Robin Hood on the Grand Canal

Economic Shock and Rebellions in Qing China, 1650-1911 *

Yiming Cao †
Department of Economics
Boston University

Shuo Chen ‡
Department of Economics
Fudan University

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Abstract

Social scientists have long pondered the effects of economic shock on social conflict. However, the causal evidence discovered so far is limited to a small subset of economic shocks, and the findings are still inconclusive. This paper uses the abandonment of China's Grand Canal – perhaps the largest infrastructure project in the pre-modern world – in 1826 as a natural experiment to study the link between economic shocks and social conflicts. Using a dataset covering 575 counties from 1650 to 1911, we have found that negative economic shocks significantly generated social instability: in the period of post-abandonment, the annual frequency of rebellions was 0.0094 higher in counties bordering the canal than those that are not. The magnitude of the effect accounted for about 124% of the sample mean and was robust across various specifications. We then compare the relative explanatory power of alternative explanations, and conclude that the reform was most likely to arouse rebellions by reducing opportunity cost of the rebels, specifically through the interruption of trade in urban areas.

Keywords: Economic Shocks; Conflict; Rebellions; the Grand Canal; China

JEL Classification Numbers: O13, O17, D74, H56, N45, N95, Q34.

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†Address: 270 Bay State Road,Boston, MA 02215, USA, e-mail: *yiming@bu.edu*.

‡Address: 600 GuoQuan Road, Yangpu District, Shanghai, 200433, China, e-mail: *cs@fudan.edu.cn*.

1 Introduction

Social scientists have long pondered the effects of economic shocks on social conflict. They have provided substantial evidence that these two factors are negatively correlated (Collier and Hoeffler, 1998, 2004; Fearon and Laitin, 2003; Humphreys, 2005; Buhaug and Rød, 2006; Ross, 2006; Angrist and Kugler, 2008; Bellows and Miguel, 2009; Kung and Ma, 2014a). An emerging literature seeks to isolate exogenous variations to identify their causality. However, most of the causal evidence is limited to climate shocks on agricultural productivity (Miguel et al., 2004; Miguel, 2005; Mehlum et al., 2006; Miguel, 2007; Burke et al., 2009; Miguel and Satyanath, 2011; Ciccone, 2008) and price shocks to global commodities (Besley and Persson, 2008; Brckner and Ciccone, 2010; Dube and Vargas, 2013), and the findings are still inconclusive (Bazzi and Blattman, 2014; Burke et al., 2015; Sarsons, 2015). This paper attempts to contribute to the literature using a novel natural experiment – the abandonment of China's Grand Canal in 1826 – to examine the link between economic shocks and social conflicts.

The Grand Canal is perhaps the largest and oldest infrastructure in the pre-modern world. It spans 1,776 kilometers (1,104 miles) in length, passing through six provinces in the north-eastern and central-eastern plains of China. This area was populated by over 126 million inhabitants in early nineteenth century, accounting for about 15% of the world population. The first parts of the canal dated back to the fifth century BC, while the various sections were finally integrated into a nationwide system during the Sui Dynasty (581-618 AD). The primary purpose of the canal was to transport tribute grain from southern China to Beijing, the capital city of the empire. In early nineteenth century, approximately 3.5 million piculs of rice (roughly 560 million lb) were delivered annually. Meanwhile, the canal benefited the adjacent regions by reducing the transport cost for long-distance trade. Grain junks were allowed to carry certain amount of duty-free commodities during their service. Private junks also used the canal extensively for trade, travel and pleasure. The Grand Canal thus developed into one of the most popular trade routes within China.

Starting from 1826, the Grand Canal was gradually abandoned by the Qing government as the exclusive route for tribute grain transportation. One significant consequence of the reform was the unprecedented decline in trade around the canal. On one hand, the dismiss of official grain junks directly reduced the number of commodities carried on the canal. On the other hand, the negligence of conservancy after the reform destroy the canal's navigability so that private trade also suffered. By early twentieth century, the canal had become so clogged with silt that much of its length was no longer navigable. This marked the overall decline of the canal corridor economic belt. Historians have long argued that the abandonment of the canal was responsible for the subsequent wave of social unrest in late Qing Dynasty (Esherick, 1988), yet the hypothesis has never been systematically tested.

The abandonment of the Grand Canal provides us with an ideal opportunity to study the link between economic shocks and social conflicts. First, the reform was not generally expected, and was primarily due to political rather than economic consideration of the new emperor. This provides plausibly exogenous shocks to the local economy. Second, there is rich information available on

social unrest in historical China over a long period of time. The dataset we newly constructed consists of 575 counties over 262 years (from 1650 to 1911). It is based on the historical records officially compiled by the Qing court, providing detailed information on the time, location and activities for each rebelling event throughout the Qing Dynasty. Lastly, by focusing on variations within a single country, we believe that our sample was relatively homogeneous with respect to ethnicity, institution and culture, the other important factors in the conflict literature (Hegre and Sambanis, 2006; Laitin, 2007; Djankov and Reynal Querol, 2010; Kung and Ma, 2014b; Janus and Riera-Crichton, 2015; Jha, 2013).

We began our analysis with the standard differences-in-differences (DD) strategy. Specifically, we compare the relative change in the number of rebellions in counties along the canal relative to the others. Our findings across various specifications suggest a higher number of rebellions associated with the canal's abandonment: relative to the counties away from the canal, those bordering the canal experienced 0.0094 higher number of rebellions after the reform (relative to before). The effect corresponds to a 124% increase relative to the sample mean (0.0076), and is significant at the 95% confidence interval.

The baseline model with binary treatment is then refined by allowing continuous measures of intensity. To this end we exploit two sources of cross-county variations: (i) the length of the canal within a county, and (ii) the distance from the county to the canal. Consistent with our expectation, the number of rebellions is estimated to be an increasing function of length, and a decreasing one of distance. Estimates from more flexible specifications further verify that the effects are specific to counties within $150km$ from the canal. We interpret this as the range of the canal's impact.

To reconcile with the fact that the reform took a gradual process, we extend the two-period model into continuous measures of reform progress. The most natural way is to use the number of years after the reform as a linear measure of completeness. The result suggests an enhancing impact as the reform unfolds. More flexible decade-by-decade estimates allow us to further explore the nonlinear dynamics of rebellions over time. After the abandonment of the canal, the number of rebellions kept increasing for over 30 years; then the effect appears to fade, but it still remains positive and significant by the end of our analysis. In this specification, the coefficients estimated for periods prior to the reform also serve as a verification of the common trends assumption that validate our identification method.

Several robustness checks are performed in order to assess the quality of previous identification. For example, there might be concerns that our results suffer from omitted variable bias. To address it, we include a set of control variables from the literature on the determinants of conflict: weather, geography, agricultural technology and culture. Our results are robust to the inclusion of all these factors. Another concern regards the possibility of reverse causality in the later periods of the sample. To this end, we restrict our analysis to truncated sample periods to mitigate the threat. The results confirm that our findings are not affected by excluding potentially endogenous periods. Finally, to avoid the spurious correlations due to noise, we conduct a falsification test, comparing the treatment effects we have estimated to the distribution of placebo treatment effects when county

locations are randomly assigned. It reinforces that it is unlikely for noises in the data to affect our results.

What are the underlying mechanisms behind the the observed effects? We investigate two hypotheses proposed in the conflict literature: (i) the decline in *state capacity*, and (ii) the reduction in *opportunity cost*. After comparing various evidence regarding the relative explanatory power of the competing theories, we find that the opportunity cost hypothesis appears more consistent with what we observe in the data. In particular, it seems due to the interruption of trade in the urban sectors. We briefly discuss the possible implication in terms of the underlying social structure in urban regions, and as a tentative attempt, relate this to the evolution of organized crimes and the rise of communism in the early twentieth century.

Our study thus contribute to the emerging literature on the causal relationship between economic shock and conflict (See Blattman and Miguel (2010) for an overview). The existing literature primarily focuses on economic shocks associated with weather volatility (Miguel et al., 2004; Miguel, 2005; Mehlum et al., 2006; Miguel, 2007; Burke et al., 2009; Miguel and Satyanath, 2011; Ciccone, 2008) and commodity price (Besley and Persson, 2008; Brckner and Ciccone, 2010; Dube and Vargas, 2013). Such shocks, while causally well-identified, represent a narrow subset of economic shocks that is transitory, rural specific, and policy irrelevant. To complement them, this paper examines the effects of permanent economic shock to the urban sector initiated by government, which carries distinct implications rarely documented in the current literature. First, while a transitory shock only changes the current economic condition, permanent ones affect all subsequent periods as well as people's expectations about the future [1]. Consistent with Iyigun et al. (2017), we find that conflicts induced by a permanent shock tends to be more frequent and persistent. Second, unlike their rural counterparts, labor force in densely populated urban areas have more collective consciousness and organized politics. Such social structure is likely to become hotbeds of gangsters and organized crimes in the lack of socio-economic opportunities. This pattern, which is confirmed in our data, is consistent with the case studies on the evolution of gangs and mafia in the United States (Haller, 1971; Hagedorn and Macon, 1988; Critchley, 2008). Finally, in terms of policy, our findings suggest the openness to trade as a potential way to prevent violent conflict.

This paper is also related to the impact of transportation infrastructure. Economic historians have documented extensive evidence regarding the impact of transportation infrastructure, in particular, the building of highways and railroads (Fogel, 1979, 1994; Fernald, 1999; Haines and Margo, 2006; Baum-Snow, 2007; Atack et al., 2008; Michaels, 2008; Atack et al., 2010; Duranton and Turner, 2012; Donaldson, forthcoming; Donaldson and Hornbeck, forthcoming; Perlman, 2016) . While most of them focus on the economic consequences, we provide evidence on the non-economic consequences of transportation infrastructure. Recent work exploring this topic includes Sokoloff (1988), Burgess and Donaldson (2010), Agrawal et al. (2017), and Perlman and Schuster (forthcoming). Another departure of our paper from the existing literature is the discussion of

[1] It is unclear whether a permanent shock would exhibit more or less detrimental effects than the transitory ones due to the interplay of "adaptation" and "intensification" effects. See Iyigun et al. (2017) for detailed discussion of these two terms.

abandonment rather than construction. The detrimental effect revealed in our analysis should be taken into consideration by policy makers regarding relevant plans.

That the abandonment of the reform appears to have persistent effects on the emergence of organized crimes and the rise of communism in early 20th century speaks to the growing literature on the legacies of historical events (See Nunn (2009) for a decent review). Several channels behind such persistence has been well explored, from formal institution (Sokoloff and Engerman, 2000; Acemoglu and Robinson, 2001; Dell, 2010), to culture (Tabellini, 2008; Fernndez and Fogli, 2009; Tabellini, 2010; Nunn and Wantchekon, 2011; Voigtländer and Voth, 2012; Grosjean, 2014; Chen et al., 2017) and genetics (Ashraf and Galor, 2013; Arbatli et al., 2015; Galor and Klemp, 2017). Our findings, while preliminary, highlight the role of social structure as another possible channel. In this sense, it follows the same idea with Moscona et al. (2017) that establishes segmentary lineage organization in Sub-Saharan Africa as a predictor of modern civil wars.

For those who are particularly interested in the social economic dynamic of China, this paper offers another explanation to the waves of its substantial social unrest. Recently, a growing literature shows that the overall conflict in historical China was significantly related to variations in climate (Bai and Kung, 2011; Chen, 2015), technology (Jia, 2014) and social norms (Kung and Ma, 2014b). This paper suggests that policies chosen by the government were also responsible. In this sense, our research is closely related to Bai and Jia (2016), which attributes the political instability in the early twentieth century to the 1905 abolition of the Civil Service Exam.

The remaining parts of this paper is organized as follows. The next section presents the background of the Grand Canal as well as its abandonment. Then, Section 3 presents the data. Section 4 formalizes our empirical strategy and demonstrates the baseline results. Section 5 is the robustness checks. Section 6 discusses the possible mechanisms and their implications. Concluding remarks are offered in Section 7.

2 Background

2.1 The Grand Canal

The Grand Canal is the longest and oldest artificial waterway in the world. Located in the north-eastern and central-eastern plains of China, it runs 1,776 kilometers (1,104 miles) linking the capital Beijing in the north and the city of Hangzhou in the south [2] (see Figure 1). The first parts of the canal dated back to the fifth century BC, while the various sections were finally integrated into a nationwide system during the Sui Dynasty (581-618 AD). As noted by Elvin (1973), it was probably an engineering feat without parallel in the world of its time in terms of scale. More than 126 million people lived in this area in 1820, which accounted for about 15% of the world population.

The Grand Canal was originally constructed to secure the food supply in the capital of the

[2] Along the canal, there are 6 provinces: Zhili (now Hebei), Shandong, Jiangsu, Zhejiang, Henan and Anhui. The Grand Canal goes across the first 4 provinces while very close to the last two.

empire. As Chinas political center and the most populated city, Beijing had a population of over a million in 1820 AD. Many of its residents consisted of the court, official personnel, scholars, imperial soldiers and their families (Morse, 1913; Chi, 1936). All such people who were not involved in agricultural production created huge demand for rice. However, rice production was clustered in the southern part of China where there was abundant, fertile land and suitable weather (rain and sunshine) for agriculture [3]. The spatial misallocation of population and crop production required shipping a huge amount of rice to the capital. In the early nineteenth century, approximately 3.5 million piculs of rice (roughly 560 million pounds) was delivered to the capital annually (Huang, 1918). The Grand Canal served as the main artery for the shipping. Therefore, to maintain the well-functioning of the canal was one of the most crucial tasks for the Qing government (Hummel, 1991; Leonard, 1988; Cheung, 2009).

Besides the crucial role in rice shipping, the Grand Canal also benefited the adjacent regions by facilitating regional trade and providing urban employment. In terms of regional trade, the government allowed the grain junks to carry certain number of duty-free commodities during their service. The popular commodities ranged from bamboo, woods, paper, china and silk to pears, jujube and walnuts. Historians estimated that these grain junks shipped approximately 1.26 million piculs of duty-free commodities (roughly 200 million pounds) annually in the early 19th century (Ni, 2005). In addition, the canal was also extensively used by private junks for trade, travel and pleasure (Gandar, 1894; Hinton, 1952). The total number of commodities transported along the canal added up to over 10 million piculs (roughly 1.5 billion pounds) each year. In terms of employment, the Grand Canal benefited people alongside by creating numerous jobs in the urban area. They were hired either by the government in boat construction and canal maintenance, or by the private sector in restaurants, hotels and commercial services.

The Grand Canal thus boosted the economy alongside and created large commercial cities. One prominent example is Linqing, which was initially a minor county before the construction of the canal. However, it had developed into a trade center by early Qing dynasty, and was promoted to a municipality in 1777. The prosperity of the corridor was also reflected in population density. In 1820, the population density in prefectures along the canal was 45% higher than in the others.

2.2 Abandonment of the Grand Canal

However, the transportation infrastructure of such importance was gradually abandoned after 1826. The reform was initiated by a combination of natural and human factors. In 1825, the breach of the embankment dam at the intersection between the Yellow River and the canal temporarily interrupted the grain transportation along the canal. Daoguang Emperor (1821 - 1850), the $7th$ emperor of the Qing Dynasty, distinguished himself from his predecessors by making a decision to totally abandon the Grand Canal and choose the east-China sea route as the alternative, which was generally unexpected. The decision was more political than economic because this provided

[3] Figure A1 shows the suitability index for wetland rice in China. Most areas around Beijing is not suitable for rice plantation, while the most suitable lands are cluster in the south.

the new emperor with the opportunity to appoint his trusted followers and to establish his own authority. The canal was abandoned gradually rather than rapidly for safety considerations.

In 1826, the government shipped 1.63 million piculs (roughly 260 million pounds) of tribute rice collected in Jiangsu by the sea. It was first shipped from Shanghai to Tianjin in 1,562 chartered ships, and then conveyed to the capital city of Beijing (Hinton, 1952). The sea transportation area expanded to Jiangsu and Zhejiang after 1852, which accounted for half of the rice amount in the tribute grain system. The lack of use led to negligence in the canals maintenance which worsened its condition. Therefore, the government officially announced the canals abandonment in 1901 when much of its length had become too clogged to navigate. Figure A3 plots the amount of tribute rice shipped in the canal using the five year moving average. Although the actual amount kept fluctuating overtime, there was a consistent drop in shipping amount right after the 1826 experiment. Therefore, we chose 1826 as the first post reform year in our baseline analysis [4].

