Title
Essays on Social Change and Economic Development

Author
Zhang, Boxiao

Publication Date
2022

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Essays on Social Change and Economic Development

A dissertation submitted in partial satisfaction

of the requirements for the degree

Doctor of Philosophy in Economics

by

Boxiao Zhang

2022

ABSTRACT OF THE DISSERTATION

Essays on Social Change and Economic Development

by

Boxiao Zhang
Doctor of Philosophy in Economics
University of California, Los Angeles, 2022
Professor Dora Luisa Costa, Chair

This dissertation contributes toward our understanding of social change and socio-economic development. Chapter 1 introduces multiple key factors driving social change and leading to economic and social development. In Chapter 2 to Chapter 4, by analyzing historical natural experiments, I study the role of information, social interactions, and human capital in social changes, and their relationship with economic and social development.

Chapter 2, "Political Information, Social Interactions, and Protest in Late Imperial China", investigates how information and social interactions drive social change by leading to collective actions (protests). A modern communication infrastructure allows information to reach people through the news media, while social interactions are needed to coordinate social movements. The postal system's rapid construction in 1903-1910 in China let newspapers spread information directly to an increasing portion of the population. The change in information diffusion coincided with intensive media attention on revolutionary activities before the Revolution of 1911. I find that the construction of more post offices in a place led to more protests in the years with more reports about revolutionary activities in newspapers. I further disentangle the roles of direct information diffusion and social interactions. I define a village network based on the village's location, the walking time between villages, and the village's dialect group. I build and estimate a game-theoretical

model based on the village network. As political information directly changed the villages which had post offices nearby and could receive information, I also find a strong peer effect: a village was affected by its expectation of its neighbors' actions. The peer effect spread the direct impact of political information through social interactions.

Chapter 3, "Wartime Social Interactions and Veteran Migration in The Post-American Civil War Era", explores the role of social interactions in social change and economic development after the American Civil War. I focus on temporary social interactions among African American veterans during the American Civil War (1861–1865), and examine the long-term impacts of temporary social interactions on veterans' migration and income in 1870–1900. I find that wartime social networks (veterans from the same company) persistently affected veterans' location choices in the post-Civil War period. By estimating discrete choice migration models, I quantified that the veterans were more likely to move to a county where men from their military company lived. I further show the long-term benefits of living together. Veterans earned higher incomes after the war if they lived in the same county with wartime friends who had higher incomes after the war.

Chapter 4, "Temple Destruction, School Construction, and Modern Human Capital in 20th Century China" (jointly written with Shaoda Wang), studies how modern human capital emerged in early 20th-century China and its impacts on economic development. We documented a historical episode known as the Temple Destruction Movement (TDM), during which Chinese local governments appropriated huge amounts of Buddhist and Taoist temple assets to support the modernization of the local schooling system. We found that before the TDM, the initial stock of temple assets was uncorrelated with the levels and trends of human capital development. However, after the TDM started, regions with higher initial stocks of temple assets constructed more modern schools, enrolled more students in modern educational programs, and produced more modern elites.

The dissertation of Boxiao Zhang is approved.

Michela Giorcelli

Bernardo Santos da Silveira

Nico Voigtlaender

Dora Luisa Costa, Committee Chair

University of California, Los Angeles

2022

DEDICATIONS

To my parents, my grandmother, and my family

Contents

List of Figures

List of Tables

ACKNOWLEDGMENT

I am especially grateful to my Committee Chair Dora Luisa Costa, for her invaluable support and guidance throughout my PhD studies. I am extremely thankful for the support and advice from my other committee members Michela Giorcelli, Bernardo Santos da Silveira, and Nico Voigtlaender. I thank Martha Bailey, Moshe Buchinsky, Daniel Haanwinckel, and other participants at the UCLA applied micro proseminar and UCLA economic history proseminar for insightful discussion. I thank participants in various conferences for helpful comments. I thank the Center for Economic History at UCLA, the department of Economics at UCLA, and the Economic History Association for generous funding. All remaining errors are mine.

VITA

Education

University of California, Los Angeles

M.A. in Economics 2018

Peking University

M.A. in Economics 2016

B.A. in Economics 2014

B.A. in History 2014

Honors and Awards

Best Paper Award, Economic History Proseminar, UCLA ($3,000) 2021

Dissertation Year Fellowship, UCLA ($20,000) 2021–2022

Exploratory Travel and Data Grant, Economic History Association ($2,500) 2021

Lewis L. Clarke Graduate Fellowship Fund, UCLA ($2,450) 2020

Summer Fellowship, UCLA ($4,250) 2020

Center for Economic History Graduate Fellowship, UCLA ($6,000) 2020

Center for Economic History Graduate Fellowship, UCLA ($10,000) 2016–2017

Outstanding Graduate Student, Peking University 2014

President's Undergraduate Research Fellowship, Peking University 2012–2014

Chapter 1

Introduction

There is a long tradition of looking to history to understand social change and economic development. This dissertation employs both new historical data and modeling methods to study how information, social interactions, and human capital, could drive social change and lead to economic and social development. The unique historical events that I examine, allow me not only to understand the past but also provide perfect laboratories to develop and test economic questions, including the following: What is the relative role of information diffusion and social interaction in spreading social protests and facilitating political modernization? How do social interactions affect long-term migration and economic development? What economic and political factors lead to investments in the modern human capital necessary for development?

In Chapter 2, I investigate how advances in communication infrastructure drive social change by leading to collective actions (protests) through the channel of information diffusion in news media and the channel of social interactions. The postal system's rapid construction in 1903–1910 in China let newspapers spread information directly to an increasing portion of the population for the first time. The change in information diffusion coincided with intensive media attention on revolutionary activities before the Revolution of 1911. The major newspapers in large cities intensively reported revolutionary activities, and the reports were diffused to villages nationwide through the postal system. By examining protests in the

1900s before the 1911 Chinese Revolution, I document a casual effect of political information on protests. I identify the role of political information by creating a unique dataset about the expansion of the postal system between 1903 and 1910, and the political information about revolutionary activities in newspapers. I find that the construction of more post offices in a place led to more protests in the years with more reports about revolutionary activities in newspapers.

I further disentangle the roles of direct information diffusion and social interactions. I define a village network based on the village's location, the walking time between villages, and the village's dialect group. I build and estimate a game-theoretical model based on the village network. A village makes the strategic decision to have protests, which is affected by its neighbors' behavior. As political information directly changed the villages which had post offices nearby and could receive information, I also find a strong peer effect: a village was affected by its expectation of its neighbors' actions. The estimation shows that the impact of receiving political information is spread out through social interactions between villages. For an informed village with access to newspapers, political information increased 8% probability of having protests. It further increased the probability of having protests by 1.5% for the neighbors of the informed village.

In addition to the role in the spread of social protests, how do social interactions affect people's migration decisions and economic development in the long term? Chapter 3 focuses on social change and economic development in the U.S. in the late 19th century, and explores the long-term impacts of temporary social interactions among African American veterans. I investigate how temporary social networks among African American veterans during the American Civil War (1861–1865) affected their location choices in the post-Civil War period. By estimating discrete choice migration models, I quantified that the veterans were more likely to move to a county where men from their military company lived. The wartime social network's effect is sizable compared to other county characteristics. I found that the selection problem in data and the shared military experience could hardly bias the main

findings with robustness checks. By focusing on heterogeneous military companies and using the "weak" social networks as an instrument, I further ruled out the competing explanation that veterans with similar location preferences drove the effect. I further found the long-term benefits of living together as well. The quality, instead of the quantity, of the network mattered. Veterans earned higher incomes after the war if they lived in the same county with wartime friends who had higher incomes after the war.

Chapter 4 follows Chapter 2 to study modernization and economic development in Late Qing and Early Republican China; from the 1900s to the 1930s. During China's transformation from a traditional society to a modern country, investment in education played a pivotal role in the formation of modern human capital. As modern human capital has long been regarded as a crucial factor for economic development, traditional societies generally lacked the economic resources to effectively modernize their existing education systems. To understand the economic modernization process, it is critical to carefully examine the political and economic factors that allow modern human capital to emerge and thrive in traditional societies. Chapter 4 (jointly written with Shaoda Wang) studies how modern human capital emerged in early 20th-century China. We document a historical episode known as the Temple Destruction Movement (TDM), during which Chinese local governments appropriated huge amounts of Buddhist and Taoist temple assets to support the modernization of the local schooling system. We found that before the TDM, the initial stock of temple assets was uncorrelated with the levels and trends of human capital development. However, after the TDM started, regions with higher initial stocks of temple assets constructed more modern schools, enrolled more students in modern educational programs, and produced more modern elites. A back-of-the-envelope calculation showed that the TDM can account for nearly 70% of China's modern school construction in the early 20th century, consistent with historical records collected from numerous county gazetteers. Further analysis showed that the TDM was most effective in the presence of a strong government and a powerful civil society because the former made

it easier to appropriate assets from the religious sector, while the latter helped prevent the confiscated religious assets from being captured by local officials.

Chapter 2

Political Information, Social Interactions, and Protest in Late Imperial China

2.1 Introduction

Advances in information and communication infrastructure can drive social change through two distinct channels: information diffusion and social interactions. First, communication infrastructure and technologies could help news media directly spread information to people. Information in news media changes people's beliefs, attitudes, and ideology (Gentzkow and Shapiro, 2004; DellaVigna and Gentzkow, 2010), and can lead to protests and social movements (Enikolopov et al., 2020; Wang, 2021). Second, the communication and transportation infrastructures also could enable social interactions, through which information is passed on and behaviors are affected. The information flows facilitate cooperation and shape collective actions (Melander et al., 2020; García-Jimeno et al., 2022). However, it is unclear whether advances in communication infrastructure lead to collective actions because of direct information diffusion in news media or because of social interactions.

Therefore, to understand the social impact of communication infrastructure, it is important to carefully examine the relationship between information diffusion and collective actions and the role of social interactions. Does the construction of information

and communication infrastructure help people receive political information and change their behaviors in participating in collective actions? How do social interactions spread the impact from those who received information to others?

I am able to disentangle the roles of direct information diffusion and social interactions in collective action by using evidence from a historical natural experiment: the geographical expansion of the postal system before the 1911 Chinese Revolution. To the best of my knowledge, my paper provides the first evidence of strategic behaviors in social interactions in the context of political information diffusion. The rapid construction of post offices beginning in 1896 gave villages access to major newspapers through the postal system. During the years before the Revolution of 1911, the major newspapers thus spread political information about revolutionary activities, which received intense media attention. I show that both direct information diffusion in newspapers and social interactions led to local protests. The construction of post offices caused more protests in the years with more political information in newspapers. Political information directly increased the probability of having protests in villages that had access to major newspapers ("informed" villages). Social interactions then spread the direct impact of receiving political information from "informed" villages to their neighbors.

I can establish the causal links between local protests and increasing exposure to political information in newspapers, and how social interactions led to the spread of information from "informed" villages to their neighbors, because I created a comprehensive panel dataset of post offices, villages, newspaper content, and local protests from archival records. First, I digitized postal maps to collect the locations of post offices constructed in 1903–1910. I define the villages as the "informed" or "uninformed" ones based on their walking time to the nearest post office. As more post offices were constructed, the increase in the share of "informed" villages created temporal and spatial differences in information availability. Second, I quantify the volume of political information in newspapers by counting the number of reports about revolutionary activities in major daily newspapers. I collect reports about

major revolutionary activities in the 1900s, including assassinations, revolts, petitions, and the founding of organizations. In the full-text databases of newspapers, I find the related reports of these activities each year. Third, I use the number of local protests as the outcome.

I find that the increase in information availability, combining with a large volume of political information in newspapers, led to more local protests. The news reports about revolutionary activities could encourage people to participate in local protests by showing the weakness of the imperial government and an opportunity to have local protests. To identify the effect of political information on local protests, I exploit geographic variation in information availability and changes in newspapers' content. I use panel analysis to compare prefectures with a higher or lower share of "informed" villages, in the years with more or fewer reports about revolutionary activities in newspapers. The results show that a place with a higher share of "informed" villages, in the years with more newspaper reports on revolutionary activities, had more local protests.

An endogeneity problem in the above results may come from the correlation of two variables: post office construction and the change over time in political information in newspapers. Besides providing exposure to information, the post offices also represent the state's ability to acquire local information and state investment in a region. When there was more political information in newspapers, the government might sense the higher probability of local protests in some places and acquire more local information by constructing more post offices. This would underestimate the effect of political information because, in the years with more political information, the total number of post offices in a location (including newly constructed post offices) would represent a stronger state capacity, reducing the number of protests relative to other years. On the contrary, in the years with more political information, the government could have constructed more post offices in places which were suitable for construction because of their stability. This would lead me to overestimate the effects of political information on protests.

To have an instrument for the construction of post offices, I obtain simulated

counterfactual distributions of places where post offices would have been constructed if the government were only considering efficiency. The efficient way of expanding a postal system is to construct new post offices in places that are well-connected to the existing postal system, in order to have efficient new postal routes. Therefore, I randomly draw points around each new post office. The point is considered an unsuitable location for constructing a post office if it is not well-connected to the existing postal system. I drop the unsuitable points and consider all the remaining points and existing post offices as a simulated distribution of post offices. I then define the simulated share of "informed" villages based on the simulated distribution of post offices. I use a "Monte Carlo"-type method by repeating the above steps 1,000 times and taking the average value of all the simulated shares of "informed" villages. I use the average value as the instrument to represent the information availability under a counterfactual distribution of post offices, had they been constructed for no other reason than efficiency.

The IV results find a larger effect of political information on local protests. The evidence suggests that the government intentionally built more post offices so that it would have stronger capacity in places where it expected protests to happen. This leads to an underestimation in the OLS analysis. Therefore, both the coefficient and the quantified effect of political information on local protests are larger in the IV analysis.

In the second part, I investigate how social interactions between villages impacted local protests under increasing exposure to information. I define villages' network structure based on the villages' locations, the walking time between villages, and the dialect groups of villages. When more post offices were constructed, more "informed" villages were created as well as more "informed" neighbor villages around some villages. I build and estimate a game model of social interactions based on the village network, in which whether a village had protests was affected by both the direct and peer effect (Lin and Xu, 2017; Xu, 2018). The political information may have directly changed "informed" villages. On the other side, the peer effect examines whether a village's actions were affected by the actions it expected its neighbors to

take. I find a significant direct effect and a strong peer effect. Political information directly increased the probability of having protests for "informed" villages. Meanwhile, the strong peer effect spread the impact by changing the beliefs of the neighbors of "informed" villages.

As the estimation of the model finds the strong peer effect in the social interactions between villages, I provide region-level evidence to show that the strong peer effect made the villages with a high percentage of "informed" neighbors as the key players. In a region, a strong peer effect would encourage collaboration and facilitate local protests, when more "informed" villages were in the neighborhood and when they received a large volume of public political information. The villages with a high percentage of "informed" neighbors in a region would be key to local protests if the peer effect mattered. Therefore, I measure the strength of the peer effect in a region by the share of villages having more than x% "informed" neighbors, where x represents some thresholds. The general effect from the share of "informed" villages is not significant after including the strength of the peer effect. More villages with percentages of "informed" neighbors higher than the thresholds are the main reason for more local protests in years with more political information. The results justify why public information and social interactions are essential in local protests and how different distributions of information injection points matter.

My paper contributes to a growing literature on the impact of news media and communication technologies and infrastructures. The existing literature provides evidence showing the effects of media on ethnic animosity (DellaVigna et al., 2014), political knowledge and beliefs (Gentzkow and Shapiro, 2004; Snyder Jr and Strömberg, 2010; Chen and Yang, 2019), voting behavior (Gentzkow and Shapiro, 2006; Gentzkow, 2006; DellaVigna and Kaplan, 2007; Gerber et al., 2009; Chiang and Knight, 2011; Enikolopov et al., 2011; Gentzkow et al., 2011), incumbency advantage (Ansolabehere et al., 2006; Prior, 2006), public spending (Strömberg, 2004) and social capital (Olken, 2009). News media also played an important role in major historical events, such as the rise of the Nazis (Adena et al., 2015), the Serbo-Croatian conflict (DellaVigna et al., 2014), the Rwandan

genocide (Yanagizawa-Drott, 2014), and the Arab Spring (Acemoglu et al., 2018). It has also been shown that the development of new communication technology such as radios, telephones, and the internet has promoted collective actions (Miner, 2015; Enikolopov et al., 2020; Manacorda and Tesei, 2020; Wang, 2021). Besides these advances in communication technology, the postal system in 1903–1910's China provided the first exposure of a large number of Chinese people to news media. This paper shows how the news media and communication technology backfired on the imperial government and led to protests.

My paper unites several strands of the literature on social interactions and collective action. Tilly (1977) emphasizes the importance of "mobilization" in the formation of collective actions. Existing literature finds that social interactions can affect the extent of mobilization and facilitate collaboration in social movements (Granovetter, 1978; Melander et al., 2020; Cantoni et al., 2019; González, 2020; García-Jimeno et al., 2022). My paper shows how social interactions work as a critical intermediate factor by spreading the direct impact of information diffusion and changing public belief. My paper is also related to the broader literature on information diffusion and peer effects in social networks and is the first to estimate the direct effect of information diffusion and peer effects on social networks. A theoretical literature has discussed information diffusion on social networks (Bala and Goyal, 1998; Young, 2009; Banerjee et al., 2013; Jackson and Yariv, 2011; Jackson et al., 2017) and a handful of papers have estimated peer effects (Manski, 2000; Blume et al., 2011), particularly in the context of a coordination game (Lin and Xu, 2017; Xu, 2018).

This paper speaks to the literature explaining political modernization in late imperial China and the Chinese Revolution in 1911. The studies of China's political modernization have focused on the well-informed elite who prompted the regime change from the Qing empire to Republican China (Esherick, 1976). Empirical evidence shows that the abolition of the civil service exam, an elite recruitment system, affected political stability and pushed

the traditional elite to participate in revolution (Bai and Jia, 2016). Meanwhile, foreign education, in the form of overseas students in Japan, also facilitated a political transformation in late imperial China (Kung and Wang, 2020). On the other side, historians discuss the role of the gentry class in local social conflicts. The deterioration of local governance and the decay of the lower gentry in rural areas triggered local protests and served as an important driving force of the Chinese Revolution (Skocpol and Theda, 1979; Fairbank, 1986). Empirical study has found that the loss of upward mobility caused the emergence of "bad gentry" and led to more local protests (Hao et al., 2020). My emphasis provides a new perspective by showing how the rising power of news media, with the help of communication infrastructure, affected local protests. My findings could help explain China's social change and political modernization by showing how a modern infrastructure backfired on a weak imperial government.

The remainder of this paper is organized as follows. Section 2.2 documents the historical background of the postal system construction and the newspapers' development in China. Section 2.3 explains the collection of data and the key measures. Section 2.4 shows how political information led to more local protests, and explains the research design, the endogeneity problem, the instrumental results, and the robustness checks. Section 2.5 further discusses information diffusion and social interactions in village networks and estimates the direct and peer effects in the occurrence of local protests. Section 2.6 concludes.

2.2 Historical Background

In this section, I offer historical background on the construction of the postal system in early 20th-century China, and describe how the postal system helped the spread of political information in newspapers.

2.2.1 The Construction of The Postal System

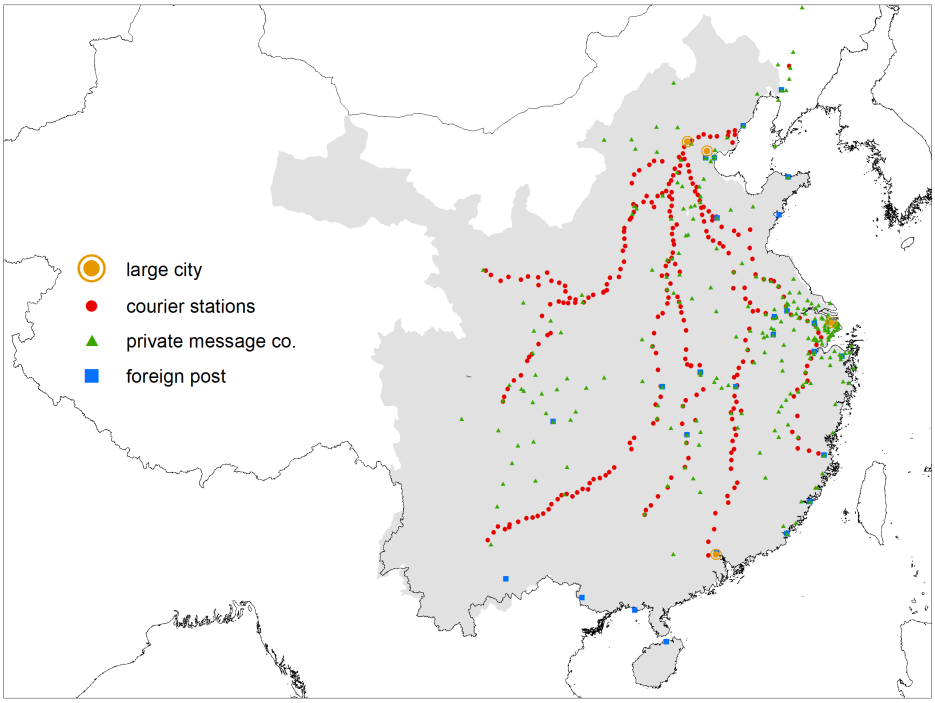
Started in 1896, the postal system in China quickly expanded to many villages in 1902–1910. The rapid construction of post offices allowed the newspapers to spread information directly to an increasing portion of the population at a low cost for the first time in China's history.

