tian*), most of the temple land was managed by clans. Unfortunately, the gazetteers did not provide detailed breakdowns of public land across the above categories. Nevertheless, we use the share of a prefecture's total arable land that was owned or managed by the clans (*Clan land*) as a proxy for the region's clan landownership and for its clans' resource pooling effectiveness.

To verify the resource pooling mechanism, we run a two-stage analysis. In the first stage, we predict each prefecture's clan land share using its clan density based on all genealogies compiled before 1911 (normalized by the average population during the Qing dynasty), together with a host of controls.[28] As reported in columns (1) and (2) of Table 7, prefectures with higher clan density also had statistically significantly larger clan land shares than other prefectures, thus supporting the clan's resource pooling function. This result is robust to the inclusion of both the controls used earlier and three additional ones: each prefecture's river density, distance to the coastline and distance to the Grand Canal.[29]

In the second stage, we use the predicted clan land share from the first stage (columns (1) and (2)) to explain cross-sectional variation in the instances of cannibalism throughout the Qing dynasty. The respective results displayed in columns (3) and (4) of Table 7 provide strong support for our claim that prefectures with a stronger clan presence had higher clan land shares than other prefectures and, hence, better resource pooling, which led to lower cannibalism rates during years with severe drought events.

7. Conclusions

This paper documents a mitigating effect of the Confucian clan—the predominant kinship organization in historical Chinese society—on violence through its resource pooling and risk sharing roles. After controlling for alternative channels and effects, we document a negative causal link between clan prevalence and the frequency of cannibalism at the prefecture-level during the 1470–1911 period. Using each prefecture's share of clan landownership as a proxy for clan resource pooling effectiveness, we further show that intra-clan risk mitigation is the key mechanism underlying the clan's attenuating effect on violence.

We note one caveat. To successfully provide resource pooling and risk-sharing, a social organization such as the clan must establish many cultural norms, ritual practices and physical embodiments to set the boundaries of "club" membership (Greif, 1993; Chen, 2010) and alleviate adverse selection and moral hazard issues. However, such group identity-building innovations can have unintended consequences, such as the sacrifice of individual freedom and intensification of inter-group competition and even hostility (Sambanis and Shayo, 2013). For instance, in the Qing dynasty, many clans organized their own militia, leading to bloody inter-clan conflicts in Fujian and Guangdong provinces (Ebrey and Watson, 1986; Rowe, 1998). Moscona et al. (2020) present similar examples of inter-lineage violence in African societies. Therefore, the improved risk mitigation associated with clans in historical China came at a significant cost. Alternatively, some societies relied on religion-based social organizations, rather than kinship-based clans, to achieve inter-member risk sharing in a wider community (see Chen, 2022, for more extensive discussions), though it came at heavy costs as well. We suggest that such social risk-mitigation solutions should be replaced by formal financial development, as the latter makes available better and cheaper risk management tools (Chen et al., 2022) and leads to markedly improved human conditions.

Declaration of competing interest

There is no conflict of interest to declare.

[27] To our knowledge, this is the only historical data source that breaks down information on landownership by owner type. We are unaware of any such systematic data for a wide collection of counties or prefectures for earlier periods.

[28] We repeat the analysis by applying a three-stage least squares exercise: first, we use our IV to predict each prefecture's clan density; second, we use the IV-predicted clan density to predict the prefecture's clan land share; and third, we use the predicted clan land share from the second stage to predict instances of cannibalism in the prefecture during the Qing dynasty. This analysis yields qualitatively similar findings to those in Table 7.

[29] The calculations of river density, distance to the coastline and distance to the Grand Canal are based on data from CHGIS: https://sites.fas.harvard.edu/~chgis/data/chgis/v6/ (accessed February 9, 2022). The 1,776-km (1,104-mile) Grand Canal, which ran from Beijing in the north to Hangzhou in the south, was first connected during the Sui dynasty (581–618 CE) to enable tributary grain transport from the south to the imperial capitals in the north. The Canal later became a major backbone for inter-regional commerce, enriching the surrounding regions. Thus, distance to the Grand Canal is a proxy for each prefecture's access to Grand Canal-based commercial markets. The same rationale supports the use of river density and distance to the coastline as alternative proxies for measuring a prefecture's level of commercial development and per-capita income.