The abandonment of the Grand Canal inevitably led to the decline of the economic belt along it. As the only north-south waterway in east China, the reform forced most commodities to be transported by land, which was 9-10-fold more costly in pre-modern China (Watson, 1972; Shiue, 2002). Meanwhile, job opportunities depending on the canal trade disappeared. As a result, the regions around the canal lost their previous advantage over other regions and many people lost their jobs. As shown in Figure 2, regions adjacent to the canal witnessed such recession did not recover until the early twentieth century. The above-mentioned canalside city Linqing is an epitome of those cities whose population had fallen fourfold: from over 200 thousand in the late 18th century to less than 50 thousand early 20th century (Cao, 2001).

It is widely believed that the abandonment of the canal also led to great social disorder in the region. For example, there was a widely-distributed ballad in 19th century Shandong called "Broken the boat, disordered the world", indicating the destructive consequences induced by the closure of the canal. Some qualitative and anecdotal evidence attempts to explore the correlation. For example, Esherick (1988) argues that the disruption of the canal was responsible for the boxing rebellions in the late 19th century. Another famous example is the Green Gang, the prominent criminal organization in early 20th century, whose predecessors were the workers becoming unemployed due to closure of the canal (Martin, 1996). Such evidences enable scholars to speak highly of the effects of the canals abandonment on local instability. However, the hypothesis has not been systematically tested so far, and that is what we intend to do in this paper.

3 Data

In order to conduct our empirical analysis, we construct a state-of-the-art panel data set from a number of historical sources spanning the period 1650 - 1911. Our dataset, which covers 575 counties in 6 provinces adjacent to the Grand Canal, allows us to empirically test the effect of the canal's abandonment on social instability. We conduct our empirical analysis at the county level,

[4] In the flexible analysis section, we allow the cutoff year to vary and estimate the treatment effects every 10 years. The results confirm our argument that the reform produced significant effect right after the first experiment in 1826.

the most disaggregated administrative divisions in historical China, to unveil the huge heterogeneity that is likely to exist at more aggregate levels (e.g. provinces and prefectures) [5].

3.1 Rebellions

Our main dependent variables are the presence and number of rebellions reported in each county and year. The information comes from *Qing Shilu* (Veritable Records of the Qing Emperors), the official record of imperial edits and official memorials about events of national significance. According to Chinese historians, *Qing Shilu* is the most complete and systematic source of original information on social unrest occurred during the Qing dynasty. It provides detailed records on the place and time of rebellions meticulously complied by the Qing court. To unambiguously identify the link between local economic shock and social instability we focus our analysis on the onset of rebellions, excluding the wars that spread across regions and those lasted for years . For our sample period, there are 1,141 reported rebellions in total and 4.35 annually. The sample means of the presence and number of rebellions are 0.0073 and 0.0076 respectively.

3.2 Intensities of the Canal's Impact

We determine the intensities of the canals impact by the geographic locations of the counties. The locations are obtained from the digital maps available at China Historical GIS Website [6]. We employ both discrete and continuous measures of intensities. The discrete measure of intensities is a dummy variable indicating if the county bordered the canal. In our sample, 73 out of the 575 counties are along the canal boundary. The continuous measures of intensities are defined in two ways: the distance to the canal and the length of the canal contained within the counties' boundaries. The sample average distance from the canal is 118 kilometers (roughly 73 miles), while the farthest county is 499 kilometers (310 miles) away. The length of the canal segment contained in a county is 32.45 kilometers (20.16 miles) on average, with the longest being 91.44 kilometers (56.82 miles).

3.3 Control Variables

We included a bunch of controls from the conflict literature to eliminate certain omitted variables as followings:

Climate The first control variable we consider is climate shocks (Miguel et al., 2004; Miguel, 2005; Hsiang et al., 2011, 2013). We obtained climate information from two independent sources. One is the historical temperature reconstructed by Mann et al. (2009) at 5×5 arc degrees based on 1209 geological proxy records over the past 1500 years (e.g., tree-ring, coral, sediment, ect.). We assigned the grid-cell temperature to counties in our sample and define temperature anomaly

[5] For example, Cao County had experienced 21 rebellions throughout the Qing dynasty while the most stable county in the same prefecture only experienced 3.

[6] http://www.fas.harvard.edu/ chgis/

if the temperature was beyond 1 standard error of the mean of all years. In our sample, anomalous temperature thus defined took place every 3 years in a county. The other source is the presence of extreme drought and flood compiled by Chen and Kung (2016). A representative county in our sample experienced extreme drought every 10.24 years and extreme flood every 13.44 years. To develop an intuition for the data, we plot the spatial and chronological distribution for each of the three climate measures in Figure A4. We do not see any evidence of climate shock specific to the canal area or around 1826.

Geography Another key determinant of conflict is geography. To this end, we include two geographical measures into our analysis. The first is the terrain ruggedness index suggested by Nunn and Puga (2012). It is defined by the square root of the sum of the squared differences in elevation between one central grid cell and the eight adjacent cells (Riley et al., 1999). Grid-cell elevation per 30×30 arc seconds are obtained from GTOPO30 (Survey, 1996). For each county, the ruggedness index is constructed by computing the mean of all grid-cells contained in it. The spatial distribution of the ruggedness index is depicted in Figure A5, with a mean of 16.92 and a standard deviation of 19.53. Second, as we have summarized in the previous section, the Yellow River is also likely to play some role in initiating the reform. Therefore, we include the distance from the Yellow River as a second control for geography. The average distance from the Yellow River is 297 kilometers (185 miles).

Technology Jia (2014) suggests that social conflicts are also subject to technological changes in the agricultural sector, especially the introduction of New World crops (Jia, 2014; Iyigun et al., 2015). This may also lead to inconsistent estimates as long as the crops spread along the canal. Therefore, we also controlled for the planting duration of maize and sweat potato, the two most important New World crops in China (Jia, 2014; Chen and Kung, 2016). Figure A6a shows the year when the two crops are first adopted, which do not seem dependent on the canal. Figure A6b calculates for each year the number of counties that the crops have been adopted. Again, the spread of the crops does not coincide with the reform.

Culture Culture is another factor that underpins violence documented in the literature (Jha, 2013; Voigtländer and Voth, 2012; Grosjean, 2014). In China's context, Confucianism represents one type of cultural norm that is associated with conflict (Kung and Ma, 2014b). Therefore, we include the number of *jinshi* - the highest attainable qualification under China's civil exam focusing on the thoughts of Confucianism - as a measure of culture. In our sample, the average number of *jinshi* is 0.16 per county year. The spatial and chronological distribution of *jinshi* is dipicted in Figure A7a which does not appear to be associated with the reform.

Table 1 summarizes the sources and descriptive statistics of all the variables used in our analysis. In addition to the main variables above, we also collect some additional variables to help distinguishing between the mechanisms that potentially explain our findings. The sources and

descriptive statistics of these variables are listed as "Supplements" in Table 1. A more detailed description of them is included in the Data Appendix.

3.4 Suggestive Evidence

Before proceeding to formal analysis, some descriptive evidence will be demonstrated to suggest the intuition. Figure 4 shows the distribution of rebellions overtime. We can see clearly that the frequency of rebellions experienced significant increase following the abandonment of the canal: from 1.37 annually before 1825 to 10.47 annual after it. The number kept increasing until the peak was reached in 1861, when a total of 66 rebellions took place. It was not until the 1870s did the begin to fall. The spatial distribution of rebellions also reveals the potential relationship between the canals abandonment and social instability. The left panel of Figure 5 shows the distribution of rebellions in the pre-abandonment period, while the right panel shows that in the post period. The color intensity represents the number of rebellions reported. In the pre-abandonment period, the rebellions were less frequent but more dispersed. In the post period, the total number of rebellions increased, while, more importantly, the relative change was larger in areas near the canal. Henceforth the above visualized evidence of temporal as well as spatial distribution gives us the intuition that the abandonment of the canal should significantly contribute to the overall upheaval of rebellions in the mid nineteenth century.

Table 2 translates such intuition into a precise but naive calculation. We calculated the relative change in the number of rebellions before and after the abandonment in both areas and performed the standard t test. We first notice that rebellions were more frequent in canalside counties and post-abandonment years as well: the frequency of rebellions increased 0.0240 and 0.0146 respectively for canalside and non-canalside counties after the canals abandonment in 1825. The relative change is 0.0094 higher at 0.01 level of significance for counties along the canal, accounting for a 124% change relative to the sample mean of 0.0076.

4 Empirical Strategies and Results

This section estimates the impact of the abandonment of the Grand Canal on rebellions. Our baseline estimation follows the standard difference-in-differences (DD) strategy, where we compare the relative change in the number of rebellions in counties along the canal relative to the others. The identification strategy and results are presented in Section 4.1. As an extension of the analysis, Section 4.2 generalizes the standard DD estimation with continuous measures of intensity to explore finer spatial and chronological variations.

4.1 Baseline Specification and Results

We estimate the following equation as our baseline specification:

$$Y_{ct} = \beta Bordering_c \times Post_t + \delta_c + \sigma_t + \chi_{ct} + \varepsilon_{ct} \tag{1}$$

where c indexes counties and t indexes years. The outcome of interest, denoted Y_{ct}, is the number of rebellions recorded in county c in year t. $Bordering_c$ is a dummy variable that equals one if a county is located adjacent to the canal and zero otherwise. Hence, the treated group contains counties that bordered the canal, while the control group contains counties that did not. $Post_t$ is a dummy variable that equals one for the years after the abandonment. The equation also controls for county and year fixed effects, δ_i and σ_t; χ_{ct} denotes other controls. The coefficient of interest in equation (1) is β, the estimated impact of the canal's abandonment on the number of rebellions. The coefficient is expected to be positive, which would suggest a greater increase in the number of rebellions in canalside counties.

The results are reported in Table 3, where the dependent variables are the number of rebellions. All four columns adopted similar model specification with different set of controls. In Column (1), we control for county fixed effects and year fixed effects as the baseline. In this way, we rule out all time-invariant county features (e.g. location), and year shocks that unanimously affect all regions (e.g. overall capacity of the state). Column (2) further includes province-emperor fixed effects to account for unobservable factors associated with regimes, e.g., policy preferences of the emperors. Then, in Column (3), we include prefecture specific year trends to account for difference in regional trends. Column (4) includes all previous controls simultaneously. For each column, the standard errors reported in the parentheses are clustered at the county level (as reported in the parentheses) [7]. We also include Conley standard errors in the square brackets following the approaches suggested in Conley (1999) and Conley (2008) to adjust for spatial correlations.

The results obtained across all specifications are significantly positive, suggesting a higher number of rebellions associated with the canal's abandonment. As an example of interpretation, the point estimator in Column (1) represents 0.0094 higher number of rebellions experienced by counties bordering the canal (relative to the others) after the reform (relative to before). The effect corresponds to a 124% increase relative to the sample mean (0.0076), and is significant at the 95% confidence interval. The estimated coefficients from columns (2) to (4) are very close to that in Column (1) in terms of magnitude as well as significant levels.

The analysis is replicated in Appendix A using alternative outcome measures to account for potential measurement issues. First, To reduce the potentially biasing effects of extreme values, we use binary measures of outcomes, where the dependent variables are coded as 1 if there is any rebellion case recorded and 0 otherwise. The results are reported in Table A2. The estimated coefficients and standard errors are almost unchanged relative to those in Table 3. Second, we present in Table A3 the results where the rebellions are normalized by population [8]. The estimated coefficients across all specifications suggest an additional 0.0004 rebellions per 10 thousand people. The scale accounts for 133% increase relative to the sample mean, which is pretty close to the

[7] We have also clustered the standard errors at prefectures to account for within prefecture correlations. The results are reported in Table A1. The standard errors are much larger, but still preserves significance.

[8] Prefecture level population in 1660, 1776, 1820, 1851, 1880, and 1910 is compiled by Cao (2001). For our analysis, we construct annual county population measures assuming even distribution across counties and linear changes over time.

non-normalized estimates.

4.2 Generalized Estimates

One limitation to our empirical studies is the lack of well-defined treated and control groups. In the baseline we use a coarse specification that assumes binary treatment and two time periods, which would potentially underestimate the true effects. To refine the identification, this section generalizes the specification by allowing continuous treatment measures across counties and years. We begin by exploring variations in treatment intensity across counties. The intensity is measured both *internally* and *externally* [9]. The internal measure exploits variation in the length of the canal within a county, while the external one measures the distance from the county to the canal. As for the time dimension, we use the number of years after the initial reform to account for the gradual abandonment process. Models that simultaneously allow for extensions in both dimensions are also estimated.

We start with models with continuous treatment intensity. As an internal measure of intensity, we exploit variations in the length of the canal contained in a county. Specifically, we conducted the regression analysis on the following specification:

$$Y_{ct} = \beta Length_c \times Post_t + \delta_c + \sigma_t + \chi + \varepsilon_{ct} \tag{2}$$

$$Y_{ct} = \sum_{\iota=0}^{80} \beta_\iota Post_t \times Length_\iota + \delta_c + \sigma_t + \chi + \varepsilon_{ct} \tag{3}$$

where Equation (2) assumes a linear function of canal length, while Equation (3) uses a more flexible specification to estimate a separate coefficient for each length interval. The coefficient β estimated from Equation (2) represents the relative change in the number of rebellions per kilometer length of the canal. It is expected to be positive as the impact of the canal should be larger in counties containing longer segments. As a further extension, the coefficients β_ιs in Equation (3) estimate the treatment effects for each of the 10-km intervals with counties away from the canal (i.e., the baseline control group) as the reference group. Accordingly, We would expect these estimates to be increasing with ι's.

The coefficients estimated from Equation (2) with county, year and province-emperor fixed effects are reported in column (2) of Table 4, whereas the first column is taken from Table 3, column (2) as a comparison. As expected, the estimated coefficient β suggests an increase of 0.0003 rebellions per kilometer length of the canal, significant at the 99% confidence interval. This means that an additional 25 kilometer length of the canal accounts for 100% increase in rebellions relative to the sample mean [10]. For further illustration, we plotted in Figure 6 the coefficients along with

[9] We use the term *internal measure* to represent intensity measures within the baseline treated group,i.e., counties along the canal. Correspondingly, *external measure* refers to variations in intensity among all sample regions.

[10] For robustness, we also analyzed models where the length of the canal is normalized by the size of the county (i.e., a density measure). The results, while not reported for brevity, are consistent with our non-normalized estimates. Interested readers may contact the authors for more details.

the 95% confidence intervals estimated from Equation (3). The coefficients kept increasing with the length of the canal, but did not reach statistical significance until a length of $40km$. Therefore, counties marginally intersect the canal are not statistically different from those away from the canal in rebellions. In other words, the treatment effects we have observed in the baseline primarily come from counties intensively treated by the canal.

Alternatively, the external measure of intensity exploits variations in the distance to the canal, following similar specifications:

$$Y_{ct} = \beta Distance_c \times Post_t + \delta_c + \sigma_t + \chi + \varepsilon_{ct} \tag{4}$$

$$Y_{ct} = \sum_{\rho=0}^{400} \beta_\rho Post_t \times Distance_\rho + \delta_c + \sigma_t + \chi + \varepsilon_{ct} \tag{5}$$

where $Post_t$ is interacted with $Distance_c$, the distance to the canal, and each of the 25-kilometer distance interval, respectively [11]. The estimated coefficient β from Equation (4) represents the relative change in rebellions per kilometer away from the canal, which is expected to be negative as the impact diminishes. Equation (5) estimates the treatment effects for each of the 25-km distance interval with counties 400 kilometers as the reference group. We expect their estimates to be smaller for intervals with larger distance.

Column (3) of Table 4 presents the estimated coefficients from Equation (4). Consistent with our expectation, it suggests 0.01 less rebellions per hundred kilometers away with 1% level of significance. Figure 7 plots the estimated coefficients from Equation (5) for each of the distance intervals. The coefficients keep decreasing, and preserve significance within a distance of 150 kilometers. Counties located beyond 150 kilometers from the canal are not distinguishable from farther ones in terms of rebellions. Therefore, we interpret $150km$ as the range of the canal's impact.

