Eclipses and the Memory of Revolutions: Evidence from China

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Abstract

We study the historical roots of social unrest in China. In particular, we investigate whether the incidence of social unrest against local government officials under the Qing dynasty period (1644-1912) has a persistent effect on the incidence of anti-government protests in present-day China. To generate plausibly exogenous variation in the incidence of past protests, we exploit differences in the visibility and magnitude of solar eclipses across Chinese counties during the Qing dynasty period. In the Confucianism tradition, solar eclipses are considered a negative divine signal on the legitimacy of the ruler, and can thus facilitate the coordination of protest actions. We test this hypothesis using detailed data on the timing and location of anti-government rebellions extracted from local chronicles. We show that counties within the totality zone of an eclipse were significantly more likely to experience a rebellion in the eclipse year. We find that plausibly exogenous variation in past rebellions generated by the incidence of solar eclipses has a positive effect on the incidence of social protests in present-day China. Leaders of early anti-Qing rebellions were recorded in popular culture and celebrated in temples, favoring the transmission of the memory of their actions across generations. The persistent effect of past protests is concentrated in counties with such temples and memorials, consistent with a long-term memory of revolutions.

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I Introduction

Throughout history, social protests have shaped societies, influenced policy-makers' agendas, and, in some instances, forced regime changes. From the Arab Spring uprisings of 2010-12 to the Hong Kong protests of 2019-20, the last decade has witnessed a large number of such episodes. Although many communities within a country often share similar grievances towards their government, protests do not erupt with the same intensity everywhere. Existing research has focused on how an individual decision to participate in protest actions interact with others', and pointed to coordination and information frictions as potential drivers of the incidence of social protests.[1]

In this paper we bring evidence on a specific determinant of observed differences in the incidence of protests: the existence of a historical tradition of anti-government sentiment within a given community. Recent experimental evidence has shown that past participation in protests has persistent effects on an individual's probability to participate in future protests (Bursztyn et al. 2019). However, there is no direct empirical evidence on whether persistence in protest participation exists at the community-level, and whether it can be transmitted across generations over long periods of time.

To study this question, we present empirical evidence from China. In particular, we investigate whether the incidence of social unrest against local government officials under the Qing dynasty (1644-1912) has a persistent effect on the incidence of anti-government protests in present-day China. The main identification challenge is that unobservable characteristics that make certain communities more rebellious in the past, might also make them more rebellious centuries later. We overcome this challenge by exploiting exogenous variation in the incidence of past protests generated by the visibility and magnitude of solar eclipses across Chinese regions. In the Confucianism tradition, a solar eclipse is considered a negative signal from the divinity on the legitimacy of a ruler. We argue that eclipses acted as a salient and observable signal with a shared interpretation among the local population, facilitating the coordination of anti-government actions and thus increasing the probability of local protests in communities that observed them.

To test this hypothesis we construct a new dataset containing the date and location of anti-government rebellions that occurred during the Qing dynasty period starting from prefecture and county chronicles. These local chronicles record all major events that took place in a given region – including insurgency actions – and were compiled by independent, reputable local intellectuals (Almond et al., 2019). Our datasets includes 1,806 rebellions occurred during the 268 years of the Qing dynasty. Rebellions mostly took the form of peasant uprisings, which were frequent in rural China and played an important role

[1] See Gehlbach et al. (2016) for a recent review and Cantoni et al. (2019) for experimental evidence on strategic substitutability in protest participation. See Manacorda and Tesei (2020) and Enikolopov et al. (2019) for recent evidence on the role of social media and availability of telecommunication technologies such as mobile phones as information and coordination mechanisms facilitating protest participation.

in several major political changes in Chinese history. Poverty and hunger were primary causes of peasant uprisings (Long, 2016; Wang, 1884), which targeted local elites and government officials for their unrestrained exploitation of local farmers. We merge data on the year and location (county) of protests during the Qing dynasty period with geo-located historical data on the areas of visibility and magnitude of solar eclipses from the US National Aeronautics and Space Administration (NASA). To study the persistent effects of past protests we use detailed data on current protests that has been recently made available by the China Academy of Social Sciences (CASS).

Our empirical strategy proceeds in two steps. In the first step, we test the hypothesis that solar eclipses positively affect the incidence of protests against local authorities during the Qing dynasty period. Solar exclipses are a plausibly exogeneous source of variation because their areas of visibility, as well as their timing, are solely determined by the relative position of the sun, the earth, and the moon. Consistently, we show that the exposure of Chinese counties to solar eclipses is orthogonal to a large set of observable geographical and socio-economic characteristics. We find that counties that experienced a total solar eclipse are about 17.5 percent more likely to experience a rebellion in the same year. Consistently with our interpretation, this effect is stronger in counties with larger diffusion of Confucianism.

In the second step of our empirical analysis we study the degree of persistence of past rebellions. Using variation in the incidence of past rebellions generated by eclipses, we test their long run effects on the incidence of social protests in China during the 2001-2013 period. Our 2SLS estimates indicate that one additional rebellion during the 1644-1912 period predicts 0.2 more episodes of social unrest during the 2001-2013 period. We find similar elasticities for different measures of incidence of social unrest, such as number of protests per capita, and number of protest participants per capita in a given county.

We also introduce a set of robustness test to show that our results are not driven by a spurious correlation between intensity of eclipses in the past and other geographical characteristics of Chinese counties. This is a common concern in studies that investigate the persistent effects of past phenomena on current outcomes, and which rely on geographical variation to identify such effects (Voth, 2020). In particular, we show that the frequency of past eclipses is orthogonal to a large set of geographical variables that are traditionally correlated with the intensity of economic activity in the long run, such as distance to the coast, distance to the capital city, distance to main rivers, and average terrain ruggedness at county level. Additionally, when estimating long run effects of past rebellions, we always control for province fixed effects, effectively relying on variation across counties located within the same geographical area of China. Regions affected by total eclipses tend to be relatively thin strips of land cutting across the Chinese territories, which insures we can exploit fine variation in exposure across counties within the same province.

Why should the incidence of past anti-government rebellions have long run effects on

the inclination of a certain community to protest? We argue that a potential explanation is the inter-generational transmission of the memory of these past protest experiences against the central authority. A tangible sign of this transmission is the construction of temples and memorials celebrating the leaders of anti-Qing rebellions. Commemoration of selected persons and historical episodes is a mechanism documented in many cultures as a way of shaping the collective memory and forge the cultural identity of a given community (Marschall, 2009). We think of this collective memory as a *lieux de mémoire* developed during the Qing dynasty period that can be shared and transmitted across generations by individuals that did not experience such events directly (Nora, 1989). In some instances, such collective memories from the past can be dormant for long periods of time in a given community, until "re-activated" by current events (Ochsner and Roesel, 2017).

To investigate this channel, we collected data on two potential signals of the existence of local transmission of the memory of past rebellions. First, we collected data on the date of construction and the geographical location of physical structures – such as temples – celebrating a leader of anti-Qing rebellions that occurred during the early years of the Qing dynasty. Second, we collected information on the presence of a positive recorded memory of these early anti-Qing rebels, as captured by the description of the actions of the individuals that fought against the Qing invaders in the local chronicles, in which the account has an anti-Qing tone. We think of the existence of such accounts (or legends) and of the temples celebrating early anti-Qing leaders as capturing the codification and transmission of anti-Qing sentiment within a given community. Consistent with this hypothesis, we find that the long-run effect of past rebellions is concentrated in areas that celebrated such events via temples or where such stories were recorded in local chronicles, thus preserving their memory for future generations.

Our paper is related to several streams of the literature. First, the mechanism linking solar eclipses to the probability of protests is related to the literature on coordination in protest actions and on how individuals' decision to participate in protests is influenced by the decision of others. Several papers postulate that the actions of a certain "pilot" revolutionary are treated as a signal for other people to join. For example, De Mesquita (2010) studies how a small number of rebels ("vanguard") can use violence as a form of public information, signaling to others that there are strong feelings of opposition to the government. Similarly, Lohmann (1994) exploits the events preceding the fall of the Berlin Wall to study how potentially costly (but peaceful) public demonstrations can result in an informational cascade, drawing additional participants into a demonstration as they observe fellow citizens rebelling in increasing numbers. Cantoni et al. (2019) use a field experiment in Hong Kong to study how the information of others' plans to protest affect an individual's decision to participate in protests. Our paper exploits the insight of this literature to rationalize the empirical link between solar eclipses and rebellions during the

Qing dynasty.[2]

More recently, Bursztyn et al. (2019) have studied the short-run persistence in protest participation at individual level. This is an important question because the success of a political movement often depends to its ability to sustain political engagement over time. Bursztyn et al. (2019) use a field experiment during the Hong Kong anti-authoritarian movement to show that individuals participating in the 2017 protests were significantly more likely to also participate in the following year protests. Our paper contributes to this recent literature by providing causal evidence on the long-run persistence in inclination to protest at the community level. In addition, we bring evidence on the role of the cultural transmission of the protest experience within a given community as a mechanism for long-run persistence.

Our paper is also related to the stream of the literature that focuses on the consequences of protest actions. This literature has documented that protests can have an independent impact on voting behavior (Madestam et al. 2013 and Aidt and Franck 2015), and on economic outcomes (Collins and Margo, 2007). For example, Madestam et al. (2013) use weather shocks to instrument for attendance at tea party protests in 2009 and find that protest participation in 2009 affected votes for the republican party in the 2010 US presidential elections. Our identification strategy is also related to the literature using natural phenomena as a catalyst for change in religious and political power (Lipset, 1959; Barro, 1999; Acemoglu and Robinson, 2006). Chaney (2013) analyzes the relationship between the flooding of the Nile and related shifts of political power in Egypt. He suggests that a religious figure's power increases during perilous economic circumstances brought by the Nile, and that this figure is less likely to be replaced, mainly due to their potential for coordinating a revolt. Belloc et al. (2016) find a similar result in the case of mild earthquakes in the south of Italy between 1000 and 1300, that led to an increase in the perceived power of politico-religious leaders to restore social order, delaying the transition to communal institutions. Ticku et al. (2018) offer a complementary explanation for the relationship between negative weather shocks in India and recorded temple desecration, a preemptive measure by a Muslim ruler to avoid such coordinated revolutions within their Hindu constituencies.