Appendix

Table A1
Evidence on the exclusion restriction condition of the instrumental variable.

	Treaty ports (1)	*Concession* (2)	*Church density* (3)	*Government relief* (4)
Social network	0.037*	0.024	0.687	29.454
	(0.021)	(0.018)	(0.411)	(38.103)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Observations	267	267	267	267
R-squared	0.158	0.198	0.243	0.410

Notes: The unit of observation is the prefecture. *Treaty ports* and *Concession* are dummy variables indicating whether a prefecture was a treaty port or a concession, respectively. *Church density* is the total number of churches established in a prefecture, normalized by its average population. *Government relief* is the number of times that a prefecture received public relief during the Qing dynasty. Controls include each prefecture's average population density during the Qing dynasty (in logarithm), *Terrain ruggedness index, River density, Distance to the coastline* and *Distance to the Grand Canal*. Robust standard errors (in parentheses) are clustered at the prefecture level. ***, ** and * denote significance at the 1 %, 5 % and 10 % levels, respectively.

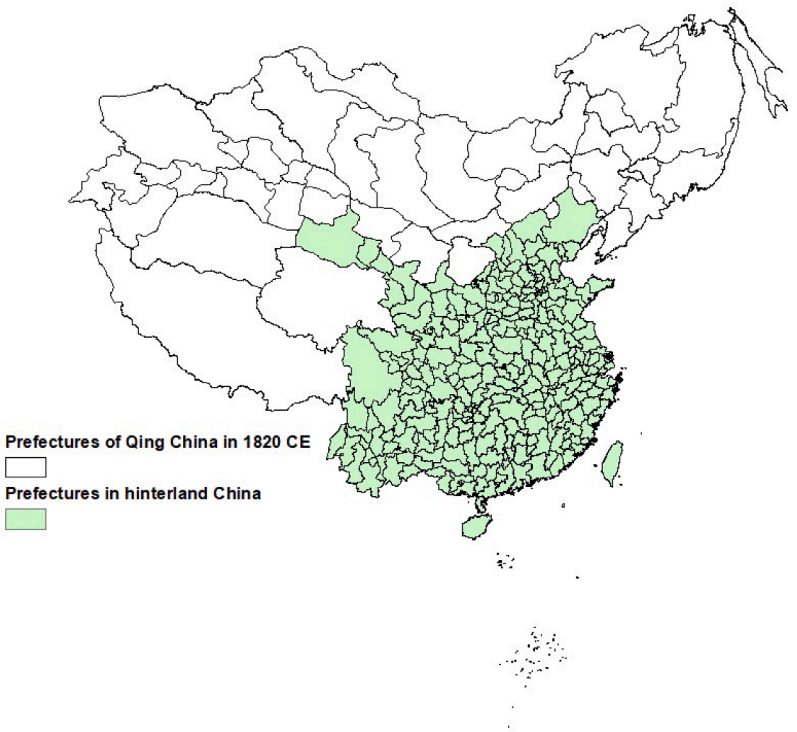


Fig. A1. Map of Qing China in 1820 CE. Notes: Green shading indicates prefectures in hinterland China.
Map source: CHGIS V6, Harvard University. https://sites.fas.harvard.edu/~chgis/data/chgis/v6/. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