Extensions in the time dimension are motivated by the gradual process of the reform. While the first experiment was launched in 1826, the canal was not officially abandoned until 1901. This raises concerns about our two-period baseline model with 1826 as the cutoff. Therefore, we extend our analysis using continuous measures of reform progress:

$$Y_{ct} = \beta Bordering_c \times PostYears_t + \delta_c + \sigma_t + \chi + \varepsilon_{ct} \tag{6}$$

$$Y_{ct} = \sum_{\tau=-100}^{60} \beta_\tau Bordering_c \times Period_\tau + \delta_c + \sigma_t + \chi + \varepsilon_{ct} \tag{7}$$

where the treatment indicator is interacted with $PostYears_t$, the number of years after the initial reform. As such, a later year represents a higher degree of reform completion. The result is reported in column (4) of Table 4 with all previous controls. The estimated coefficient β measures the difference in the slopes of post-reform trends. The difference between the treated and the

[11] Distance is measured from the county capital and the canal. The results are robust to using the least distance between county boundary and the canal as well. They are available for interested readers upon request to the authors.

control per decade later is 0.001 larger, suggesting yearly expanding trends. Figure 8 plotted the coefficients of Equation (7) to estimate the treatment effects decade by decade. In the first place, the pre-reform pattern unveiled in the figure verifies the common trends assumption which is critical in a DD context. The close-to-zero and insignificant estimated coefficients in the pre-periods suggest no evidence for diverging trends prior to the reform. This establishes the validity of our DD design. Meanwhile, the figure reveals the rebelling dynamics after the implementation of the reform. The canal's impact on rebellions arose immediately after 1826 and kept increasing throughout the next 30 years. After that the gap between the two groups started to converge, yet remained significant at the 5% level. This justifies our choice of 1826 as the cutoff.

An alternative measure of the reform progress is the amount of grain shipped via the canal, and a smaller amount represents higher intensity. However, the shipping data is only available for part of the years between 1724 and 1849 and is very noisy. Nevertheless, we estimate the treatment effects with shipping amount being the proxy for reform progress and summarize the results in Table A4. The first column estimates the treatment effects with the actual grain amount recorded, while the following two columns use the amount simulated with moving average and four-degree polynomials, respectively. The results are consistent with our expectation that smaller grain shipping amount is associated with more canalside rebellions.

Finally, we combine Equation (2) and Equation (6) to allow continuous treatment intensity in both dimensions simultaneously. Column (5) interacted $PostYears_t$ with $Length_c$, whereas Column (6) with $Distance_c$. An intuitive way to interpret the results is to refer to the relative difference in the post-reform trends. The positive coefficient in Column (5) indicates a steeper trend in places containing longer canal section, whereas the negative one in Column (6) indicates a milder one in places farther away. Taken together, the results in Table 4 reveal that the impact of the abandonment was larger in places more intensively affected by the canal, and was diverging over a period of time. This reinforced our baseline findings that the reform was associated with the subsequent wave of rebellions.

5 Robustness

5.1 Including More Controls

There might be concerns that our results suffer from omitted variable bias, i.e., other factors affecting social conflict may also be correlated with the canal. We address this concern by including a bunch of controls associated with conflict in the literature.

We have summarized in Section 3.3 the choice and sources of the control variables. For time-variant variables like climate shocks, we include them into our model directly. For the time-invariant ones such as terrain ruggedness, we interact them with the post-reform indicator to account for potential structural changes. The results are reported in Table 5. Column (1) - (8) add the set of controls one at a time, while Column (9) include all of them simultaneously. Our main coefficient of interest, $Bordering_c \times Post_t$, preserves its significance across all specifications. The magnitude

of the effects is also stable. It ranges from 0.0075 to 0.0100, around 100% to 144% of the sample mean.

As for the control variables, the correlations discovered in our data are consistent with the conflict literature. For example, extreme weather, in all sorts of measures, is associated with higher rate of rebellions. Land ruggedness, on the other hand, reduced the frequency of rebellions during the post reform periods [12]. The distance to the Yellow River constitutes another factor contributing to the rise of rebellions, as suggested by the historical context, yet it does not take away the effects of the canal. We do not find evidence that agricultural technology or culture plays significant roles in our context.

5.2 Truncated Sample Periods

Another threat to our identification strategy is the relatively long sample periods after the reform. While the launching of the reform in 1826 was not due to previous conflict around the canal, the social unrest arisen from it might reinforce and accelerate the reform process in subsequent years, raising concerns about reverse causality in the later periods [13]. To this end, we restrict our analysis to truncated sample periods to mitigate the potential biasing effects.

Figure 9 depicts the estimated coefficients and 95% confidence intervals from Equation (1) based on various sample periods. The x-axis labels the last year included in the analysis. The first sample contains all years prior to 1840, while every subsequent one adds another 10 years. Across all samples, the estimated coefficients are positive and significant, suggesting the robustness of our analysis to excluding potentially endogenous periods. Specifically, the estimates from the pre-1840 sample represent the immediate effects of the reform within the first 25 years, which provides the finest identification; yet we shall interpret its coefficient as a lower bound since the the reform was in its initial stage during this period.

5.3 Falsification Test

Because the number of treated observations is relatively small in our sample (73/575), there might be concerns of spurious correlations due to noise. To address this, we compare the treatment effects we have estimated to the distribution of placebo treatment effects when county locations are randomly assigned. Specifically, we randomly assign counties to the polygons in our sample map representing county locations, without replacement. Thus the number of placebo counties bordering the canal was the same as that of the actual ones, but the selection of counties was random. Then we estimated the placebo treatment effects using Equation (1) and compare them to that in Column (1), Table 3.

In Figure 10, we plot the distribution of t-statistics from the placebo treatment effects for $1,000$,

[12] This is consistent with the findings in Nunn and Puga (2012) that terrain ruggedness benefited the African countries by avoiding the slave trades.

[13] For instance, the capture of Jiangning (now Nanking) by the Taiping Rebellion in 1853 marked the acceleration of the reform as it blocked the source of grain transportation, according to many historians.

3,000, 5,000 and 10,000 times. The vertical lines mark the location of the t-statistic of the actual treatment effect (as in Column (1), Table 3). The share of the placebo t-statistics that is larger than the actual statistic ($P(t \leq T)$) can be interpreted as analogous to a p-value. It suggests the probability for a randomly assigned treated group to present an effect at the same or higher level of significance as the actual ones. As such, we can reject the null that our result is indifferent to the placebo ones at about 1% level of significance.

6 Discussion of Mechanisms

In previous sections we have presented evidence that relate the abandonment of the Grand Canal to the subsequent emergence of rebellions. Now we turn to discussing the mechanisms behind the correlation. The conflict literature has highlighted two distinct mechanisms that may explain our findings. First, the reform might have reduced the state capacity and hence increased the probability for the rebels to win (Besley and Persson, 2010, 2011; Michalopoulos and Papaioannou, 2013). Second, it might have lowered the opportunity cost which raised the relative benefit if succeed (Becker, 1968, 1974; Ehrlich, 1973; Hirshleifer, 1995; Grossman, 1991; Acemoglu and Robinson, 2001). Either way, the reform would increase the expected payoff of participating in rebellions and hence produce instability. In this section, we intend to compare the relative explanatory power of the alternative mechanisms by testing the validity of their predictions.

6.1 Decline in State Capacity

While county level measures of state capacity is not available in our data, we employ two indirect approaches to examine the role of state capacity. The first approach explores variations in the importance of political control. If state capacity is the primary driving force behind our results, we would expect a stronger effect in regions more important for the government. To this end, we interact our treatment indicator with two measures of importance, the number of imperial soldiers assigned and the presence of prefectural capitals. The results are reported in the first two columns of Table 6. The importance of political control, measured either way, does not exhibit higher rate of rebellion in the post reform periods. Furthermore, we do not find any evidence that the reform produced more rebellions in regions more important in political control (suggested by the triple interaction terms). The insignificance of these estimates suggest a very limited, if any, role that state capacity played in these rebellions.

The alternative approach is to check the placebo effect on other types of social unrest closely related to declined state capacity. Specifically, we test the impact of the abandonment on the frequency of being attacked and fled into by enemies, under the rationale that weak counties are vulnerable to attack and secure to retreat into. If the abandonment of the canal had reduced state capacity in its neighbors relative to the others, we shall also expect increases in their chances to be attacked or retreated into. The results are summarized in the next two columns of Table 6. Column (3) tests the placebo treatment effect on the frequency of being attacked, whereas column (4) tests

that on the frequency that defeated enemies to retreat into. Both coefficients are relatively small compared to the sample mean, and could not be significantly differentiated from zero. Thus while the abandonment of the canal raised the local onset of rebellions, there is no evidence of increases in any other types. Therefore, the data does not support the decline of state capacity as a potential mechanism.

6.2 Reduction in Opportunity Cost

An alternative hypothesis states that the reform might triggered rebellions by reducing the opportunity cost of the rebels. In rural sectors, this could happen if abandoning the canal adversely affected agricultural productivity. In urban areas where people worked in commercial sectors to make a living, it could be induced by the decline in trade accessibility. We will examine both cases in this section.

To begin with, we check, both directly and indirectly, if abandoning the canal had induced rebellions by destructing agricultural productivity. The direct approach exploits variation in grain prices compiled by Chen and Kung (2016). If agricultural productivity deteriorated after the canal was abandoned, we would observe inflation in grain prices. The first column of Table 7 regresses grain prices on the abandonment of the canal. The positive but insignificant estimated coefficient suggests little evidence for grain price inflation associated with the reform. As an indirect test, the next two columns examine if the impact of the reform was stronger in regions prominent for agriculture. To this end we multiply the baseline interaction with the suitability indicator for wheat and wetland rice, the two main crops in our sample area (Talhelm et al., 2014). While the main effects of the reform preserve their significance, we find no heterogeneity across various levels of crop suitability. Therefore, the deterioration in agricultural productivity was not supported by the data.

Then we turn to the urban sector, where we discovered several evidence supporting the channel of declined trade. The first piece of evidence comes from the underdevelopment of local markets around the canal. In the first column of Table 8, we regress the number of towns and markets reported in 1820 and 1911 on the reform. The relative change was significantly lower in regions more intensively affected by the canal. This reveals strong adverse impacts of the reform on the development of local market. Secondly, we find that the impact of the reform was stronger in more urbanized regions. To see this, we multiply our baseline interaction with the share of urban areas in 1776 and summarize the result in the second column of Table 8. In this specification, the baseline interaction $Canal \times Post$ represents the treatment effect in the absence of urbanization, while the triple interaction $Canal \times Post \times 1776Urbanshare$ estimates the upward trend as urbanization grows. The result suggests that the impact of the reform was not present in places without any urbanization, and was stronger in highly urbanized regions. The final test compares the impact of the reform in places with and without alternative trade routes. Specifically, we interact the reform indicator with the county's availability to courier roads, the major routes for north-south transportation by land. In column (3) of Table 8, the interaction between $Canal \times Post$ estimates

the treatment effects for canalside counties without access to the courier roads, while the triple interaction represents the relative change in the treatment effects in counties with such substitutes. We observe from the estimated coefficients that the access to alternative trade routes offset half of the impact induced by the reform. [14] In summary, the evidence we have uncovered is consistence with the channel of declined access to trade which reduced rebels' opportunity cost in urban sectors [15].

6.3 Discussion

That the rebellions arisen from the reform was specifically associated with urban sectors yields significant implications. Unlike their rural counterparts, labor force in densely populated urban areas have more collective consciousness and organized politics. During the era of canal transportation, various societies and associations were formed by the grain transport boatmen all over the canal [16]. In the lack of socio-economic opportunities, such organizations were likely to transform into gangsters, and become a long-lasting hotbed of organized crimes and secret societies. This transformation, while not well documented in the conflict literature, is consistent with the evolution of gangsters in Chicago (Haller, 1971), the rise of Mafia in New York city (Critchley, 2008), and many other organized crimes around the world.

We further explore this idea using two cross-sectional analysis [17]. The first exploits variation in the emergence of the Green Gang, one of China's largest and most powerful society-cum-gangster organizations in early twentieth century. To investigate, we obtain a list of Green Gang seniors and correlate their distribution with the location of canal. The result presented in the first column of Table 9 demonstrates a high concentration around the canal. The second evaluation regards the rise of communism in southern China during the 1920s. For this, we compiled the year when the first communist party group was founded for each county in Anhui, Jiangsu and Zhejiang, the provinces with the earliest communist activities in our sample. Column (2) of Table 9 presents correlation between the canal and the spread of communism. On average the emergence of communist party group was earlier in counties more intensively affected by the canal. Both results, while not necessarily causal, suggest the gangsters and secret societies as a potential legacy of the reform. Our interpretation for this persistent impact is the transformation of pre-reform labor organizations formed in urban regions.

[14] Besides, we also verified the canal's role in mitigating risk, the role that trade usually plays in the course of climate shocks, as suggested by Dube and Vargas (2013). Consistent with their argument, we find that the canal helped reducing conflict during extreme weathers, but such effect was totally absent after its abandonment. The results are available upon request to the authors.

[15] An alternative interpretation regarding our findings in the urban area is that it reflects some sort of political grievance (blaming the government for the abandonment) rather than the decline in opportunity cost. To account for this possibility, we identify a set of regions that experienced mass killing when the Qing military took over their territory in the 1640s. We would expect stronger effects at the site of mass killing if the impact we have observed is due to grievance. The result, while not reported, is inconsistent with this argument. We do not find significant difference between places with and without mass killing experience.

[16] According to historical records, these associations took control of tens of thousands of grain junks and over 50 thousand registered members by the late eighteenth century.

[17] In both analysis, we restrict our sample to counties within $150km$ from the canal.

7 Conclusion

In this paper, we use the abandonment of China's Grand Canal – perhaps the largest infrastructure project in the pre-modern world – as a natural experiment to study the link between economic shocks and social conflicts. This setting is ideal for our research purpose because the reform was generally unexpected, and was driven by political rather than economic considerations. Using a dataset covering 575 counties from 1650 to 1911, we find that the negative economic shock significantly generated social instability: compared to counties away from the canal, counties bordering the canal on average experienced 0.0094 more rebellions after the abandonment of the canal. The effect represents a 124% increase relative to the sample mean, and is significant at the 95% confidence interval. Extensions in the specification further show that the effects spread over a range of $150km$, and kept increasing throughout the next 30 years. In terms of mechanisms, we found several evidence in support of the opportunity cost hypothesis. In particular, it seems due to the interruption of trade in the urban sectors. We briefly discuss the possible implication in terms of the underlying social structure in urban regions, and as a tentative attempt, relate this to the evolution of organized crimes and the rise of communism in the early twentieth century.

This paper makes significant contribution to the conflict literature by examining a permanent shock to urban sector that was initiated by the government. Given that the existing literature primarily focuses on shocks associated with commodity price and weather volatility, our study broadens the set of causal evidence that links economic shocks to violent conflict. Besides, it can also be linked to the impact of transportation infrastructure, the persistence of historical events, and the wave of social unrest in historical China.

References

Daron Acemoglu and James A Robinson. A Theory of Political Transitions. *American Economic Review*, pages 938–963, 2001.

Ajay Agrawal, Alberto Galasso, and Alexander Oettl. Roads and Innovation. *The Review of Economics and Statistics*, 99(3):417–434, 2017. doi: 10.1162/REST_a_00619.

Joshua D Angrist and Adriana D Kugler. Rural Windfall or a New Resource curse? Coca, Income, and Civil Conflict in Colombia. *The Review of Economics and Statistics*, 90(2):191–215, 2008.

Cemal Eren Arbatli, Quamrul Ashraf, and Oded Galor. The Nature of Civil Conflict. (2013-15), 2015.

Quamrul Ashraf and Oded Galor. The "Out of Africa" Hypothesis, Human Genetic Diversity, and Comparative Economic Development. *American Economic Review*, 103(1):1–46, February 2013.

Jeremy Atack, Michael R Haines, and Robert A Margo. Railroads and the Rise of the Factory: Evidence for the United States, 1850-70. Technical report, National Bureau of Economic Research, 2008.