The rest of the paper is organized as follows. Section II provides the historical background. In this section we discuss the Confucianism interpretation of solar eclipses and their potential as a coordination device for protest actions. We also discuss the type of rebellions and the motives behind them during the Qing dynasty period. Section III

[2]A literature of coordination and coordination failure is large and can be dated back to Keynes' (1936) beauty contest analogy. The idea applies to a wide range of economic phenomena, from bank runs (Diamond and Dybvig, 1983; Shiller et al., 1984; Hertzberg et al., 2011) to asset price fluctuations (Azariadis, 1981; Cass and Shell, 1983; Obstfeld, 1984; Tirole, 1985; Grandmont, 1985; Azariadis and Guesnerie, 1986; Guesnerie, 1986; Woodford, 1986, 1990; Farmer and Guo, 1994; Benhabib and Farmer, 1999; Morris and Shin, 2002). For evidence on the coordination mechanism from lab experiments see Mehta et al. (1994a,b); Duffy and Fisher (2005); Fehr et al. (2019); Arifovic and Jiang (2014).

describes in detail our data collection process. Section IV describes our identification strategy and the main empirical results of the paper. Section V concludes.

II Historical Background

II.A Solar Eclipses as a Coordination Device in the Confucianism Tradition

Previous literature has established that any random and otherwise irrelevant event, such as a sunspot, could help coordinate actions so long as a) the signal is salient and is observable by many players (Shelling, 1960), and b) a common belief about the meaning of the signal exists between players, so that everyone might have a better prediction regarding what actions other revolutionaries might take (Duffy and Fisher, 2005). We thus argue that a solar eclipse fits the two criteria: It is both a salient signal from the perspectives of observers on earth, and a metaphor for heavenly opinion, as understood by Confucian interpretations.

Solar eclipses occur when the paths of the sun and the moon intersect so that the sun light is temporarily blocked by the moon, casting shadows on earth. A total eclipse, in which the sun is completely blocked, can only be observed in a certain stretch of area at any given time. Referred to as the zone of totality, those areas are usually several thousand kilometers long and less than one hundred kilometers wide, with observers inside the zone of totality observing the eclipse within the same day, usually several hours apart at a maximum. A total eclipse presents itself as nothing less than spectacular: the sun is blocked, and day becomes night, with stars visible for as long as one hour.

According to Confucianism, the dominant ideology in ancient China which continues to play a major role in shaping the minds and actions of Chinese society today, an eclipse is a signal regarding the legitimacy of a ruler. A paramount saint in Confucianism, Mencius, along with other sages, believed the legitimacy of emperors to come by endorsement from heaven, under the condition that the emperor takes care of his people.[3] Those tyrannical rulers who failed to do so would thus be abandoned by heaven, leaving the people with the right to overthrow them.

According to Confucianism, natural anomalies such as natural disasters (e.g. earthquakes, floods and droughts) and celestial phenomena (e.g. comet, supernova) are all indications of the dissatisfaction of the heavens against the ruler. However, a solar eclipse is the most serious condemnation from the heavens. As the sun is widely regarded as the

[3]Mencius proposed three intersections between Confucianism philosophy and politics: 1) That heaven is what grants an emperor's power (Mengzi 5A5), 2) That an emperor needs to exercise benevolent governance in accordance with the will of heaven (Mengzi 1B6, 2A5, 2B1), and 3) That an emperor who does not govern accordingly will be condemned by heaven, warning that righteous fury can come by way of natural anomaly. At those times, any consequent revolutions and regional-overthrow are legitimate (Mengzi 1B8, 2B9).

sign of the emperor (Li, 1990), an eclipse of the sun can be related to the moral faults of a ruling emperor. This idea can be dated back to the earliest books compiled by Confucius himself during the spring and autumn period of China. For instance, "The state without good governance could bring in the disasters of the solar eclipse."(Zuozhuan, Zhao, 7) or "The sun and moon did not follow common rules (eclipse) because the state governance was not good"(Shijing, Xiaoya, In October). During the Han and later dynasties, warnings of the eclipse were paramount: "The most notable is Heaven and the ultimate change that could happen to the emperor is the solar eclipse". (Wuxing, Houhan, Ji, 2003, book 7, PP429).

This eclipse-illegitimacy idea was popularized in the era of the Keju examinations, the device used in ancient China to choose civil officials, and which was the main, if not the only, social mobility channel in China (Bai and Jia, 2016). Interpretation of what an eclipse means frequently appears in all the nine works of the Confucian canon, which constitute a large portion of the question pool at all levels of the Keju examinations. This focus means that more than 5% of the population, attracted by the huge economic and social benefit of success should they pass the Keju, would spend 60% of their adult lives memorizing and understanding, in the course of things, this eclipse-illegitimacy idea. Moreover, Keju candidates, successful or not, usually enjoyed a much better social status and had a stronger voice in local affairs due to their capacity for reading and writing. Thus, when commoners had difficulty understanding what an eclipse meant, the eclipse-illegitimacy interpretation they heard from respectable local intellectuals was likely to be both intuitive and convincing to them.

This interpretation of solar eclipses as a sign of the illegitimacy of the current regime could have encouraged people to rebel. Thus, solar eclipses were feared by the regime. As a preemptive measure, it was an established tradition for emperors to issue "self-condemnation" scripts, asking for the pardon of the heavens. The first self-condemnation rescript ever issued by an emperor in the history of China, was made by emperor Wen during the Han dynasty, who was horrified by the presence of two eclipses in two consecutive months of his reign. In a famous script, emperor Wen declares, "I am incapable of ruling and taking care of my entire population and therefore bring about a solar eclipse that illustrates how large my sins were!"

The practice of issuing such self-condemnation scripts after the sight of a solar eclipse became a royal practice pass down to later generations of emperors. In addition, after a solar eclipse, an emperors usually took various measures to improve their administration to please their subjects and prevent local rebellions. Those measures included cutting local taxes, forgiving inmates of milder crimes, or allowing the people to petition in the capital and increasing Keju quotas (Zang, 2015).

Interestingly, the negative connotation of an eclipse remained diffused over time. For instance, the resignation decision of the emperor Qianlong in 1795 was believed to be

affected by the observation of consecutive solar and lunar eclipses in January of that year (Long, 2016; Wang, 1884). This persistence of the interpretation of eclipse was primarily due to the slow development of astronomical knowledge in China. Due to its political sensitivity, astronomical knowledge was largely monopolized by the government. Access to astronomical instruments and books was therefore restricted to a few government-affiliated astronomers, who held lifetime and hereditary appointments to prevent a leak of astronomical information. As a result, the majority of Chinese people had no astronomy knowledge at all. This also explains why the eclipse predictions were still very inaccurate, even in late Qing China (Lv and Shi, 2003a,b) .

II.B Social Protests under the Qing Dynasty

Peasant uprisings were very frequent in Chinese history and played a very important role in politics. For more than a millennium, China has existed as a centralized empire, with the power of local nobles and warlords greatly suppressed and local administrations controlled by delegated and short-tenured bureaucrats. As a result, grassroots peasant uprisings were usually the only viable threat to an incumbent's regime. What is more, the frequency of peasant uprisings in China was quite high. For instance, there were more than 200 large-scale peasant revolutions in the 160-year history of the North Song dynasty. In the last six years of the Qing dynasty, there were 140 peasant uprisings in China every year. The consequences of peasant uprising could be significant. Almost every dynasty's collapse in Chinese history was linked to a peasant uprising in either a direct or indirect way. Taiping's revolution, the largest peasants' uprising in Qing China, had, for example, a casualty count estimated at about 70 million (Xu and Yang, 2018).

Universal poverty and hunger are usually considered primary causes of peasant uprisings (Long, 2016; Wang, 1884). Perry (1980) suggests that the ensuing violence and banditry was simply a survival strategy for these desperate farmers, especially in regions hit by natural disasters[4]. However, uprisings were also attributable to the unrestrained behavior of local elites and local government officials, who relentlessly exploited the local peasants. The local elites, powered by their economic and social superiority, usually encroach on the private lands of peasants and profit from the manipulation of local silver-money exchange rate to exploit them. Local officials, who were usually in huge debt due to their huge investment in preparation for Keju exam, did not hesitate to levy additional taxes over peasants (Miao et al., 2020).

The peasant revolutionaries' dissatisfaction toward the local elite and officials was very noticeable from their political slogans. For instance, during the Li Zicheng revolution at the end of the Ming dynasty, peasants raised the slogan of "equalize land ownership, exempt tax and debt of the poor (to the elite)" to express their anger toward over-taxation

[4]Indeed, according to (Will, 2017), a central role of the Chinese government was to provide reliefs in response to natural disasters.

by the government, and toward exploitation by the local elite. Similar slogans were also used during the Taiping revolution. Similarly, Wang (2008); Yang (2010) suggest that exploitation of local elites and corrupt officials over peasants were the main driver of the relatively high frequency of revolutions over the last 10 years of the Qing dynasty.

The riots and uprisings of those discontent peasants were justified by Confucian classics, especially those from Mencius (OuYang, 2009). From Mencius' point of view, there is no difference in quality between ordinary people and rulers, and ordinary people could become legitimate ruler if they treat people with mercy. ("Everyone can be a saint", Mengzi, 5A6, 6B2). This idea greatly inspired Chinese people's enthusiasm for an uprising. Although failed Keju examinees constitute a large share of peasants leaders, probably due to their advantage in effective communication and plotting, we do observe some revolutionary leaders coming from the lowest peasant class with almost no education, notably the founder of the Ming dynasty, Zhu Yuanzhang. Still, his authority was beyond anyone's doubt once he ascended the throne.

III Data

In this section we describe our main data sources, and we provide details on the data collection process to construct the new data sets on the incidence of protests during the Qing dynasty period, and on the presence of signs of the anti-Qing sentiment in a given community such as temples and legends.

III.A Solar Eclipses

Data on solar eclipses is sourced from the US National Aeronautics and Space Administration (NASA). With access to route information, as well as data related to the relative position of the earth, the moon, and the sun, modern computer simulations generate detailed and accurate information relating to each eclipse, including the type, timing, and magnitude of each observable eclipse for each region of the earth. This calculation result is available for all eclipses occurring within the last 5,000 years. It was made possible to obtain maps and coordinates for all the regions where eclipses were observable during Qing China (1644-1911). We focus on those total eclipses whose zones of totality have ever touched the China territory. Figure III shows the geographical distribution of zones of totality of two eclipses, one in 1742 and the other in 1760.