Before the establishment of the postal system in 1896, China relied on a courier system and private message companies to deliver messages. There were very few postal services for the majority of ordinary people. The courier system was only used to deliver emergency messages and important documents between the central and local governments. Private message companies provided services to merchants to deliver letters and packages across major cities. After the Opium War in the 1840s, China was forced to open some places as treaty ports. Foreign countries established post offices in China's treaty ports. Foreign post offices mainly helped foreign people and foreign companies deliver international letters and packages from their home country to China. Based on historical archives and studies, Figure 2.1 shows the distribution of courier stations, private message companies, and foreign post offices before the construction of the postal system. These institutions concentrated in major cities and coastal areas and worked only for the government, merchants, and foreign people.

After signing the Treaty of Nanking by the Chinese and British governments in 1842, the Chinese Maritime Customs Service was effectively established by foreign consuls in *Shanghai* in 1854 to collect maritime trade taxes. It soon grew into a Chinese governmental tax collection agency and information service. China's central government hired foreign specialists, including Sir Robert Hart as its Inspector-General. It became a well-regulated modern organization. As a result, in 1896, China's central government put the Chinese Maritime Customs Service in charge of the construction of a postal system.

In the early 20th century, the number of post offices increased dramatically. In 1896, the first 24 post offices were constructed in China. Based on postal reports, Figure 2.2

Figure 2.1: Message Delivery before Postal System in China



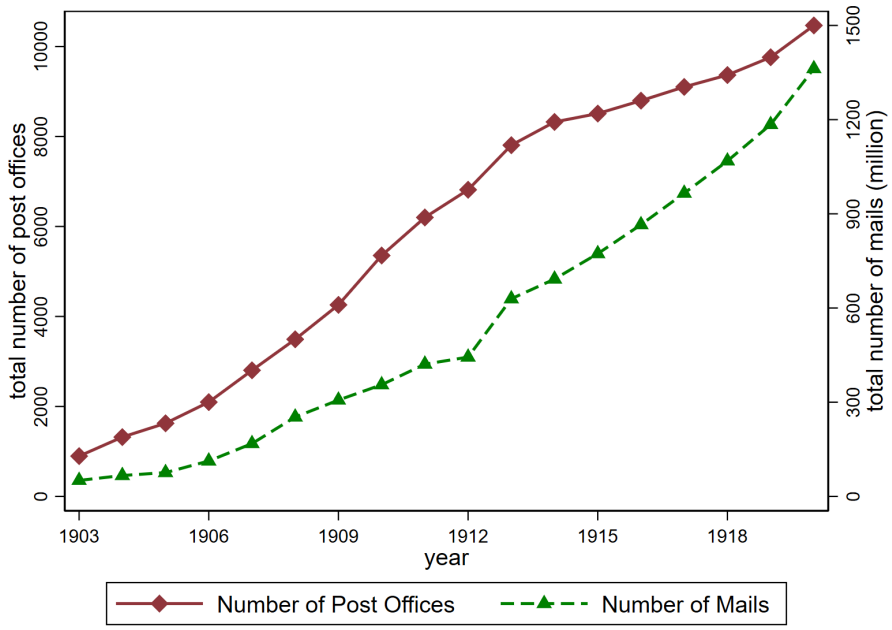
Notes: The map of courier stations is from Skinner et al. (2007). The maps of private message companies and foreign post offices are from Zhang (1936).

summarizes the total number of post offices and amount of mail delivered in China in 1903–1920. The construction of the postal system was very rapid in the first decade of the 20th century. From 1903 to 1910, the total number of post offices increased by more than five times. In 1903, there was one post office per 4,961 km^2. In 1910, one post office covered only 991 km^2 on average.

As the postal system quickly expanded from large cities and treaty ports (cities open to foreign trade) to many villages, it was the first time that material from a printing press could be delivered to many people at a low cost. The delivery cost of mail to any place was about 0.19 gram of silver[1]. As the postal system expanded with a low delivery cost, the amount of mail delivered increased from 51 million pieces in 1903 to 356 million in 1910.

[1] 0.19 g silver is about $0.094 in the current price, and could buy 0.22 kg rice in 1903–1910's average food prices. Meanwhile, the daily wage for a construction worker in Beijing in 1900–1925 was about 6.38 g silver (Allen et al., 2011).

Figure 2.2: China's Construction of Post Office, 1903–1943



Notes: Data are from the *Annual Report on Postal Service, 1903–1910*.

2.2.2 The Spread of Political Information in Newspapers

In the 1900s, the number of newspapers delivered in the postal system experienced fast growth. The major newspapers in large cities paid intensive attention to revolutionary activities. The extensive and frequent spreading of political information may have changed people's attitudes toward government and become a driving force in the formation of local protests.

The rapid growth of newspapers was driven by both the demand and the supply side. 1,591,837 newspapers (9.5% of letter mail) were sent and received through the postal system in 1905. The number further increased to 14,203,800 (20.7% of letter mail) in 1909.

On the demand side, China had many potential readers of newspapers. Historical studies estimate China's literacy rate in the 1880s. Rawski (1979) concludes that male literacy was about 30%–45% while female literacy was approximately 2%–10%[2]. Therefore, nearly 25%

[2] Rawski, Evelyn Sakakida. *Education and popular literacy in Ch'ing China*. Vol. 6. Ann Arbor: University of Michigan Press, 1979.

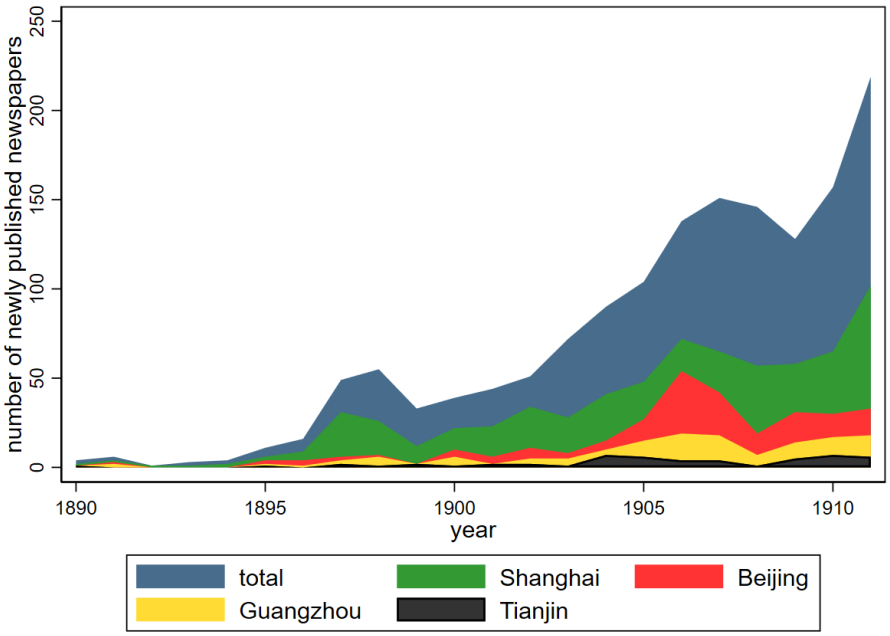
of the total population in China could read newspapers. Meanwhile, newspaper reading and recitation rooms were set up in many towns to help people with financial and literacy constraints to obtain information from newspapers.

On the supply side, as most newspapers were published in large cities and relied heavily on postal delivery, the fast construction of post offices helped the development of newspapers. In the 19th century, Christianity's expansion throughout China first introduced newspapers to the Chinese people. Foreign Protestant missionaries published newspapers for doctrinal propaganda as well as reporting news. In 1833, the first Chinese newspaper was published in Guangzhou. After the 1890s, the number and total circulation of the Chinese newspaper started to increase dramatically. Most newspapers were published in several large cities. In Figure 2.3, I show the number of newly published newspapers in 1890–1911 and the number of newspapers in *Shanghai*, *Beijing*, *Guangzhou*, and *Tianjin*. During that period, 26% of newspapers were published in *Shanghai*, while 20.6% were published in *Beijing*, *Guangzhou*, and *Tianjin*. The construction of post offices in villages facilitated the supply of more newspapers. After a post office was built in 1903, "*Dixi* village (200 km to *Shanghai*) had 29 kinds of newspapers for sale and sold 59 newspapers a day. A merchant founded a newspaper reading and recitation room to lend and read newspapers for customers."[3]

Major newspapers located in the large cities paid intensive attention to revolutionary activities. In the 1900s, there were five daily newspapers, including Shen Pao (1872–1949, in *Shanghai*), Ta Kung Pao (1902–today, in *Tianjin*), Shuntian Times (1905–1930, in *Beijing*), The Eastern Times (1904–1939, *Shanghai*), and Sin Wan Pao (1893–1949, in *Shanghai*). Among newspapers published before 1911, Shen Pao and Ta Kung Pao were the most influential newspapers, spreading current news and daily information, and are believed to have had the largest circulations (Chang, 1989a). During the years before the Revolution of 1911, revolutionaries organized many activities, including assassinations, revolts, and petitions, as well as the founding of organizations. Major newspapers located

[3] *The Alarm Bell News, December 12, 1904.*

Figure 2.3: China's Newly Published Newspapers, 1890–1911



Notes: Data are from the *Full-text Database of Late Qing and Republican Periodicals (CNBKSY)*.

in the above large cities, which were treaty ports governed by foreign countries, faced little censorship. Therefore, a lot of media attention was paid to these revolutionary activities and attracted public interest nationwide (Chang, 1989a; Fang, 1999).

The major newspapers reported revolutionary activities with an attitude of neutrality. Shen Pao was founded as a commercial newspaper, and politically it remained conservative in 1870–1900. In the 1900s, the newspaper was sold and came under the influence of people who supported the constitutional movement. It soon became a moderately liberal newspaper. Most of the time, Shen Pao reported the facts of revolutionary activities with an attitude of neutrality, but it criticized the imperial government and showed sympathy for revolutionaries in some comments. The other major newspapers were similar. The Eastern Times and Ta Kung Pao were founded by the constitutionalists. Sin Wan Pao was financed by foreign merchants. Although these major newspapers did not support the revolution, they paid a lot of attention to revolutionary activities because the reports attracted the interest of readers.

2.3 Data and Variables

In this study, I have collected data on the geographical distribution of villages, the construction of the postal system, the political information in newspapers, local protests, and various socioeconomic characteristics directly from historical archives. To the best of my knowledge, this is one of the most comprehensive datasets on early 20th-century China.

In Subsection 2.3.1, I introduce the maps of villages and post offices, and the measures of information availability and social interactions. In Subsection 2.3.2, I discuss the newspaper database and the measures of political information. In Subsection 2.3.3, I introduce information on local protests. In Subsection 2.3.4, I explain socioeconomic control variables. Table 2.1 presents the main variables used in this paper, including their definitions, sources of information, and basic summary statistics.

2.3.1 Measures of Information Availability and Social Interactions

2.3.1.1 Villages

A map from the China Historical Geographic Information System provides the locations of villages in the 1900s (CHGIS, 2016). The GIS map provides the longitude and latitude of 38,242 villages in 266 prefectures in 1911. Because villages' locations changed very little over short periods, I use the map of villages in 1911 to represent the geographical distribution of villages in 1903–1910. Figure 2.4 shows the boundary of prefectures and villages' locations.

I further digitize the dialect map from the *Language Atlas of China* and identify the dialect of villages (China Academy of Social Science, 1987). Figure 2.5 shows the dialects in the regions where Han Chinese were the majority; in these regions, people mainly spoke the Chinese language in the early 20th century. As shown in Figure 2.5, the *Language Atlas of China* divides all dialects of Chinese into 17 major groups and 144 subgroups[4]. With the

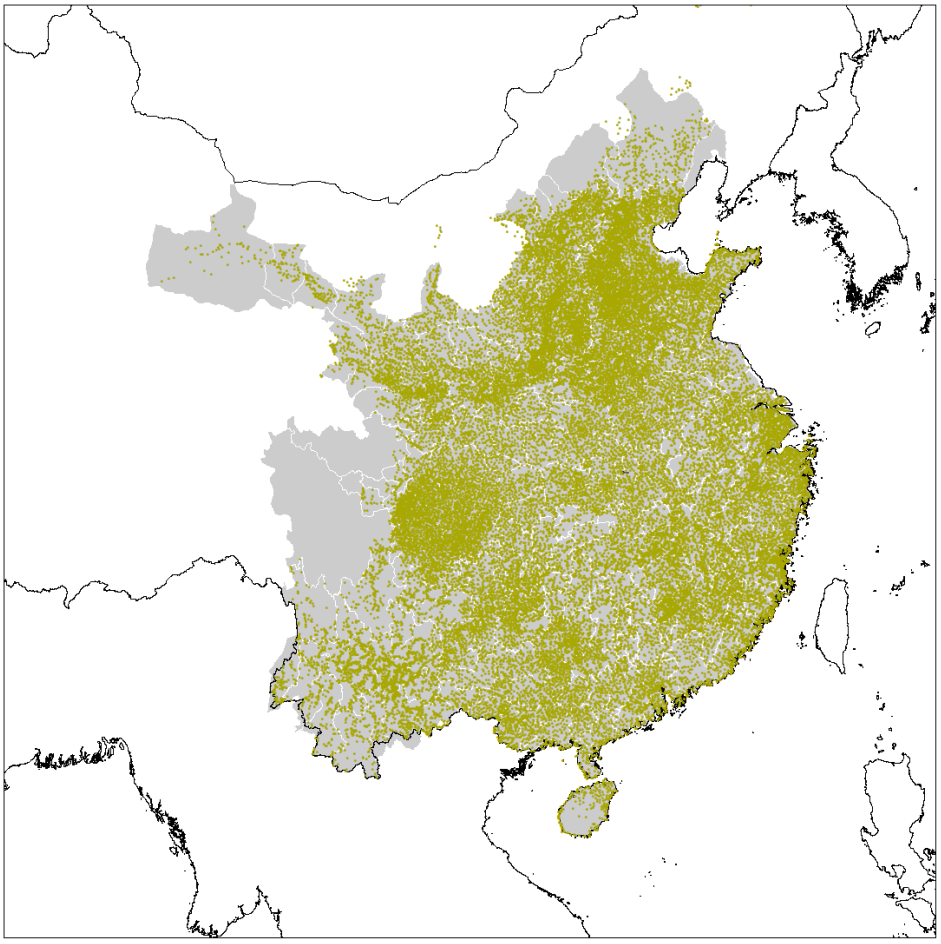
[4] The 17 major dialect groups include 8 Mandarin groups: Northeastern Mandarin, Beijing Mandarin, North Mandarin, Jiaoliao Mandarin, Zhongyuan Mandarin, Lanyin Mandarin, Southwestern Mandarin, Jianghuai

Table 2.1: Summary Statistics for Protests, Information Availability, and Control Variables

	Obs.	Mean	S.D.	Source
# of Protests (per million people)	1862	0.42	1.18	1
Share of "Informed" Villages	1862	0.41	0.30	2
Control Variables				
Village Number (# of villages within prefecture)	266	143.8	93.0	3
Population (10,000)	266	154.5	141.6	4
Area (squared km)	266	16085.2	19367.3	5
Average Tax Burden (gram of silver per person)	266	4.99	6.29	6
Average *Jinshi* (# of civil exam graduates per 10,000)	266	0.63	0.88	7
Average Primary Student (# of primary students per 10,000)	266	36.1	41.2	8
CSI (average caloric suitability index post 1500)	266	1900.9	515.1	9
Grain Price (z-score of grain price)	1862	1.42	0.97	10
Extreme Weather (Frequency of 1,5)	1862	0.13	0.18	11
Extreme Weather (Frequency of 1,2,4,5)	1862	0.50	0.27	11
Importance Level (= 0,1,2,3,4)	266	2.34	1.15	12
Whether Treaty Port (= 0,1)	266	0.18	0.39	13
Whether Having Courier Station (= 0,1)	266	0.38	0.49	14
Whether Having Private Message Company (= 0,1)	266	0.42	0.49	15
Whether Having Foreign Post Office (= 0,1)	266	0.098	0.30	15
Average Factory (# of modern factories per 10,000)	266	0.011	0.042	16
Whether Having Telegraph (= 0,1)	1862	0.58	0.49	17
Whether Having Railway (= 0,1)	1862	0.12	0.32	18

1: **# of Protests (per million people)** is constructed from the protest data (Ding and Zhang, 1982) and the population data (Ge, 2000). 2: **Share of "Informed" Villages** is constructed from the post office map collected from the *China Postal Map*, the *List and Addresses of China's Post Offices*, the village map (CHGIS, 2016), the population data (Ge, 2000), and the terrain elevation map (Danielson and Gesch, 2011). 3: **Village Number** is constructed from the village map (CHGIS, 2016). 4: **Population** is constructed from the population data (Ge, 2000). 5: **Area** is constructed from CHGIS (2016). 6: **Average Tax Burden** is constructed from the tax data (Liang, 1980) and the population data (Ge, 2000). 7: **Average *Jinshi*** is constructed from the civil exam graduate data (Jiang, 2007) and the population data (Ge, 2000). 8: **Average Primary Student Number** is constructed from the *Statistical Chart of Education* and the population data (Ge, 2000). 9: **CSI** is constructed as the average caloric suitability index post 1500 from Galor and Özak (2016). 10: **Grain Price** is the z-score of grain prices from Wang (2013b). 11: **Extreme Weather** is constructed from China Meteorological Administration (1981). 12: **Importance Level** is constructed from Liu (1993). 13: **Whether Treaty Port** is constructed from Yan (1955). 14: **Whether Having Courier Station** is constructed from Skinner et al. (2007). 15: **Whether Having Private Message Company** and **Whether Having Foreign Post Office** are constructed from Zhang (1936). 16: **Average Factory** is constructed from Chang (1989b) and Du (1991). 17: **Whether Having Telegraph** are collected from local gazetteers. 18: **Whether Having Railway** are collected from Ma et al. (1983).

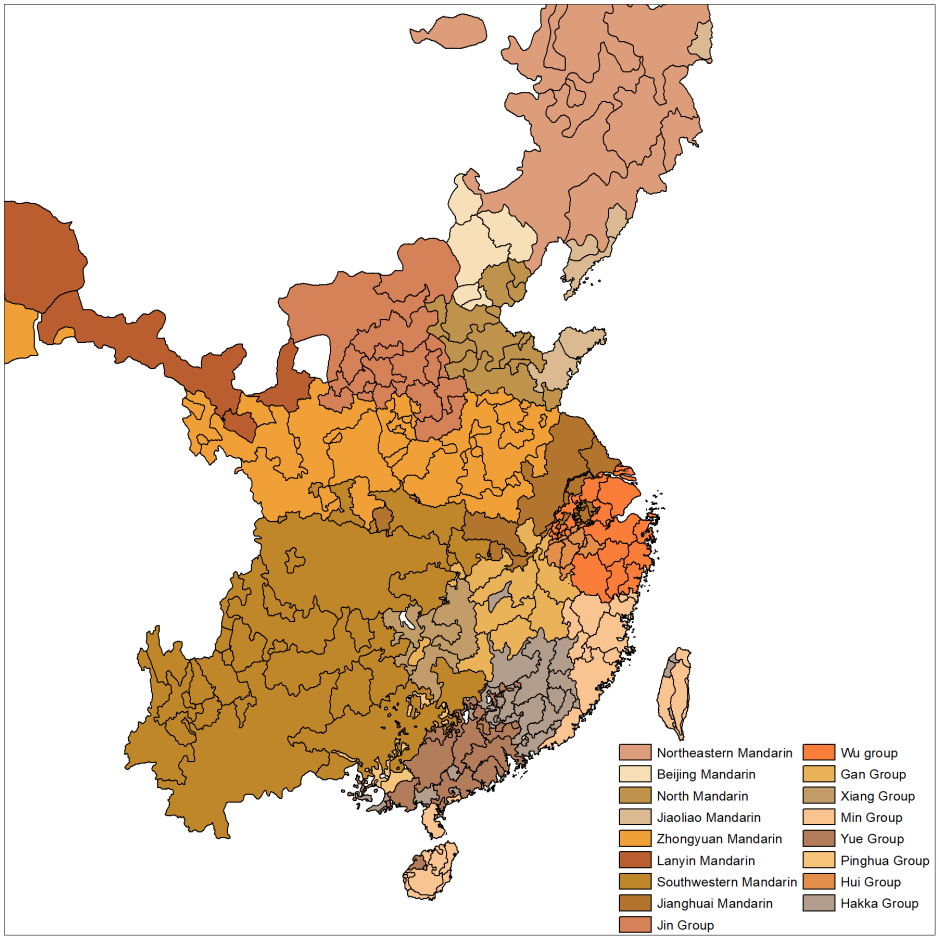
Figure 2.4: Prefectures and Villages in 1900s



Notes: The prefectures are shown by gray polygons with white outlines. The villages are represented by green points. The gray part shows the regions included in my analysis. Data are from the CHGIS database (CHGIS, 2016).

digitized dialect map, I identify the group and subgroup of the dialect associated with each village.

Figure 2.5: Dialects of Chinese



Notes: This map shows the dialects in the regions where Han Chinese were the majority, and people mainly spoke the Chinese language in the early 20th century. The major groups of dialect are shown by different colors and the subgroups are divided by lines. Data are from the *Language Atlas of China* (China Academy of Social Science, 1987).