Jeremy Atack, Fred Bateman, Michael Haines, and Robert A Margo. Did Railroads Induce or Follow Economic Growth. *Social Science History*, 34(2):171–97, 2010.

Ying Bai and Ruixue Jia. Elite Recruitment and Political Stability: The Impact of the Abolition of Chinas Civil Service Exam. *Econometrica*, 2016.

Ying Bai and James Kai-sing Kung. Climate Shocks and Sino-nomadic Conflict. *Review of Economics and Statistics*, 93(3):970–981, 2011.

Nathaniel Baum-Snow. Did Highways Cause Suburbanization? *The Quarterly Journal of Economics*, pages 775–805, 2007.

Samuel Bazzi and Christopher Blattman. Economic Shocks and Conflict: Evidence from Commodity Prices. *American Economic Journal: Macroeconomics*, 6(4):1–38, 2014.

Gary S Becker. Crime and Punishment: An Economic Approach. *Journal of Political Economy*, 76(2), 1968.

Gary S Becker. *Crime and Punishment: An Economic Approach*, pages 1–54. UMI, 1974.

John Bellows and Edward Miguel. War and Local Collective Action in Sierra Leone. *Journal of Public Economics*, 93(11):1144–1157, 2009.

Timothy Besley and Torsten Persson. State Capacity, Conflict, and Development. *Econometrica*, 78(1):1–34, 2010.

Timothy Besley and Torsten Persson. The Logic of Political Violence. *The Quarterly Journal of Economics*, page qjr025, 2011.

Timothy J Besley and Torsten Persson. The Incidence of Civil War: Theory and Evidence. Technical report, National Bureau of Economic Research, 2008.

Christopher Blattman and Edward Miguel. Civil War. *Journal of Economic Literature*, 48(1):3–57, 2010.

Markus Brckner and Antonio Ciccone. International Commodity Prices, Growth and the Outbreak of Civil War in Sub-Saharan Africa. *The Economic Journal*, 120(544):519–534, 2010.

Halvard Buhaug and Jan Ketil Rød. Local Determinants of African Civil Wars, 1970C2001. *Political Geography*, 25(3):315–335, 2006.

Robin Burgess and Dave Donaldson. Can Openness Mitigate the Effects of Weather Shocks? Evidence from India's Famine Era. *The American Economic Review*, pages 449–453, 2010.

Marshall Burke, Solomon M. Hsiang, and Edward Miguel. Climate and Conflict. *Annual Review of Economics*, 7(1), 2015.

Marshall B. Burke, Edward Miguel, Shanker Satyanath, John A. Dykema, and David B. Lobell. Warming Increases the Risk of Civil War in Africa. *Proceedings of the National Academy of Sciences*, 106(49):20670–20674, 2009.

Shuji Cao. *The Population History of China*, volume 5. Fudan University Press, Shanghai, 2001.

Qiang Chen. Climate Shocks, State Capacity and Peasant Uprisings in North China during 25C1911 CE. *Economica*, 82(326):295–318, 2015.

Shuo Chen and James Kai-sing Kung. Of Maize and Men: the Effect of a New World Crop on Population and Economic Growth in China. *Journal of Economic Growth*, 21(1):71–99, 2016.

Ting Chen, James Kai-sing Kung, and Chicheng Ma. Long Live Keju! The Persistent Effects of China's Imperial Examination System. 2017.

Sui-wai Cheung. Construction of the Grand Canal and Improvement in Transportation in Late Imperial China. *Asian Social Science*, 4(6):p11, 2009.

C. Chi. *Key Economic Areas in Chinese History as Revealed in the Development of Public Works for Water-control*. A. M. Kelley, 1936.

Antonio Ciccone. Transitory Economic Shocks and Civil Conflict. 2008.

Paul Collier and Anke Hoeffler. On Economic Causes of Civil War. *Oxford economic papers*, 50(4): 563–573, 1998.

Paul Collier and Anke Hoeffler. Greed and Grievance in Civil War. *Oxford economic papers*, 56(4): 563–595, 2004.

T. G. Conley. GMM Estimation with Cross Sectional Dependence. *Journal of Econometrics*, 92 (1):1–45, 1999.

Timothy G. Conley. *Spatial Econometrics*. Palgrave Macmillan, Basingstoke, 2008.

D. Critchley. *The Origin of Organized Crime in America: The New York City Mafia, 1891–1931*. Routledge Advances in American History. Taylor & Francis, 2008.

Melissa Dell. The Persistent Effects of Peru's Mining Mita. *Econometrica*, 78(6):1863–1903, 2010. ISSN 1468-0262. doi: 10.3982/ECTA8121.

Simeon Djankov and Marta Reynal Querol. Poverty and Civil War: Revisiting the Evidence. *Review of Economics and Statistics*, 92(4):1035–1041, 2010.

Dave Donaldson. Railroads of the Raj: Estimating the Impact of Transportation Infrastructure. *The American Economic Review*, forthcoming.

Dave Donaldson and Richard Hornbeck. Railroads and American Economic Growth: a "Market Access" Approach. *Quarterly Journal of Economics*, forthcoming.

Oeindrila Dube and Juan F Vargas. Commodity Price Shocks and Civil Conflict: Evidence from Colombia. *The Review of Economic Studies*, 80(4):1384–1421, 2013.

Gilles Duranton and Matthew A Turner. Urban Growth and Transportation. *The Review of Economic Studies*, 79(4):1407–1440, 2012.

Isaac Ehrlich. Participation in Illegitimate Activities: A Theoretical and Empirical Investigation. *The Journal of Political Economy*, pages 521–565, 1973.

M. Elvin. *The Pattern of the Chinese Past: A Social and Economic Interpretation*. Stanford University Press, 1973.

Joseph Esherick. *The Origins of the Boxer Uprising*. Univ of California Press, 1988.

James D Fearon and David D Laitin. Ethnicity, Insurgency, and Civil War. *American Political Science Review*, 97(01):75–90, 2003.

John G Fernald. Roads to Prosperity? Assessing the Link Between Public Capital and Productivity. *American Economic Review*, pages 619–638, 1999.

Raquel Fernndez and Alessandra Fogli. Culture: An Empirical Investigation of Beliefs, Work, and Fertility. *American Economic Journal: Macroeconomics*, 1(1):146–77, January 2009. doi: 10.1257/mac.1.1.146.

Robert William Fogel. Notes on the Social Saving Controversy. *The Journal of Economic History*, 39(01):1–54, 1979.

Robert William Fogel. *Railroads and American economic growth*. Cambridge Univ Press, 1994.

Oded Galor and Marc Klemp. Roots of Autocracy. (2015-7), 2017.

D. Gandar. *Le Canal Imperial: Etude Historique et Descriptive*. Kraus Reprint, 1894.

Pauline Grosjean. A History of Violence: The Culture of Honor and Homicide in the US South. *Journal of the European Economic Association*, 12(5):1285–1316, 2014. ISSN 1542-4774. doi: 10.1111/jeea.12096.

Herschell I Grossman. A General Equilibrium Model of Insurrections. *The American Economic Review*, pages 912–921, 1991.

John M Hagedorn and Perry Macon. *People and Folks. Gangs, Crime and the Underclass in a Rustbelt City*. ERIC, 1988.

Michael R Haines and Robert A Margo. Railroads and Local Economic Development: The United States in the 1850s. Technical report, National Bureau of Economic Research, 2006.

Mark H. Haller. Organized Crime in Urban Society: Chicago in the Twentieth Century. *Journal of Social History*, 5(2):210–234, 1971.

Hϕvard Hegre and Nicholas Sambanis. Sensitivity Analysis of Empirical Results on Civil War Onset. *Journal of Conflict Resolution*, 50(4):508–535, 2006.

Harold C. Hinton. The Grain Tribute System of the Ch'ing Dynasty. *The Far Eastern Quarterly*, 11(3):339–354, 1952.

Jack Hirshleifer. Anarchy and Its Breakdown. *Journal of Political Economy*, pages 26–52, 1995.

Solomon M Hsiang, Kyle C Meng, and Mark A Cane. Civil Conflicts are Associated With the Global Climate. *Nature*, 476(7361):438–441, 2011.

Solomon M. Hsiang, Marshall Burke, and Edward Miguel. Quantifying the Influence of Climate on Human Conflict. *Science*, 341(6151), 2013.

H. Huang. *The Land Tax in China*. Columbia university, 1918.

A.W. Hummel. *Eminent Chinese of the Ch'ing Period: 1644-1912*. SMC publ., 1991.

Macartan Humphreys. Natural Resources, Conflict, and Conflict Resolution Uncovering the Mechanisms. *Journal of Conflict Resolution*, 49(4):508–537, 2005.

Murat Iyigun, Nathan Nunn, and Nancy Qian. The Long-run Effects of Agricultural Productivity on Conflict, 1400-1900. 2015.

Murat Iyigun, Nathan Nunn, and Nancy Qian. Winter is Coming: The Long-Run Effects of Climate Change on Conflict, 1400-1900. (23033), January 2017.

Thorsten Janus and Daniel Riera-Crichton. Economic Shocks, Civil War and Ethnicity. *Journal of Development Economics*, 115:32–44, 2015.

Saumitra Jha. Trade, Institutions, and Ethnic Tolerance: Evidence from South Asia. *American Political Science Review*, 107(4):806C832, 2013. doi: 10.1017/S0003055413000464.

Ruixue Jia. Weather Shocks, Sweet Potatoes and Peasant Revolts in Historical China. *The Economic Journal*, 124(575):92–118, 2014.

James Kai-sing Kung and Chicheng Ma. Autarky and the rise and fall of piracy in Ming China. *The Journal of Economic History*, 74(02):509–534, 2014a.

James Kai-sing Kung and Chicheng Ma. Can Cultural Norms Reduce Conflicts? Confucianism and Peasant Rebellions in Qing China. *Journal of Development Economics*, 111(0):132–149, 2014b.

David D Laitin. *Nations, States, and Violence*. OUP Oxford, 2007.

Jane Kate Leonard. 'Controlling from Afar' Open Communications and the Tao-Kuang Emperor's Control of Grand Canal-Grain Transport Management, 1824-26. *Modern Asian Studies*, 22(4): 665–699, 1988.

Ergang Luo. *Lu ying bing zhi (Book of the Green Standard Army)*. Zhonghua Shuju, 1984.

Michael E Mann, Zhihua Zhang, Scott Rutherford, Raymond S Bradley, Malcolm K Hughes, Drew Shindell, Caspar Ammann, Greg Faluvegi, and Fenbiao Ni. Global Signatures and Dynamical Origins of the Little Ice Age and Medieval Climate Anomaly. *Science*, 326(5957):1256–1260, 2009.

B.G. Martin. *The Shanghai Green Gang: Politics and Organized Crime, 1919-1937*. University of California Press, 1996.

Halvor Mehlum, Edward Miguel, and Ragnar Torvik. Poverty and Crime in 19th Century Germany. *Journal of Urban Economics*, 59(3):370–388, 2006.

Guy Michaels. The Effect of Trade on the Demand for Skill: Evidence from the Interstate Highway System. *The Review of Economics and Statistics*, 90(4):683–701, 2008.

Stelios Michalopoulos and Elias Papaioannou. Pre-Colonial Ethnic Institutions and Contemporary African Development. *Econometrica*, 81(1):113–152, 2013.

Edward Miguel. Poverty and Witch Killing. *The Review of Economic Studies*, 72(4):1153–1172, 2005.

Edward Miguel. *Poverty and Violence: An Overview of Recent Research and Implications for Foreign Aid*. Brookings Institution Press, 2007.

Edward Miguel and Shanker Satyanath. Re-examining Economic Shocks and Civil Conflict. *American Economic Journal: Applied Economics*, 3(4):228–32, 2011.

Edward Miguel, Shanker Satyanath, and Ernest Sergenti. Economic Shocks and Civil Conflict: An Instrumental Variables Approach. *Journal of Political Economy*, 112(4):725–753, 2004.

H.B. Morse. *The Trade and Administration of China*. Longmans, Green and Company, 1913.

Jacob Moscona, Nathan Nunn, and James A. Robinson. Social Structure and Conflict: Evidence from Sub-Saharan Africa, 2017.

Yuping Ni. *Grain Transportation in the Qing Dynasty and Social Change (Chinese Edition)*. Shanghai Bookstore Publishing House, 2005.

Nathan Nunn. The Importance of History for Economic Development. *Annual Review of Economics*, 1(1):65–92, 2009.

Nathan Nunn and Diego Puga. Ruggedness: The Blessing of Bad Geography in Africa. *Review of Economics and Statistics*, 94(1):20–36, 2012.

Nathan Nunn and Leonard Wantchekon. The Slave Trade and the Origins of Mistrust in Africa. *American Economic Review*, 101(7):3221–3252, 2011.

Elisabeth Ruth Perlman. Dense Enough To Be Brilliant: Patents, Urbanization, and Transportation in Nineteenth Century America. 2016.

Elisabeth Ruth Perlman and Steven Sprick Schuster. Delivering the Vote: The Political Effect of Free Mail Delivery in Early Twentieth Century America. *Journal of Economic History*, forthcoming.

Shawn J. Riley, Stephen D. DeGloria, and Robert Elliot. A Terrain Ruggedness Index that Quantifies Topographic Heterogeneity. *Intermountain Journal of Sciences*, 5(1 - 4):23 –27, 1999.

Michael Ross. A Closer Look at Oil, Diamonds, and Civil War. *Annu. Rev. Polit. Sci.*, 9:265–300, 2006.

Heather Sarsons. Rainfall and Conflict: A Cautionary Tale. *Journal of Development Economics*, 115(0):62–72, 2015.

Carol H. Shiue. Transport Costs and the Geography of Arbitrage in Eighteenth-Century China. *American Economic Review*, 92(5):1406–1419, December 2002. doi: 10.1257/000282802762024566.

Kenneth L Sokoloff. Inventive Activity in Early Industrial America: Evidence from Patent Records, 1790C1846. *The Journal of Economic History*, 48(04):813–850, 1988.

Kenneth L. Sokoloff and Stanley L. Engerman. History Lessons: Institutions, Factors Endowments, and Paths of Development in the New World. *The Journal of Economic Perspectives*, 14(3):217–232, 2000. ISSN 08953309.

US Geological Survey. GTOPO30, 1996.

Guido Tabellini. The Scope of Cooperation: Values and Incentives. *The Quarterly Journal of Economics*, 123(3):905–950, 2008. doi: 10.1162/qjec.2008.123.3.905.

Guido Tabellini. Culture and Institutions: Economic Development in the Regions of Europe. *Journal of the European Economic Association*, 8(4):677–716, 2010. ISSN 1542-4774. doi: 10.1111/j.1542-4774.2010.tb00537.x.

T Talhelm, X Zhang, S Oishi, C Shimin, D Duan, X Lan, and S Kitayama. Large-scale Psychological Differences within China Explained by Rice versus Wheat Agriculture. *Science*, 344(6184):603–608, 2014.

Nico Voigtländer and Hans-Joachim Voth. Persecution Perpetuated: The Medieval Origins of Anti-Semitic Violence in Nazi Germany. *The Quarterly Journal of Economics*, 127(3):1339–1392, 2012. doi: 10.1093/qje/qjs019.

F. Wakeman. *The Great Enterprise: The Manchu Reconstruction of Imperial Order in Seventeenth-century China*. California University, 1985. ISBN 9780520048041.

A.J. Watson. *Transport in Transition: the Evolution of Traditional Shipping in China*. Michigan abstracts of Chinese and Japanese works on Chinese history. Center for Chinese Studies, University of Michigan, 1972. ISBN 9780892649037.

Baojiong Zhu and Peilin Xie, editors. *Ming-Qing Jinshi Timing Beilu Suoyin (Official Directory of Ming-Qing Imperial Exam Graduates)*. Shanghai: Shanghai Guji Chubanshe, 1980.