We obtain the geographical location of each county in China from the China Historical Geographic Information System (CHGIS).We combined the CHGIS and NASA information to generate the total eclipse observing information of each individual county in China for each eclipse. [5] Figure IV shows the geographical distribution of counties in the totality

[5]To do that, we make use of the website: `http://xjubier.free.fr/en/site_pages/solar_eclipses/5MCSE/xSE_2_Five_Millennium_Canon.html`

zone of solar eclipses during the Qing dynasty period.

Other geographical variables at county-level used in the empirical analysis include: latitude, terrain ruggedness, distance from the Yangzi River, distance from the coast, and distance to the capital, Beijing. The source of these additional variables is the CGHIS database.

III.B Protests during the Qing period

Our local uprising information comes from the War Chronology of China (Chinese Military History Editorial Committee (Ed.). (2003)). It includes all wars, conflicts and revolts in the history of China. We focus on the Qing's period (1644-1911). On top of the peasants revolts against Qing, the book also includes narrative of wars and battles between Qing and foreign power, conflicts between peasants and foreign power, and battles in Xinhai Revolution. We read all the records and include exclusively the peasants uprisings. Figure A.1 shows one revolt taking place in 1813. The records provide the relevant information including the time, location, cause, leader, total participants of the revolt. It also provides a brief introduction of how the revolt develops and the interaction between the rebels and the government.

The information of the War Chronology of China comes from both the central government and local chronicles. For most large-scale rebellions, there exists a very detailed central government record. Rulers were usually informed of local rebellions, and that if they did not tackle issues with great care, smaller insurgencies could easily turn into nation-wide rebellions. Therefore, local officials were required to report information about local revolutions to the central government. The failure to do so could lead to the removal of a local official.

The local chronicles, which tended to record all major local events, also recorded such insurgency actions. Most authors of the local chronicles were independent, reputable local intellectuals, who were not under the scrutiny of the government (Almond et al., 2019). Their relative freedom mitigates concerns that news relating to local insurgencies would be intentionally omitted. Moreover, there is no evidence suggesting that the recorders of the county or prefectural chronicles refrained from reporting local violent events. As indicated above, local violence usually reflected the suffering of the local people, and more often than not, the irresponsible behavior of local ministry officials.

III.C Current protest

Data on current protests comes from the local unrest database released by China Academy of Social Sciences (CASS database). This database is collected by the institute

of law of CASS, the top law related research institute and think tank in China[6]. The database covers point observations of all social unrest events that involves more than 100 participants, with each event being one observation. It contains 916 observations taking place between 2001 and 2013 in Mainland China (Hong Kong SAR and Macao SAR excluded). All observations come from the coverage of newspaper published in mainland China and the major online website. For each unrest observation (unrest) we have detailed information about the total number of participants, the aim and duration of protests, the casualties during the protests and the final resolution, etc. Figure V reports the geographical distribution of social protests during the Qing dynasty (panel a) and in the 2001-2013 period (panel b)

III.D Martyrs, Temples and Legends

To explore the role of local anti-Qing memories and traditions over the long run, we collected data on local temples and legends regarding officials who died in the war against the Qing invasion (1644-1664). The list of names of anti-Qing martyrs comes from the book "Emperor Designated Book of Pre-dynasty's Martyred Officials" (Martyred Book hereafter). This book was compiled and distributed by the Qing rulers in 1775. The reason to do so is mainly because the Qing's court, as a minority ruler, constantly aimed at inspiring trust and loyalty among its majority subjects towards the incumbent regime, and to establish its own ruling legitimacy. [7]

The book contains a comprehensive list of 1,600 civilians and military officials who died in the war against Qing's invasion. The officials' names were ordered according to the princes they served and died with. See Figure A.4 for an example of an official named Jie Chongxi who martyred with the Right Prince Lu.

As the actions of these early rebels were described in a book issued by the Qing court, these rebels were officially recognized by the government. As a result, it was legitimate for the subjects to construct temples dedicated to these martyrs ("Martyrs' Shrine"), publicly worship them and spread their legends. On the other hand, worshiping and celebrating the leaders of peasant uprisings that happened later during the Qing dynasty may have triggered the intervention of the government. Over time, the temples dedicated to early anti-Qing martyrs became a symbol and a place to worship *all* anti-Qing martyrs and rebels, whether they were recognized by the government or not. This is consistent with the Chinese tradition of expressing discontent about the government in indirect ways.[8]

[6]For more detailed information, See http://www.bjnews.com.cn/graphic/2014/02/24/306216.html

[7]Interestingly, the Qing court compiled another book, called "Double-faced Ministers", at the same time. It collected all pre-dynasty's ministries who betrayed its own regime and surrender and serve for the Qing court.

[8]In a famous case that happened in 1661, Chinese intellectuals cried in a Confucian temple as a way to express their anger towards the government's over-taxation.

We extract information on the location of temple dedicated to such Martyrs from the geographic section of the county Chronicles. The main purpose of the geographic section is to introduce the location of the important sites of the county. The temples are important not only because they serve a key religious and cultural purpose, but also because the periodic market that are held outside the temple are usually the busiest ones and were the most important gathering opportunities for rural residents in China. Figure A.2 provides an example of the description of a martyrs' temple as reported in local chronicles. County chronicles usually provide the name of the temple, the location of the temple and a brief description of the individuals worshiped in the temple. Often times, the temples themselves was named after the worshiped individuals. The temple would be called a "Martyrs' Shrine" if multiple martyrs were worshiped there.

As a sign of respect, martyrs are usually introduced by their posthumous title rather than by their names. We hired graduate students from history department to find all the posthumous titles of martyred officials. We then use both electronic and manual searches to locate the martyrs' temples in the county chronicles. For those counties with multiple versions of chronicles compiled in different period, we searched all the chronicles and get rid of the repetitive observations. We finally find 308 martyrs' temples records in county chronicles. Figure VI, panel (a), shows the geographical distribution of the anti-Qing temples in our dataset.

The accounts of martyrs' actions against the Qing's invasion was usually recorded in the "memorabilia" section of local chronicles. Memorabilia mainly record the important events that took place within the county. The heroic fight and the sacrifice in face of the Qing's invasion would not be missed by the local historians, especially after the Qing court officially recognized the legitimacy of those actions. Notice that the heroic actions of local martyrs were reported in the chronicles even when the actual battle did not take place within the boundaries of the county. Figure A.3 presents an example of an account of a martyr's actions. The chronicle is from the county of Guichi, Jiangsu province, and provides a detailed description of the anti-Qing struggle of martyr Cao Dagao, despite the fact that his actions mostly took place in the Jiangxi province. His associate and a non-local martyr, Jie Chongxi, was also mentioned in the local account because of his connection with Cao.

Again, we use both electronic and manual searches to collect all the legends of martyred officials in the chronicles. We use both the names and the posthumous title in the searches. We get rid of repetitive observations among the different versions of the same county chronicles. To isolate the effect of the local diffusion of anti-Qing sentiment, we focus in particular on written accounts that describe the rebels' actions with a positive tone. We find 1284 martyrs' legends in county chronicles. Figure VI, panel (b) shows the geographical distribution of counties where we find anti-Qing legends.

IV Identification Strategy and Results

Our empirical strategy proceeds in two steps. First, we document the effect of solar eclipses on the probability of rebellions during the Qing dynasty period, from 1644 to 1912. Our objective is to test the hypothesis that solar eclipses positively affect the incidence of protests against local authorities. We start by discussing why we consider solar eclipses a valid instrument for social unrest during the Qing dynasty period in section IV.A. All the results of the first step of our empirical analysis are then presented in section IV.B.

In the second step of our empirical analysis we study the degree of persistence of past rebellions. Using variation in the incidence of past rebellions generated by eclipses, in section IV.C we test their long run effects on the incidence of social protests in China during the 2001-2013 period. In section IV.D, we discuss and provide evidence on a potential mechanism behind this persistence effect. In particular, we argue that the memory of rebellions occurred during the Qing dynasty was transmitted within a given community via temples and legends celebrating the leaders of such rebellions. We test this argument using data on the dates and geographical location of the temples constructed to celebrate rebel leaders of the past across China, as well as the codification of anti-Qing fighters' stories in local chronicles.

IV.A Solar Eclipses as an Instrument for Rebellions

Our main identification assumption is that both the timing and the geographical exposure of different counties to a solar eclipse are exogenous. This assumption is based on the fact that areas where a solar eclipse is visible, as well as its date, are solely determined by the relative position of the sun, the earth, and the moon. Thus, the degree of exposure of a given area to an eclipse should be orthogonal to geographic, demographic, economic and cultural characteristics of that area.

To validate this assumption in our data, we compare Chinese counties that are inside vs outside the totality zone of solar eclipses on a large set of observable characteristics. These characteristics include the size of the county as captured by its area and population, a large set of geographical characteristics including latitude, longitude, distance to the Yangtze river, distance to the imperial capital Beijing, distance to the coast, as well as average terrain ruggedness. We also include a set of socio-economic characteristics available in our data for the Qing period, including the share of non-Han population, the presence of places of worship of different religions, and the total amount of the "land tax" – the local agricultural tax which can be used as an imperfect proxy of local economic development.

The results of this balance test are reported in Table I. As shown, we find no significant differences across this large set of observable characteristics between counties inside vs outside the zone of totality during the Qing dynasty period. This lends support to our

assumption that the geographical distribution of eclipse visibility is as good as random.

In section II.A we argued that eclipses can increase the probability of protest events by favoring coordination among protesters. Even if the timing and location of eclipses is itself random, it may bring about other incidences – such as natural disasters — which themselves might increase the probability of social unrest. For instance, some researchers have argued that eclipses increase the probability/intensity of the El Niño and La Niña effects, a weather phenomenon that can increase the risk of extreme weather events (Lin et al., 1999). Thus, in Table I, we also compare eclipse and non-eclipse counties in terms of the incidence of four major natural disasters: droughts, floods, earthquakes, and locust infestations. These are among the most prominent natural disasters that could have affect the Chinese rural economy at the time, which mostly relied on agriculture. As such, the central government of the Qing dynasty kept a detailed record of such events, from which we extracted our data. As shown in Table I, we find no systemic differences in the incidence of these natural disasters across counties that experienced eclipses versus those that did not during the period under study.