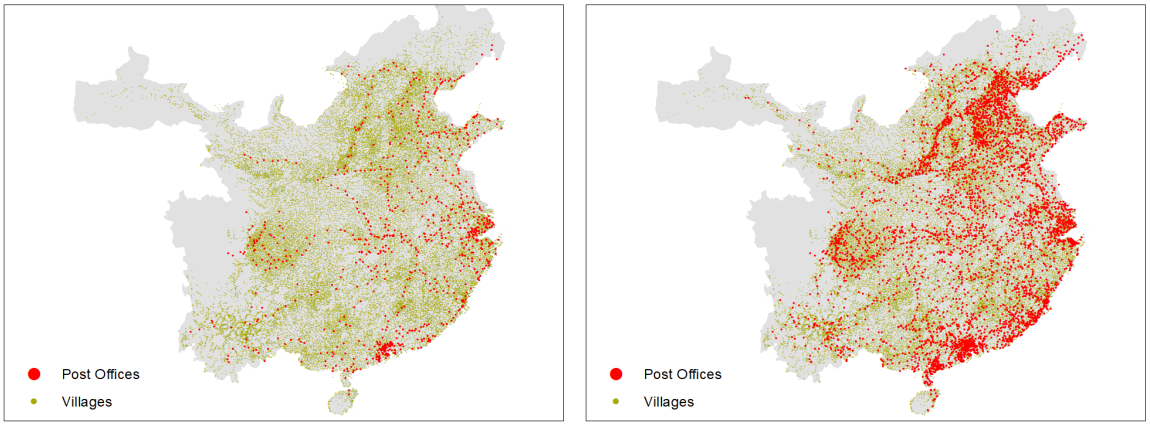
2.3.1.2 Post Offices

I digitized the information on China's postal system in two sources to find the locations of post offices existing in 1903–1910. First, the postal maps in some years show the distribution

Mandarin; and 9 Non-Mandarin groups: Jin Group, Wu group, Gan Group, Xiang Group, Min Group, Yue Group, Pinghua Group, Hui Group, Hakka Group. Within a major dialect group, there are subgroups.

of post offices. Second, the list of China's post offices records the addresses of all post offices. The maps and lists provide the villages, towns, and streets where post offices are located. To obtain the longitude and latitude of each post office, I use the Chinese Civilization in Time and Space (CCTS) (Academia Sinica, 2020) and the Max Planck Institute for the History of Science Database (MPIWG) (The Max Planck Institute for the History of Science and The Department of History of Shanghai Jiao Tong University, 2019). The CCTS and MPIWG databases provide geo-referenced scanned military maps (1:50,000) of China in the late 19th century and early 20th century. These maps were charted for military purposes, covering China's main territory with geographic elements such as cities, villages, towns, and streets in great detail. I used the databases to manually find the location of post offices and then obtained the longitude and latitude of the post offices based on the geo-referenced maps. To the best of my knowledge, I have collected the location of post offices in 1903, 1905, 1906, 1907, 1908, 1909, and 1910. In Figure 2.6, I show the distribution of post offices and villages in 1903 and 1910 in the part of China on which the paper focuses.

Figure 2.6: Post Offices in 1903 and 1910



(a) 1903 (b) 1910

Notes: This map shows the distribution of post offices and villages in the regions included in my analysis.

The specific sources of post office data and the details of geocoding are summarized in Data Appendix.

2.3.1.3 Information Availability

I use the maps of post offices and villages described to define the "informed" villages. First, I obtain the terrain elevation map from the Global Multi-resolution Terrain Elevation Data 2010 (GMTED 2010), which is a raster map providing elevation in each cell of 7.5 longitude arc-seconds by 7.5 latitude arc-seconds (Danielson and Gesch, 2011). Second, I compute the walking time of a round trip between a village and its nearest post office. The walking time depends on the distance as well as the walking speed determined by the slope (elevation difference). I use Tobler's hiking function, which is an exponential equation that describes how human walking speed varies with slope (Tobler, 1993). With the locations of villages and post offices and the terrain elevation map, I used Dijkstra's algorithm to determine the minimum walking time path (fastest route) from each village to its nearest post office. The details of computing walking time based on Dijkstra's algorithm are summarized in Data Appendix. Lastly, I define a village in a year as "informed" if the walking time of a round trip between the village and its nearest post office is less than 12 hours. People who lived in "informed" villages could go to a post office every day. The other villages are defined as "uninformed".

I compute the share of "informed" villages with a prefecture in each year to measure the information availability. The fast construction of post offices created a large temporal and spatial variation in the availability of information. Figure 2.10 shows that, as more post offices were constructed over time, the share of "informed" villages in the whole country increased from 0.211 in 1903 to 0.588 in 1910. Figure 2.11 shows the changes in the distribution of the variable. In 1903, the share of "informed" villages in most prefectures was below 0.25. As of 1910, more than half of prefectures had a share larger than 0.5.

2.3.1.4 Social Interactions

I use the village map, the terrain elevation map, and the dialect groups to measure social interactions between villages. First, with the villages' locations and the terrain elevation

map, I found a village's route to other villages with minimum walking time, again using Dijkstra's algorithm. If the walking time of a round trip between two villages is less than 12 hours, people could make a round trip within one day. Second, the language of Chinese has a huge diversity in pronunciation[5]. Standardized pronunciation was not introduced before the 1950s. With the dialect map, I identified the dialect group that each village belongs to. Belonging to the same dialect group could mean more accessible communication, a similar cultural identity, and a higher bilateral trust level.

I assume different people who lived in two villages would probably have local social interactions if the walking time of a round trip between two villages is less than 12 hours and two villages spoke the same dialect. Therefore, in Section 2.5, I define the village network and identify a village's neighbors based on walking time and dialect group.

2.3.2 Measures of Political Information

The volume of political information is quantified by the number of reports about revolutionary activities from major newspapers. I first collected 133 major events in 1900–1911, including assassinations, revolts, petitions, and the founding of organizations. For each event, I collected the keywords, including the names of leaders or people who participated, and other related words. There are full-text databases of all the reports in the two largest daily newspapers, Shen Pao and Ta Kung Pao[6]. I searched the keywords and read all the search results to exclude the reports that contained the keywords but are unrelated to the event. I counted the number of reports about revolutionary activities each year to measure the political information in newspapers.

An alternative measure for the volume of political information is the number of reports about revolutionary activities from other newspapers. Instead of a full-text database, there are only databases with digitized titles and scanned articles for the other

[5] The Automated Similarity Judgment Program (ASJP) shows that the linguistic distance between Beijing Mandarin and Cantonese is higher than the pairs between Spanish, French and Italian.

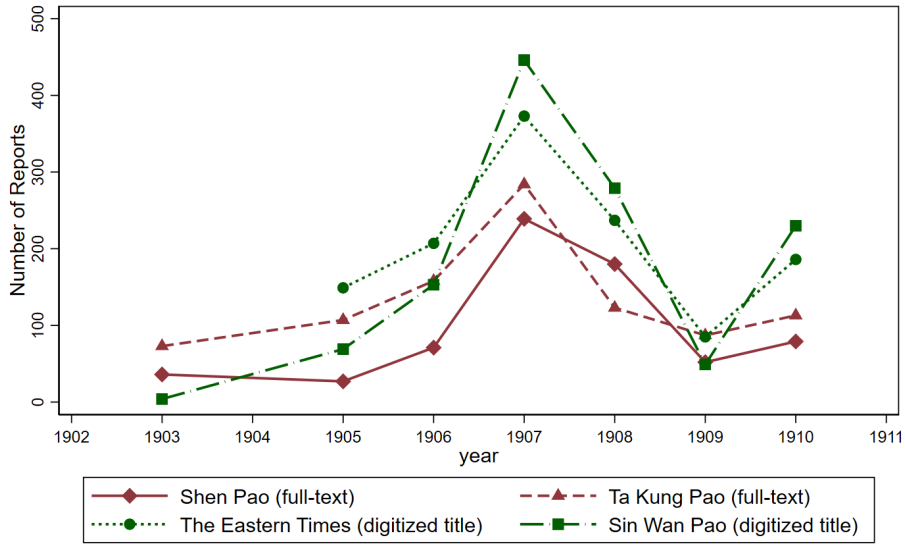
[6] The full-text database of Shen Pao: https://www.tbmc.com.tw/en-us/product/78
The full-text database of Ta Kung Pao: http://tk.cepiec.com.cn/tknewsc/tknewskm

two daily newspapers, The Eastern Times and Sin Wan Pao[7]. I searched the keywords in the digitized titles of The Eastern Times and Sin Wan Pao. I read all the search results and excluded the reports that contained the keywords but are unrelated to the event. I count the number of reports about revolutionary activities in each year in these two daily newspapers as an alternative measure of political information.

I use the number of reports (in hundreds) about revolutionary activities in the two largest daily newspapers, Shen Pao and Ta Kung Pao, as the measure for the volume of political information. I also use the number of reports (in hundreds) in the other two daily newspapers, The Eastern Times and Sin Wan Pao, and the total number of reports (in hundreds) in all four daily newspapers, as the alternative measures.

All measures of political information are very similar. In Figure 2.7, I show the number of reports about revolutionary activities in each year in the four daily newspapers in China in the 1900s, including Shen Pao, Ta Kung Pao, The Eastern Times, and Sin Wan Pao. The number of reports in these daily newspapers is highly correlated, which shows the robustness of the measures of political information.

Figure 2.7: Political Information in Newspapers, 1903–1910



[7] The database of The Eastern Times and Sin Wan Pao: https://www.cnbksy.com

2.3.3 Local Protests

My source of information on local protests is the *Chronology of Civil Protests in the Late Qing Dynasty* (Ding and Zhang, 1982). Historians summarized most kinds of social conflicts in 1902–1911, including protests, strikes, revolts, and riots. Their summary records the conflict's date, location, leader (peasants, workers, merchants, or elites), reason, and activity. I carefully examine these records and exclude the revolts related to military and gang rebellion, anti-Christian riots, and revolutionary revolts. My data only includes local protests and strikes triggered by rising living costs, low wages, high tax burden, or high land rent.

I use the data on local protests to measure collective actions. I calculate the number of local protests that happened in each prefecture and each year. Using the 1910 population as the denominator, I define the number of protests (per million people). I also summarize the data at county level, and identify whether a county had local protests in a year.

2.3.4 Other Historical Variables

I make use of a rich set of historical control variables. First, I control the basic information of the prefectures, including the population, land area, land productivity (measured by the caloric suitability index), importance level of the prefecture government (as defined by the central government), and whether the prefecture had a treaty port (forced open to international trade). Second, I focus on the factors which would likely be correlated with local protests, including the tax burden, number of *Jinshi* (high-level government officials, who were the traditional elites), number of modern primary students, local grain prices, frequency of extreme weather, and number of modern factories. Third, I collect whether a prefecture had other information institutions and other communication and transportation infrastructures, including courier stations, private message companies, foreign post offices, telegraph access, and railways.

I discuss these historical control variables in greater detail as follows.

First, I collect prefecture-level information on the local population from the Population History of China by Ge (2000), which uses rich historical records to recover China's population distribution from 200 BC to 1953 AD. For the Qing dynasty, the Republic of China, and the PR China, Ge (2000) construct a prefecture-level population dataset for six years: 1776, 1820, 1850, 1880, 1910, and 1953. This dataset is recognized as providing reliable demographic records for historical China, and has been widely used by economic historians.

Second, I calculate the administrative areas for each prefecture in 1911 from the China Historical Geographic Information System (CHGIS, 2016).

Third, during the Qing dynasty, the local governments were required to collect fixed amounts of silver and grain as the agricultural tax. The agricultural tax contributed about 40% of the total fiscal income in 1900s. I compute the agricultural tax burden in each prefecture from Liang (1980). I use the grain price data to compute the total amounts of agricultural tax burden in the unit of silver.

Fourth, the civil exam in the Qing dynasty (1644–1911) operated at different administrative levels, and there existed explicit quota for each jurisdiction for each level of exam. Throughout the 268 years of the Qing dynasty, nearly 27,000 successful candidates (*Jinshi*) passed the exam at the highest level and became government officials. From the *Official Records of Jinshi in the Qing Dynasty* by Jiang (2007), I identify each successful candidate's prefecture of origin and aggregate to construct a prefecture-level dataset of successful candidates. The number of *Jinshi* measure the levels of traditional elite in each prefecture.

Fifth, I digitize historical records on modern education from the *Statistical Chart of Education* collected by the Ministry of Education of the Chinese government. I collect the number of modern primary students in each prefecture in 1909. The number of modern primary students measure the levels of modern human capital in each prefecture.

Sixth, I measure the land productivity by the Caloric Suitability Indices (CSI) constructed by Galor and Özak (2016). The CSI data provides the maximum potential caloric yield attainable in each cell of 5 longitude arc-degrees by 5 latitude arc-degrees. For each prefecture, I compute the average value of the maximum potential caloric yield attainable in the post-1500 period.

Seventh, the *Database of Grain Prices in the Qing Dynasty* records prefecture-level monthly grain prices during 1736–1911, including the lowest and highest prices in each prefecture in each month for each crop Wang (2013b). I compute the standard score (z-score) of rice and wheat prices for each prefecture and each year between 1903 and 1910.

Eighth, the historical climate data are drawn from the *Distribution Gallery of Droughts and Floods in the Past Five Hundred Years of China* (China Meteorological Administration, 1981). The original sources of historical climate data are county gazetteers and official archives, containing a data set of droughts and floods for 120 meteorological stations from 1470 to 2000. For each year, the data uses a five-point scale to assign a Drought/Flood Index (DF-index) number that categorizes the local disaster status at each station: 1, severe flood; 2, light flood; 3, moderate conditions; 4, light drought; and 5, severe drought. The dataset has been widely used in previous studies, and its consistency and reliability have been carefully examined and confirmed by a number of meteorologists. In this paper, I count the frequency of serious droughts and floods (DF-index=1 or 5) in 1903–1910 and use this total as a measure of extreme weather frequency. To convert station-level information into my prefecture-level variables, I use a conventional approach called the inverse distance-weighted (IDW) method. The IDW method assumes that a prefecture's climate is an average of the climates at all nearby stations, weighted by the distances between the prefecture and the nearby stations. Therefore, I have the frequency of extreme weather among prefectures in 1903–1910.

Ninth, I construct a group of four variables to measure the administrative characteristics of every prefecture. Liu (1993) summarizes the designation of every

prefecture, which indicates whether a prefecture belongs to any of the four categories: *chong* (important in transportation/communication), *fan* (important in public affairs), *pi* (difficult to gather taxes), and *nan* (high crime rate). I digitize this information and create a dummy variable for each category. In the Qing dynasty, the central government defined a prefecture's importance based on whether it belongs to none, one, two, three, or all of these four categories. In the same way, I define the variable of prefectures' importance level as equal to 0, 1, 2, 3, or 4, where a higher value represents a higher level of administrative importance.

Tenth, some regions, known as the "treaty ports," were forced by western countries to open for international trade after the first opium war (1839–1842). Since these prefectures experienced very different development paths, I digitize this information from the *Selected Statistical Materials on Modern Chinese Economic History* (Yan, 1955) and construct a dummy variable for treaty ports.

Eleventh, I collect the information on whether a prefecture has courier stations, private message companies, and foreign post offices before the construction of the postal system. The GIS map constructed by Skinner et al. (2007) contains information on all the 283 courier stations in the Qing dynasty. The addresses of private message companies and foreign post offices are collected from Zhang (1936), and the longitudes and latitudes are obtained by geocoding.

Twelfth, Chang (1989b) and Du (1991) summarize the information of the newly constructed modern factories between 1840 and 1937, including the founding year, location, industry, assets and owners. I count the total number of newly constructed modern factories in 1903–1910 in each prefecture.

Thirteenth, I collect information on the construction of the telegraph network. I check the local gazetteer for the month of each prefecture with the telegraph station opened before 1911. I define a dummy variable to indicate whether a prefecture had telegraph access in a year. The dummy is equal to 1 if a prefecture had a telegraph station before the December

of a given year. 139 among 266 prefectures had telegraph access before 1903, while 171 prefectures had telegraph stations in 1910.

Fourteenth, I collect information on the construction of the railway from the *Chronology of China's Railway Construction, 1881–1981* by Ma et al. (1983). I obtain the year of each prefecture with access to the railway before 1911. I define a dummy variable to indicate whether a prefecture had railways in a year. The dummy is equal to 1 if a prefecture had railways before the December of a given year. 18 among 266 prefectures had railway access before 1903, while 48 prefectures had railways in 1910.

2.4 Political Information in Newspapers and Protests

In this section, I investigate the effects of political information on local protests. In Subsection 2.4.1, I present the preliminary analysis and discuss the research design. In Subsection 2.4.2, I show the effects of political information on local protests. In Subsection 2.4.3, I discuss the endogeneity problem, the method of constructing the instrument, and the results of the IV regressions. Subsection 2.4.4 includes robustness checks to address other potential problems.

2.4.1 Preliminary Analysis and Research Design

In the years with more reports about revolutionary activities in newspapers, "informed" villages received more political information. Having more "informed" villages in a prefecture could potentially lead to more local protests. I present the preliminary analysis of the cross-sectional relationships between information availability and local protests in different years. I then discuss the research design of a panel analysis to investigate the effect of political information on local protests.

I estimate the cross-sectional relationships between information availability and local protests in different years using the following equation:

$$Protest_p = \lambda_0 + \lambda_1 Share\,Village_p + \gamma X_p + \varepsilon_p \tag{2.1}$$

where $Protest_p$ is defined as the number of protests (per million people) in prefecture p; $Share\,Village_p$ is defined as the share of "informed" villages in prefecture p; X_p is a set of control variables; and ε_p is the error term.

In 1903–1910, as the volume of political information fluctuated over the years, the cross-sectional relationships between information availability and local protests also changed. In Table 2.2, I show the regression results from estimating equation (2.1) in 1903, 1905, 1906, 1907, 1908, 1909, and 1910. The number of reports about revolutionary activities in each year is summarized in the first row. In 1903 and 1909, the volume of political information was low, and the share of "informed" villages was negatively correlated with local protests. On the other hand, when the volume of political information was high in 1907 and 1908, the coefficient of the share of "informed" villages was significantly positive.

Table 2.2: Relationship between Information Availability and Local Protests

	Number of Protests (per million)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	1903	1905	1906	1907	1908	1909	1910
Share of "Informed" Villages	-0.697	-0.589	0.219	0.933	0.593	-0.591	-0.0276
	(0.36)*	(0.51)	(0.31)	(0.30)***	(0.26)**	(0.30)*	(0.38)
Controls	YES	YES	YES	YES	YES	YES	YES
R-squared	0.230	0.239	0.323	0.318	0.177	0.211	0.159
Obs.	266	266	266	266	266	266	266

This table reports estimation results of equation (2.1). Coefficients are reported, with robust standard errors in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

The cross-sectional results suggest a panel analysis comparing the relationships between information availability and protests in years with more or less political information. To investigate the effect of political information, I estimate the following equation:

$$Protest_{pt} = \beta_0 + \beta_1 Share\,Village_{pt} + \beta_2 Share\,Village_{pt} \times Report_t + \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \tag{2.2}$$

where $Protest_{pt}$ is defined as the number of protests (per million people) in prefecture p in year t; $Share\,Village_{pt}$ is defined as the share of "informed" villages in prefecture p in year t; $Report_t$ is defined as the number of reports (in hundreds) about revolutionary activities in Shen Pao and Ta Kung Pao in year t; X_{pt} is a set of control variables; δ_p is the time-invariant effect unique to prefecture p; η_t is the time fixed effect; and ε_{pt} is the error term.

The above panel analysis compares the cross-sectional correlations between the presence of post offices and local protests' occurrence in different years. Besides providing information, the post offices represent the state's ability to acquire local information and state investment in a region. The cross-sectional correlation between the post offices and local protests is negative in a year with low political information, because either stronger state capacity or more state investment usually decreases the probability of having local protests. The panel analysis compares the relationships between post offices and protests in years with more or less political information. The effect of political information is identified as the share of "informed" villages having a less negative impact, or a positive impact, on local protests in the years with more political information.

2.4.2 Findings with OLS Analysis

Following the research design, I estimate equation (2.2) to study how political information caused local protests.

The regression results are summarized in Table 2.3. In column 1, I only include the share of "informed" villages, and the coefficient is negative and statistically significant. Because more post offices in a prefecture (a higher share of "informed" villages) also represent the state's ability to acquire local information and prevent local protests, as well as state investment, the share of "informed" villages in a prefecture is negatively correlated with the occurrence of local protests. In column 3, I further include the interaction between the share of "informed" villages and the number of reports. The interaction is positive and statistically significant, showing that a prefecture with a higher share of

"informed" villages, in the years with more political information in newspapers, had more local protests. In column 2 and 4, I include variables which could be correlated with local protests, including the frequency of extreme weather, grain price, and the dynamic impacts of population, land area, average tax burden, average *Jinshi* number, caloric suitability index, importance level of the prefecture government, treaty port dummy, courier station dummy, private message company dummy, foreign post office dummy, and average number of modern factories. I find the baseline results to be highly robust. To the extent that the common confounding factors would likely be correlated with some of these historical control variables, the inclusion of these variables barely changes the baseline coefficients.

Table 2.3: Effects of Political Information on Local Protests (OLS)

	Number of Protests (per million)			
	(1)	(2)	(3)	(4)
Share of "Informed" Villages	-0.964	-0.946	-1.853	-1.536
	(0.25)***	(0.27)***	(0.35)***	(0.34)***
Share of "Informed" Villages			0.714	0.506
× Number of Reports			(0.18)***	(0.16)***
Controls	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.429	0.529	0.441	0.532
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862

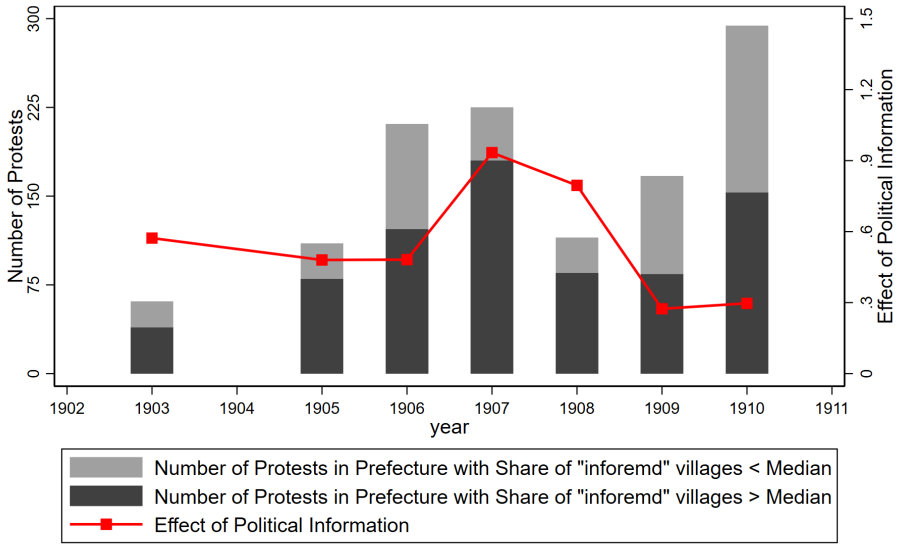
This table reports estimation results of equation (2.2). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Column 4 is my preferred specification. With all the controls included, it robustly shows the negative coefficient of the share of "informed" villages and the positive interaction term. The results show that the presence of post offices was negatively correlated with local protests in years without a large volume of political information. However, when the increase in access to information availability coincided with a large volume of political information in newspapers, it would lead to more local protests. The information infrastructure could work as a backfire to the government with a large volume of political information.