Figures

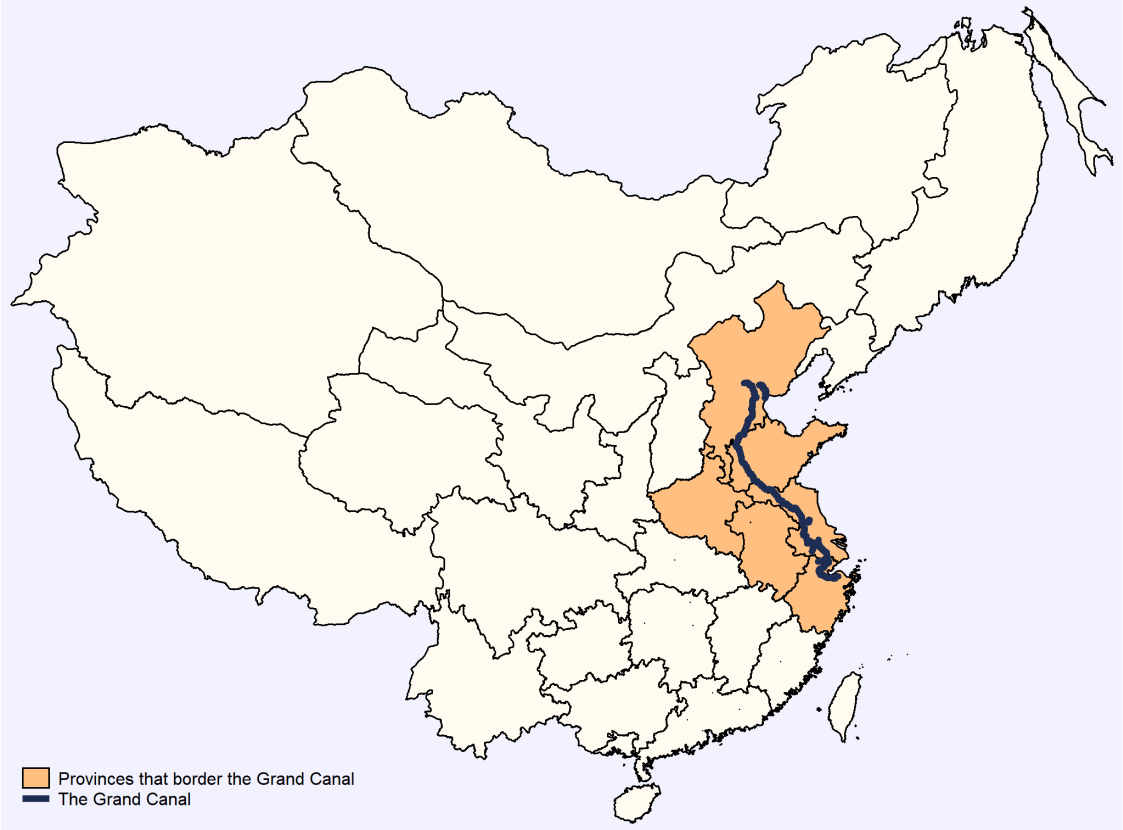


Figure 1: Location of the Grand Canal

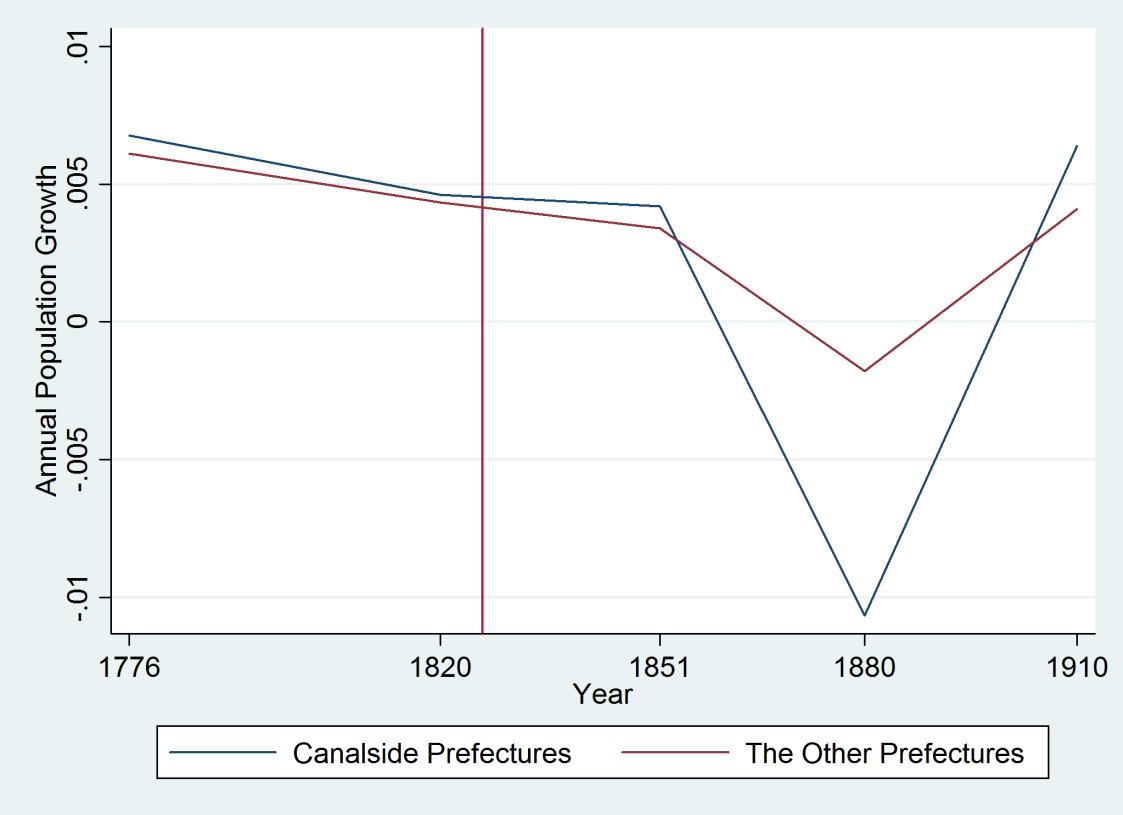


Figure 2: Annual Population Growth at the Prefecture Level

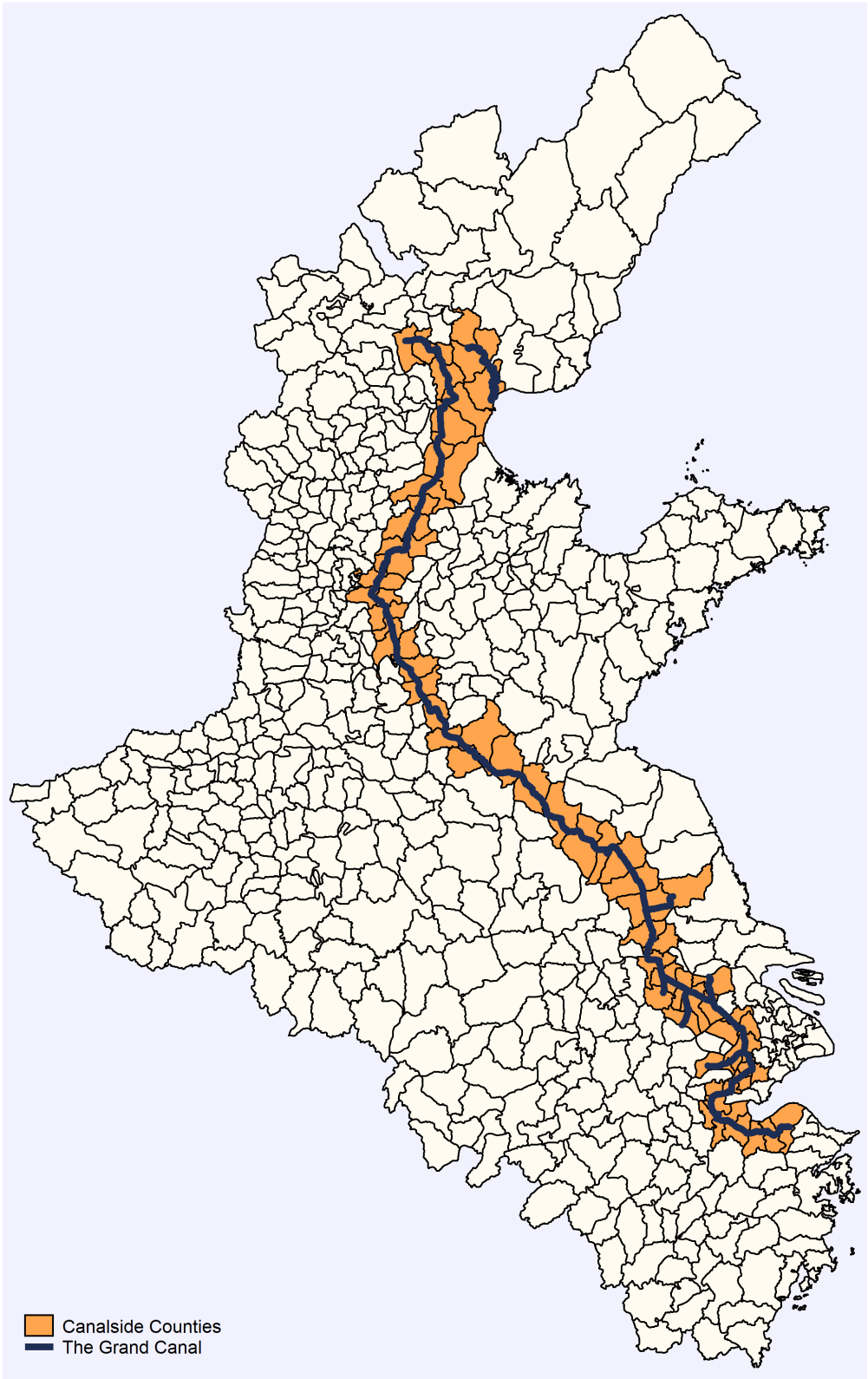


Figure 3: Counties Contained in the Sample

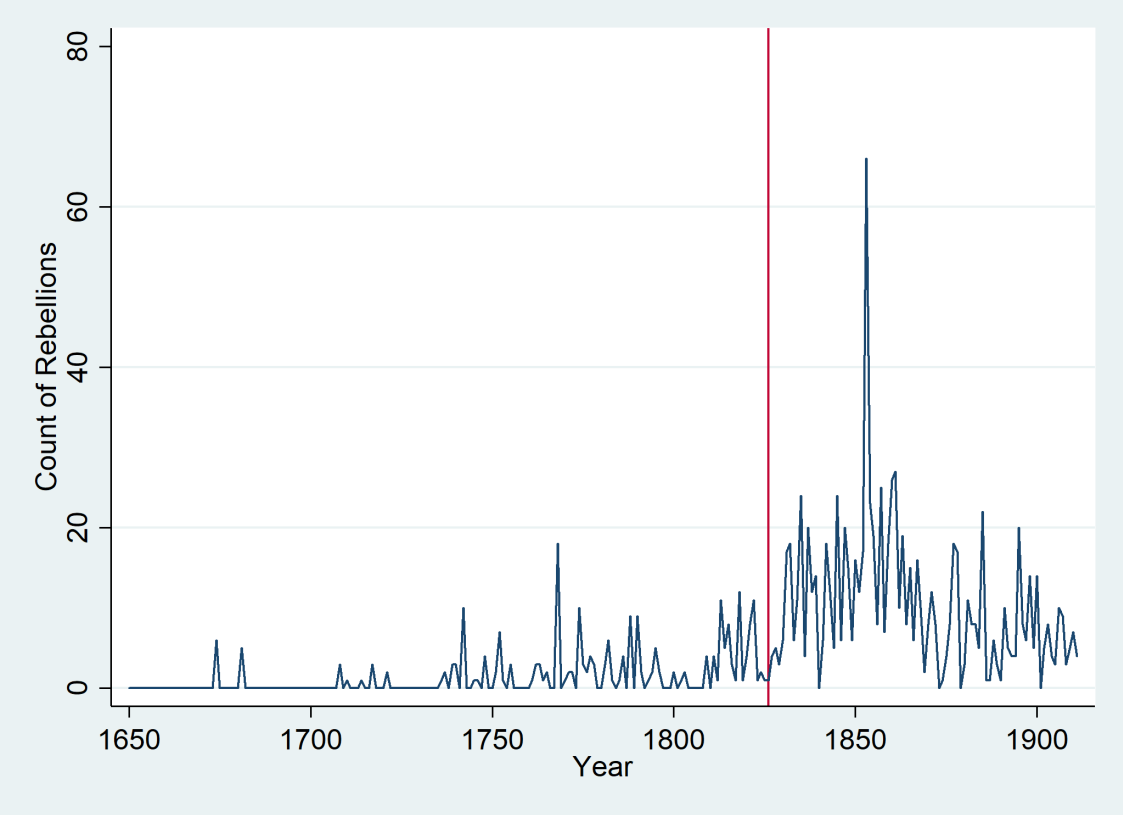


Figure 4: The Dynamics of Rebellions over Time

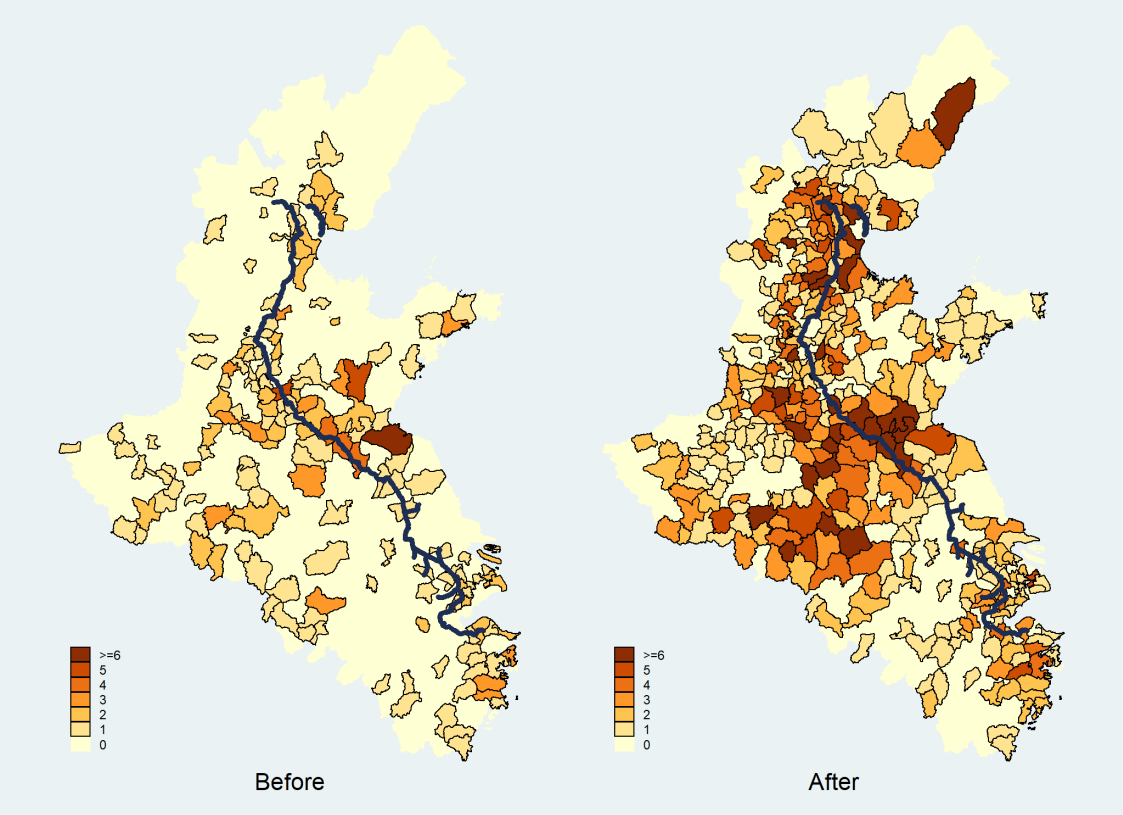


Figure 5: The Spatial Distribution of Rebellions before and after the Abandonment