Another potential concern is whether the timing of eclipses could have been predicted by Chinese astronomers and thus anticipated by either the rebels or the central government. As we discuss in section II, the deep-rooted interpretation of eclipses as negative omen for the regime even in the late stages of the Qing period was itself a sign of the slow development of astronomical knowledge in China. Because politically sensible, astronomical knowledge was largely monopolized by the government. Access to astronomical instruments and books was restricted to a few government-affiliated astronomers, who held lifetime and hereditary appointments to prevent a leak of astronomical information. As a result, the majority of Chinese people had no astronomy knowledge whatsoever. This also explains why the prediction of eclipses were very inaccurate, even in the late stages of Qing China (Lu and Shi, 2003,a,b).

IV.B The Effect of Solar Eclipses on Rebellions in Qing China

We start by studying the effect of solar eclipses on local rebellions during the Qing dynasty period. Our baseline specification is as follows:

$$1(rebellion)_{it} = \alpha_i + \alpha_t + \beta I(Eclipse)_{it} + \varepsilon_{it} \tag{1}$$

The outcome variable $protest_{it}$ captures the number of social unrest episodes recorded in county i, year t, as reported in local chronicles and described in section III. The independent variable $I(Eclipse)_{it}$ is an indicator function equals to 1 if county i was in the totality zone of a solar eclipse during year t. The totality zone of an eclipse is the area on the surface of the earth in which the moon covers the totality of the sun disk, effectively turning the day into night. Notice that our measure of eclipse intensity are

based on its theoretical visibility in perfect weather conditions – i.e. in the absence of clouds – as reported by NASA, and thus should be thought of as an intention-to-treat effect of eclipses. The specification reported in equation (1) includes county and year fixed effects.

In addition to equation (1), we also estimate the following augmented specification:

$$1(rebellion)_{ipt} = \alpha_i + \alpha_t + \alpha_{pt} + \beta I(Eclipse)_{it} + \theta X_{i,t-1} + \varepsilon_{ipt} \tag{2}$$

which includes time varying county-level controls as well as province p fixed effects interacted with year fixed effects. Time varying controls at county-level are meant to capture alternative determinants of protests that we can observe in our data. They include the natural disasters discussed above, a variable that indicates whether there was any famine in the region, and variables capturing government budget policy: a dummy that indicates whether the central government has made infrastructure expenditures in the region in the previous year, and a variable that indicates whether there is a taxation relief from the central government in the previous year.[9]

A standard econometric challenge when exploiting variation across geographical units as a source of cross-sectional variation is the geographical correlation among those units, which might lead to inflated t-statistics. To account for spatial autocorrelation in residuals, we cluster standard errors at the prefecture level in all our specifications. Prefectures are intermediate administrative units between counties and provinces. In our sample, each prefecture encompasses on average 6.3 geographically contiguous counties.

The results of estimating equation (1) are reported in Table II. The estimated coefficient in column (1) indicates that counties that experience a total solar eclipse have a 17.5 percent higher probability of also experiencing a rebellion. In column (2) we control for province-specific trends and in column (3) we augment our baseline specification with the set of time varying county-characteristics used in Table I. As shown, the point estimate are unchanged by the inclusion of these controls.

Next, we explore the timing of the relationship between eclipses and rebellions. First we study this by augmenting equation 2 with leads and lags in the total eclipse dummy. The results are reported in Table III. As shown, the effect of total solar eclipses on unrest materializes in the same year in which the eclipse occurs. As shown, leads and lags of the total eclipse dummy do not explain unrest.

We explore further the timing of the effect of eclipses on rebellions with the following dynamic specification:

[9]Using data on European countries during the XXth century, previous research has shown that austerity measures can be a powerful determinant of social unrest (Ponticelli and Voth, 2020).

$$1(rebellion)_{it} = \alpha_i + \alpha_t + \sum_{k=-3}^{k=+3} \gamma_k I(year = k) + \varepsilon_{it} \quad (3)$$

where $I(year = k)$ is a dummy equal to 1 if year $t = k$ for county i, and captures the time relative to an eclipse in county i, which we set at $k = 0$. We include the 3 years prior and the 3 years after an eclipse. The specification includes calendar year and county fixed effects, as in equation (1). Notice that this specification focuses on counties that experienced an eclipse at some point during the period under study. The results of estimating equation (3) are reported in Figure VII and confirm that the effect of eclipses on rebellion is contemporaneous. Figure VII also shows the absence of pre-existing trends in rebellions in counties that experienced an eclipse at $k = 0$.

IV.B.1 Sanity checks

The potential of solar eclipses to start local rebellions relies on two premises. First, solar eclipses being a prominent indicator of the regime illegitimacy. Second, this idea being widely shared by the local population. In what follows we conduct two sanity checks on these premises.

We start by testing to what extent eclipses differ from other unusual natural events as a signal of regime illegitimacy. To this end, we focus on two other rarely observed natural events that are reported in local chronicles: earthquakes and the birth of an albino cub in a given county. Although they might also cause the spread of rumors and panic among local people, these events are not linked to the illegitimacy of the regime in the Confucian tradition. If it is the local illegitimacy interpretation of the eclipse that brings about the local rebellion, one would expect that the documented effects on rebellion to be much weaker for these anomalies. Columns (1) and (2) of Table A.1 report the results. As shown, these other unusual natural events have no impact on the occurrence of local rebellions.

The other premise behind the link between solar eclipses and rebellions is a shared interpretation that solar eclipses are a divine signal of undermined legitimacy. The eclipse-illegitimacy interpretation is mainly held by the Confucian school. To proxy for the local diffusion of the eclipse-illegitimacy interpretation, we make use of the geographical distribution of Confucian temples, under the plausible assumption that regions with a larger presence of Confucian temples had a larger diffusion of Confucian ideology among the local population (Kung and Ma, 2014). We obtain information on the presence of Confucian temples from the local chronicles. The results are reported in column (3) of Table A.1 and show that the effect of solar eclipses on local rebellions is higher in Confucian counties.

IV.C The Persistence of Protests

In this section we test whether the incidence of social protests within a given community persists over the long-run. In particular, we exploit plausibly exogenous variation in the incidence of past rebellions generated by eclipses during the Qing dynasty to test their long run effects on the incidence of protests in present-day China. For this analysis, we rely on a set of cross-sectional regressions of current incidence of protests across Chinese counties on the incidence of protests in those same counties during the Qing dynasty period. We instrument the latter with the overall incidence of solar eclipses in a given county during the Qing dynasty period.

We start by discussing the cross-sectional version of our first stage specification, which is as follows:

$$\sum_{t=1644}^{1912} 1(rebellion)_{ipt} = \alpha_p + \gamma \sum_{t=1644}^{1912} I(Eclipse)_{it} + \eta_{ip} \quad (4)$$

Equation (4) links the overall number of protests observed in a county during the 1644-1912 period with the overall number of total eclipses visible from that same county during the same period. We include in this specification county-level controls, county population size categories fixed effects and province-level fixed effects.[10] The results are reported in Table IV. The estimated coefficient in column (1) indicates that Chinese counties experiencing 1 additional total eclipse during the 1644-1912 period experienced 0.45 more rebellions against local authorities during the same period. The first-stage F statistics is 59.7.[11]

In columns (2) and (3) we use two alternative measures of a county exposure to solar eclipses: the number of all types of eclipses weighted by their magnitude (i.e. the percentage of the sun disk covered) in column (2), and the total number of eclipses, independently from their magnitude, in column (3). As shown, the first stage coefficient is positive and highly significant irrespective of the measure used. However, total eclipses have a significantly larger impact on the incidence of rebellions than eclipses that do not fully cover the sun disk.

Next, in Table V, we study the effect of past protests on the incidence of current protests. To measure the incidence of current protests we create three main outcome variables: number of social protests, number of social protest per capita, and number of participants in social protests per capita in a given county during the period 2001-2013. The data on social protests is sourced from the China Academy of Social Sciences Dataset described in section III. For each of these three outcomes, we present a simple correlation

[10] Population statistics for the Qing dynasty period are from Skinner (1964), which categorizes each county into one of 11 population size categories, ranging from counties with up to 1000 individuals to counties with population above 500,000 individuals.

[11] Kleibergen-Paap Wald F-statistic.

of past protests on current protests, a reduced form specification of current protests on the number of eclipses experienced by a county during the Qing dynasty period, and an instrumental variable estimate which uses equation 4 as first stage. All specifications in Table V include the same set of county controls and fixed effects used in the first stage results reported in Table IV, and report standard errors clustered at the prefecture level – the intermediate administrative unit between counties and provinces – to account for spatial autocorrelation in the error term.

Let us start by discussing the magnitude of the 2SLS coefficients, which capture the effect of past protest on the incidence of current protests. The magnitude of the coefficient in column (3) indicates that counties that experienced 1 additional rebellion against local government during the 1644-1912 period experienced 0.21 more episodes of social unrest during the 2001-2013 period. This magnitude corresponds to about 14 percent of a standard deviation in the level of protest activity registered in the 2001-2013 period across Chinese counties. About 20 percent of the 1855 counties in our sample have experienced some protest events during the 2001-2013 period. If we estimate the regression in column (3) using a dummy which takes value 1 if any protest was observed in the 2001-2013 period, the estimated effect of past rebellions instrumented with the incidence of total eclipses is 0.11 with a t-stat of 2.91 (column (6)). This indicates that counties that had 1 additional anti-Qing rebellion in the past – due to their exposure to total eclipses – are about 11 percent more likely to also have experienced some form of social unrest in the 2001-2013 period.

We find similar effects when using alternative outcomes such as number of protest events per capita or protest participation per capita as outcome variables, as shown in Table **??**. Notice also that the 2SLS estimates in both tables are between 3 and 5 times larger than the OLS estimates. This downward bias in the OLS estimation could be driven by several potential sources of endogeneity in the OLS regression. For example, traditionally more rebellious regions might be treated differently by the central government over time so to avoid such rebellions to resurface. If the central government measures are effective, this would make such regions less likely to display rebellions in the future.