In Figure 2.8, I quantify the effect of political information on local protests. I compute

the coefficient of interaction, multiplied by the number of reports in each year, and divide by the standard deviation (S.D.) of the protests in each year[8]. If all villages in a prefecture changed from "uninformed" to "informed" and thus received the given number of reports in a year, the effect measures the S.D. by which local protests increase. The effect of political information on local protests is reasonably large. The difference in the variable of local protest (per million people) between the 90th and 10th percentile prefecture is 1.2 S.D. In 1907 and 1908, with a large volume of political information, counterfactually making all villages "informed" would have been enough to change a prefecture with a few protests to a place with many. Meanwhile, as I plot the total number of protests that happened nationwide, the effect of political information is not correlated with it. The years with more political information were not also the years with more protests nationwide. On the other hand, in years with more political information, more protests happened in prefectures with a share of "informed" villages larger than median. This justifies the argument that the volume of political information affected only "informed" places and is not just another proxy for nationwide political instability.

Figure 2.8: The Dynamic Effects of Political Information (OLS)



[8] Number of Reports (in hundreds) × coefficient of interaction / S.D. in Number of Protest (per million people)

2.4.3 Endogeneity and IV Analysis

The results from the OLS analysis could be biased if two variations, post office construction and the political information in newspapers, are correlated. To have an instrument for the construction of post offices, I obtain simulated counterfactual distributions of where post offices would have been built over time if the government's only consideration was efficiency in postal delivery. The IV results find a larger effect of political information and justify the underestimation in the OLS results.

The endogeneity problem in the above panel analysis may come from the correlation of two variations: post office construction and the change over time in political information in newspapers. In the years with more political information, if the government expected protests to happen in some places, it may have intentionally built more post offices as a means of state control in order to prevent protests. In that case, in the years with more political information, the construction of post offices (the share of "informed" villages) would have had a more negative effect on local protests than the years with less political information. The panel analysis ignores this difference and compares the relationships between post offices and protests in different years. Therefore, the effects of political information on protests could be underestimated. On the other hand, in the years with more political information, the government could have constructed more post offices in places where it expected no protest to happen because of the stability. In that case, in the years with more political information, the construction of post offices (the share of "informed" villages) would have a less negative effect on local protests, compared to the years with less political information. This would overestimate the effects of political information on protests.

To have an instrument for the construction of post offices, I obtain simulated counterfactual distributions of where post offices would have been constructed over time if the government were only considering efficiency. I adopt the intuition that the efficient way of expanding a postal system is to construct new post offices in places where 1) new post

offices can cover new service areas, and 2) new post offices are well-connected to the existing postal system. Therefore, a location is suitable for a new post office only if it is well-connected to the existing postal system. If a new post office was built in an unsuitable location, it probably was built for some reasons other than efficiency.

To determine whether a post office was constructed for endogenous reasons, I find suitable locations in randomly drawn points by the following steps.

In step 1, for each newly constructed post office, I randomly draw one point within a buffer. The buffer is chosen as a circle with a 50 km radius.

In step 2, I drop the points which are located farther from the existing postal system than the median distance of an existing post office nearby. The existing postal system means the post offices existing the year before the new construction year. I define a point as less connected to the existing postal system if: 1) the point's distance to the nearest existing post offices (within a 100 km search radius) is less than the median distance of nearby existing post offices to their nearest post offices; or 2) the point's average distance to the five nearest existing post offices (within a 100 km search radius) is less than the median average distance of nearby existing post offices to their five nearest post offices; or 3) the number of existing post offices within a 100 km radius of the point is less than the median number of existing post offices within 100 km radius of the nearby existing post office; or 4) there are no existing post offices within a 100 km radius of the point. The nearby existing post offices include post offices within 200 km. I further drop the points with too high slopes ($>$ 10 degrees) or too long a distance to the river ($>$ 10 km). The reason is that most post offices were constructed in flat places which are close to a river.[9]

In step 3, as I have drawn one point for each newly constructed post office and dropped the non-suitable points, I have obtained a simulated distribution of efficient locations for post offices, with all points that are not dropped and all existing post offices.

In step 4, I define "informed" villages based on the simulated distribution of post offices.

[9] As shown in Figure 2.12, 99.7% of post offices were in places where the slope is less than 10 degrees; 82.8% of post offices were within 10 km of a river.

I compute the simulated shares of "informed" villages for all prefectures.

In step 5, I use a "Monte Carlo"-type method by repeating the above steps 1,000 times and take the average value of all the simulated shares of "informed" villages. I follow the above steps each year to obtain the average value of simulated shares in 266 prefectures in 1903–1910.

Figure 2.13 shows simplified maps to illustrate the steps. In panel (a), which shows step 1, one point (a pink point) is randomly drawn within the buffer around each of the three actual new post offices (red points). In panel (b), which shows step 2, I decide whether the randomly drawn points are not suitable for construction. The pink point near the post office in the middle is dropped because it is unsuitably far away from the existing post offices (green points). In panel (c), I obtain a simulated distribution of post offices with two points that are not dropped and all existing post offices. I define the village on the top and in the bottom (blue triangle) as "informed" and the middle village as "uninformed" based on the simulated distribution of post offices. On the other side, as shown in panel (d), the middle village will be defined as "informed" based on the actual distribution of post offices. Therefore, the simulated distribution of post offices represents construction for no reasons other than efficiency. Such efficiency considerations would have led to a different group of "informed" villages than the actual distribution of post offices.

The average simulated share of "informed" villages works as an instrument to represent the availability of information under a counterfactual (efficient) distribution of post offices. In the above steps, when a point around a new post office is dropped, villages near it are defined as "uninformed" in the simulated distribution of post offices while they are "informed" in the actual distribution of post offices. For villages near a new post office which was likely constructed for endogenous reasons, they are defined as "uninformed" in many cases during 1,000 simulations. In a prefecture with more endogenous post offices, the average value of all the simulated shares of "informed" villages is much lower than the actual share of "informed" villages. On the other hand, in a prefecture with few post offices constructed for endogenous

reasons, the average values of all the simulated shares of "informed" villages are similar to the actual share.

The counterfactual distributions of post offices suggest that the government intended to construct more post offices in places where it expected protests to happen. A total of 1,000 random points are drawn for each post office, and Figure 2.14 shows the number of remaining points around a post office. For post offices constructed in a prefecture where protests happened in the year of construction, more points around them are dropped, compared to post offices constructed in a prefecture without protests. This supports my previous conjecture that the post offices in places with protests were constructed for endogenous reasons. If the government expected protests to happen in some places, it may have built more post offices in these areas in order to have stronger capacity.

I use the average simulated share of "informed" villages and the interaction of this share and $Report_t$ as the instruments for $Share\,Village_{pt}$ and $Share\,Village_{pt} \times Report_t$ in equation (2.2). The IV regressions are represented by equation (2.3), and the first stages are represented by equations (2.4) and (2.5). The reduced form regression is shown in equation (2.6). In equation (2.7), I show a more intuitive "first stage" by regressing the actual share of "informed" villages on the average simulated share of "informed" villages.

$$\textbf{IV: } Protest_{pt} = \mu_0 + \mu_1 Share\,Village_{pt} + \mu_2 Share\,Village_{pt} \times Report_t + \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \tag{2.3}$$

$$\textbf{First Stage: } Share\,Village_{pt} = \alpha_0 + \alpha_1 AS\,Share\,Village_{pt} + \beta_2 AS\,Share\,Village_{pt} \times Report_t + \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \tag{2.4}$$

$$\textbf{First Stage: } Share\,Village_{pt} \times Report_t = \theta_0 + \theta_1 AS\,Share\,Village_{pt} + \theta_2 AS\,Share\,Village_{pt} \times Report_t + \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \tag{2.5}$$

$$\textbf{Reduced Form: } Protest_{pt} = \pi_0 + \pi_1 AS\,Share\,Village_{pt} + \pi_2 AS\,Share\,Village_{pt} \times Report_t + \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \tag{2.6}$$

$$Share\,Village_{pt} = \alpha_0 + \alpha_1 AS\,Share\,Village_{pt} + \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \tag{2.7}$$

I first show the results of equation (2.7) in column 1 and 2 in Table 2.4. A higher average simulated share is significantly positively correlated with a higher actual share. The results of equation (2.6) are summarized in columns 3 and 4 in Table 2.4. These reduced-form results are similar to OLS results.

Table 2.4: "First Stage" and Reduced-Form

	Share of "Informed" Villages		Number of Protests (per million)	
	(1)	(2)	(3)	(4)
Average Simulated Share of "Informed" Villages	0.519 (0.019)***	0.530 (0.019)***	-1.221 (0.31)***	-1.379 (0.33)***
Average Simulated Share of "Informed" Villages × Number of Reports			0.754 (0.19)***	0.694 (0.18)***
Controls	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.933	0.941	0.435	0.530
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862

This table reports estimation results of equation (2.7) and (2.6). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

IV regression results from estimating equation (2.3) are summarized in Table 2.5. Column 1 repeats the OLS results in column 4 in Table 2.3. In column 2, I use the average simulated share and its interaction with the number of reports as the instruments. In the IV results, the interaction between the share of "informed" villages and the number of reports is still significantly positive. In column 2, the Kleibergen-Paap Wald F statistic measures weak instruments, and the value of 373.12 strongly suggests that my instruments are not weak. Meanwhile, the p-value of the endogeneity test is 0.035, which rejects the null hypothesis and indicates the existence of endogeneity and the need for instrumental variables.

I quantify the effect of political information on local protests for IV results. I again

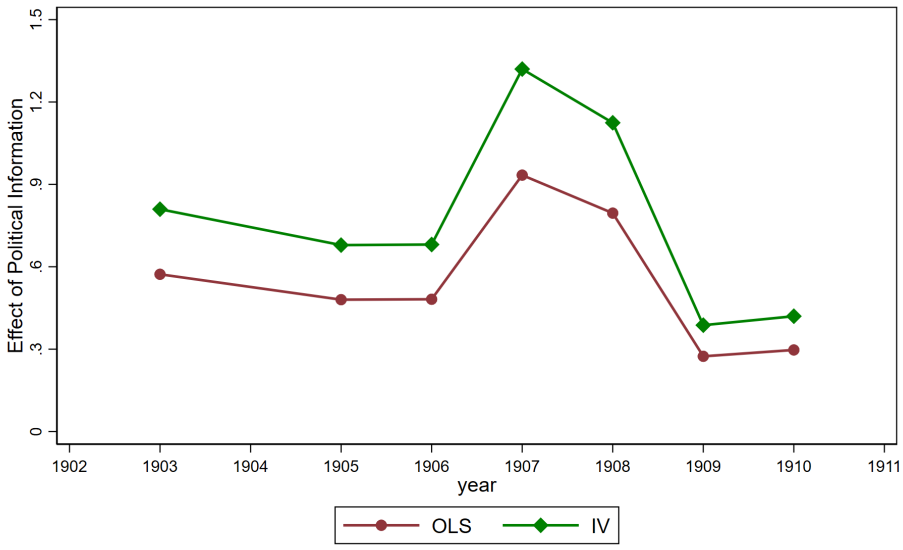
Table 2.5: Effects of Political Information on Local Protests (IV)

	Number of Protest (per million)	
	(1)	(2)
	OLS	IV
Share of "Informed" Village	-1.536	-2.030
	(0.34)***	(0.49)***
Share of "Informed" Village	0.506	0.739
× Number of Reports	(0.16)***	(0.18)***
Controls	YES	YES
Year FE	YES	YES
Prefecture FE	YES	YES
R-squared	0.532	0.226
Num. of Prefecture	266	266
Obs.	1862	1862
K-P Wald F		373.12
Endogeneity Test		.035

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

compute the coefficient of interaction, multiplied by the number of reports in each year, and divide by the S.D. of the protests in each year. In Figure 2.9, I plot the dynamic effects of political information on local protests both for the OLS results in column 1 and the IV results in column 2 in Table 2.5.

Figure 2.9: The Dynamic Effects of Political Information (IV)



The IV results find a larger effect of political information and justify the underestimation

in the OLS results. Both the coefficient of the interaction term and the dynamic effects of political information on local protests are larger in the IV results than in the OLS results. This shows that the OLS results underestimate the effect of political information, as I have argued above.

2.4.4 Robustness Check

To rule out other concerns about the main findings, I conduct a series of additional analyses.

First, because daily newspapers were located in large cities, places close to large cities might not rely on the postal system to receive political information in newspapers. I exclude four prefectures containing large cities and nine prefectures next to them. The results of excluding these 13 prefectures are summarized in Table 2.8. The effect of political information is robustly significant, showing that the availability of political information due to having a post office strongly affected places that were far from large cities and relied on the postal system to receive information.

Second, compared to those in cities, people who lived in rural areas relied more on the post offices to obtain information. I explore whether political information through the postal system affected the number of protests in rural areas. For each local protest, I define whether it occurred in an urban area or in a rural area. The effects of political information on protests that happened in urban and rural areas are summarized in Table 2.9. In columns 1 and 3, political information had an insignificant effect on local protests that happened in urban areas. As columns 2 and 4 show, political information significantly increased local protests that happened in rural areas.

Third, other communication or transportation infrastructure may have affected information diffusion in the postal system. The construction of the telegraph started as early as the 1880s in China. Unlike the postal system, the telegraph was expensive and was mainly used to deliver valuable military and commercial information between cities. In columns 1 and 3 in Table 2.10, I include a dummy of whether a prefecture had telegraph

access and its interaction with the number of reports. Because telegraph construction represents state capacity as well, the negative coefficient of the telegraph dummy shows the negative correlation between state capacity and local protests. However, the interaction of the telegraph and the number of reports is not significant. Because ordinary people mainly relied on post offices for receiving information, the effect of political information through the telegraph is negligible compared with the effect through the post office. In addition, the construction of the railway started in the 1880s. In columns 2 and 4 in Table 2.10, I include a dummy of whether a prefecture had a railway nearby and its interaction with the number of reports. Because railways can facilitate more frequent communication, the interaction of the railway and the number of reports significantly increased local protests. However, after I control for the railway, the effect of the post office is robust.

Fourth, I try different model specifications in Table 2.11. In columns 1 and 4, I define the dependent variable as the logistic value of the number of local protests. In columns 2 and 5, I use a dummy of whether a prefecture had a protest as the dependent variable. In columns 3 and 6, I run a Poisson regression with the number of local protests as the dependent variable. The main findings are robust to Log form, Logit, or Poisson regression with fixed effects.

Fifth, I use alternative measures of political information. In columns 1 and 3 in Table 2.12, I use the number of reports (in hundreds) in the other two daily newspapers, The Eastern Times and Sin Wan Pao, to measure political information. In columns 2 and 4, I use the total number of reports (in hundreds) in all four daily newspapers, including Shen Pao, Ta Kung Pao, The Eastern Times, and Sin Wan Pao. In all columns, the main findings are robust to alternative measures of political information.

Sixth, I use alternative measures of information availability. In the main findings, a village is defined as "informed" in a given year if the walking time of a round trip between the village and its nearest post office is less than 12 hours. In columns 1 and 3 in Table 2.13, I defined a village as "informed" if the walking time is less than 8 hours. In columns 2 and

4, I defined a village as "informed" if the walking time is less than 16 hours. In all columns, the main findings are robust to alternative measures of information availability.

Seventh, because the construction of new post offices greatly changed the availability of information every year, the previous years' political information should have limited impacts on the current year's local protests. In column 1 in Table 2.14, I include the interaction between the share of "informed" villages and the number of reports in both the current year and the year before $(T-1)$. In column 2, I further include the interaction between the share of "informed" villages and the number of reports in the two years before $(T-2)$. In column 3, I use the average simulated share of "informed" villages, its interaction with $Report_t$, and its interaction with $Report_{t-1}$ as the instruments. In column 4, I use the average simulated share of "informed" villages and its interactions with $Report_t$, $Report_{t-1}$, and $Report_{t-2}$ as the instruments. The political information in previous years did not significantly affect the current year's local protests. In contrast, the current year's political information robustly increased local protests after accounting for the previous years' political information.

2.5 Information Diffusion, Social Interactions, and Protests

This section focuses on social interaction as a critical intermediate factor between political information diffusion and local protests. In Subsection 2.5.1, I introduce a network-based game model of social interactions between villages. In Subsection 2.5.2, I discuss the method to estimate the model. In Subsection 2.5.3, I show the estimation results including the significant direct effect and strong peer effect in the model. In Subsection 2.5.4, I provide prefecture-level evidence by disentangling and quantifying the peer effect from the general effect of political information on local protests.

2.5.1 Model of Information Diffusion and Social Interactions

In this subsection, I build a game model of social interactions based on the village network, which is defined by the villages' locations, the walking time between villages, and the dialect groups of villages. I consider whether a village that had protests was affected by both the direct effect of receiving political information and the peer effect of its neighbors' actions.

The construction of post offices and the spread of political information may have facilitated local protests through two channels: information diffusion and social interactions. When more post offices were constructed, more "informed" villages were created. The political information in newspapers may have directly changed "informed" villages and led to local protests around them. Meanwhile, because collective actions require cooperation, it is important for people to know the actions of others near them. The probability of having local protests around a village would be affected by the expected actions of its neighbors. The "informed" villages may have changed their neighbors' probability of having protests through social interaction.

I use the village map, the terrain elevation map, and the dialect groups to define the village network and identify the neighbors of the villages. In the village network, a village's neighbors are identified as nearby villages which had the same dialect. I define a village as a vertex. I define an edge between two villages if: (1) the walking time of a round trip between two villages is less than 12 hours and (2) the two villages belong to the same dialect group. Furthermore, belonging to the same dialect group could facilitate communication and trust. The above steps define a village network with 38,242 vertices and 542,001 edges.

I consider a game-theoretic model of social interactions based on the village network, in which whether a village had protests was affected by both the direct and peer effect. The construction of post offices created injection points of information. The neighbors of a village are defined as other villages that share an edge with it. Therefore, the neighbors of a village are nearby villages that shared a similar dialect. While the political information may have

directly changed "informed" villages, a peer effect means that a village's action was affected by the expected actions of its neighbors.

Several mechanisms can explain the existence of the peer effect. First, villages might learn information about protests from their neighbors, which could cause a change in behavior. Second, the success of a protest could be affected by the number of participants. If people in many villages nearby participated, then people in a village could be more likely to have protests if they expected that the protest could achieve change. Third, the cost of having a protest could decrease as more people participated. People might believe that it is unlikely to be punished by the government if many were protesting.

Following the above intuitions, I consider a setup based on Lin and Xu (2017) and Xu (2018), and build the model. There were N villages indexed by i and connected by the defined network. The links in the network and other characteristics are public information $\boldsymbol{W}$. Villages chose simultaneously whether to have protests in a year; the decision is denoted by $k \in A = \{1, 0\}$. Before choosing, village i received a private information shock $\epsilon_{it} = (\epsilon_{it,0}, \epsilon_{it,1})$. $U_{it,1}(\boldsymbol{W}, \varepsilon_{it})$ is village i's willingness to have protests (action 1) in year t, while $U_{it,0}(\boldsymbol{W}, \varepsilon_{it})$ represents village i's unwillingness to have protests (action 0) in year t. Therefore, the willingness of a village to have (or not have) protests is given by:

$$U_{it,1}(\boldsymbol{W}, \varepsilon_{it}) = \underbrace{\beta_1 Informed_{it} + \beta_2 Informed_{it} \times Report_t}_{Direct\ Effect} + \underbrace{\frac{\alpha}{N_i} \sum_{j \in F_i} E[A_{jt}|\boldsymbol{W}]}_{Peer\ Effect} + \tag{2.8}$$

$$\delta_p + \eta_t + \gamma X_{pt} + \epsilon_{it,1}$$

$$U_{it,0}(\boldsymbol{W}, \varepsilon_{it}) = \epsilon_{it,0} \tag{2.9}$$

First, village i's willingness to have protests (action 1) in year t is affected by whether the village was "informed" ($Informed_{it}$) and the volume of political information it received if it was informed ($Report_t$). Second, the willingness to have protests was also determined by the expected actions of neighbors. The set F_i includes all villages which were neighbors of village i. $E[A_{jt}|\boldsymbol{W}]$ is the expectation on village j's action A_{jt} conditional on public

information $\boldsymbol{W}$. As villages chose simultaneously whether to have protests, a village formed an expectation about the equilibrium probability of its neighbors' action based on public information. Third, besides the direct and peer effects, δ_p and η_t are the fixed effects that affect the willingness to have a protest in prefecture p at time t. X_{pt} represents other factors related to the willingness to have a protest in prefecture p and at time t[10]. Fourth, $\epsilon_{it} = (\epsilon_{it,0}, \epsilon_{it,1})$ represents the private information shock of village i.