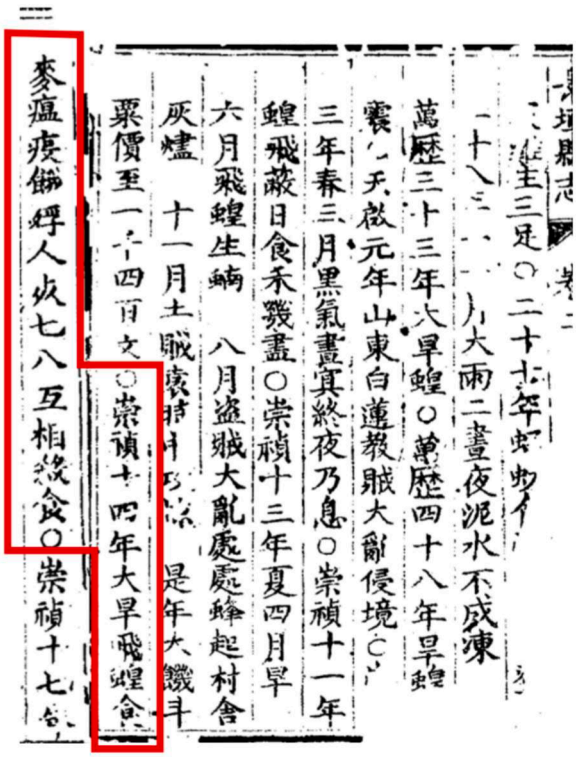


Fig. A2. Example of a Local Gazetteer Documenting Cannibalism. Notes: The text in the red box indicates that in 1641 CE, a great drought occurred and wheat plants were eaten by flying locusts, resulting in countless deaths and forcing the remaining population to resort to cannibalism to survive. Source: Local Gazetteers of Changyuan County (Henan Province), vol. 2: Natural Disaster. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

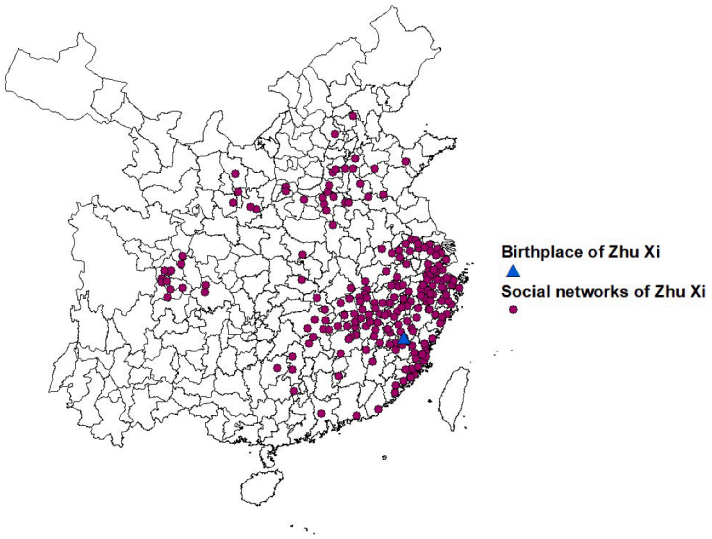


Fig. A3. The social network of Zhu Xi. Notes: Each red dot represents the geolocation of one person who directly communicated with Zhu Xi (e.g., his disciples, friends and relatives) during his lifetime. Map source: CHGIS V6, Harvard University. https://sites.fas.harvard.edu/~chgis/data/chgis/v6/. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

References

Acemoglu, Daron, Johnson, Simon, Robinson, James A, 2002. Reversal of fortune: geography and institutions in the making of the modern world income distribution. Q. J. Econ. 117 (4), 1231–1294.

Anderson, Robert W, Johnson, Noel D, Koyama, Mark, 2017. Jewish persecutions and weather shocks: 1100–1800. Econ. J. 127 (602), 924–958.

Bai, Ying, Kung, James Kai-Sing, 2011. Climate shocks and Sino-nomadic conflict. Rev. Econ. Stat. 93 (3), 970–981.

Bai, Ying, Kung, James Kai-Sing, 2015. Diffusing knowledge while spreading god's message: protestantism and economic prosperity in China, 1840–1920. J. Eur. Econ. Assoc. 13 (4), 669–698.