Although counties exposed and counties non-exposed to total eclipses during the Qing dynasty period were similarly likely to be have a Confucian temple at baseline, the results presented in Table A.1 show that Confucian areas are those traditionally more responsive to the impact of eclipses on social protests. Thus, a potential concern with the estimates reported in Table V is that the driver of the long-run effects of past protests on current protests is the local diffusion of Confucianism, as the compilers of our experiment are more likely to be Confucian areas. To explore this issue, we replicate the IV estimates presented in Table V restricting our sample to traditionally Confucian counties (those with local presence of a Confucian temple). The results are reported in Table A.2 and show that all our main results are robust to exploiting variation in the incidence of solar

eclipses *within* the sample of Confucian counties.

IV.D The Memory of Past Protests

Why does the incidence of past rebellions have long run effects on the inclination of a certain community to organize anti-government protests centuries later? In this section we discuss and test a potential mechanism behind this persistence: the inter-generational transmission of the memory of past protest experiences. In China, the experience of anti-government rebellions of the past is often transmitted across generations through the stories of the leaders of those past rebellions. A tangible sign of this transmission within a given community is, for example, the construction of temples and memorials celebrating the leaders of anti-government protests that occurred during the Qing dynasty. Such mechanisms of commemoration of selected persons and historical episodes are used in many cultures as a way of shaping the collective memory and forge the cultural identity of a given community.[12]

In order to provide evidence on this channel we collected data on two potential signals of the existence of local transmission of the memory of past rebellions. First, we collected data on the date of construction and the geographical location of physical structures – such as temples or memorials – celebrating a leader of anti-Qing rebellions that occurred during the early years of the Qing dynasty. Second, we collected information on the presence of a positive recorded memory of these early anti-Qing rebels in the local chronicles. As described in section III, by positive recorded memory we intend the existence of a description of the actions of the individuals that fought against the Qing invaders, in which the account has an anti-Qing tone. We think of the existence of such accounts (or legends) and of the temples celebrating early anti-Qing leaders as capturing the codification and transmission of anti-Qing sentiment within a given community.

We then test empirically whether the effect of past rebellions on current protests is different across areas with vs without these signs of transmission of the memory of past rebellions. To this end, we estimate the following specification:

$$\begin{aligned}\sum_{t=2001}^{2013} 1(protest)_{ipt} &= \alpha_p + \gamma_1 \sum_{t=1644}^{1912} \widehat{1(rebellion)_{it}} + \gamma_2 1(Temple) \\ &+ \gamma_3 \sum_{t=1644}^{1912} \widehat{1(rebellion)_{it}} \times 1(Temple) + \eta_{ip} \qquad (5)\end{aligned}$$

where $1(Temple)$ is an indicator function that is equal to one if the county has a temple or memorial celebrating a local leader of anti-government rebellions during the

[12] See, for example, (Marschall, 2009) on the role of memorials in South Africa post-apartheid.

Qing dynasty. The incidence of protests during the Qing period is instrumented with the incidence of total eclipses as per our first stage equation (4). We estimate a similar specification for the presence of positive recorded memory of early anti-Qing rebels in the local chronicles.

The results of this analysis are reported in Table VII. In column (1) we report the correlation between past protests and current protests as already documented in Table V. In columns (2) and (3) we estimate an OLS version of equation (5), which shows that the correlation in column (1) is stronger in counties that celebrated the leaders of past protests via temples and memorials and where the memory of anti-Qing actions remained recorded in local chronicles. In column (4) to (6) we then present the second stage coefficients of these heterogeneous effects. The results of column (5) show that the long-run effect of past rebellions is concentrated in counties that celebrated those rebellions via temples dedicated to local rebel leaders, thus preserving their memory for future generations. Similarly, in column (6), we document that such persistence is driven by counties were the memory of anti-Qing actions remained recorded in the local chronicles.

V Concluding Remarks

This articles shows that plausibly exogeneous differences in the incidence of past protests can have a persistent effect on the tendency to protest of a given community in the long-run. Our evidence also indicates that the cultural transmission of the past protest experience via the celebration of its leaders is a potential mechanism behind the documented persistence.

Since the existing literature has not explored whether persistence in protest participation exists at the community-level, and whether it can be transmitted across generations over long periods of time, there is no obvious benchmark with which to compare the magnitude of the estimates reported in this paper. To the best of our knowledge, the only available evidence on persistence in protest participation is at the individual level and over the short-run. In an experimental setting, Bursztyn et al. (2019) find that participation in the July 1, 2017 Hong Kong protests makes individuals around 47 percent more likely to participate in the same type of protest the following year.[13] Recent literature has also stressed the role of memory in guiding individual decisions. For example, Bordalo et al. (2020) present a model where memory of past individual experiences serves as an initial anchor to evaluate current decisions. Our evidence suggests that even the memory of events not directly experienced by an individual – but that are transmitted across generations within a given community – can act as a reference point for future behavior by members of that community.

Of course, the evidence on the channel is only suggestive, but the results presented

[13]The source is Table C.9, Panel B in Bursztyn et al. (2019).

in the last section of this paper clearly signal that this is a promising avenue for future research. In this sense, China is a very interesting setting to study the persistence of local collective memory. Just in the last two decades, the Chinese society has experienced large rural-urban migrations. One would expect this intense migration process to attenuate the influence of symbols and stories of the past on current behavior, especially given these stories are celebrating the fight against a foreign ruler that has not been in power for more than a century. On the other side, certain traits of the Chinese society – such as the importance of family ties and the local community in the Confucian tradition and the justified right to upraise against local authorities perceived as exploitative – are consistent with the existence of these long run effects.

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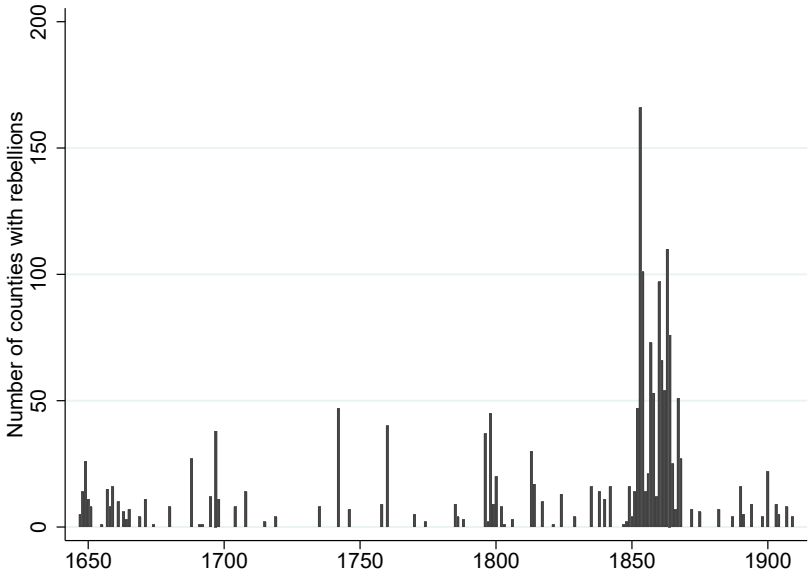
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Figures and Tables

Figure I: Number of counties with social unrest by year: 1644-1912



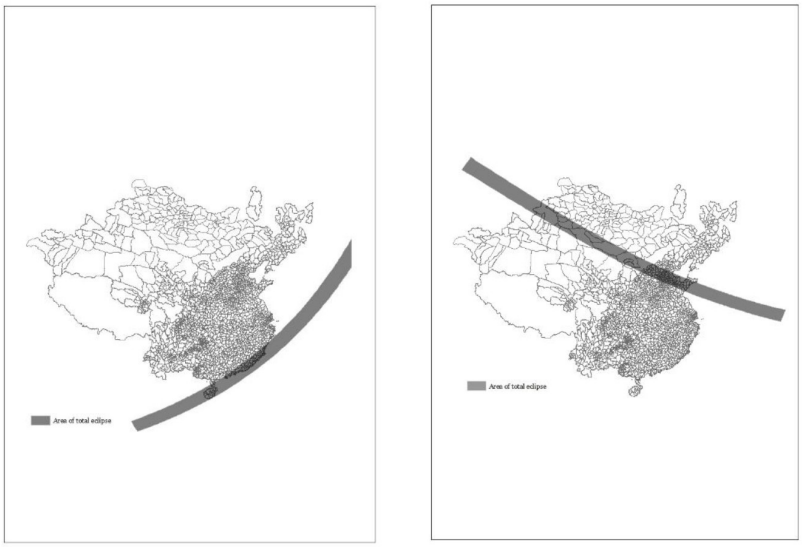
Notes: This figure shows the total number of counties having social unrest in each year throughout Qing China (1644-1912). The clustering of the social unrests during 1850s and 1860s are caused by the Taiping rebellion (1851-1864) and Nian rebellion (1853-1868).

Figure II: Number of counties experiencing total eclipses by year: 1644-1912



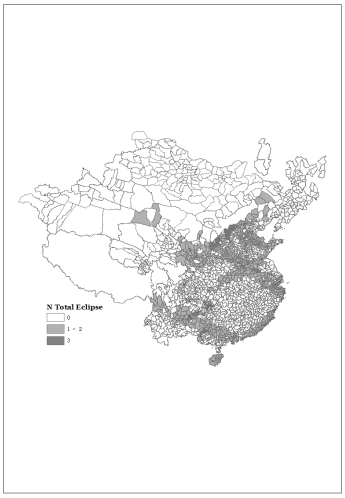
Notes: This figure shows the total number of counties experiencing total eclipses in each year throughout Qing China (1644-1912).

Figure III: Examples of Zones of Totality for Two Eclipses



Notes: This figure shows the zones of totality of two eclipses: The one took place in 1742 (left) and in 1760 (right). The zone of totality was calculated using eclipse information calculated by NASA.