The villages' mean unwillingness to have protests (action 0) in year t is normalized as 0. Therefore, the village i's unwillingness to have protests (action 0) in year t is only determined by the private information shock.

Parameter β_1 and β_2 represents the direct effect of receiving political information. Parameter α represents the peer effect, i.e., the effect of village i's expectations about all its neighbors ($\frac{1}{N_i}\sum_{j\in F_i} E[A_{jt}|\boldsymbol{W}]$) affected village i's action.

I use the notion of a Bayesian Nash equilibrium (BNE). A strategy for village i is a mapping from its private information shock and all the public information (the network structure and observable characteristics) to an action. Because a village did not observe the private information shocks of other villages, it formed expectations about their actions using the public information and the distribution of private information shocks. In a Bayesian Nash equilibrium, the strategy of every village would be to choose an action based on the willingness or unwillingness to have protests. As argued in Lin and Xu (2017) and Xu (2018), the existence of a Bayesian Nash equilibrium follows from Brouwer's fixed point theorem.

A key concern is the possibility of multiple equilibria of the model. Crucially, Lin and Xu (2017) and Xu (2018) provide and prove the conditions for equilibrium uniqueness. Following their argument, I provide the two assumptions which guarantee a unique pure strategy Bayesian Nash Equilibrium in my settings. The first assumption is that ϵ_{it} are distributed i.i.d. across actions and villages, and follow an extreme value type I distribution with density function $f(t) = exp(-t)exp[-exp(-t)]$. The second assumption is that $\alpha < 2$. Intuitively,

[10] X_{pt} includes all the control variables in prefecture-level analysis in Subsection 2.4.2.

it requires the peer effects to be bounded above. In my context, such an assumption means that, if the average probability of neighbors having protests increases by one percentage point, then the peer effect on a village's probability of having protests has to change by less than one percentage point. Because it is impossible to test for the validity of this assumption, I will show that the estimation results are consistent with the model's key assumption.

2.5.2 Estimation

Here, I characterize the equilibrium of the model. Under specific conditions, the true parameters in the model can be estimated as long as I find the unique pure strategy Bayesian Nash Equilibrium (BNE). I then use the Nested Pseudo Likelihood Estimation (NPLE) method to estimate the model.

To estimate the above model, I first need to characterize the equilibrium. I let $\sigma_{it}(\boldsymbol{W};\theta)$ be the probability of choosing action 1 (have protest) given public information ($\boldsymbol{W}$) and parameters (θ), and $\sigma^*_{it}(\boldsymbol{W})$ be the equilibrium probability. Because the private information shock ϵ_{it} is assumed to be a random term drawn from an extreme value type I distribution, the best responses of all villages, let $\sigma_{it}(\boldsymbol{W};\theta)$ to solve equation system (2.10).

$$\sigma_{it}(\boldsymbol{W};\theta) = \frac{exp(\tau \boldsymbol{W} + \frac{\alpha}{N_i}\sum_{j\in F_i}\sigma_{jt}(\boldsymbol{W};\theta))}{1+exp(\tau \boldsymbol{W} + \frac{\alpha}{N_i}\sum_{j\in F_i}\sigma_{jt}(\boldsymbol{W};\theta))},\ \forall i,t \tag{2.10}$$

Under specific assumptions, there exists a unique pure strategy Bayesian Nash Equilibrium for the model, as well as a unique solution $\sigma^*_{it}(\boldsymbol{W})$ of the equation system. By definition, the unique solution is equal to the probability of choosing action 1 (have protest) given public information ($\boldsymbol{W}$) and true parameters (θ_0), i.e. $\sigma^*_{it}(\boldsymbol{W}) = \sigma_{it}(\boldsymbol{W};\theta_0)$. The true parameters can be estimated as long as I find the unique pure strategy Bayesian Nash Equilibrium.

I use the Nested Pseudo Likelihood Estimation (NPLE) method to estimate the model. The pseudo log-likelihood function is defined as:

$$\hat{L}_n(\theta, \sigma_{it}) = \frac{1}{7n} \sum_{i=1}^{n} \sum_{t=1903}^{1910} \{Y_{it} \ln[\sigma_{it}(\boldsymbol{W}; \theta)] + (1 - Y_{it}) \ln[1 - \sigma_{it}(\boldsymbol{W}; \theta)]\} \tag{2.11}$$

Because I do not have information on the village's participation in local protests, Y_{it} is measured by whether a protest happened in year t in a county to which village i belongs. County is an administrative level below prefecture. In the 1900s, a prefecture usually had about 10 counties, and a county would have about 20 villages on average. Here, I use the proxy variable which defines villages in the same county as taking the same actions. This would mechanically generate a strong peer effect if most villages in the same county were neighbors to each other. However, this potential concern would be unlikely to drive the estimation of peer effect because 76.4% of the villages had at least one neighbor in a different county[11]. In most cases, whether villages in a county had protests would be affected by their neighbors in other counties.

The algorithm of NPLE is summarized in the following steps. In step 1, I start with guessing an arbitrary group of initial values $\sigma_{it}^{[0]}$.

In step 2, given the probability of choosing action 1 in the last iteration ($\sigma_{it}^{[m-1]}$), I estimate the parameters in the current iteration ($\hat{\theta}^{[m]}$).

$$\hat{\theta}^{[m]} = \underset{\theta}{argmax}\ \hat{L}_n(\theta, \sigma_{it}^{[m-1]}) \tag{2.12}$$

In step 3, given the probability of choosing action 1 in the last iteration ($\sigma_{it}^{[m-1]}$), and the estimated parameters in the current iteration ($\hat{\theta}^{[m]}$), I update the probability of choosing action 1 in the current iteration.

$$\sigma_{it}^{[m]} = \frac{exp(\tau^{[m]}\boldsymbol{W} + \frac{\alpha^{[m]}}{N_i} \sum_{j \in F_i} \sigma_{jt}^{[m-1]})}{1 + exp(\tau^{[m]}\boldsymbol{W} + \frac{\alpha^{[m]}}{N_i} \sum_{j \in F_i} \sigma_{jt}^{[m-1]})},\ \forall i, t \tag{2.13}$$

In step 4, this procedure stops at the M-th iteration when $||\sigma^{[M]} - \sigma^{[M-1]}||$ is less than

[11] Totally, 41.8% of the edges in the village network are between two villages from different counties.

a predetermined tolerance 10^{-6}.

The algorithm finds the unique pure strategy Bayesian Nash Equilibrium by iteration and estimates the parameters under the equilibrium.

2.5.3 Direct Effect and Peer Effect

The estimation of the model finds significant direct effect and strong peer effect.

Table 2.6 presents the estimation results. Column 1 presents maximum likelihood estimates without peer effects. Column 2 reports NPLE with peer effects. In column 3, the average expectation of neighbors' actions is weighted by the inverse of walking time. In column 4, the average expectation is weighted by the neighbors' degrees. The results are robust to all columns. "Informed" villages had a higher probability of having protests in years with more political information. In addition, a village's probability of having protests was positively and strongly affected by the average expectation of its neighbors' actions.

Table 2.6: Direct Effect and Peer Effect

	(1)	(2)	(3) Weighted by 1/time	(4) Weighted by degree
"Informed"	-0.229	-0.215	-0.212	-0.216
$\frac{dp}{dx}$	[-0.048]	[-0.045]	[-0.044]	[-0.045]
	(0.028)***	(0.028)***	(0.029)***	(0.028)***
"Informed" × Number of Reports	0.131	0.116	0.115	0.117
$\frac{dp}{dx}$	[0.027]	[0.024]	[0.024]	[0.024]
	(0.020)***	(0.020)***	(0.020)***	(0.020)***
Peer Effect: $\frac{1}{N_i}\sum_{j\in F_i} E[A_{jt}]$		0.906	0.924	0.890
$\frac{dp}{dx}$		[0.19]	[0.19]	[0.18]
		(0.055)***	(0.057)***	(0.054)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
Obs.	267694	267694	267694	267694

This table reports estimation results of equation (2.11). Coefficients are reported, with standard errors in round brackets and Average Marginal Effects in square brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

To get a sense of the magnitude of the direct and peer effects, I compute and report the average marginal effect in square brackets in Table 2.6. Column 2 is my preferred

specification. In 1907, a year with a large volume of political information, "informed" villages had an 8% higher probability of having protests than "uninformed" villages[12]. If all of a village's neighbors were "informed", compared with another village which had all "uninformed" neighbors, the peer effect further increased the probability of having protests by 1.5%[13]. In 1909, a year with a small volume of political information, "informed" villages had a 1.2% lower probability of having protests than "uninformed" villages[14]. If all of a village's neighbors were "informed", compared with another village with all "uninformed" neighbors, the peer effect further decreased the probability of having protests by 0.2%[15].

The above findings suggest that, as the political information directly changed "informed" villages, the strong peer effect helped spread the impact from "informed" villages to their neighbors. Social interactions worked as a critical intermediate factor between political information diffusion and local protests.

Next, I conduct robustness checks to address potential concerns. First, in the above estimation, I define the edges between two villages based on whether they belong to the same dialect group. Because belonging to different dialect groups did not entirely prevent communication and cooperation, I define another village network in which two villages have an edge as long as the round-trip walking time is less than 12 hours. I estimate the model with the village network, which is only based on geographical factors. In Table 2.15, the results are robust, with the estimated peer effect slightly larger. Second, as I have argued above, the proxy variable of the village's participation in local protests defines villages in the same county as taking the same actions. To address the potential concern that the definition of proxy variable drives the results, I exclude 9,643 villages whose neighbors were all in the same county as themselves. To do that, I follow the algorithm of NPLE to estimate the model with all villages until it converged. I then estimate equation (2.11) with the data and $\sigma_{it}^{[M]}$ obtained in the last iteration, only keeping 28,599 villages which had at least one

[12] In 1907, there were 523 news reports. $5.23 \times 0.024 - 0.045 = 0.08052$
[13] $0.08052 \times 0.19 = 0.0153$
[14] In 1909, there were 139 news reports. $1.39 \times 0.024 - 0.045 = -0.01164$
[15] $-0.01164 \times 0.19 = -0.0022$

neighbor in a different county. The results in Table 2.16 are robust, indicating that the strong peer effect found in Table 2.6 is unlikely driven by the method of defining the proxy variable for a village's participation in local protests. Third, I use another way to define the proxy variable of the village's participation in local protests. Instead of defining villages in the same county as taking the same actions, I define the 20 villages closest to the location of each protest as having protests, and the other villages as not having protests. I estimate the model with the alternative proxy as the dependent variable. In Table 2.17, the results are generally robust, with larger estimated peer effect, indicating that the strong peer effect found in Table 2.6 is not affected by the method of defining the proxy variable for a village's participation in local protests.

2.5.4 Peer Effect in Region-level Evidence

Because the estimation results of the model show a strong peer effect in the social interactions between villages, in this subsection I attempt to provide more region-level evidence to further justify the critical role of social interaction in mediating between political information diffusion and local protests.

In a region, a strong peer effect would encourage collaboration and facilitate local protests. Because the share of "informed" villages measures the general level of information availability, I define a measure to represent the strength of peer effect in prefectures. By looking at a village's neighbors, I compute the percentage of "informed" neighbors of that village and compare the percentage with a threshold x%. (x% = 60%, 70%, ...) In the years with more political information, a village with a high percentage of "informed" neighbors might have a strong belief that its neighbors received a large volume of political information and would participate in a protest with high probability. Therefore, the villages with a high percentage of "informed" neighbors would be critical to local protests if the peer effect mattered. For a prefecture, I measure the strength of peer effect by the share of villages whose percentage of "informed" neighbors is higher than x%. The network

structure of villages and the geographical distribution of post offices give me the variation of the strength of peer effect across prefectures and over time. A place with most villages connected and post offices evenly distributed would have a larger share of "informed" villages. However, a place with a group of villages closely connected and post offices concentrated around them (i.e., more villages with higher percentage of "informed" neighbors) is expected to be more affected by the peer effect.

In Figure 2.15, I show the relationship between the share of "informed" villages and the share of villages whose percentage of "informed" neighbors is higher than 90%. As I have argued, the general level of information availability is not fully correlated with the strength of the peer effect. Specifically, the changes in the general level of information availability and the strength of the peer effect are even less correlated.

I investigate the impact of the peer effect at the prefecture level using the following equation:

$$\begin{aligned} Protest_{pt} =& \beta_0 + \beta_1 Share\,Village_{pt} + \beta_2 Share\,Village_{pt} \times Report_t + \\ & \beta_3 Share\,Village\,Neighbor_{pt} + \beta_4 Share\,Village\,Neighbor_{pt} \times Report_t + \\ & \gamma X_{pt} + \delta_p + \eta_t + \varepsilon_{pt} \end{aligned} \tag{2.14}$$

where $Protest_{pt}$ is defined as the number of protests (per million people) in prefecture p in year t; $Share\,Village_{pt}$ is defined as the share of "informed" villages in prefecture p in year t; $Share\,Village\,Neighbor_{pt}$ is defined as the share of villages having more than x% "informed" neighbors in prefecture p in year t; $Report_t$ is defined as the number of reports about revolutionary activities in Shen Pao and Ta Kung Pao in year t; X_{pt} is a set of control variables that vary both across prefectures and over time; δ_p is the time-invariant effect unique to prefecture p; and η_t is the time fixed effect.

The regression results are summarized in Table 2.7. Column 1 repeats the OLS results in column 4 in Table 2.3. In columns 2–5, I include the peer effect. In column 2, the peer effect is measured by the share of villages having more than 60% "informed" neighbors. The

thresholds are 70%, 80%, and 90% in columns 3, 4, and 5. In columns 2–5, the interaction term $ShareVillage_{pt} \times Report_t$ is insignificant. After including the peer effect, the general effect from the share of "informed" villages is not significant. Intuitively, in years with more political information, as a higher level of information availability led to more protests, more villages with high percentages of "informed" neighbors were the essential channel. The peer effect in social interactions worked as a critical intermediate factor between receiving political information and local protests.

Table 2.7: Peer Effects of Political Information on Local Protests

	Number of Protest (per million)				
	(1)	(2)	(3)	(4)	(5)
		60%	70%	80%	90%
Share of "Informed" Village	-1.536	-0.610	-0.263	-0.140	-0.541
	(0.34)***	(0.86)	(0.78)	(0.64)	(0.50)
Share of "Informed" Village × Number of	0.506	0.130	0.165	0.204	0.117
Reports	(0.16)***	(0.46)	(0.45)	(0.43)	(0.34)
Share of Villages Having More than x%		-0.901	-1.877	-1.577	-1.374
"Informed" Neighbors		(0.75)	(0.74)**	(0.61)**	(0.49)***
Share of Villages Having More than x%		0.623	0.721	0.813	0.856
"Informed" Neighbors × Number of Reports		(0.34)*	(0.34)**	(0.34)**	(0.39)**
Controls	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES	YES
R-squared	0.532	0.532	0.534	0.535	0.535
Num. of Prefecture	266	266	266	266	266
Obs.	1862	1862	1862	1862	1862

This table reports estimation results of equation (2.14). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

2.6 Conclusion

In this paper, I shed new light on the role of the communication infrastructure as a driving force in social changes, in the context of late imperial China. I disentangle and identify the two main channels through which the construction of a communication network leads to collective actions: information diffusion and social interactions. I find that advances in communication infrastructure, specifically the expansion of the postal system, facilitated

information diffusion and contributed to rising media power. Social interactions strengthened and spread the impact of information diffusion and led to collective actions.

This paper provides a new perspective in explaining the collapse of imperial China and China's subsequent political modernization. The construction of a communication infrastructure led to political information diffusion. The communication infrastructure construction backfired on the weak imperial government. The news media and the political information diffusion through a modern communication infrastructure may have paved the road to the radical revolutions in China afterward.

2.7 Appendix Tables

Table 2.8: Effects of Political Information, Excluding Large Cities

	Number of Protest (per million)	
	(1)	(2)
	OLS	IV
Share of "Informed" Village	-1.679	-2.296
	(0.39)***	(0.55)***
Share of "Informed" Village	0.567	0.785
× Number of Reports	(0.17)***	(0.19)***
Controls	YES	YES
Year FE	YES	YES
Prefecture FE	YES	YES
R-squared	0.507	0.214
Num. of Prefecture	253	253
Obs.	1771	1771
K-P Wald F		312.45
Endogeneity Test		.048

This table reports OLS and IV estimation results of equation (2.2) and (2.3) by excluding large cities and regions close to large cities. Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.9: Effects of Political Information on Rural and Urban

	Number of Protests (per million)			
	(1)	(2)	(3)	(4)
	Urban	Rural	Urban	Rural
Share of "Informed" Villages	-0.0615	-1.474	0.00589	-2.036
	(0.042)	(0.33)***	(0.087)	(0.48)***
Share of "Informed" Villages	0.0278	0.478	0.0290	0.710
× Number of Reports	(0.020)	(0.15)***	(0.023)	(0.17)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.694	0.484	0.307	0.219
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862
K-P Wald F			373.12	373.12
Endogeneity Test			.27	.033

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.10: Effects of Political Information, Controlling Telegraph and Railway

	Number of Protest (per million)			
	(1) OLS	(2) OLS	(3) IV	(4) IV
Share of "Informed" Village	-1.518	-1.614	-2.015	-2.088
	(0.34)***	(0.36)***	(0.49)***	(0.52)***
Share of "Informed" Village	0.496	0.651	0.735	0.906
× Number of Reports	(0.16)***	(0.19)***	(0.18)***	(0.21)***
Telegraph(=1)	-0.185		-0.202	
	(0.19)		(0.19)	
Telegraph(=1) × Number	0.0201		0.00562	
of Reports	(0.074)		(0.072)	
Railway(=1)		-0.0438		-0.105
		(0.25)		(0.25)
Railway(=1) × Number of		0.355		0.394
Reports		(0.15)**		(0.15)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.532	0.536	0.227	0.233
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862
K-P Wald F			364.06	378.09
Endogeneity Test			.039	.031

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.11: Effects of Political Information, Function Forms

	x = Number of Protest (per million)					
	(1) OLS $\ln(1+x)$	(2) OLS Logit	(3) OLS Poisson	(4) IV $\ln(1+x)$	(5) IV Logit	(6) IV Poisson
Share of "Informed" Village	-0.564	-3.861	-3.293	-0.652	-3.195	-4.145
	(0.14)***	(1.17)***	(0.62)***	(0.19)***	(1.84)*	(1.00)***
Share of "Informed" Village	0.144	1.056	0.639	0.264	1.479	0.660
× Number of Reports	(0.065)**	(0.58)*	(0.31)**	(0.065)***	(0.63)**	(0.33)**
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES	YES	YES
R-squared	0.581			0.197		
Num. of Prefecture	266	174	181	266	174	181
Obs.	1862	1218	1267	1862	1218	1267
K-P Wald F				373.12		

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.12: Effects of Political Information, Alternative Measures of Political Information

	Number of Protests (per million)			
	(1) OLS Other	(2) OLS All	(3) IV Other	(4) IV All
Share of "Informed" Villages	-1.378	-1.444	-1.968	-2.018
	(0.32)***	(0.33)***	(0.48)***	(0.49)***
Share of "Informed" Villages	0.239	0.167	0.389	0.261
× Number of Reports	(0.084)***	(0.055)***	(0.096)***	(0.063)***
Controls	YES	YES	NO	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.531	0.531	0.224	0.225
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862
K-P Wald F			355.24	360.57
Endogeneity Test			.033	.032

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.13: Effects of Political Information, Alternative Measures of Information Availability

	Number of Protests (per million)			
	(1) OLS 8 Hours	(2) OLS 16 Hours	(3) IV 8 Hours	(4) IV 16 Hours
Share of "Informed" Villages	-1.801	-0.916	-2.279	-2.362
	(0.41)***	(0.29)***	(0.54)***	(0.60)***
Share of "Informed" Villages	0.683	0.306	0.947	0.736
× Number of Reports	(0.20)***	(0.14)**	(0.24)***	(0.18)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.531	0.527	0.226	0.206
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862
K-P Wald F			202.69	125.09
Endogeneity Test			.271	.001

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.14: Effects of Political Information, Previous Years' Political Information

	Number of Protests (per million)			
	(1) OLS	(2) OLS	(3) IV	(4) IV
Share of "Informed" Villages	-1.741	-1.506	-2.273	-1.912
	(0.38)***	(0.41)***	(0.57)***	(0.69)***
Share of "Informed" Villages	0.446	0.360	0.702	0.620
× Number of Reports	(0.16)***	(0.14)**	(0.18)***	(0.17)***
Share of "Informed" Villages	0.239	0.315	0.171	0.212
× Number of Reports in T-1	(0.22)	(0.22)	(0.12)	(0.12)*
Share of "Informed" Villages		0.175		0.146
× Number of Reports in T-2		(0.16)		(0.17)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.533	0.533	0.227	0.228
Num. of Prefecture	266	266	266	266
Obs.	1862	1862	1862	1862
K-P Wald F			236.19	121.85
Endogeneity Test			.024	.048

This table reports OLS and IV estimation results of equation (2.2) and (2.3). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.15: Direct Effect and Peer Effect, Village Network Only Based on Geographical Factors

	(1)	(2)	(3) Weighted by 1/time	(4) Weighted by degree
"Informed"	-0.229	-0.211	-0.207	-0.212
$\frac{dp}{dx}$	[-0.048]	[-0.044]	[-0.043]	[-0.044]
	(0.028)***	(0.028)***	(0.028)***	(0.028)***
"Informed" × Number of Reports	0.131	0.113	0.112	0.114
$\frac{dp}{dx}$	[0.027]	[0.024]	[0.023]	[0.024]
	(0.020)***	(0.020)***	(0.020)***	(0.020)***
Peer Effect: $\frac{1}{N_i}\sum_{j\in F_i} E[A_{jt}]$		1.053	1.079	1.032
$\frac{dp}{dx}$		[0.22]	[0.23]	[0.22]
		(0.059)***	(0.061)***	(0.059)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
Obs.	267694	267694	267694	267694