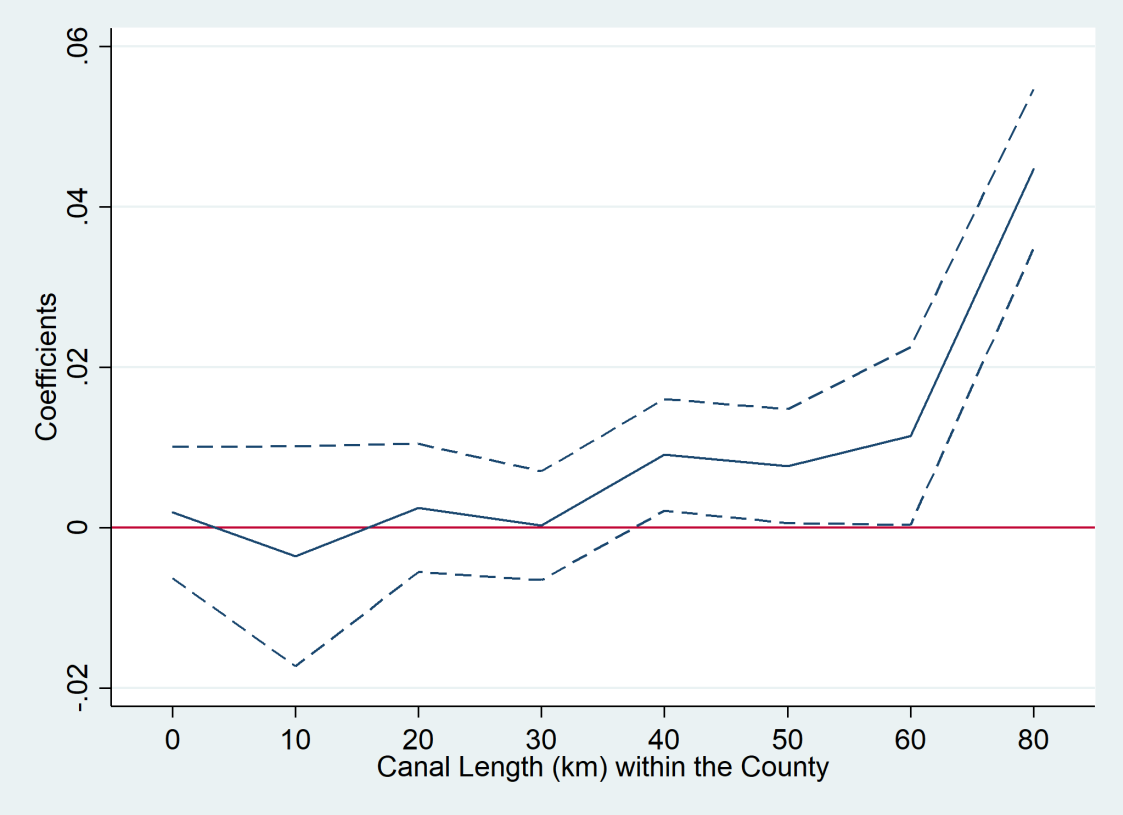


Figure 6: More Flexible Estimation of the Treatment Effects by Canal Length



Figure 7: More Flexible Estimation of the Treatment Effects by Distance to the Canal

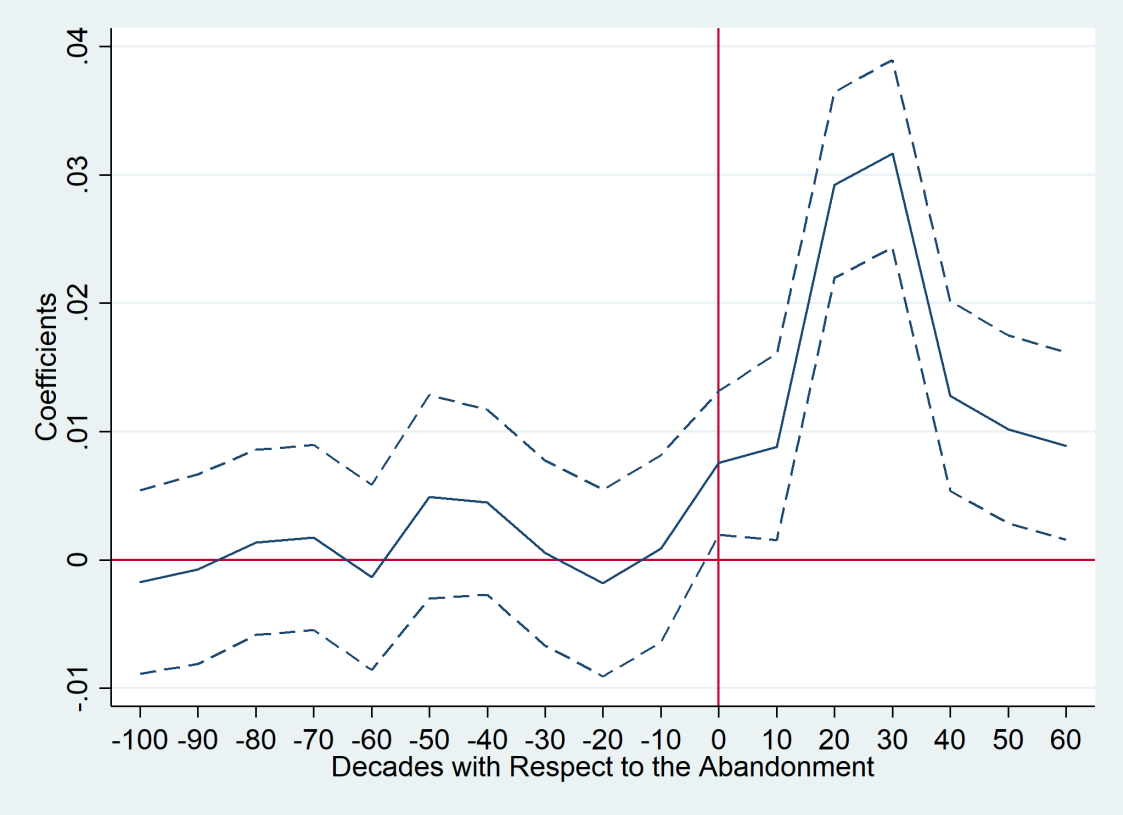


Figure 8: More Flexible Estimation of the Treatment Effects by Decades



Figure 9: Treatment Effects with Gradually Expanding Years of Analysis

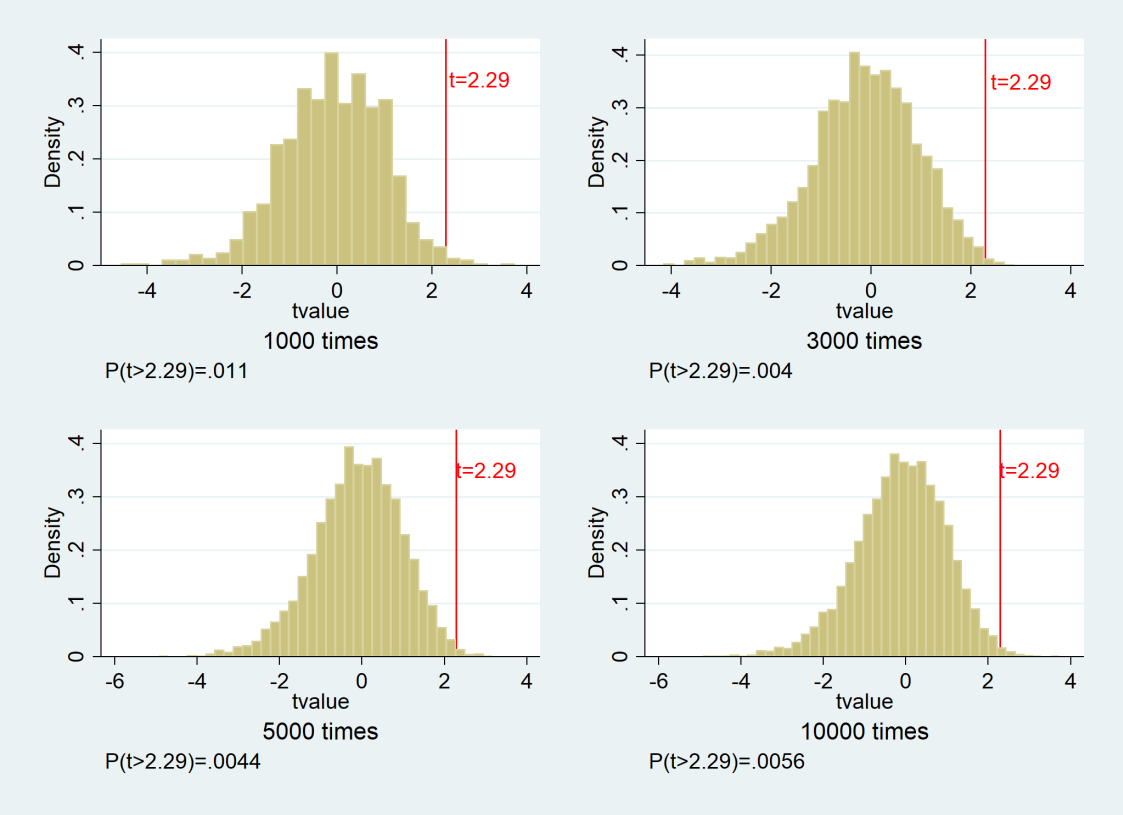


Figure 10: The Distribution of t-statistics from Randomly Assigned Placebo Treatment Effects

Tables

Table 1: Descriptive Statistics

	Source	Obs.	Mean	S.D
Outcomes				
Presence of Rebellions (Onset)	1	150650	0.0073	0.0854
Number of Rebellions (Onset)	1	150650	0.0076	0.0894
Treatments				
Being Along the Grand Canal	2	575	0.1270	0.3332
Length of Canal within Boundary (km)	2	575	4.1196	13.3217
Distance from the Grand Canal (km)	2	575	118.0353	113.4459
Controls				
Temperature Deviated from 1961-2006 Mean	3	143838	-0.1954	0.3343
Drought	4	150650	0.0976	0.2968
Flood	4	150650	0.0743	0.2623
Ruggedness Index	5	575	72.7510	97.6787
Distance from the Yellow River (km)	2	575	296.8347	267.3429
Year of Maize Adoption	4	563	1718.4050	95.6149
Year of Sweet Potato Adoption	4	231	1755.0130	51.2365
jinshi	6	150650	0.1563	0.8558
Supplements				
Imperial Soldiers Stationed	7	575	154.2104	345.8505
Prefecture Capital	2	575	0.1391	0.3464
Number of Attacking Cases	1	150650	0.0054	0.0822
Number of Retreating Cases	1	150650	0.0036	0.0690
Average Grain Price (Liang/KCal)	4	91110	0.5980	0.1856
Suitability Index for Wheat (Irrigation, M Input)	8	575	4793.0057	1836.9174
Suitability Index for Wetland Rice (Irrigation, M Input)	8	575	3758.3572	1231.6994
Number of Towns and Local Markets	2	1150	12.4957	10.7650
1776 urbanshare	4	563	8.6055	3.7947
Along the Qing Courier Routes	2	575	0.2800	0.4494
Mass Kill during the Qing Invasion	9	575	0.0226	0.1488
Senior Green Gang Members	10	575	0.2435	1.0592
Year of First Communist Party Branch	11	569	1928.2583	5.2102

Data Sources:

1. Veritable Records of the Qing Emperors (*Qing Shilu*)
2. Harvard Yenching Institution (2007), CHGIS, Version 4.
3. Mann et al. (2009)
4. Chen and Kung (2016)
5. Nunn and Puga (2012)
6. Zhu and Xie (1980)
7. Luo (1984)
8. FAO (2012), GAEZ: http://fao.org/Ag/AGL/agll/gaez/ index.htm.
9. Wakeman (1985)
10. Encyclopedia of the Green Gang (*Qingbang Tongcao Huihai*)
11. Local gazettes

Table 2: Comparing the Number of Rebellions between the Treatment and the Controls

	Before 1825	After 1825	Difference
Counties Along the Grand Canal	0.0048	0.0288	0.0240***
	(0.0704)	(0.1730)	(0.0018)
Counties not Along the Grand Canal	0.0020	0.0166	0.0146***
	(0.0462)	(0.1322)	(0.0004)
Difference	0.0028***	0.0122***	0.0094***
	(0.0005)	(0.0019)	(0.0015)

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively.

Table 3: The Effects of the Abandonment of the Canal on the Number of Rebellions

	Dependent variable: Number of Rebellions			
	(1)	(2)	(3)	(4)
Along Canal × After Abandonment	0.0094**	0.0100***	0.0076**	0.0076**
	(0.0037)	(0.0038)	(0.0037)	(0.0037)
	[0.0026]	[0.0026]	[0.0027]	[0.0026]
Constant	0.0119***	-0.0066***	-0.0026	-0.4522**
	(0.0004)	(0.0011)	(0.0749)	(0.1814)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Province × Emperor FE	No	Yes	No	Yes
Prefecture Year Trend	No	No	Yes	Yes
Mean of the Dependent Variable	0.0076	0.0076	0.0076	0.0076
No. of Observations	150650	150650	150650	150650
No. of Counties	575	575	575	575
No. of Clusters	575	575	575	575
Adjusted R-squared	0.0250	0.0263	0.0277	0.0290

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. Standard errors in parentheses are clustered at the county level. Standard errors in square brackets are Conley standard errors robust for spatial correlation.

Table 4: Continuous Treatment Effects of the Abandonment of the Canal on the Number of Rebellions

Measure of Treatment Intensity:	*Dependent variable:* Number of Rebellions					
	(1)	(2)	(3)	(4)	(5)	(6)
Binary (Baseline):						
Along Canal × After Abandonment	0.0100***					
	(0.0038)					
Continuous intensity:						
Canal Length × After Abandonment		0.0034***				
		(0.0013)				
Distance to Canal × After Abandonment			-0.0005***			
			(0.0001)			
Continuous progress						
Along Canal × Years after Abandonment				0.0011*		
				(0.0006)		
Continuous in both						
Canal Length × Years after Abandonment					0.0004**	
					(0.0002)	
Distance to the Canal × Years after Abandonment						-0.0001***
						(0.0000)
Constant	-0.0066***	-0.0066***	-0.0091***	-0.0066***	-0.0066***	-0.0079***
	(0.0011)	(0.0011)	(0.0013)	(0.0011)	(0.0011)	(0.0012)
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × Emperor FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of the Dependent Variable	0.0076	0.0076	0.0073	0.0076	0.0076	0.0073
No. of Observations	150650	150650	139384	150650	150650	139384
No. of Counties	575	575	532	575	575	532
No. of Clusters	575	575	532	575	575	532
Adjusted R-squared	0.0263	0.0266	0.0265	0.0261	0.0263	0.0262

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. Standard errors are clustered at the county level. The length and distance measures are rescaled to 10km. Number of years after the reform is measure at decades.

Table 5: The Effects of the Abandonment of the Canal with Multiple Controls

	Dependent variable: Number of Rebellions								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Canal × Post	0.0097**	0.0100***	0.0100***	0.0076**	0.0091**	0.0099***	0.0100***	0.0100***	0.0075*
	(0.0038)	(0.0038)	(0.0037)	(0.0038)	(0.0038)	(0.0038)	(0.0037)	(0.0038)	(0.0039)
Climate:									
Temperature Deviation	0.0072**								0.0063**
	(0.0029)								(0.0030)
Drought		0.0019**							0.0024***
		(0.0009)							(0.0009)
Flooding			0.0023**						0.0026**
			(0.0010)						(0.0011)
Geography:									
Ruggedness × After				-0.0000***					-0.0000***
				(0.0000)					(0.0000)
Distance to Yellow River × After					-0.0000***				-0.0000**
					(0.0000)				(0.0000)
Technology:									
Maize Adopted						0.0017			0.0020*
						(0.0011)			(0.0011)
Sweet Potato Adopted							-0.0002		-0.0004
							(0.0013)		(0.0013)
Culture:									
jinshi								0.0002	0.0003
								(0.0002)	(0.0003)
Constant	-0.0042***	-0.0066***	-0.0067***	-0.0002	-0.0045***	-0.0063***	-0.0066***	0.0125***	0.0012
	(0.0014)	(0.0011)	(0.0011)	(0.0012)	(0.0010)	(0.0012)	(0.0011)	(0.0011)	(0.0022)
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × Emperor FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of the Dependent Variable	0.0075	0.0073	0.0073	0.0073	0.0073	0.0074	0.0074	0.0073	0.0077
No. of Observations	143838	150650	150650	150650	150650	147506	147506	150650	141218
No. of Counties	549	575	575	575	575	563	563	575	539
No. of Clusters	549	575	575	575	575	563	563	575	539
Adjusted R-squared	0.0274	0.0263	0.0263	0.0266	0.0266	0.0267	0.0267	0.0263	0.0282

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. The treatment is measured by along canal indicator. Standard errors are clustered at the county level.