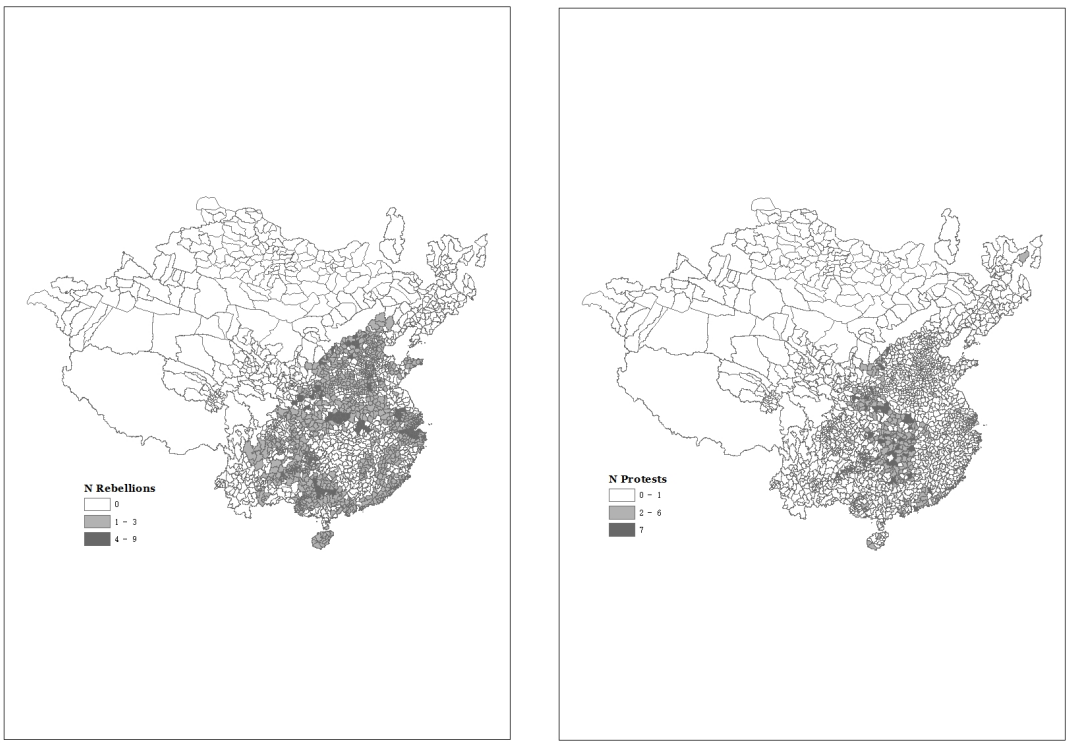
Figure IV: Total Eclipses Visible in Each County in 1644-1912



Notes: This figure shows the total number of eclipses that each county has observed throughout Qing China (1644-1912).

Figure V: Geographical distribution of social unrest

(a) 1644-1912 (b) 2001-2013



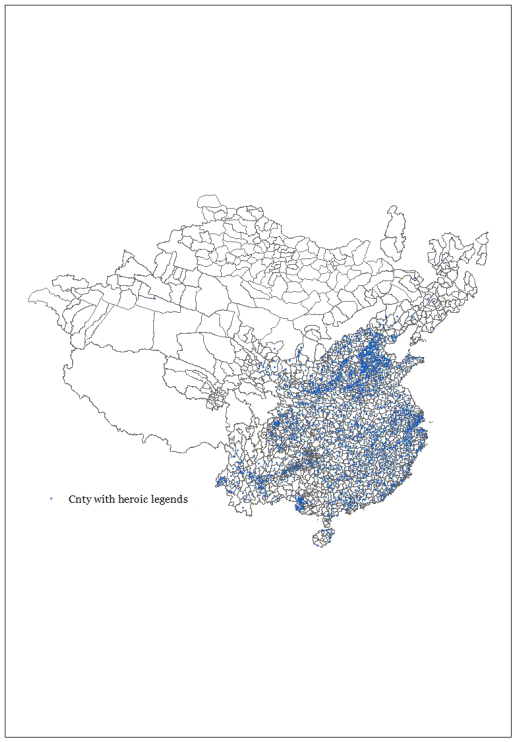
Notes: Panel (a) shows the total number of rebellions that each county has experienced throughout Qing China (1644-1912). Panel (b) shows the total number of protests that each county has experienced between 2001 and 2013.

Figure VI: Geographical distribution of Anti-Qing Memory

(a) Temple

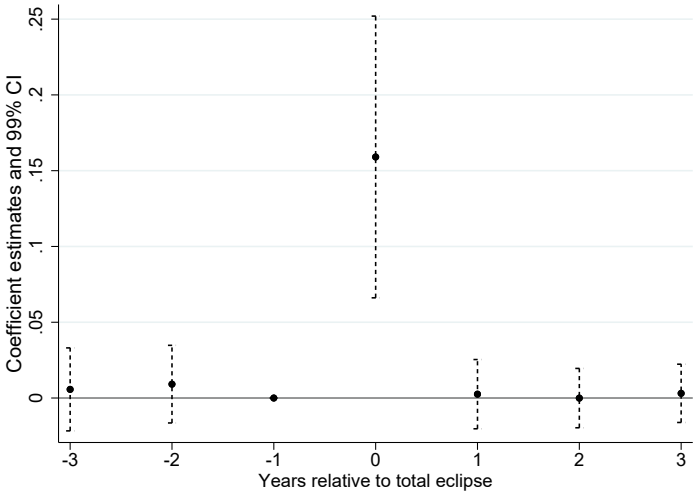


(b) Legend



Notes: Panel (a) shows the geographical distribution of temples in memory of officials martyred during the anti-Qing war (1644-1664). Panel (b) shows the geographical distribution of county chronicles' mentioning of the heroic legends of officials martyred during the anti-Qing war (1644-1664).

Figure VII: Timing of the effect of eclipses on probability of rebellion



Notes: This table reports the coefficient and 99% confidential intervals of the incidents of rebellions on the up-to-3-period leads and lags of incidents of eclipse. All regressions include baseline county level controls as well as county and year fixed effect. Standard errors used to construct confidence intervals are clustered at county level.

Table I: Balance test for counties inside/outside totality zone of the eclipse

Variables	Eclipse Sample	No-eclipse Sample	Diff	P-value of t.test
Rebellion	0.113	0.055	0.058	0.000
Longitude	113.143	113.117	0.026	0.859
Latitude	31.336	31.044	0.292	0.108
Area	2190.281	2137.552	52.729	0.371
Distance to nearest main river	0.001	0.001	0.000	0.213
Distance to the nearest church	0.000	0.000	0.000	0.304
Distance to coast line	0.010	0.010	0.000	0.479
Distance to the nearest garrison	0.003	0.004	0.000	0.373
Distance to the capital (Beijing)	0.007	0.007	0.000	0.274
Ruggedness	1.815	1.805	0.010	0.249
Population	2.747	2.814	-0.067	0.162
No-Han	0.018	0.024	-0.007	0.101
Confucian Temple	0.572	0.597	-0.025	0.149
Sum_JuanGong	0.499	0.505	-0.007	0.740
#(Genealogy)	39.222	40.011	-0.788	0.919
Secret Religions	0.062	0.060	0.002	0.793
Flood	0.011	0.007	0.004	0.658
Drought	0.006	0.008	-0.002	0.616
Locust disaster	0.003	0.005	-0.002	0.573
Earthquake	0.001	0.002	-0.001	0.923
Land tax	2.507	2.500	0.007	0.053
Disaster	0.035	0.040	-0.004	0.505
Famine	0.016	0.016	0.000	0.953

Notes: *Ruggedness* is the geographical unevenness of the earth surface of the county. The variable is constructed following Nunn and Puga (2012). *Sum_JuanGong* is the local's total Keju quota, or the total number of local candidates allowed to join higher-level Keju examinations. The variable is constructed following Bai and Jia (2016). *#(Genealogy)* is the extant family genealogies from the region and it represents the strength of family ties and the extent of collectivism. Only those counties inside the eclipses' totality zone can observe the total eclipse. The total number of observation of counties outside totality zone is 487,005. The total number of observation of counties inside totality zone is 860.

Table II: The Effect of Total Eclipses on The Probability of Rebellions

VARIABLES	(1) 1(rebellion)	(2) 1(rebellion)
I(Total Eclipse)	0.175***	0.181***
	(0.044)	(0.043)
$1(\text{Famine})_t$		0.004
		(0.004)
$1(\text{Natural disaster})_t$		0.000
		(0.000)
$1(\text{Construction of new infrastructure})_{t-1}$		-0.001**
		(0.001)
$1(\text{Tax exemption})_{t-1}$		0.005
		(0.003)
Observations	487,865	487,865
R-squared	0.048	0.204
Year FE	y	y
County FE	y	y
Provice × year FE	n	y
N clusters (prefectures)	296	296

Notes: The specification is reported in equations (1) and (2) . The dependent variable, *Rebellion*, is the dummy variable that equals 1 for the county-year observations if there were any rebellions and 0 if otherwise. *1(Total Eclipse)* is a dummy variable that equals 1 if the county was within the totality zone of an eclipse in a given year, and 0 otherwise. *1(Famine)* is a dummy variable that equals 1 if there were any famines and 0 if otherwise. *1(Natural disaster)* is a dummy variable that equals 1 if there were any natural disasters and 0 if otherwise. *1(Construction of new infrastructure)* is a dummy variable that equals 1 if there was any government expenditure on local infrastructure in the previous year and 0 if otherwise. *1(Tax exemption)* is a dummy variable that equals 1 if there was any reduction in local taxation in the previous year and 0 if otherwise. We control for the year fixed effect, county fixed effect and interactions between the province fixed effect and the year fixed effect. Standard errors clustered at the prefecture-level (one administrative unit below provinces, and one above counties) reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table III: Dynamic Specification

VARIABLES	(1) 1(rebellion)	(2) 1(rebellion)
I(Total Eclipse)$_{t-2}$	0.002	0.003
	(0.003)	(0.004)
I(Total Eclipse)$_{t-1}$	0.004	0.002
	(0.007)	(0.007)
I(Total Eclipse)	0.178***	0.186***
	(0.044)	(0.044)
I(Total Eclipse)$_{t+1}$	-0.000	0.002
	(0.005)	(0.003)
I(Total Eclipse)$_{t+2}$	0.003	0.003
	(0.004)	(0.004)
Observations	480,445	480,445
R-squared	0.049	0.206
Year FE	y	y
County FE	y	y
Provice × year FE	n	y
N clusters (prefectures)	296	296

Notes: The specification is reported in equation (3). Two lags and leads of the total eclipse dummy are included. The controls are the same as Table II. We control for the year fixed effect, county fixed effect and interactions between the province fixed effect and the year fixed effect. Standard errors clustered at the county level reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table IV: First Stage: The Effect of Incidence of Eclipses on Incidence of Rebellions in the 1647-1909 period