This table reports estimation results of equation (2.11). Coefficients are reported, with standard errors in round brackets and Average Marginal Effects in square brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.16: Direct Effect and Peer Effect, Villages with Neighbors in Other Counties

	(1)	(2)	(3) Weighted by 1/time	(4) Weighted by degree
"Informed"	-0.259	-0.244	-0.240	-0.244
$\frac{dp}{dx}$	[-0.055]	[-0.051]	[-0.050]	[-0.051]
	(0.032)***	(0.032)***	(0.032)***	(0.031)***
"Informed" × Number of Reports	0.148	0.133	0.132	0.134
$\frac{dp}{dx}$	[0.031]	[0.028]	[0.027]	[0.028]
	(0.022)***	(0.022)***	(0.022)***	(0.023)***
Peer Effect: $\frac{1}{N_i}\sum_{j\in F_i} E[A_{jt}]$		0.958	0.987	0.931
$\frac{dp}{dx}$		[0.20]	[0.21]	[0.20]
		(0.066)***	(0.069)***	(0.064)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
Obs.	200193	200193	200193	200193

This table reports estimation results of equation (2.11). Coefficients are reported, with standard errors in round brackets and Average Marginal Effects in square brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 2.17: Direct Effect and Peer Effect, Alternative Proxy of Whether Villages Having Protests

	(1)	(2)	(3) Weighted by 1/time	(4) Weighted by degree
"Informed"	-0.165	-0.149	-0.145	-0.151
$\frac{dp}{dx}$	[-0.035]	[-0.032]	[-0.031]	[-0.032]
	(0.027)***	(0.027)***	(0.027)***	(0.026)***
"Informed" × Number of Reports	0.116	0.091	0.089	0.093
$\frac{dp}{dx}$	[0.025]	[0.019]	[0.019]	[0.02]
	(0.019)***	(0.019)***	(0.019)***	(0.018)***
Peer Effect: $\frac{1}{N_i}\sum_{j\in F_i} E[A_{jt}]$		1.681	1.702	1.630
$\frac{dp}{dx}$		[0.36]	[0.36]	[0.35]
		(0.052)***	(0.053)***	(0.051)***
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
Obs.	267694	267694	267694	267694

This table reports estimation results of equation (2.11). Coefficients are reported, with standard errors in round brackets and Average Marginal Effects in square brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

2.8 Appendix Figures

Figure 2.10: The Share of "Informed" Villages

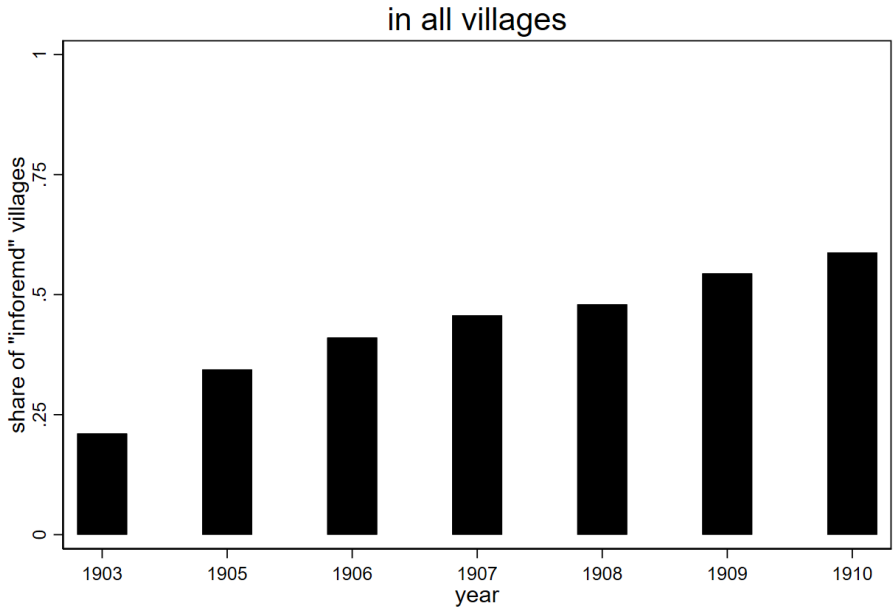


Figure 2.11: The Share of "Informed" Villages in Prefectures

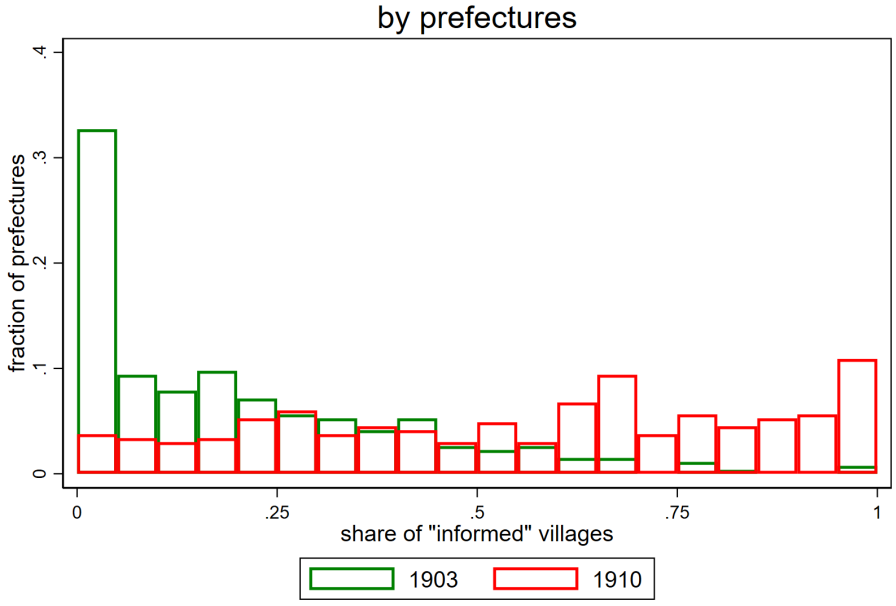


Figure 2.12: The Post Offices' Slope and Distance to River

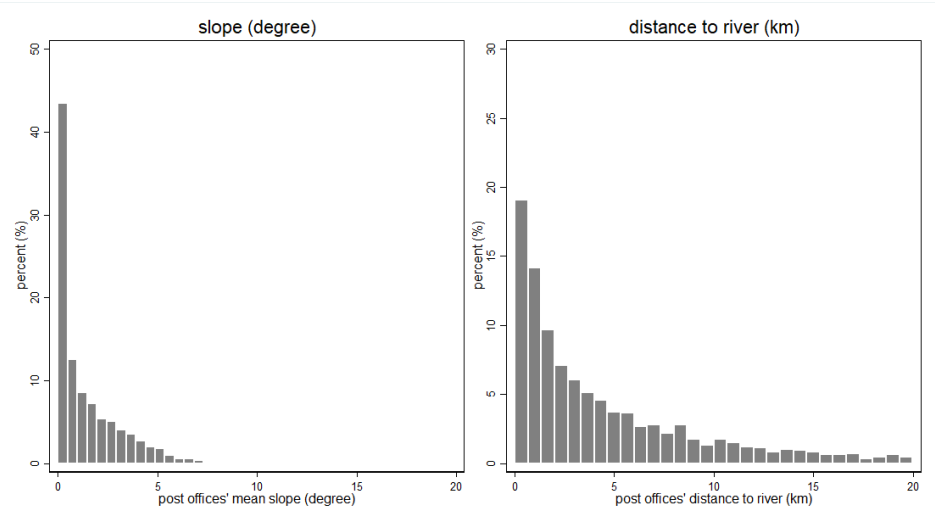
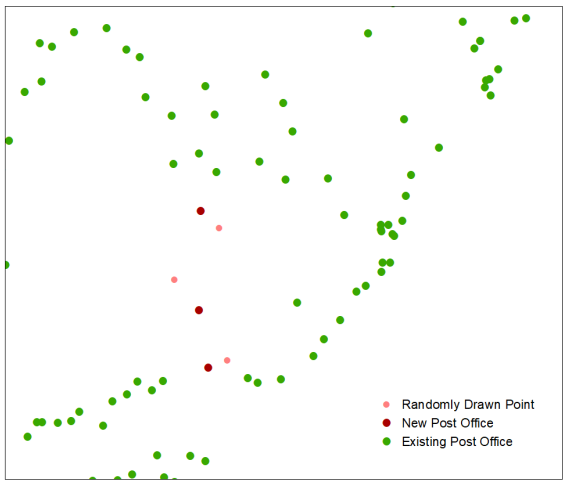
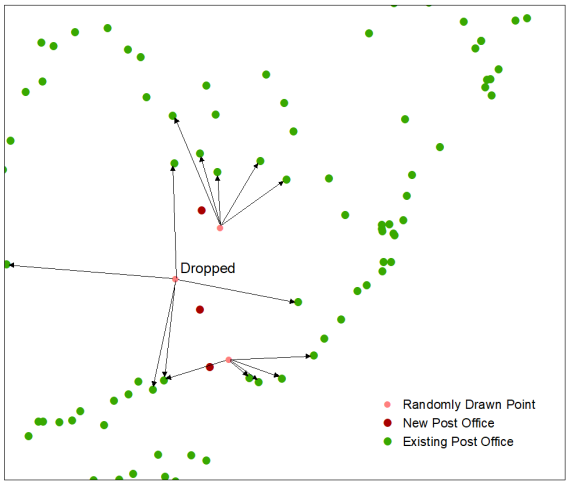


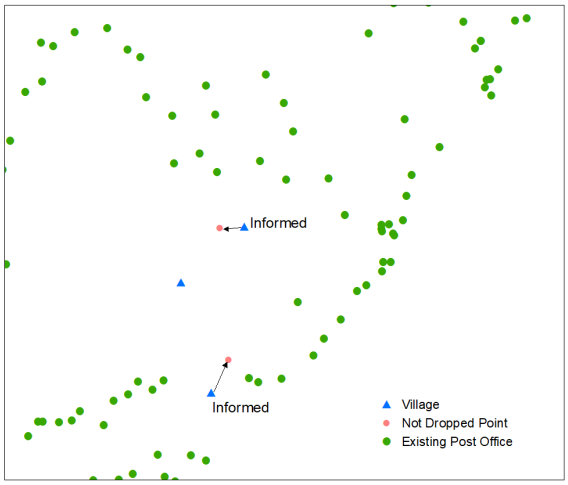
Figure 2.13: Define IV



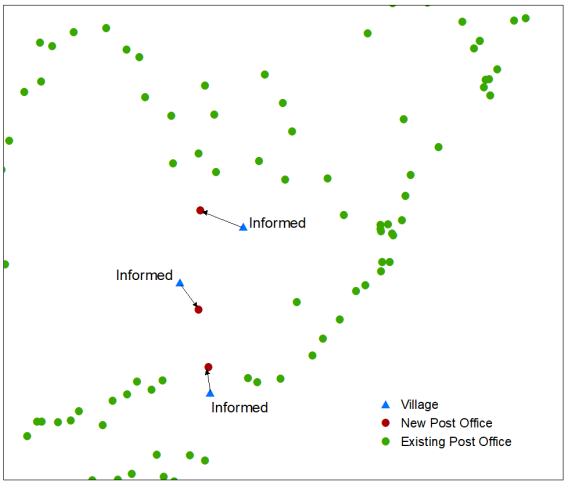
(a) Step 1



(b) Step 2



(c) Step 3 and 4



(d) Actual

Figure 2.14: The Share of Left Points Around Post Offices

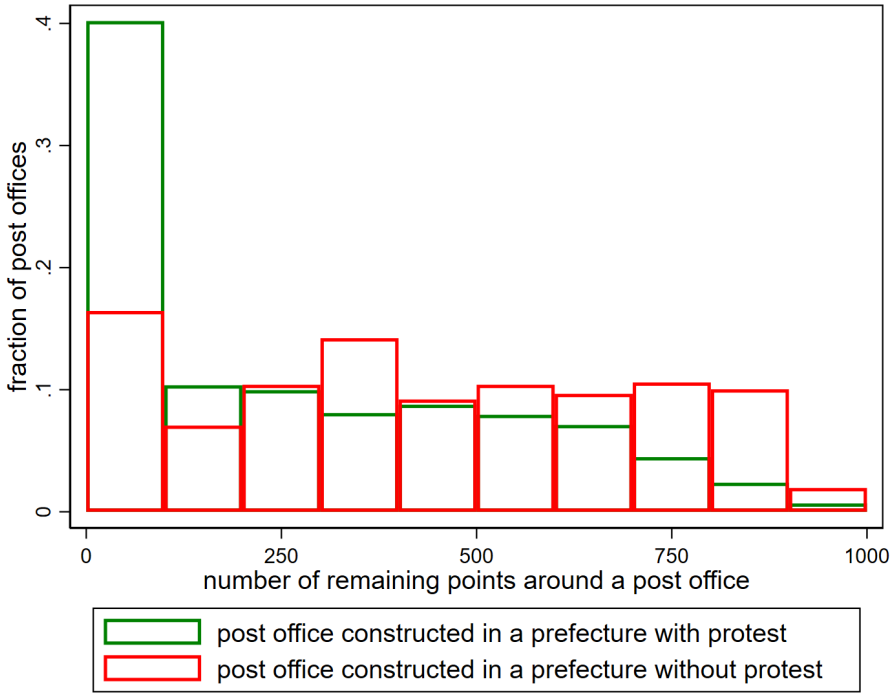
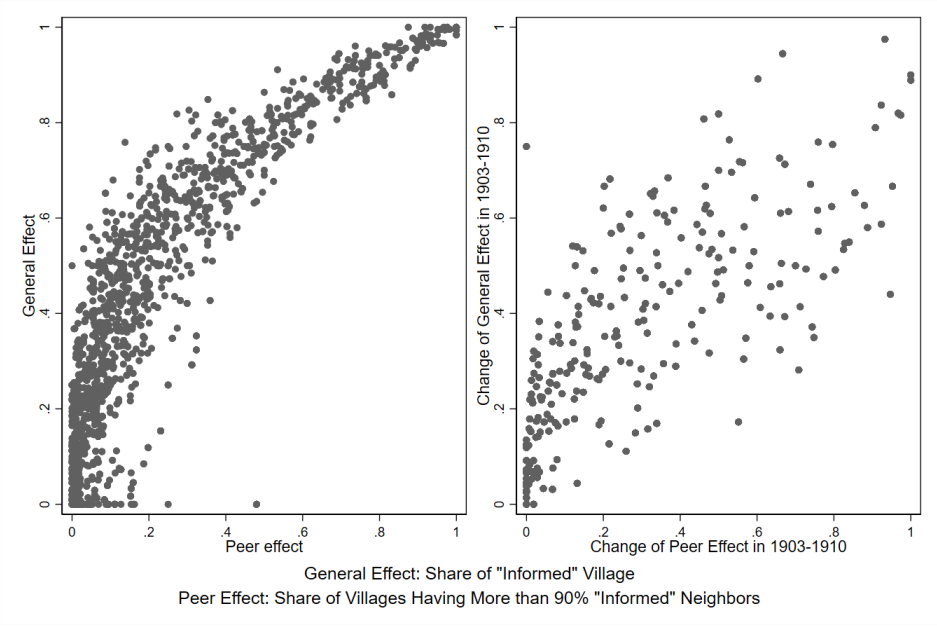


Figure 2.15: The General Effect and Peer Effect



2.9 Data Appendix

2.9.1 Geocoding of Post Office

Table 2.18 provides the specific sources of post office data.

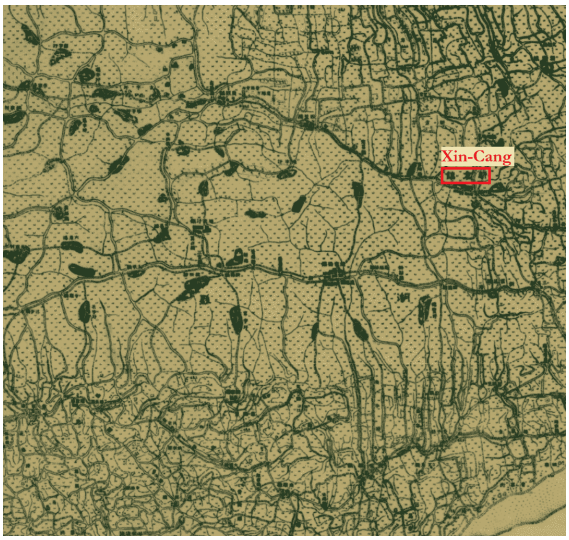
Table 2.18: Sources of Post Office Data, 1903–1910

Year	Source
1903	大清推广邮政舆图 The Postal Map of the Qing Empire, 1903
1905	光绪三十一年邮政事务总论 The Annual Report on Postal Service, 1905
1906	光绪三十二年邮政事务总论 The Annual Report on Postal Service, 1906
1907	大清邮政舆图 The Postal Map of the Qing Empire, 1907
1908	大清邮政汇编初续 The List of Post Offices in the Qing Empire, 1908
1909	宣统元年通邮局所汇编 The List of Post Offices in the Qing Empire, 1909
1910	宣统二年通邮局所汇编 The List of Post Offices in the Qing Empire, 1910

In 1903 and 1907, the postal maps show approximate locations of post offices. To obtain the longitude and latitude of post offices, I manually find the exact locations of post offices in two GIS databases, the Chinese Civilization in Time and Space (CCTS) (Academia Sinica, 2020) and the Max Planck Institute for the History of Science Database (MPIWG) (The Max Planck Institute for the History of Science and The Department of History of Shanghai Jiao Tong University, 2019). Figure 2.16 shows an example of the geocoding process. In panel (a), the screenshot of a postal map provides the approximate locations of three post offices (red circled). It also shows the names of the villages or towns where the three post offices locate, including *Xin-Cang*, *Zha-Pu*, and *Shen-Dang*. I then manually find the exact locations of the above three places in the CCTS and MPIWG database. In panels (b), (c), and (d), the screenshots show the exact locations (red circled) in the GIS database. As the CCTS and MPIWG databases provide geo-referenced scanned military maps (1:50,000), a pin dropped in the GIS database gives me the longitude and latitude.

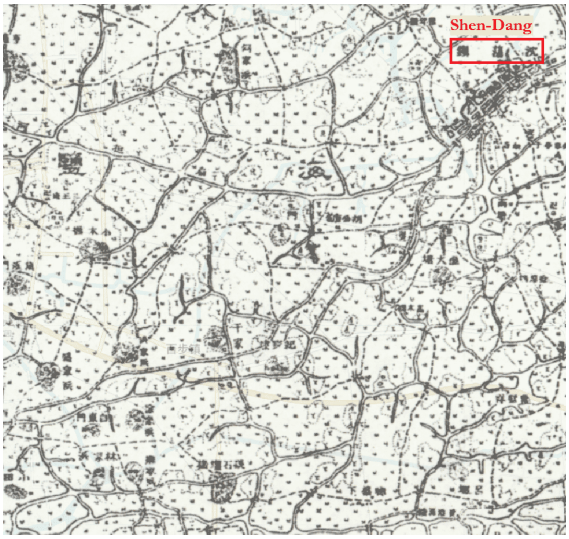
Figure 2.16: Geocoding Example

(a) Postal Map



(b) GIS Database

(c) GIS Database



(d) GIS Database

In 1905, 1906, 1908, 1909, and 1910, the list of post offices only provides the names of the villages, towns, and streets where post offices locate. With this information, I could still manually find the exact locations of post offices in the GIS database.

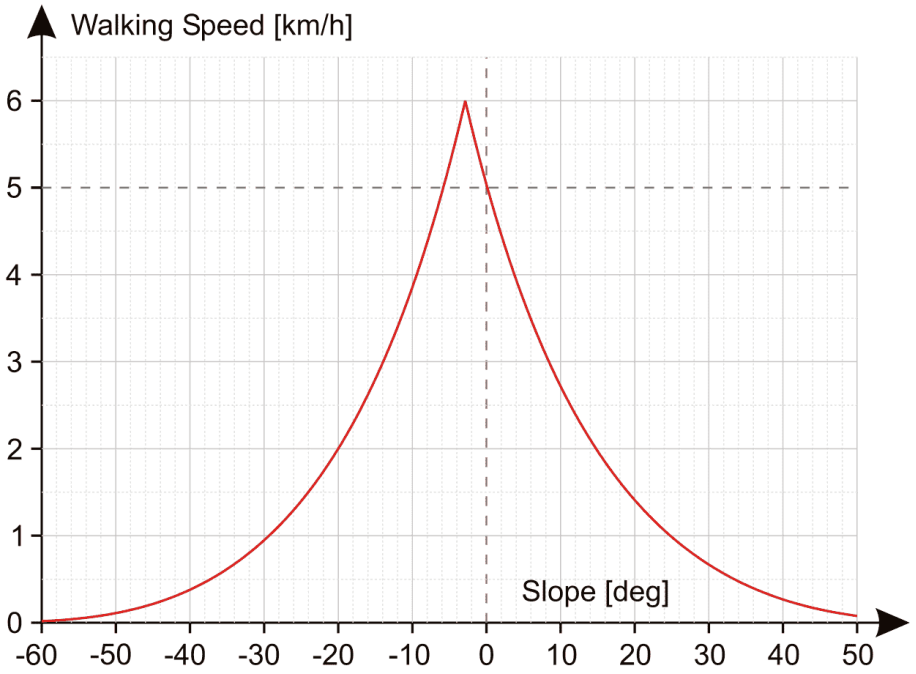
To check the accuracy of the above geocoding process, I further collect the current address of these historical post offices by knowing how the historical names of the villages, towns, and streets changed today. I obtain the longitudes and latitudes of the post offices based on the current addresses. I compare the longitudes and latitudes obtained from the CCTS and MPIWG database and obtained from the current addresses. For very few post offices (108 in 4,622), the longitudes and latitudes obtained from the two sources have a big difference. I then carefully reexamine the geocoding process for these post offices. To the best of my knowledge, the longitudes and latitudes of post offices obtained from the CCTS and MPIWG database are accurate.