Baker, Hugh DR, 1979. Chinese Family and Kinship. Columbia Univ. Press, New York, NY.

Baten, Joerg, Ma, Debin, Morgan, Stephen, Wang, Qing, 2010. Evolution of living standards and human capital in China in the 18th–20th centuries: evidences from real wages, age-heaping, and anthropometrics. Explor. Econ. Hist. 47 (3), 347–359.

Becker, Sascha O, Hsiao, Yuan, Pfaff, Steven, Rubin, Jared, 2020. Multiplex network ties and the spatial diffusion of radical innovations: Martin Luther's leadership in the early reformation. Am. Sociol. Rev. 85 (5), 857–894.

Bol, Peter K, 2008. Neo-Confucianism in History. Cambridge, Harvard University Asia Center: Distributed by Harvard Univ. Press, MA.

Braggion, Fabio, Manconi, Alberto, Zhu, Haikun, 2020. Credit and social unrest: evidence from 1930s China. J. Financ. Econ. 138 (2), 295–315.

Burgess, Robin, Deschenes, Olivier, Donaldson, Dave, Greenstone, Michael, 2017. Weather, Climate Change and Death in India. Working Paper, University of Chicago. https://epic.uchicago.edu/wp-content/uploads/2019/07/Publication-9.pdf.

Burke, Marshall, Hsiang, Solomon M, Miguel, Edward, 2015. Climate and conflict. Annu. Rev. Econom. 7 (1), 577–617.

Cao, Jiarui, Xu, Yiqing, Zhang, Chuanchuan, 2022. Clans and calamity: how social organizations saved lives during China's great famine. J. Dev. Econ. 157, 102865.

Cao, Shuji, 1997. Shuyi Liuxing Yu Huabei Shehui De Bianqian (Epidemic plagues and social changes of the northern region). Lishi Yanjiu (Histor. Res. J.) 1, 17–31.

Cao, Shuji, 2000. Zhongguo Renkou Shi: Ming Shiqi (History of Population in China: The Ming Period). Fudan Univ. Press, Shanghai.

Cao, Shuji, 2001. Zhongguo Renkou Shi: Qing Shiqi (History of Population in China: The Qing Period). Fudan Univ. Press, Shanghai.

Chen, Daniel L, 2010. Club goods and group identity: evidence from Islamic resurgence during the Indonesian financial crisis. J. Polit. Econ. 118 (2), 300–354.

Chen, Shuo, Kung, James Kai-Sing, 2016. Of maize and men: the effect of a new world crop on population and economic growth in China. J. Econ. Growth 21 (1), 71–99.

Chen, Ting, Kung, James Kai-Sing, Ma, Chicheng, 2020. Long live Keju! The persistent effects of China's civil examination system. Econ. J. 130 (631), 2030–2064.

Chen, Zhenhan, Xiao, Guoliang, Xiong, Zhengwen, 2012. Qingshilu Jingjishi Ziliao (Economic History Materials from the Veritable Records of the Qing Dynasty). Peking Univ. Press, Beijing.

Chen, Zhiwu, 2022. Wenmin De Luoji (The Logic of Civilization). CITIC Press, Beijing.

Chen, Zhiwu, Ma, Chicheng, 2021. The Confucian Clan As a Risk-Sharing Institution: How Pre-Industrial China Became the Most Populous Nation. Working Paper, University of Hong Kong. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3859796.

Chen, Zhiwu, Ma, Chicheng, Sinclair, Andrew, 2022. Banking on the Confucian clan: why China developed financial markets so late. Econ. J. 132 (644), 1378–1413.

Chen, Zhiwu, Peng, Kaixiang, Zhu, Lijun, 2017. Social-economic change and its impact on violence: homicide history of Qing China. Explor. Econ. Hist. 63, 8–25.

CHGIS, 2016. China Historical Geographic Information System, Version 6. Fairbank Center for Chinese Studies of Harvard University and the Center for Historical Geographical Studies at Fudan University.