VARIABLES	(1) N Rebellions (1647-1909)	(2) N Rebellions (1647-1909)	(3) N Rebellions (1647-1909)
$(\text{N Total Eclipses})_{1647-1909}$	0.452***		
	(0.119)		
$(\text{N Eclipses - weighted by magnitude})_{1647-1909}$		0.050***	
		(0.018)	
$(\text{N Eclipses})_{1647-1909}$			0.029**
			(0.011)
Observations	1,855	1,855	1,855
R-squared	0.341	0.307	0.308
Provice FE	y	y	y
County pop categories FE	y	y	y
County-level controls	y	y	y
N clusters (prefectures)	296	296	296

Notes: The specification is reported in equation (4). The dependent variable is the total number of rebellions throughout the Qing dynasty period (1647-1909) in each county. The dependent variable in Column (4) is the total number of rebellions normalized by the county's total population. The independent variable is the sum of the eclipses, added up by various methods. *(N Total Eclipses)*$_{1644-1912}$ is the number of total eclipses observed in the county throughout Qing dynasty. *(N Eclipses - weighted by magnitude)*$_{1644-1912}$ is total number of all types of eclipses weighted by their magnitude (expressed in percentage of the sun disk covered by the moon). *(N Eclipses)*$_{1644-1912}$ is the unweighted sum of all types of eclipses. All specifications include: fixed effects for the 25 provinces of China, fixed effects and for the 11 categories of county population size during the Qing dynasty period as reported in Skinner (1964), county-level controls as in Table II. Standard errors clustered at the prefecture-level (one administrative unit below provinces, and one above counties) reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1..

Table V: The Effect of the Incidence of Past Rebellions on the Incidence of Current Protests

	(1)	(2)	(3)	(4)	(5)	(6)
	N Protests			1(Protest)		
VARIABLES	OLS	RF	IV	OLS	RF	IV
$(\text{N Rebellions})_{1647-1909}$	0.065***		0.215**	0.034***		0.112***
	(0.024)		(0.109)	(0.009)		(0.039)
$(\text{N Total Eclipses})_{1647-1909}$		0.097*			0.051***	
		(0.051)			(0.015)	
Observations	1,855	1,855	1,855	1,855	1,855	1,855
R-squared	0.552	0.551	-0.021	0.401	0.397	-0.061
Provice FE	y	y	y	y	y	y
County pop categories FE	y	y	y	y	y	y
County-level controls	y	y	y	y	y	y
N clusters (prefectures)	296	296	296	296	296	296

Notes: In columns (1)-(3), the dependent variable is the total number of social unrest episodes recorded in a given county by the CASS database. In columns (4)-(6), the dependent variable is a dummy equal to 1 if the county experienced some protest events in the 2001-2013 period according to the CASS data set. $(N\ rebellion)_{1644-1912}$ is the total number of rebellions during the Qing dynasty period. $(N\ Total\ Eclipses)_{1644-1912}$ is the number of total eclipses observed in the county during the Qing dynasty period. All specifications include: fixed effects for the 25 provinces of China, fixed effects and for the 11 categories of county population size during the Qing dynasty period as reported in Skinner (1964), county-level controls as in Table II. Standard errors clustered at the prefecture-level (one administrative unit below provinces, and one above counties) reported in brackets. Significance level: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table VI: The Effect of the Incidence of Past Rebellions on the Incidence of Current Protests: Additional Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	N Protests per capita			Protest size per capita		
VARIABLES	OLS	RF	IV	OLS	RF	IV
$(\text{N Rebellions})_{1647-1909}$	0.009*		0.050**	0.021***		0.080**
	(0.005)		(0.025)	(0.007)		(0.032)
$(\text{N Total Eclipses})_{1647-1909}$		0.023**			0.036***	
		(0.010)			(0.012)	
Observations	1,855	1,855	1,855	1,855	1,855	1,855
R-squared	0.515	0.516	-0.059	0.493	0.492	-0.050
Provice FE	y	y	y	y	y	y
County pop categories FE	y	y	y	y	y	y
County-level controls	y	y	y	y	y	y
N clusters (prefectures)	296	296	296	296	296	296

Notes: In columns (1)-(3), the dependent variable is the total number of social unrest episodes recorded in a given county by the CASS database divided by the county's population. In columns (4)-(6), the dependent variable is the sum of all participants in social unrest episodes reported in CASS normalized by the county's population. $(N\ rebellion)_{1644-1912}$ is the total number of rebellions during the Qing dynasty period. $(N\ Total\ Eclipses)_{1644-1912}$ is the number of total eclipses observed in the county during the Qing dynasty period. All specifications include: fixed effects for the 25 provinces of China, fixed effects and for the 11 categories of county population size during the Qing dynasty period as reported in Skinner (1964), county-level controls as in Table II. Standard errors clustered at the prefecture-level (one administrative unit below provinces, and one above counties) reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

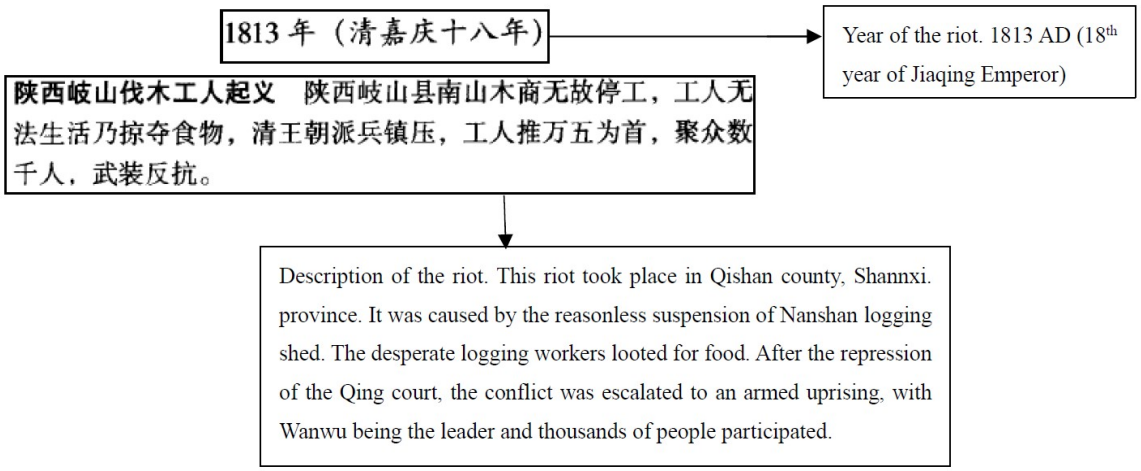
Table VII: The Effect of the Incidence of Past Rebellions on the Incidence of Current Protests: Heterogeneous Effects by Memory of Past Protests

	(1)	(2)	(3)	(4)	(5)	(6)
	N Protests			N Protests		
VARIABLES	OLS	OLS	OLS	IV	IV	IV
$(\text{N Rebellions})_{1647-1909}$	0.065***	0.007	-0.047	0.215**	0.061	-0.042
	(0.024)	(0.023)	(0.035)	(0.109)	(0.101)	(0.137)
1(Temple)		-0.004			-0.293	
		(0.129)			(0.428)	
$(\text{N Rebellions})_{1647-1909} \times 1(\text{Temple})$		0.357***			0.578*	
		(0.083)			(0.340)	
1(Anti-Qing Memory)			0.051			-0.153
			(0.062)			(0.216)
$(\text{N Rebellions})_{1647-1909} \times 1(\text{Anti-Qing Legends})$			0.158***			0.350*
			(0.051)			(0.193)
Observations	1,855	1,855	1,855	1,855	1,855	1,855
R-squared	0.552	0.573	0.558	-0.021	0.032	-0.017
Provice FE	y	y	y	y	y	y
County pop categories FE	y	y	y	y	y	y
County-level controls	y	y	y	y	y	y
N clusters (prefectures)	296	296	296	296	296	296

Notes: The specification is reported in equation (5). The dependent variable in all columns is the total number of social unrest episodes recorded in a given county by the CASS database. We report the OLS results in columns (1)-(3) and the 2SLS results in columns (4)-(6). *(N rebellion)*$_{1644-1912}$ is the total number of rebellions during the Qing dynasty period. *1(Temple)* is a dummy variable that equals 1 if the county has any temple or memorial celebrating anti-Qing martyrs, and 0 if otherwise. $1(Anti-QingMemory)$ is a dummy variable that equals 1 if there is any description of heroic legends of anti-Qing martyrs in the county chronicles, and 0 if otherwise. All specifications include: fixed effects for the 25 provinces of China, fixed effects and for the 11 categories of county population size during the Qing dynasty period as reported in Skinner (1964), county-level controls as in Table II. Standard errors clustered at the prefecture-level (one administrative unit below provinces, and one above counties) reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1..