Table 6: Testing the Shocks to State capacity

	Dependent variable:			
	Baseline Outcome		Placebo Outcome	
	Rebellions (Onset Case)		Attack Case	Retreat Case
	(1)	(2)	(3)	(4)
Canal × Post	0.0003**	0.0003***	0.0000	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0000)
Soldiers × Post	-0.0003			
	(0.0002)			
Canal × Post × Soldiers	0.0000			
	(0.0000)			
Prefecture Capital × Post		0.0047		
		(0.0029)		
Canal × Post × Capital		-0.0003		
		(0.0002)		
Constant	0.0120***	0.0123***	0.0137***	0.0040***
	(0.0004)	(0.0004)	(0.0003)	(0.0002)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Mean of the Dependent Variable	0.0076	0.0073	0.0054	0.0036
No. of Observations	150650	143052	150650	150650
No. of Counties	575	546	575	575
Adjusted R-squared	0.0253	0.0245	0.0959	0.0785

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. The treatment is measured by the length of canal within a county. Standard errors are clustered at the county level.

Table 7: Testing the Shocks to Agricultural Productivity

	Dependent variable:		
	Grain Price	Number of Rebellions	
	(1)	(2)	(3)
Canal × Post	0.0003	0.0003***	0.0003***
	(0.0004)	(0.0000)	(0.0001)
Canal × Post × Wetland Rice Suitability		0.0001	
		(0.0002)	
Canal × Post × Wheat Suitability			0.0001
			(0.0001)
Constant	0.4372***	0.0119*	0.0129**
	(0.0321)	(0.0066)	(0.0066)
Dual Interactions	No	Yes	Yes
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Mean of the Dependent Variable	0.5980	0.0076	0.0076
No. of Observations	91110	150650	150650
No. of Counties	560	575	575
Adjusted R-squared	0.7062	0.0252	0.0256

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. The treatment is measured by the length of the canal within a county.

Table 8: Testing the Shocks to Trade Accessibility

	Dependent variable:		
	Town Number	Number of Rebellions	
	(1)	(2)	(3)
Canal × Post	-0.1234***	-0.0023*	0.0028***
	(0.0389)	(0.0012)	(0.0006)
Canal × Post × 1776 Urbanshare		0.0004***	
		(0.0001)	
Canal × Post × Courier			-0.0015**
			(0.0008)
Constant	1.2222***	0.0117*	0.0116*
	(0.0292)	(0.0066)	(0.0066)
Dual Interactions	No	Yes	Yes
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Mean of the Dependent Variable	2.1228	0.0076	0.0076
No. of Observations	1104	147506	150650
No. of Counties	575	563	575
Adjusted R-squared	0.6523	0.0253	0.0249

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. The treatment is measured by the length of canal within boundary normalized by the sizes of the counties.

Table 9: Testing the Persistent Effects of the Reform

	Dependent variable:	
	Green Gang Seniors	Year of Communism Emergence
	(1)	(2)
Canal	0.0305***	-0.0327*
	(0.0098)	(0.0189)
Constant	0.0000	1926.0647***
	(0.0000)	(0.5876)
Prefecture FE	Yes	Yes
Mean of the Dependent Variable	0.3533	1926.7339
No. of Observations	317	109
Adjusted R-squared	0.1712	0.0597

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. The treatment is measured by the length of canal within boundary.

A Supplementary Results

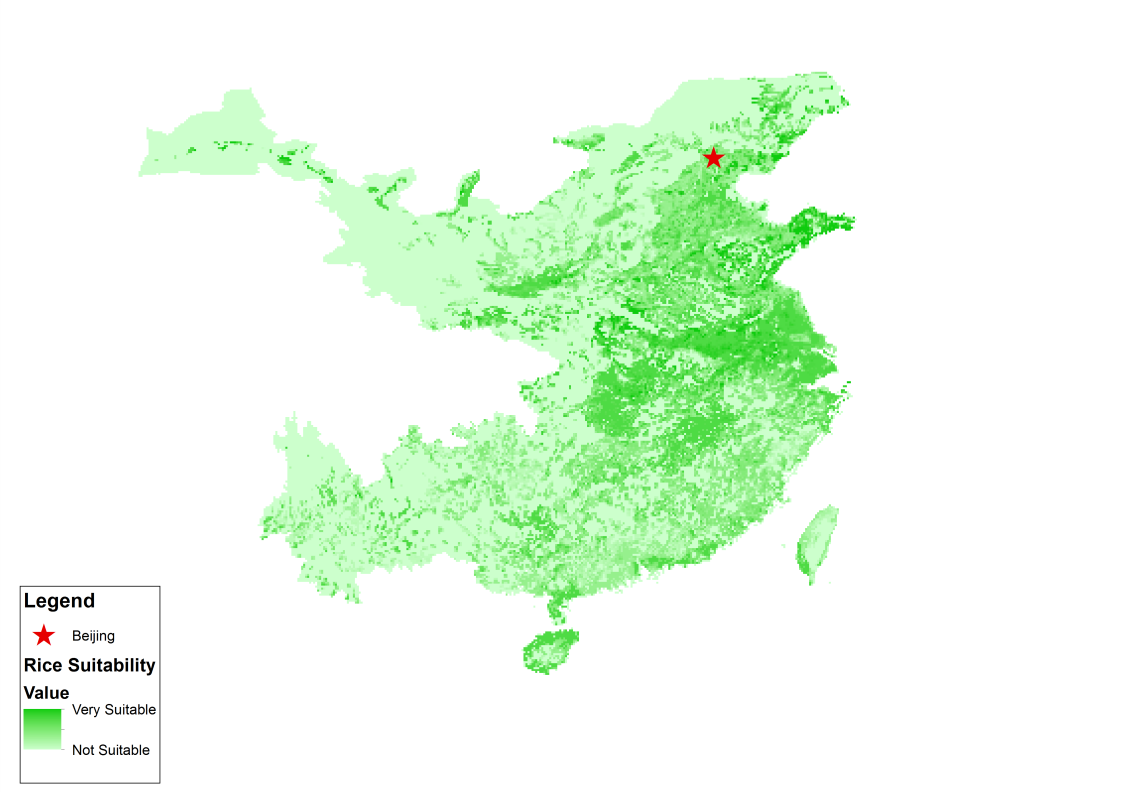


Figure A1: Suitability Index for Wetland Rice (irrigation, medium input)

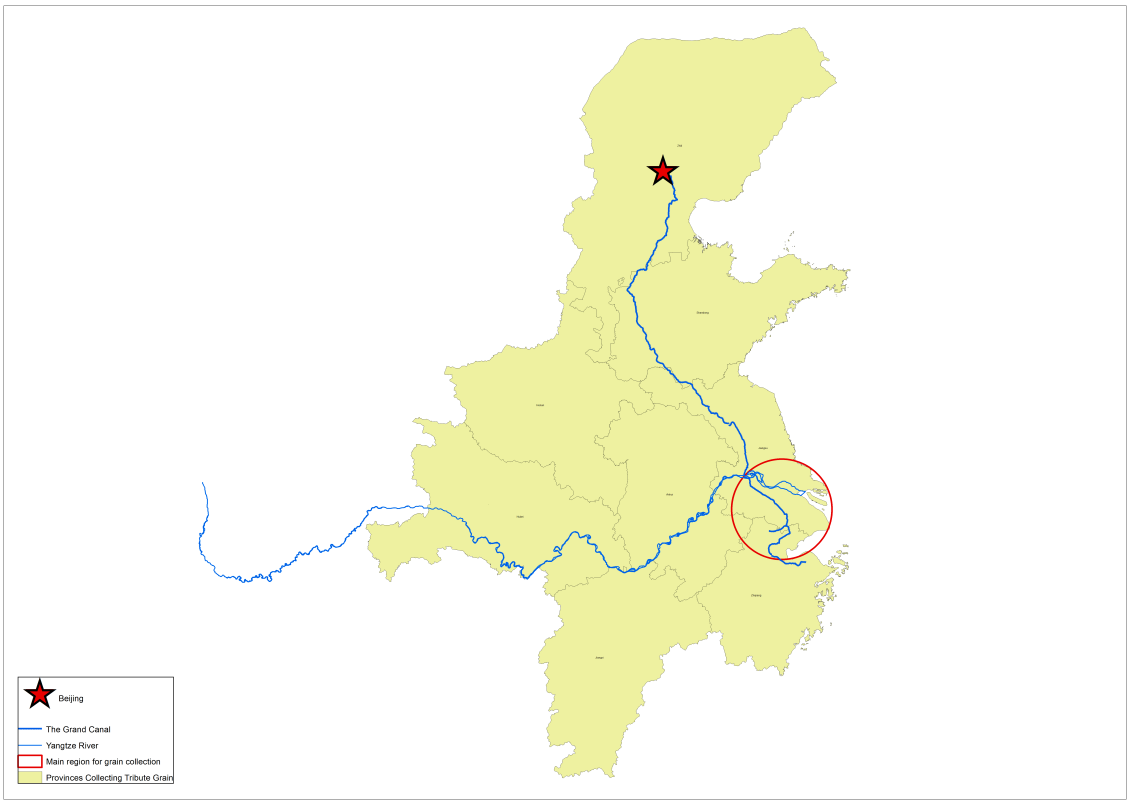


Figure A2: Sources and Shipping Routes of tribute rice in the Qing Dynasty

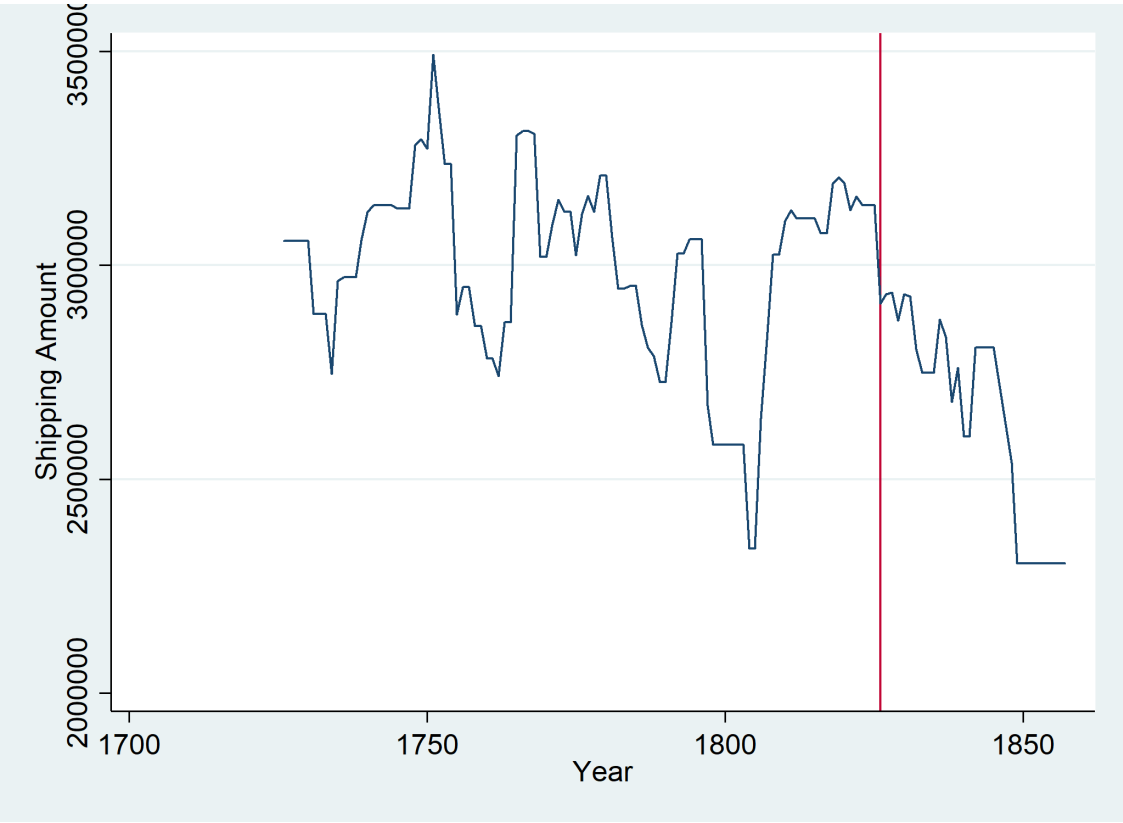
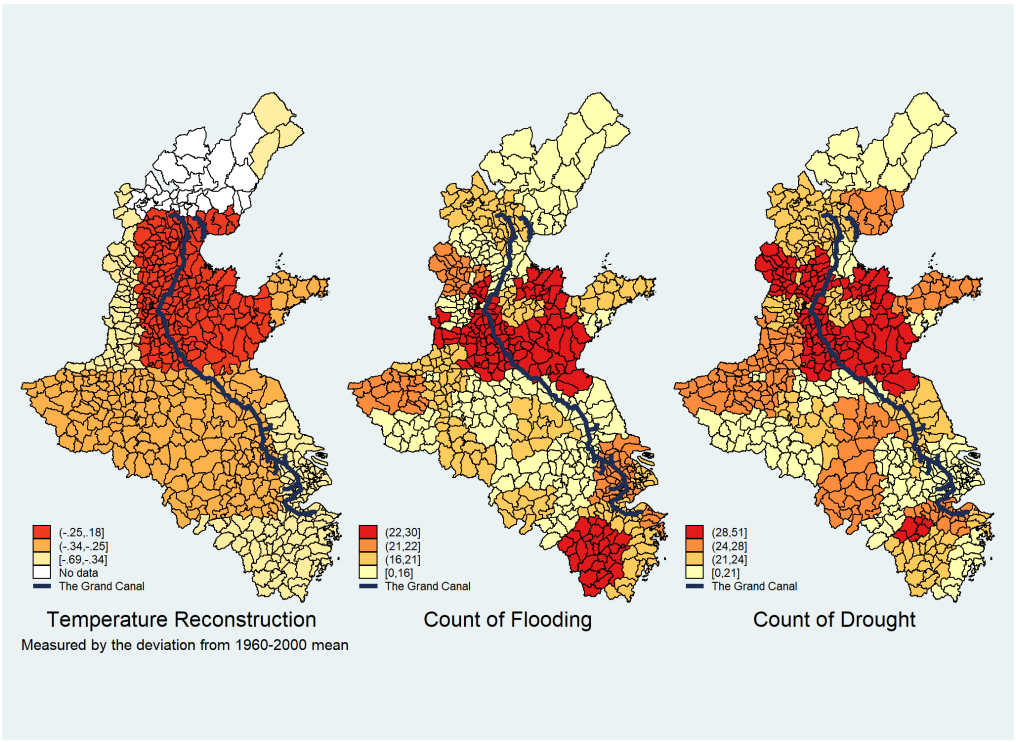
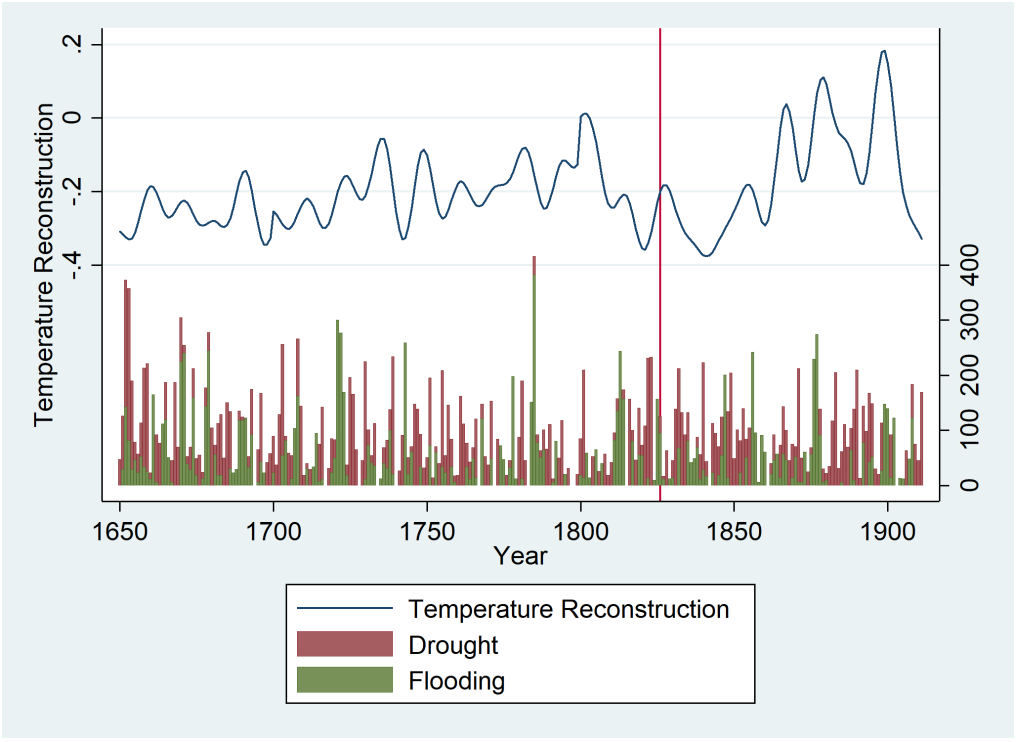