China's Military History Editorial Committee, 2003. Zhongguo Lidai Zhanzheng Nianbiao (A Chronology of Warfare in Dynastic China), 2nd ed. Jiefangjun Chubanshe, Beijing.

Chinese Academy of Meteorological Science, 1981. Zhongguo Jin Wubai Nian Hanlao Fenbu Tuji (The Distribution Atlas of Drought and Flood in China in the Most Recent Five Hundred Years). Ditu Chuban She, Beijing.

Degusta, David, 1999. Fijian cannibalism: osteological evidence from Navatu. Am. J. Phys. Anthropol. 110 (2), 215–241.

Dennerline, Jerry, 1986. Marriage, adoption, and charity in the development of lineages in Wu-hsi from Song to Ch'ing. In: Ebrey, Patricia Buckley, Watson, James L. (Eds.), Kinship Organization in Late Imperial China, 1000–1940. Univ. of California Press, Berkeley, CA, pp. 170–209.

Diamond, Jared M, 2000. Talk of cannibalism. Nature 407 (6800), 25–26.

Dikötter, Frank, 2010. Mao's Great Famine: The History of China's Most Devastating Catastrophe. Bloomsbury, London/New York, pp. 1958–1962.

Dix-Carneiro, Rafael, Soares, Rodrigo R, Ulyssea, Gabriel, 2018. Economic shocks and crime. Am. Econ. J. Appl. Econ. 10 (4), 158–195.

Ebrey, Patricia Buckley, 1991. Confucianism and Family Rituals in Imperial China. Princeton Univ. Press, Princeton, NJ.

Ebrey, Patricia Buckley, Watson, James L, 1986. Kinship Organization in Late Imperial China. Univ. of California Press, Berkeley, CA, pp. 1000–1940.

Edgerton-Tarpley, Kathryn, 2008. Tears from Iron: Cultural Responses to Famine in Nineteenth-century China. Univ. of California Press, Berkeley, CA.

Enke, Benjamin, 2019. Kinship, cooperation, and the evolution of moral systems. Q. J. Econ. 134 (2), 953–1019.

Fafchamps, Marcel, Lund, Susan, 2003. Risk-sharing networks in rural Philippines. J. Dev. Econ. 71 (2), 261–287.

Greif, Avner., 1993. Contract enforceability and economic institutions in early trade: the Maghribi traders' coalition. Am. Econ. Rev. 83 (3), 525–548.

Greif, Avner, Tabellini, Guido, 2017. The clan and the corporation: sustaining cooperation in China and Europe. J. Comp. Econ. 45 (1), 1–35.

Hartwell, Robert M, 1982. Demographic, political, and social transformations of China, 750–1550. Harv. J. Asiat. Stud. 42 (2), 365–442.

Ho, Ping-ti, 1962. The Ladder of Success in Imperial China: Aspects of Social Mobility, 1368–1911. Studies of the East Asian Institute. Columbia Univ. Press, New York, NY.

Iyigun, Murat, Nunn, Nathan, Qian, Nancy, 2017. Winter is coming: the long-run effects of climate change on conflict, 1400-1900. Working Paper, No. w23033. Nal Bureau Econ. Res. https://www.nber.org/papers/w23033.

Ji, Xiaofeng, 1996. Zhongguo Shuyuan Cidian (A Compendium on the Chinese Academies). Zhejiang Jiaoyu Chubanshe, Hangzhou.

Jia, Ruixue, 2014a. Weather shocks, sweet potatoes and peasant revolts in historical China. Econ. Journal 124 (575), 92–118.

Jia, Ruixue, 2014b. The legacies of forced freedom: China's treaty ports. Rev. Econ. Stat. 96 (4), 596–608.

Kinnan, Cynthia, Townsend, Robert, 2012. Kinship and financial networks, formal financial access, and risk reduction. Am. Econ. Rev. 102 (3), 289–293.