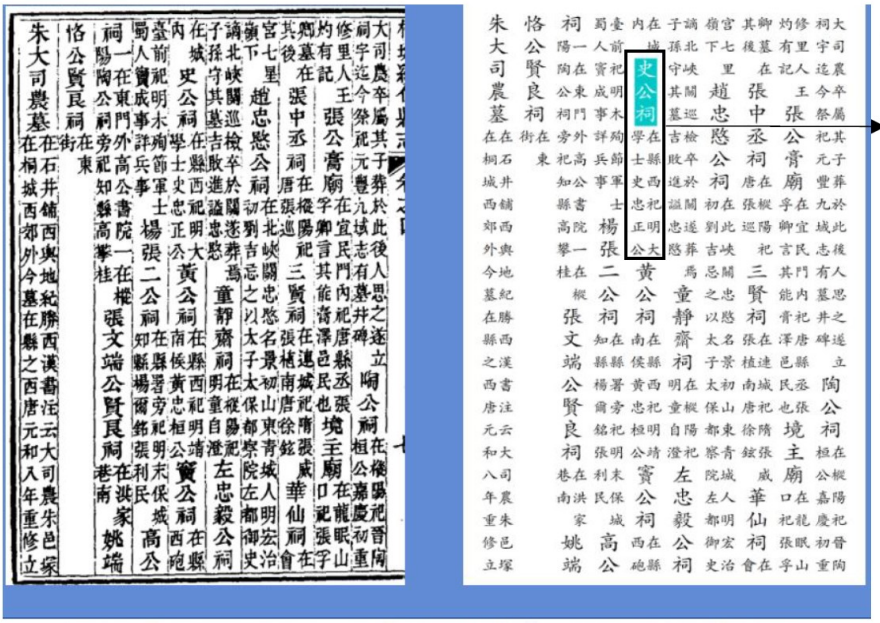
Appendix

FIGURE A.1



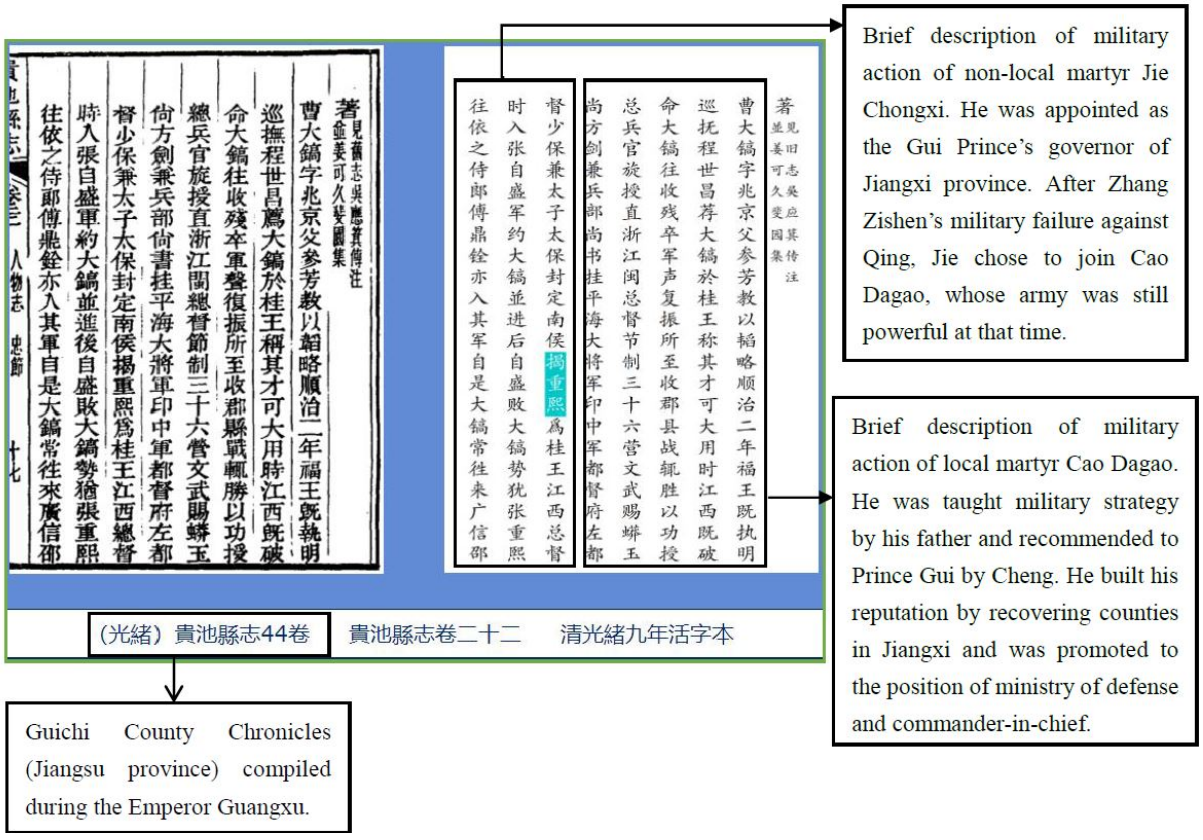
Notes: This figure shows a riot record in the book Chronology of Wars in Chinese History (Zhongguo Lidai Zhanzheng Nianbiao). The year of the riot and a short description regarding the location, the reason, the leader and number of participants is provided. It also provides a short discussion between the process of the revolt and the government's reaction.

FIGURE A.2



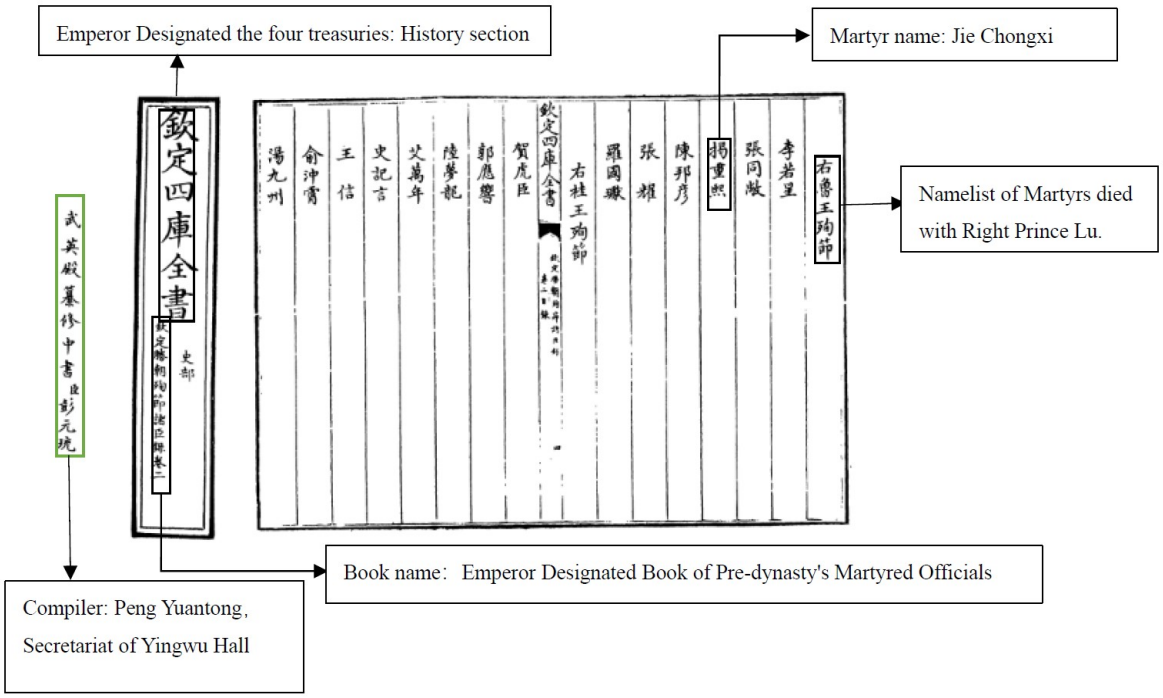
Notes: This figure shows an example of the location of the martyrs' temples. The temple location information comes from the local chronicles. It also provides the posthumous title of the martyr.

FIGURE A.3



Notes: This figure shows an example of the martyrs' legends. On top of the martyr who was originated from the county, e.g., Cao Dagao, it also mentioned his non-local associated and also a martyr, Jie Chongxi.

FIGURE A.4



Notes: The figure shows the name list of Anti-Qing martyrs. The name list comes from the Emperor Designated the Four Treasuries (Qinding Siku Quanshu), the encyclopedia compiled by Qing court. The names of the martyrs are ordered according to the princes they served and died with.

Table A.1: Sanity Checks

Variables	(1) 1(rebellion)	(2) 1(rebellion)	(3) 1(rebellion)
Anomalies indicator	Mild earthquake	Other anomalies	1(Total Eclipse)
Anomalies indicator	-0.002	0.005	0.142***
	(0.002)	(0.007)	(0.024)
1(Total Eclipse) * Confucian temples			0.081**
			(0.037)
Disaster in year (t-1)	-0.000	-0.001	-0.000
	(0.000)	(0.000)	(0.000)
Famine in year (t-1)	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)
New infrastructure in year (t-1)	-0.001**	-0.001**	-0.001**
	(0.001)	(0.001)	(0.001)
No full taxation in year (t-1)	0.005*	0.005*	0.005*
	(0.002)	(0.002)	(0.002)
Observations	487865	487865	487865
R-squared	0.194	0.194	0.205
County FE	y	y	y
Year FE	y	y	y
Province FE * Year FE	y	y	y

Notes: The specification is reported in equation (1). In columns (1) and (2), the independent variable of interest, the indicator of anomalies, is changed from the *Eclipse* to *Mild earthquakes* and *Other anomalies*. In columns (3) and (4), we include the *1(Total Eclipse)'* interaction with the *Confucian temple* and the *Christian church*. *1(Total Eclipse)* is a dummy variable that equals 1 if there were any total eclipse and 0 if otherwise. *1(Confucian temple)* is a dummy variable that equals 1 if there has been any Confucian temple in the county and 0 if otherwise. *1(Christian church)* is a dummy variable that equals 1 if there has been any Christian church in the county and 0 if otherwise. We control for the province fixed effect and county-level controls as in Table II. Standard errors clustered at the county level reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table A.2: The Effect of the Incidence of Past Rebellions on the Incidence of Current Protests
Confucian Counties Sample

VARIABLES	(1) N Protests IV	(2) N Protests per capita IV	(3) Protest size per capita IV
$(\text{N Rebellions})_{1647-1909}$	0.368**	0.088**	0.138***
	(0.180)	(0.041)	(0.041)
Observations	840	840	840
Provice FE	y	y	y
County pop categories FE	y	y	y
County-level controls	y	y	y
N clusters (prefectures)	204	204	204

Notes: In column (1), the dependent variable is the total number of social unrest episodes recorded in a given county by the CASS database. In columns (42), we normalize the same outcome by the county's population. In column (3), the dependent variable is the sum of all participants in social unrest episodes reported in CASS normalized by the county's population. All columns report the 2SLS regression results conditioning on the sample of counties that report having a Confucian temple during the Qing dynasty period. $(N\ rebellion)_{1644-1912}$ is the total number of rebellions during the Qing dynasty period. $(N\ Total\ Eclipses)_{1644-1912}$ is the number of total eclipses observed in the county during the Qing dynasty period. All specifications include: fixed effects for the 25 provinces of China, fixed effects and for the 11 categories of county population size during the Qing dynasty period as reported in Skinner (1964), county-level controls as in Table II. Standard errors clustered at the prefecture-level (one administrative unit below provinces, and one above counties) reported in brackets. Significance level: *** p<0.01, ** p<0.05, * p<0.1.