Figure A3: Shipping Amount of Grains



(a) Across Regions



(b) Over Time

Figure A4: Distribution of Climate Measures

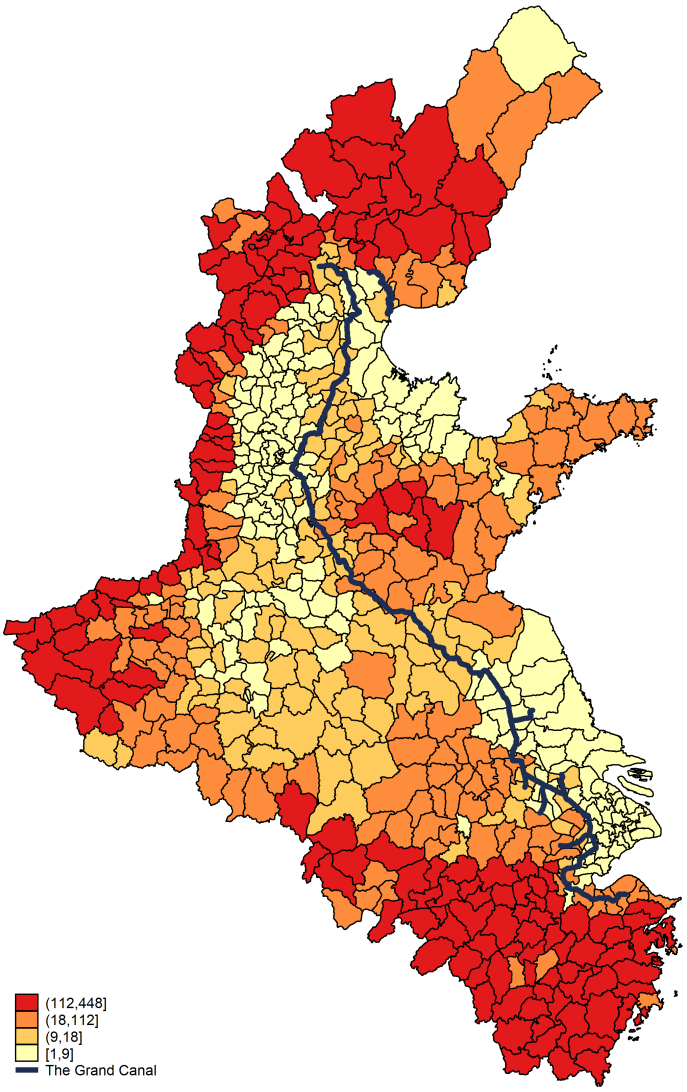
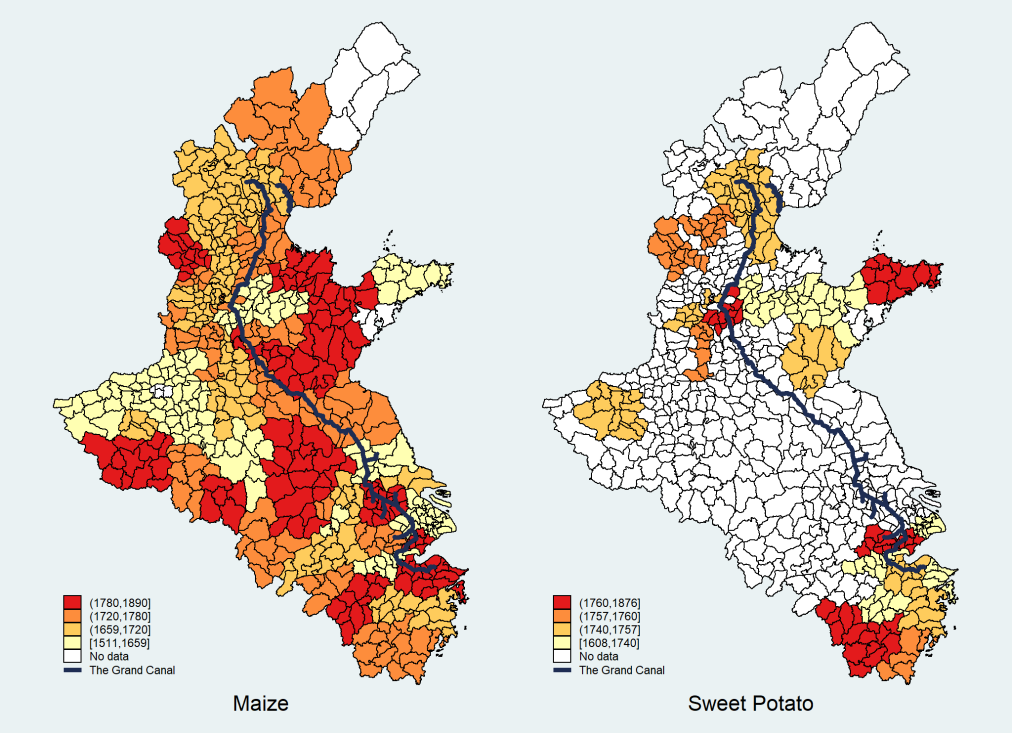
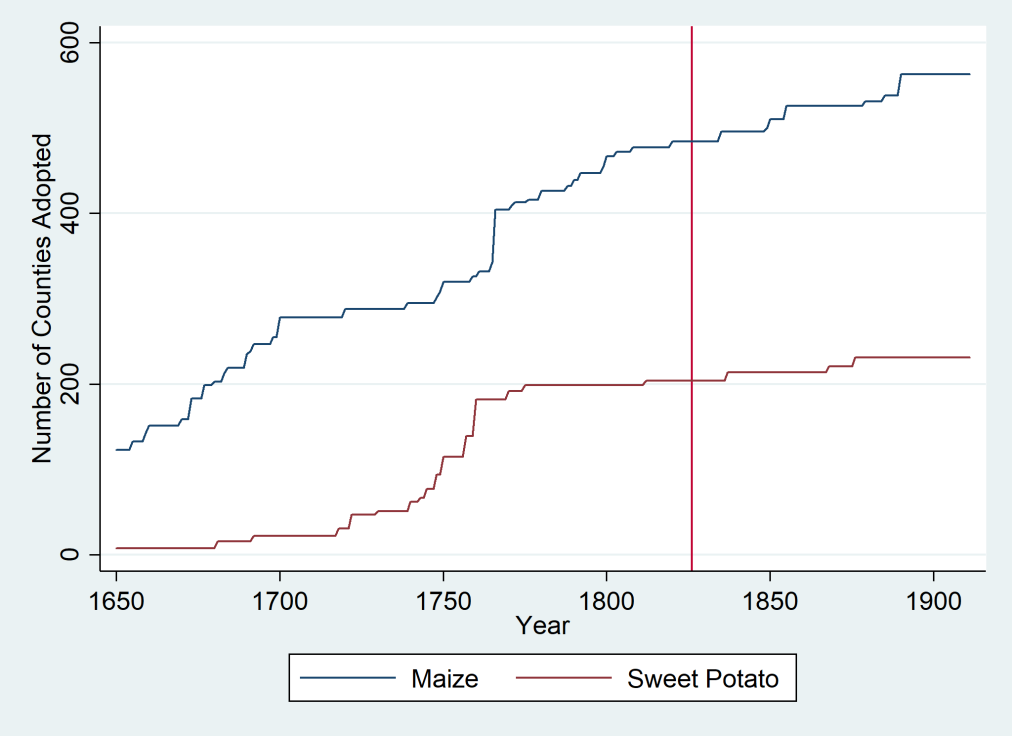


Figure A5: Spatial Distribution of the Ruggedness Index

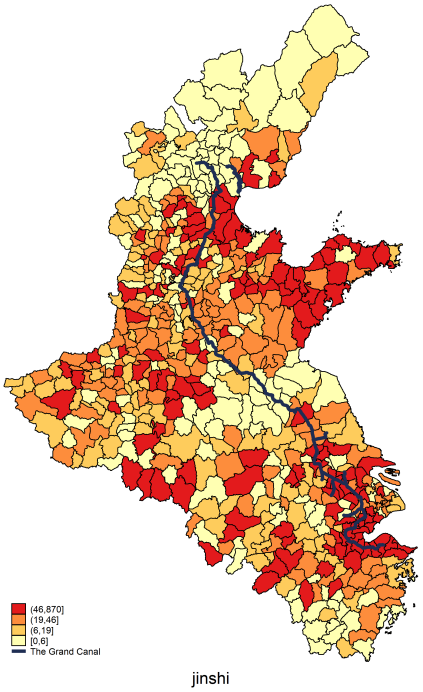


(a) Year of Adoption

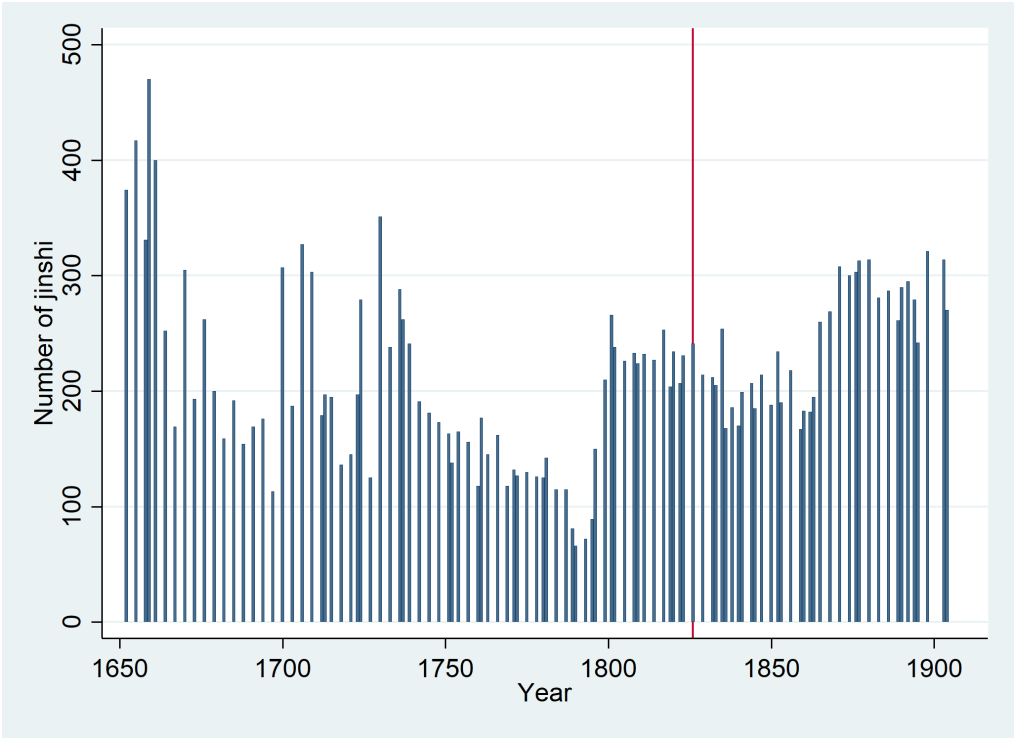


(b) Number of Counties Adopted

Figure A6: The spread of New World Crops



(a) Across Regions



(b) Over Time

Figure A7: The Distribution of *jinshi*

Table A1: The Effects of the Abandonment of the Canal on the Number of Rebellions Clustered at Prefectures

	Dependent variable: Number of Rebellions			
	(1)	(2)	(3)	(4)
Along Canal × After Abandonment	0.0094**	0.0100**	0.0076*	0.0076*
	(0.0044)	(0.0040)	(0.0042)	(0.0040)
	[0.0026]	[0.0026]	[0.0027]	[0.0026]
Constant	0.0119***	-0.0066***	-0.0026	-0.4522***
	(0.0007)	(0.0020)	(0.0290)	(0.1576)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Province × Emperor FE	No	Yes	No	Yes
Prefecture Year Trend	No	No	Yes	Yes
Mean of the Dependent Variable	0.0076	0.0076	0.0076	0.0076
No. of Observations	150650	150650	150650	150650
No. of Counties	575	575	575	575
No. of Clusters	79	79	79	79
Adjusted R-squared	0.0250	0.0263	0.0277	0.0290

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. Standard errors in parentheses are clustered at the prefecture level. Standard errors in square brackets are Conley standard errors robust for spatial correlation.

Table A2: The Effects of the Abandonment of the Canal on the Presence of Rebellions

	Dependent variable: Presence of Rebellions			
	(1)	(2)	(3)	(4)
Along Canal × After Abandonment	0.0090**	0.0097***	0.0071**	0.0071**
	(0.0035)	(0.0035)	(0.0035)	(0.0035)
	[0.0025]	[0.0025]	[0.0025]	[0.0025]
Constant	0.0121***	-0.0062***	-0.0074	-0.4471**
	(0.0004)	(0.0010)	(0.0749)	(0.1803)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Province × Emperor FE	No	Yes	No	Yes
Prefecture Year Trend	No	No	Yes	Yes
Mean of the Dependent Variable	0.0073	0.0073	0.0073	0.0073
No. of Observations	150650	150650	150650	150650
No. of Counties	575	575	575	575
No. of Clusters	575	575	575	575
Adjusted R-squared	0.0239	0.0253	0.0265	0.0278

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. Standard errors in parentheses are clustered at the county level. Standard errors in square brackets are Conley standard errors robust for spatial correlation.

Table A3: The Effects of the Abandonment of the Canal on Rebellions Normalized by Population

	Dependent variable:			
	Number of Rebellions		Presence of Rebellions	
	(1)	(2)	(3)	(4)
Along Canal × After Abandonment	0.0004*	0.0004**	0.0003*	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
	[0.0002]	[0.0001]	[0.0001]	[0.0001]
Constant	0.0001***	-0.0001***	0.0001***	-0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Province × Emperor FE	No	Yes	No	Yes
Mean of the Dependent Variable	0.0003	0.0003	0.0003	0.0003
No. of Observations	129854	129854	129854	129854
No. of Counties	575	575	575	575
No. of Clusters	563	563	563	563
Adjusted R-squared	0.0145	0.0171	0.0139	0.0165

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. The dependent variables are normalized by population. Standard errors in parentheses are clustered at the county level. Standard errors in square brackets are Conley standard errors robust for spatial correlation.

Table A4: Continuous Treatment Effects using the Amount of Grain Shipped via Canal

	Dependent variable: Number of Rebellions		
	(1)	(2)	(3)
Canal Length × Shipping Amount (Actual)	-0.0017**		
	(0.0008)		
Canal Length × Shipping Amount (Moving Average)		-0.0005**	
		(0.0002)	
Canal Length × Shipping Amount (Simulated)			-0.0103***
			(0.0032)
Constant	-0.0033	-0.0077***	-0.0049***
	(0.0116)	(0.0009)	(0.0010)
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Province × Emperor FE	Yes	Yes	Yes
Mean of the Dependent Variable	0.0055	0.0083	0.0075
No. of Observations	25750	66950	81885
No. of Counties	515	515	515
Adjusted R-squared	0.0111	0.0266	0.0280

Note: *, **, and *** denote significance at the 90%, 95%, and 99% levels respectively. Canal Length is measured per $10km$, and shipping amount is measured per million dan. Standard errors in Columns (2) and (3) are clustered at the county level.