Kung, James Kai-sing, Ma, Chicheng, 2014. Can cultural norms reduce conflicts? Confucianism and peasant rebellions in Qing China. J. Dev. Econ. 111, 132–149.

Lang, Olga, 1946. Chinese Family and Society. Yale Univ. Press, New Haven, CT.

Lee, Harry F, 2019. Cannibalism in Northern China between 1470 and 1911. Reg. Environ. Change 19 (8), 2573–2581.

Leung, Angela K, 1997. Charitable Acts and Edification: Charitable Organizations During Ming-Qing Periods (Shishan Yu Jiaohua: Ming Qing De Cishan Zuzhi. Linking Publishing Press, Taipei.

Li, Ming-tse Lillian, 2007. Fighting Famine in North China: State, Market, and Environmental Decline, 1690s–1990s. Stanford Univ. Press, Stanford, CA.

Liang, Ruobing, Wang, Xiaobing, Yamauchi, Futoshi, 2021. Cotton revolution and widow chastity in Ming and Qing China. Am. J. Agric. Econ. 103 (1), 232–252.

Liu, Hui-chen Wang, 1959. An analysis of Chinese clan rules: Confucian theories in action. In: Nivison, David S, Wright, Arthur F (Eds.), Confucianism in Action. Stanford Studies in the Civilizations of Eastern Asia. Stanford Univ. Press, Stanford, CA.

Martin, John Jeffries, 2017. Cannibalism as a Feuding ritual in early modern Europe. Acta Histriae 25 (1), 97–108.

Meng, Xin, Qian, Nancy, Yared, Pierre, 2015. The institutional causes of China's great famine, 1959–1961. Rev. Econ. Stud. 82 (4), 1568–1611.

Miguel, Edward, 2005. Poverty and Witch Killing. Rev. Econ. Stud. 72 (4), 1153–1172.

Mobarak, Ahmed Mushfiq, Rosenzweig, Mark R, 2013. Informal risk sharing, index insurance, and risk taking in developing countries. Am. Econ. Rev. 103 (3), 375–380.

Morse, Adair, 2011. Payday lenders: heroes or villains? J. Financ. Econ. 102 (1), 28–44.

Moscona, Jacob, Nunn, Nathan, Robinson, James A, 2020. Segmentary lineage organization and conflict in sub-Saharan Africa. Econometrica 88 (5), 1999–2036.

Mu, Zhange, Zuoxian, Li, Zizhen, Gong, 2008. Daqing Yitong Zhi (The Comprehensive Gazetteers of the Great Qing). Shanghai Guji Chubanshe, Shanghai.

Nunn, Nathan, Qian, Nancy, 2014. US food aid and civil conflict. Am. Econ. Rev. 104 (6), 1630–1666.