2.9.2 Walking Time and Dijkstra's Algorithm

The GIS database includes the locations of villages and post offices, and the elevation for each cell of 7.5 longitude arc-seconds by 7.5 latitude arc-seconds. I first convert the GIS database into a raster surface with each cell of 1 km by 1 km, where the number of cells is not too large for algorithms to be feasibly operated using a desktop computer. On the raster surface, I identify the cells which have a village or a post office within them. To compute the walking time between two points (between two villages or between a village and a post office), it is equivalent to compute the walking time between the two cells that the two points belong to. The mover faces both the horizontal and vertical cost to walk from one cell to another on the raster surface. The horizontal cost is the horizontal distance to move from one cell to another cell next to it. The vertical cost is the penalty in walking speed when moving uphill or downhill. As shown in Figure 2.17, Tobler's hiking function is an exponential equation that describes how human walking speed varies with slope (Tobler, 1993). Therefore, a minimum walking time path from one cell to another is determined by

the elevations of cells around them and could be very different from a straight line.

Figure 2.17: Tobler's Hiking Function



The "Path Distance" tool in ArcGIS uses the Dijkstra's Algorithm to find the least cost path (in my case, the minimum walking time path) from one cell to another. The processing that occurs in the "Path Distance" tool in ArcGIS is introduced online. With the "Path Distance" tool, I obtain the minimum walking time path between villages and post offices, and compute the walking time.

Chapter 3

Wartime Social Interactions and Veteran Migration in The Post-American Civil War Era

3.1 Introduction

Social networks play an essential role in shaping economic outcomes (Jackson, 2011; Topa, 2011; Beaman, 2016). Recent evidence shows that temporary social networks, which are exogenously formed with previously unknown people, have persistent and important effects (Costa et al., 2018; Battiston, 2018). For example, soldier's wartime experiences may expose them to social interactions with many strangers. The American Civil War (1861–1865) created "the closest tie which is possible between men"[1] for more than 2 million white men and nearly 0.2 million African American men who served in the Union Army. During the post-Civil War period, the U.S. experienced fast urbanization, and manufacturing gradually became the engine of economic growth. The veterans who survived the war benefited from the wartime social networks by learning about economic opportunities in different locations and occupations. The potential value of war experience for African American men could be large, as they lacked extensive social networks before the Civil War. After spending two years of their lives with 100–150 friends in the same company, did these wartime social networks have persistent effects in the post-Civil War period?

[1] Oliver Wendell Holmes, 1884 Memorial Day Speech.

This paper investigates the effects of wartime social networks on African American veterans' location choice and income level for 30 years after the war. In the post-Civil War period, a veteran faced the decision of choosing a place to locate. Because previous evidence emphasizes the role of social networks as a source of information (Conley and Udry, 2010) and chain migration (Munshi, 2003), I focus on the effect of veterans' wartime social networks on their location choice. In the post-Civil War period, a veteran's wartime social networks in a county are defined as the number of men from the same military company who lived in the county. Because a company usually had around 100–150 African American soldiers, belonging to the same company created close ties between the soldiers and made them wartime friends. I find that veterans preferred to live in a county with more men from the same wartime company. With one additional wartime friend residing in a county, the probability of veterans choosing that county is 13.6% higher. The effect of wartime social networks is sizable compared to other county characteristics, such as the distance from the veteran's county of origin, manufacturing output, degree of urbanization, or political attitude toward African Americans. Meanwhile, literacy and good health condition are complements to the social network. Literate veterans and veterans in good health condition had a stronger incentive to move to the location of their wartime friends.

A competing explanation for the above results is the *contextual effect*. The recruitment of African American soldiers during the war was local. The African American soldiers could enlist with friends or with people born in the same place. Because wartime social networks are defined as men from the same wartime company living in a county after the war, the variable may also capture the veterans' similar preferences, including preferences based on a shared place of origin. A veteran's higher probability of choosing a county with more men from the same wartime company could be because of the *contextual effect* of having a similar preference instead of the *endogenous effect* due to the behavior of the groups (Manski, 1993). To deal with this problem, I first focus on veterans from companies with a high level of heterogeneity in age or birthplace. When I restrict the analysis to a group of veterans

who were less likely to have similar preferences than the entire sample, the effect of wartime social networks is robust. Second, I use "weak" wartime social networks as the instrument. The "weak" wartime social networks of a veteran are defined as the number of men in the same company who end up living in the same county after the war, who were born in different states or enlisted in different states from the veteran. The "weak" wartime social networks are less correlated with a veteran's location preference because veterans who came from different places were less likely to have similar preferences. Meanwhile, more "weak" wartime friends living in a county would attract more veterans from the same company to choose the county. By using the "weak" wartime social networks as the instrument, I find that the wartime friends who were less likely to have similar preferences as a veteran would affect the veteran's choice in an even greater way. These results could rule out the competing explanation that the veterans' similar preferences mainly drive the large effect of wartime social networks within companies.

I conduct a series of additional analyses to rule out other potential problems in the main findings. First, I discuss the selection problem in the data because only some of the veterans were successfully linked to pension records and census data. I show the results are robust to limiting the analysis to the subsamples with a relatively high linkage rate. Second, a potential explanation for the main findings is common military experiences. Veterans in the same military company could learn the same location information during the war and thus shared the same post-war location choice. I exclude the veterans who were more likely to be affected by common military experiences and find no evidence that veterans elected to live with more wartime friends mainly because of the same location information learned during the war.

The paper's second set of results shows how veterans benefited from living together with their wartime friends. As they lived closely with their wartime friends, veterans could learn about economic opportunities and job information or obtain social support. I show that the quality of wartime social networks affected veterans' income levels. When choosing

a county with more men from the same war company, veterans did not have significantly higher incomes levels. However, the quality of wartime social networks mattered. I define wartime social network quality as the mean income of a veteran's wartime friends living in the same county. Veterans benefited in income level from having been in the same company during the war and living in the same county after the war, with friends who had higher incomes after the war. The quality of wartime friends could further have an intergenerational impact on veterans' children. Living with wartime friends who had higher incomes could increase a veteran's educational investment in his children and lead to a higher probability of the children being literate.

This paper addresses three strands of literature. First, there is a rich and growing empirical literature focusing on the effects of social networks. Social networks may bring job referrals and offers and thus affect people's occupation and working choices (Montgomery, 1991; Marmaros and Sacerdote, 2002; Dustmann et al., 2015). People could learn information though social interactions formed in their neighborhoods and are drawn to locations where their peers moved previously (Moretti, 1999; Ioannides and Datcher Loury, 2004; Bayer et al., 2008; Costa et al., 2018; Büchel et al., 2020). Social networks are vital for newly arrived immigrants, who have very few social networks in the destination country (Munshi, 2003; Edin et al., 2003; McKenzie and Rapoport, 2007; Battiston, 2018; Battisti et al., 2022). This paper focuses on the African American population in the post-American Civil War period, who were very similar to newly arrived immigrants in the sense that they both lacked social networks outside their place of origin as well as social contacts with people of higher economic standing. This paper provides new evidence about how social networks affected African American veterans' migration and income.

Second, after the American Civil War, there was a large divergence between the South and North in both wage level and productivity. This divergence, as well as extreme racial discrimination in the South, should have created a strong incentive for migration from the South to the North (Eli et al., 2018). However, before the Great Migration in the 20th

century, there was no large-scale trend of African American migration from the rural South to the other parts of the U.S. (Lemann, 2011; Black et al., 2015). In the post-Civil War period, nearly 80% of the African American population was concentrated in the South. More than 80% of the African American population had never experienced any migration, based on the census in 1870–1900.[2] A large body of existing literature offers many explanations about the low mobility of the African American population. These reasons include illiteracy or poor health (Logan, 2009), institutional discrimination (Naidu, 2012), and a lack of promotion opportunities and limited access to industrial jobs (Boustan, 2009).

Although the mobility of the African American population was very low during the post-Civil War period, the mobility of the African American veterans was relatively large. Following the same definition, the migrant percentage in the "Colored Troops" sample used in this paper was more than 50% in 1870–1900. White veterans were more likely to move to a location where more fellow members of their wartime company lived (Costa et al., 2018). For African American veterans, the wartime social networks allowed them to learn about migration opportunities, to learn how to write, and to adopt a freeman's identity (Costa and Kahn, 2006). This paper shows how the wartime social networks motivated African American veterans' migration, which could partly explain the lack of mobility for the majority African American population.

Third, several papers study social networks formed during the American Civil War. During the war, these social networks impacted men's willingness to risk death (Costa and Kahn, 2003) and their ability to survive in the camps of prisoner of war (Costa and Kahn, 2007b). These social networks persisted as men pursued economic opportunities in the locations with more wartime friends (Costa et al., 2018). As the previous literature mainly studies white veterans (Costa et al., 2017), this paper focuses on African American veterans, who have been understudied.

The remainder of this paper is organized as follows. Section 3.2 documents the historical

[2] Here I define the migration as living in a state different from the state of birth.

background and facts. Section 3.3 introduces the data and explains the variables. Section 3.4 presents the conditional logistic model as the methodology and estimates how wartime social networks affected a veteran's location choice. Section 3.5 further discusses the robustness checks and the use of instruments to rule out potential problems in the main findings. Section 3.6 studies the benefits from the quality of wartime social networks. Section 3.7 concludes the paper.

3.2 Historical Background

This section first introduces the history of the African American military in the American Civil War (1861–1865) and the African American veterans. Second, I show the change of the African American veterans' distribution over time and discuss how the African American veterans were different from the African American population.

The Second Confiscation Act of July 17, 1862, was the first step toward African Americans' enlistment in the Union Army during the Civil War.[3] Although it did not explicitly allow African Americans to join the army, several African American regiments were formed after its implementation. In January 1863, the War Department officially authorized the formation of African American regiments. In May, the Bureau of Colored Troops was established to regulate African American soldiers and to recruit officers. The War Department authorized the Northern states to recruit African American regiments and tried to recruit in the Union-occupied South. Approximately 175 regiments composed primarily of African American soldiers were recruited. By the end of the Civil War, 186,017 African American men had entered the U.S. Colored Troops. During the Civil War, an African American company contained roughly 100–150 African American soldiers. Since most companies were discharged in 1865, the soldiers lived together for about two

[3] The first official authorization to employ African Americans in federal service was the Second Confiscation and Militia Act of July 17, 1862. This act allowed President Abraham Lincoln to receive into the military service persons of African descent and gave permission to use them. However, the President did not authorize use of African Americans until issuance of the Emancipation Proclamation on January 1, 1863.

years. African American soldiers from the same companies formed close social networks.

Recruitment took two forms. First, the Union Army could establish headquarters in a community and have white officers recruit in the surrounding countryside. Second, the Union Army could send some African American soldiers, with troops for protection, out on a recruitment campaign. Usually, the recruits and their families were recruited directly from slavery. The troops sometimes moved to different areas to recruit more men, and runaway slaves would also cross into the border states and to Union-occupied territory to enlist.

The method of recruiting African American soldiers was local and not entirely random. The African American soldiers enlisted in the same place or at the same time might belong to the same regiment or the same company. Men would enlist with one or several friends. Therefore, while I define wartime social networks as the men from the same company, the variable may also capture preferences related to a shared place of origin. However, although the companies were recruited locally, there was diversity within companies of the U.S. Colored Troops, measured by place of birth, place of enlistment, and age. The African American soldiers in the same companies were born or enlisted in different states and had a large age variance. The veterans' human capital and acquisition of information was improved by serving in heterogeneous companies. Soldiers could learn about life in different parts of the country and learn about migration opportunities from travel and from their wartime friends (Costa and Kahn, 2006).

After the war, the African American veterans were discharged and needed to make a location choice. If a veteran stayed in a Southern state, he and his family would usually encounter hostility, anger, and mistrust. The African American veteran found himself with less voice in the government, courts of law, and the workplace. Their military service made the veterans an obvious target for the frustrations of whites.[4] Thus the societies' hostility became the "push" factor in a veteran's migration decision. In addition, his literacy, health condition, and social networks also affected his incentive to move. Wartime friends could

[4] Leon F. Litwack, *Been in the storm so long: The aftermath of slavery*, p. 289–290.

provide support to a veteran when he moved to a new location (Costa and Kahn, 2006). Meanwhile, literacy and good health condition are strong predictors of migration for African American veterans and could be a complement to social networks (Logan, 2009).

Veterans had higher mobility than the general African American population. In 1870–1900, less than 20% of veterans stayed in the state where they were discharged. Meanwhile, an increasing number of veterans chose to live in states that were different from their state of birth. As shown in Table 3.1, nearly 40.4% of veterans were living in states that were different from their state of birth. The number increased to 45.6% in 1880 and 50.8% in 1900. Although the share of migrants among African American veterans was lower than for the white population, it was much larger than for the African American population. Veterans were also more likely to migrate out of the South than the general African American population.

Table 3.1: The Mobility of African American Population and African American Veterans

		N	migrant (%)	migrant out of South (%)	lived in South (%)
1870	White population (male, born in 1825–1849)	58,267	57.9	51.3	15.7
	African American population (male, born in 1825–1849)	6,419	31.7	8.2	74.4
	veteran sample	5,437	40.4	22.3	42.5
1880	White population (male, born in 1825–1849)	5,524,505	62.5	55.3	15.4
	African American population (male, born in 1825–1849)	520,994	36.7	10.4	73.4
	veteran sample	6,134	45.6	26.5	40.6
1900	White population (male, born in 1825–1849)	202,046	64.4	56.4	15.7
	African American population (male, born in 1825–1849)	18,856	38.2	11.4	75.6
	veteran sample	4,050	50.8	30.8	39.9

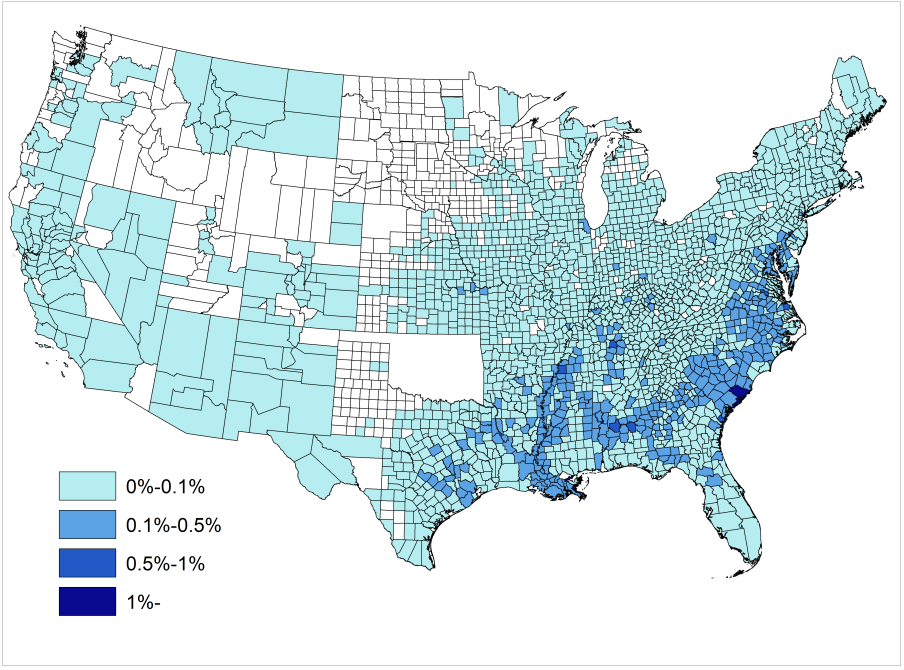
The 1870 census data is based on a 1% sample; 1880 census data is a full sample; 1900 census data is a 5% sample. Migrant (%) is defined as the share of the population who lived in a state different from the state of birth. Migrant out of South is defined as the share of the population who lived in a non-Southern state different from the state of birth.

I compare the distribution of African American veterans and the African American population across counties. Figure 3.1 presents maps for the African American veterans

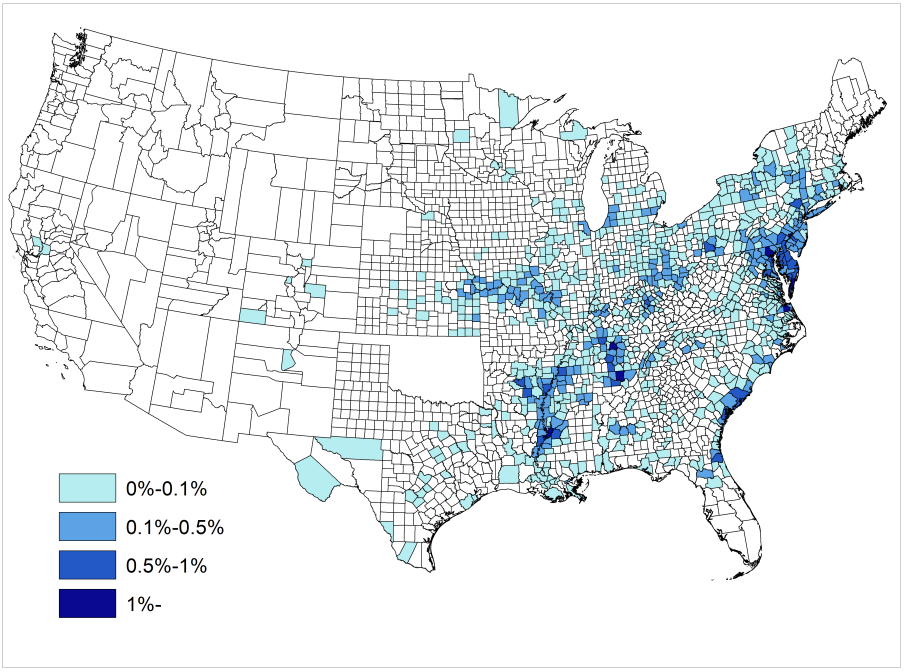
and the African American population. Based on the African American veteran sample, which includes about 6,000 African American veterans, I compute the percentage of all the 6,000 African American veterans in each county in 1880. I use the 1880 census, which is a full sample of the African American population. To make the census sample comparable to the veteran sample, I only keep observations for male African Americans whose age was 31–55 in 1880. From the 1880 census data, I also compute the percentage of those African Americans in each county. Panel (a) in Figure 3.1 shows that most African Americans were concentrated in the South. Meanwhile, as shown in panel (b), African American veterans were concentrated in the South and the North. Compared with the African American population, the veterans were more likely to migrate and live outside the South.

Many veterans experienced migration during the post-Civil War period. In 1880, 26.4% of veterans migrated to a different county from where they lived in 1870. In 1900, 26.4% of veterans lived in another county from where they lived in 1880. Furthermore, there was a time pattern that wartime friends migrated to live together. In 1870, about 70% of veterans chose to live in a county with at least five wartime friends (men from the same military company). In 1880 and 1900, about 75% and 87% of veterans were located in a county with at least five wartime friends. Figure 3.2 shows the number of veterans in each county in 1870, 1880, and 1900, which also suggests a pattern of veterans migrating to live together. Therefore, wartime social networks could have an impact on the veterans' location choice.

Figure 3.1: The Distribution of Male African Americans and Veterans



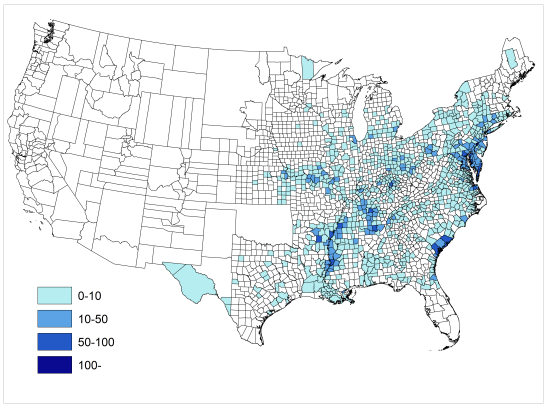
(a) The Percentage of Male African Americans



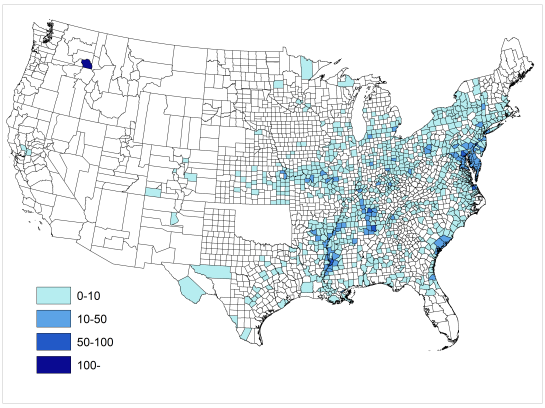
(b) The Percentage of Veterans

Notes: This map shows the distribution of African American veterans and the male African American population in 1880. In panel (a), I only keep the male African Americans whose age was 31–55 in 1880 and compute the percentage of the male African Americans in each county. In panel (b), I compute the percentage of all veterans in each county.