Gráda, Ó., 2015. Eating People Is Wrong, and Other Essays On Famine, Its Past, and Its Future. Princeton Univ. Press, Princeton, NJ.
Parker, Geoffrey, 2013. Global Crisis: War, Climate Change and Catastrophe in the Seventeenth Century. Yale Univ. Press, New Haven, CT.
Pinker, Steven, 2011. The Better Angels of Our Nature: The Decline of Violence in History and Its Causes. Penguin UK, London.
Rosenzweig, Mark R, 1988. Risk, implicit contracts and the family in rural areas of low-income countries. Econ. J. 98 (393), 1148–1170.
Rosenzweig, Mark R, Stark, Oded, 1989. Consumption smoothing, migration, and marriage: evidence from rural India. J. Polit. Econ. 97 (4), 905–926.
Rowe, William T, 1998. Ancestral rites and political authority in late imperial China: chen Hongmou in Jiangxi. Mod. China 24 (4), 378–407.
Sambanis, Nicholas, Shayo, Moses, 2013. Social identification and ethnic conflict. Am. Polit. Sci. Rev. 107 (2), 294–325.
Schutt, Bill, 2017. Cannibalism: A Perfectly Natural History. Algonquin Books, Chapel Hill, NC.
Shanghai Library, 2009. Zhongguo Jiapu Zongmu (General Catalogue of Chinese Genealogy). Shanghai Guji Chubanshe, Shanghai.
Shiue, Carol H, 2004. Local granaries and central government disaster relief: moral hazard and intergovernmental finance in eighteenth- and nineteenth-century China. J. Econ. Hist. 64 (1), 100–124.
Siegel, David A, 2009. Social networks and collective action. Am. J. Pol. Sci. 53 (1), 122–138.
Stauffer, Milton Theobald, 1922. The Christian Occupation of China: A General Survey of the Numerical Strength and Geographical Distribution of the Christian Forces in China Made By the Special Committee On Survey and Occupation, China Continuation Committee, 1918–1921. China Continuation Committee, Shanghai.
Stoneking, Mark, 2003. Widespread prehistoric human cannibalism: easier to swallow? Trends Ecol. Evol. (Amst.) 18 (10), 489–490.
Tackett, Nicolas, 2014. The Destruction of the Medieval Chinese Aristocracy. Harvard Univ. Asia Center, Boston, MA.
Townsend, Robert, 1993. The Medieval Village Economy: A Study of the Pareto Mapping in General Equilibrium Models. Princeton Univ. Press, Princeton, NJ.
Twitchett, Denis C, 1959. The Fan clan charitable estate, 1050–1760. In: Nivison, David S, Wright, Arthur F (Eds.), Confucianism in Action. Stanford Studies in the Civilizations of Eastern Asia. Stanford Univ. Press, Stanford, CA, pp. 97–133.
United States Geological Survey, 1996. GTOPO30 Global 30 Arc-Second Elevation. USGS Center for Earth Resources Observation and Science, Sioux Falls, SD.
Voigtländer, Nico, Voth, Hans-Joachim, 2012. Persecution perpetuated: the medieval origins of anti-semitic violence in Nazi Germany. Q. J. Econ. 127 (3), 1339–1392.
Wu, Genzhou, 2011. Qingdai Jinshi Lishi Dili Fenbu Yanjiu (Studies on the spatial distribution of Jinshi during the Qing dynasty). Kaoshi Yanjiu (Exam. Res.) 3, 72–80.
Xiao, Lingbo, Yan, Junhui, 2019. Reconstruction of poor/bumper autumn harvest index series based on historical chorography and its relationship with climate change in North China from 1736 to 1911. Acta Geographica Sinica 74 (9), 1777–1788.
Yan, Zhongping, 1955. Zhongguo Jindai Jingjishi Tongji Ziliao Xuanji (Selection of Statistics on Economic History of Modern China). Kexue Chubanshe, Beijing.
Zelin, Madeleine, 2005. The Merchants of Zigong: Industrial Entrepreneurship in Early Modern China. Columbia Univ. Press, New York, NY.
Zhang, Chuanchuan, 2020. Clans, entrepreneurship, and development of the private sector in China. J. Comp. Econ. 48 (1), 100–123.
Zhang, De-er, 2004. Zhongguo Sanqiannian Qixiang Jilu Zongji (Comprehensive Compilation of Weather Records in Last Three Millenniums of China). Jiangsu Educational Press, Nanjing.
Zhao, Dingxin, 2015. The Confucian-Legalist State: A New Theory of Chinese History. Oxford Univ. Press, Oxford, UK.
Zheng, Qilai, 1994. Zhongguo Gudai De Shiren: ren Chi Ren Xingwei Toushi (Cannibalism in ancient China: a perspective on cannibalistic behavior). Zhongguo Shehui Kexue Chubanshe.
Zhou, Xun, 2012. The Great Famine in China, 1958–1962: A Documentary History. Yale Univ. Press, New Haven, CT.
Zingales, Luigi, 2015. Presidential address: does finance benefit society? J. Finance 70 (4), 1327–1363.