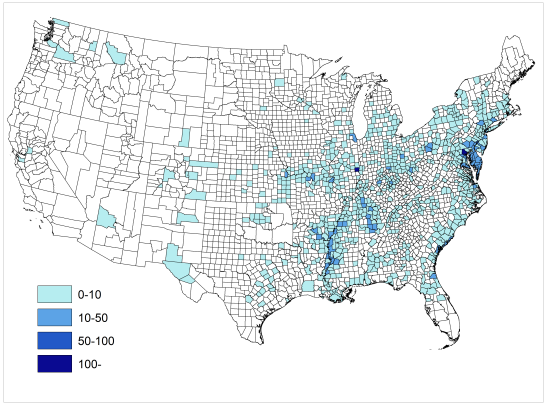
Figure 3.2: The Number of Veterans



(a) 1870



(b) 1880



(c) 1900

3.3 Data and Variables

This paper combines the African American veterans' characteristics and county variables in 1870, 1880, and 1900. In Subsection 3.3.1, I provide information on African American veterans. In Subsection 3.3.2, I discuss the county variables, which are obtained from census data in 1870, 1880, and 1900. In Subsection 3.3.3, I introduce the samples and key variables for the empirical analysis.

3.3.1 Veteran Information

I obtain the information on African American veterans' from the original USCT sample and the extended USCT sample, which are collected by the NIA-funded Early Indicators project (Fogel et al., 2004; Costa et al., 2015). The sample contains about 20,000 African American veterans from 169 companies. The veterans are linked to their military service records, pension records, surgeon's certificates, and census data. As shown in Table 3.2, 12,620 veterans are successfully linked to their pension records so that I could know their death years. Among these 12,620 veterans, 7,660 veterans were alive in 1870, and 7,183 and 4,805 were alive in 1880 and 1900, respectively. Most of those who were still alive could be further linked to the census data. The key variable for studying migration and location choice is where the African American veterans were located in each census year. In 1870, 1880, and 1900, I obtain the county of residence for most living veterans. Table 3.2 summarizes the sample of African American veterans. There are 5,437 veterans in my sample in 1870 and 6,134 and 4,050 veterans in 1880 and 1900, respectively.

The veteran's data include three kinds of variables. First, the data include the African American veteran's military record, including the enlistment period, a dummy for illness or wound, and a dummy of whether the veteran was a non-commissioned officer during the war.

Second, the data include a dummy for whether the veteran or his dependents (parents, widow, or children) obtained a pension, his weight and height, and the death year based on

the pension record and physical examinations in surgeon's certificates. As a veteran could have more than one physical examination in different years, I obtain physical examinations between 1870 and 1890 and define a veteran's weight based on the physical examination closest to 1880. I use the height and weight to compute the body mass index (BMI) and define a BMI dummy as equal to 1 if the BMI of a veteran is between 18.5 and 25.

Third, for each census year, I can obtain the African American veterans' birth state, age, literacy, their children's literacy, and occupation. The occupation category is based on the 1950 classification system. For each occupation, the census data compute the occupation income score. This is a constructed variable that assigns occupational income scores to each occupation. Specifically, the variable assigns each occupation in 1880 a value representing the median total income (in hundreds of 1950 dollars) of all persons with that particular occupation in 1950. Thus, the occupation income score provides a continuous measure of the income level of veterans' occupations, according to the economic rewards enjoyed by people working at them in 1950. Meanwhile, by occupation category, I define a dummy for high-skilled occupations (Professional, Technical; Managers, Officials, and Proprietors; Clerical and Kindred; Sales workers; Craftsmen) and low-skilled occupations (Farmers; Operatives; Service Workers; Farm Laborers; Laborers).

3.3.2 County Variables

I use the census data in 1870, 1880, and 1900 to compute county-level variables. The summary statistics of variables are shown in Table 3.2.

First, I obtain variables related to economic opportunity, including the urban population share (%) and the per capita manufacturing output. I further obtain the variables that represent the race-specific economic opportunity. I compute the average occupational income scores and literacy rates for the male African Americans. I also compute the white population share (%) and the African American population share (%).

Second, from the 1880 census data (100% sample), I compute each county's school

attendance (%) and school quality measure. The school attendance (%) is computed based on the percentage of African American children (aged 5–20) who were pupils. Following Bleakley and Hong (2021), the measure of school quality is constructed as an output-to-input index. The input here is the stock of time in school. I measure the stock of time in school by summing school attendance flows across different observed school ages in 1880. For each of the members of African American population whose age was 5–20 in 1880, I assume he/she attended school since age 5 if he/she was observed in school in 1880. I compute the years of schooling for each African American person based on his or her age and school attendance in the 1880 census. The summation of all the African American population's years of schooling measures the total stock of time in school. The stock of time in school T_c in county c is $T_c = \sum_i (age_i - 5)SA_i$, where SA_i is a dummy for school attendance for an African American individual i who lived in county c in 1880, and age_i is the age. The output, in this case, is defined as the literacy rate for the member of African American population whose age was 5–20 in a county in 1880. Therefore, the literacy to years-of-schooling ratio as an output-to-input index measures education quality in a county. The school attendance (%) and the literacy to years-of-schooling ratio represent every county's education condition.

Third, I define the political attitude as the percentage of the votes cast for the Republican Party in the most recent congressional election in each county because the Republican Party was more friendly to African Americans during that period.

3.3.3 Samples and Key Variables

I cross the veteran data with the county data to estimate how individual and county characteristics could affect a veteran's choice of residing in a specific county. Therefore, the number of observations is the number of veterans multiplied by the number of counties. An observation is veteran i's choice of county j. It is equal to 1 if veteran i lived in county j and equal to 0 otherwise. I cross the data for 1870, 1880, and 1900. Therefore, I have three datasets for three census years.

Table 3.2: Summary Statistics for Veteran Information and County Variables

veteran variables	1870	1880	1900
number of veterans	20002	20002	20002
number of veterans linked to pension record (knowing death year)	12620	12620	12620
number of veterans alive	7660	7183	4805
number of veterans linked to census	5437	6134	4050
enlistment period (year)	2.748	2.748	2.742
	(0.660)	(0.662)	(0.667)
illness or wound (=1)	0.615	0.618	0.623
	(0.487)	(0.486)	(0.485)
officer (=1 if a non-commission officer)	0.230	0.236	0.236
	(0.421)	(0.425)	(0.425)
literacy (=1 if literate)	0.244	0.280	0.372
	(0.429)	(0.449)	(0.483)
pension (=1 if had pension)	0.0642	0.0797	0.738
	(0.245)	(0.271)	(0.440)
BMI	23.77	23.82	23.88
	(4.129)	(3.904)	(4.101)
BMI dummy (=1 if $18.5 < \text{BMI} < 25$)	0.837	0.834	0.839
	(0.369)	(0.372)	(0.367)
age	31.83	40.92	59.52
	(8.866)	(8.828)	(8.030)
high-skilled occupation (=1 if had high-skilled occupation)	0.0484	0.0748	0.0938
	(0.215)	(0.263)	(0.292)
OIS (occupation income score)	15.22	17.28	17.77
	(6.265)	(5.933)	(6.097)
county variables	**1870**	**1880**	**1900**
N	2138	2316	2287
urban pop share (%)	7.128	8.834	15.23
	(16.762)	(18.007)	(22.108)
manufacturing output (per capita)	45.62	38.99	70.52
	(75.833)	(63.870)	(109.759)
OIS, mean of male African American	9.863	9.872	10.41
	(3.936)	(4.051)	(4.858)
literacy (%), male African American	68.34	68.51	53.22
	(15.992)	(17.239)	(24.367)
African American population share (%)	15.96	16.08	16.27
	(21.816)	(22.416)	(22.352)
white population share (%)	83.25	83.08	83.73
	(21.866)	(22.167)	(22.352)
percent of voting for REP in the most recent congressional election	36.95	34.32	39.95
	(26.171)	(25.015)	(22.310)
school attendance (%) for age 5–20	5.017	4.751	4.817
	(8.535)	(8.349)	(8.388)
literacy (%) to year of schooling ratio	1.440	1.355	1.370
	(4.721)	(4.558)	(4.580)

Each observation is a veteran in the upper panel and a county in the lower panel. Means are reported with standard errors in the round brackets.

My primary variable of interest is wartime social networks. I define this variable as the number of men from the same military company of veteran i who choose to live in county j (veteran i is excluded). This variable is veteran-county-specific, which means that the variable changes in different counties for different veterans. I also define the total number of veterans who choose to live in county j. This variable represents the veterans' general preference for the counties.

Furthermore, I construct a set of control variables for veteran's location preferences. First, because most African American veterans' birth county is missing in the sample, I use veteran i's enlistment county to represent his original county. Many African American veterans enlisted in their birthplace, and the enlistment county may affect a veteran's location choice after the war. I define the variables about veteran i's original county and county j: a dummy for whether the two counties are the same; a dummy for whether the two counties are in the same state; and the distance between the two counties. To control for the effect of the place of birth, I define a dummy for whether county j is located in veteran i's birth state. To further control for the veterans' general preference for the counties, I define the total number of veterans who were born in the state in which county j is located and the number of men from veteran i's wartime company who were born in the state in which county j is located. To control for military experience, I collect the discharge state of each company and the states that each company had stayed in during the war.[5] I define a dummy for whether county j is located in veteran i's discharge state and a dummy for whether county j is located in a state where veteran i had stayed during the war.

In the second set of empirical results, I show the effect of wartime social networks on veterans' income levels. I focus on 1880's veteran data because most veterans' ages were between 31–55 in 1880, and the 1880 data have the largest sample size. Income level is measured by occupation income score. In total, 34 different occupations were assigned to veterans in the sample. The occupation income score ranges from 6 to 80, with a mean

[5] Frederick H. Dyer, *A Compendium of the War of the Rebellion*, Part III.

of 17.27 and a standard deviation (S.D.) of 5.93. For each veteran, I define the quantity of wartime social networks as the number of men from the same wartime company who lived in the same county in 1880. The quality of wartime friends is measured by the mean occupation income score for the wartime friends of a veteran who lived in the same county as the veteran in 1880. For each veteran, I also collect individual characteristics, including a dummy for literacy, a BMI dummy (=1 if $18.5 < \text{BMI} < 25$), a dummy for illness or wound, the enlistment period, a dummy for whether the veteran was an officer during the war, and age.

3.4 Social Networks and Location Choice

In this section, I show how the wartime social networks affected the veterans' location choice. In Subsection 3.4.1, I introduce the conditional logistic model. In Subsection 3.4.2, I present the regression results and discuss the magnitude and economic intuitions of the main findings. In Subsection 3.4.3, I investigate the heterogeneous effects of wartime social networks for veterans in different regions or with varying levels of education or health conditions.

3.4.1 Conditional Logistic Model

To estimate how wartime social networks and other individual and county characteristics can affect a veteran's location choice, I use the conditional logistic model. The conditional logistic model allows veteran i to choose among J counties. The probability of veteran i choosing county j is expressed below. The numerator is the exponential of choice j's characteristics, and the denominator is the summation of the exponentials of all choices' characteristics:

$$P_{i,j} = \frac{e^{\beta_1' Z_j + \beta_2 \cdot WSN_{ij} + \beta_3' D_j + \beta_4' d_{ij}}}{\sum_{j=1}^{J} e^{\beta_1' Z_j + \beta_2 \cdot WSN_{ij} + \beta_3' D_j + \beta_4' d_{ij}}} \tag{3.1}$$

$P_{i,j}$ is the probability of veteran i choosing county j. $P_{i,j}$ is equal to 1 if veteran i lives in county j, and it is equal to 0 if the veteran does not. The primary variable of interest is

wartime social networks WSN_{ij}, a veteran- and county-specific variable. It is defined as the number of men from the same military company as veteran i who live in county j (veteran i is excluded).

Z_j are the county characteristics. I use county j's urban population share (%) and per capita manufacturing output to control economic opportunities, the percentage of the votes cast for the Republican Party in the congressional election to control political attitude, and school attendance (%) and the literacy to years-of-schooling ratio to control education conditions. I further control the white population share (%) and a dummy for whether county j is in a Southern state. D_j and d_{ij} are county-specific and veteran- and county-specific control variables, which are related to a veteran's preference for counties. First, I control the total number of veterans who live in county j, representing the veterans' general preference for the counties. I also control the total number of veterans born in the state in which county j is located and the number of men from the same company as veteran i who were born in the state in which county j is located. Second, I control the variables related to veteran i's original county and birth state. Third, I control the variables related to veteran i's military experience, including the discharge state and the states he had stayed in during the war.

I interpret the coefficient by reporting the odds ratio, which is e^{β}. If county j_1 is 1 unit higher in WSN_{ij} than county j_2, the odds ratio is e^{β_2}. $e^{\beta_2} - 1$ measures how much greater the probability is of veteran i choosing county j_1 than county j_2.

$$\frac{P_{i,\,j_1}}{P_{i,\,j_2}} = e^{\beta_2} \tag{3.2}$$

I add the interactions of individual variables with wartime social networks and county variables. The probability of veteran i choosing county j is expressed below, including the interactions.

$$P_{i,\,j} = \frac{e^{\,\beta_1' Z_j + \beta_2 \cdot WSN_{ij} + \beta_3' D_j + \beta_4' d_{ij} + Z_j' B X_i + \beta_6' X_i \cdot WSN_{ij}}}{\sum_{j=1}^{J} e^{\,\beta_1' Z_j + \beta_2 \cdot WSN_{ij} + \beta_3' D_j + \beta_4' d_{ij} + Z_j' B X_i + \beta_6' X_i \cdot WSN_{ij}}} \tag{3.3}$$

The interpretation of the interactions is similar. If county j_1 is 1 unit higher in WSN_{ij} than county j_2, and if veteran i_1 is 1 unit higher for the first term in X_i than veteran i_2, the ratio of the odds ratios for veteran i_1 and i_2 is as shown below, meaning that WSN_{ij} has a larger effect on i_1:

$$\frac{P_{i_1,\,j_1}}{P_{i_1,\,j_2}} \Big/ \frac{P_{i_2,\,j_1}}{P_{i_2,\,j_2}} = e^{\beta_{6,1}} \tag{3.4}$$

3.4.2 The Effect of Social Networks

Using the conditional logistic model, I obtain the odds ratios based on the samples in 1870, 1880, and 1900. I summarize the regression results in Table 3.3. In columns 1, 2, and 3, I show the results in 1880. In column 1, I include the total number of veterans who live in county j to control the veterans' general preference for the counties. To control the effect of original county, I include a dummy for whether veteran i's original county and county j are the same, a dummy for whether the two counties are in the same state, and the distance between the two counties. To control the effect of the place of birth, I include a dummy for whether county j is located in veteran i's birth state. In column 2, I include county j's urban population share (%), per capita manufacturing output, the percentage of the votes cast for the Republican Party in the congressional election, school attendance (%) for people aged 5–20, literacy to years-of-schooling ratio, white population share (%), and a dummy for whether county j is in a Southern state. In column 3, as common military experiences of veterans in a same company could potentially affect their location choices, I include a dummy for whether county j is located in veteran i's discharge state and a dummy for whether county j is located in a state where veteran i had stayed in during the war.

In columns 4 and 5, I include all the control variables and use data from 1870 and 1900. The standard errors are clustered at the company level because the location preferences of veterans in the same wartime company may be correlated. In the first row, I show the odds ratio of the number of men from the same company (veteran i is excluded). In the second row, I show the odds ratio of the total number. I interpret the result in column 3 for 1880, but the results in other years are similar.

One additional man from the same wartime company living in county j can increase the probability of choosing county j by 13.6%. The effect is quite large, as one additional veteran from other companies only increases the probability of choosing county j by 1.8%. I list all the odds ratios for county characteristics. The probability of choosing county j is significantly increased if there is a higher level of urbanization, a higher percentage of votes cast for the Republican Party, a higher rate of school attendance (%), a lower literacy to years-of-schooling ratio, and a shorter distance between the original county and county j. There are two coefficients that may be different from expectations. First, with higher per capita manufacturing output, the probability of choosing county j is insignificant. This indicates that African American people were not more likely to move to a place with a higher level of industrialization. This result is reasonable, given the historical background that African Americans' opportunity to work in industry were very limited (Boustan, 2009). Second, a higher literacy to years-of-schooling ratio does not significantly increase the probability of choosing county j. Since I control for school attendance (%), the literacy to years-of-schooling ratio better captures school quality in a county. The result indicates that school quality in a county was not a significant factor driving where African Americans veterans chose to live.

To understand how large the effect of wartime social networks is, I compare the odds ratios. The impact of one additional man from the same company is equivalent to a 7.8 additional veterans, a 26.2 percentage increase in urbanization (%), a 38.9 percentage increase in voting for the Republican Party (%), a 10.3 percentage increase in school

Table 3.3: Social Networks and Location Choice

odds ratio	=1 if veteran i lives in county j =0 otherwise				
	(1)	(2)	(3)	(4)	(5)
	1880	1880	1880	1870	1900
WSN_{ij}	1.1766	1.1359	1.1362	1.1382	1.1920
	(0.036)***	(0.022)***	(0.022)***	(0.018)***	(0.035)***
$Veteran\ Number_j$	1.0195	1.0177	1.0175	1.0257	1.0330
	(0.002)***	(0.002)***	(0.001)***	(0.002)***	(0.002)***
$Original\ State_{ij}$	15.0363	2.2777	2.2455	2.1557	2.0321
	(1.515)***	(0.270)***	(0.272)***	(0.281)***	(0.275)***
$Original\ County_{ij}$	8.3696	2.7103	2.6991	3.1428	2.6822
	(1.485)***	(0.425)***	(0.422)***	(0.461)***	(0.435)***
$Birth\ State_{ij}$	7.5564	4.4056	4.4459	6.3496	3.5023
	(0.916)***	(0.344)***	(0.349)***	(0.506)***	(0.316)***
urban pop share (%)		1.0052	1.0052	1.0014	1.0165
		(0.002)**	(0.002)***	(0.002)	(0.001)***
manufacturing output (per capita)		1.0007	1.0007	0.9994	0.9999
		(0.001)	(0.001)	(0.001)	(0.000)
GOP (%)		1.0109	1.0107	1.0035	1.0050
		(0.002)***	(0.002)***	(0.002)**	(0.002)***
school attendance (%)		1.0132	1.0131	1.0132	1.0126
		(0.002)***	(0.002)***	(0.002)***	(0.002)***
literacy-to-schooling ratio		0.8924	0.8926	0.9040	0.9241
		(0.023)***	(0.023)***	(0.023)***	(0.027)***
$Distance_{ij}$		0.9949	0.9949	0.9944	0.9959
		(0.000)***	(0.000)***	(0.000)***	(0.000)***
$Discharge\ State_{ij}$			1.3294	1.4505	1.2517
			(0.188)**	(0.230)**	(0.199)
$Stayed\ State_{ij}$			0.8532	0.9015	0.9198
			(0.108)	(0.122)	(0.130)
County-specific controls	NO	YES	YES	YES	YES
Veteran- and county-specific controls	NO	YES	YES	YES	YES
Obs.	14200210	14200210	14200210	11624306	9262350
Number of veterans	6134	6134	6134	5437	4050

This table reports estimation results of equation (3.1). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j. $Original\ State_{ij}$ is equal to 1 if county j is in the same state of veteran i's original county, and is equal to 0 otherwise. $Original\ County_{ij}$ is equal to 1 if county j is veteran i's original county, and is equal to 0 otherwise. $Birth\ State_{ij}$ is equal to 1 if county j is in veteran i's birth state, and is equal to 0 otherwise. $Distance_{ij}$ is the distance from county j to veteran i's original county (km). $Discharge\ State_{ij}$ is equal to 1 if county j is in veteran i's discharge state, and is equal to 0 otherwise. $Stayed\ State_{ij}$ is equal to 1 if county j is in a state where veteran i had stayed, and is equal to 0 otherwise.

attendance (%), and a 27.2 km decrease in the distance from the county of origin. From these comparisons, it is clear that the effect of wartime social networks is sizable and strongly affected a veteran's county choice.

The effect of wartime social networks is significant after controlling for the location effects. To control various location effects, I include the veteran's birth state, enlistment place, discharge state, and the states where the veteran had stayed during the war. The location effect is large. As shown in column 3 in Table 3.3, compared with other locations, a veteran was 345% more likely to choose a county in his birth state and 170% to come back to his enlistment place. Meanwhile, the probability of a veteran staying in the discharge state was 33% higher than other locations. The birth state, enlistment place, and discharge state of a veteran are strong predictors of his location choices after the war. However, after controlling for the location effects, wartime social networks still played an important role in location decisions.

Costa et al. (2018) finds that wartime social networks (veterans from the same company) significantly affected white veterans' location choice in the post-Civil War period. In 1900, one additional man from a white veteran's wartime company increased his probability of living in the county by 21%. Comparably, as shown in column 5 in Table 3.3, in 1900, one additional man from the same wartime company living in the county can increase an African American veteran's probability of choosing the county by 19%. Wartime social networks were as important for white veterans as for African American veterans. As discussed in Section 3.2 and shown in Table 3.1, there was a large difference in the share of migrants between the white population and the African American population. Moreover, the share of migrants for African American veterans was much larger than for the African American population. The results show that wartime social networks motivated African American veterans' migration and could be an important factor for explaining the lack of mobility for the majority of the African American population.

3.4.3 Heterogeneous Effects of Social Networks

In the decision of migration and location, "push" factors in different regions as well as veteran's literacy and health condition could be related to the effect of wartime social networks. For "push" factors, veterans might have a stronger incentive to live with their wartime friends when they were in a region where the political attitude toward African Americans was more hostile. Meanwhile, literacy could be both a substitute for and complement to the social network. Literate veterans could benefit more from social networks because they had a good chance of earning a higher income in the new location. They also relied less on social networks because they would not need to receive as much information from their social network to learn about opportunities in other locations. Health condition is a complement to the social network. If a veteran believed himself to be in good health condition, he might be more likely to accept the cost to migrate to friends. I test the above hypothesis in this subsection.

I first study whether the effect of wartime social networks is larger in places where African American veterans faced greater hostility. I focus on the veterans who chose to stay in a Southern state. Former African American soldiers and their families became targets of mobs in the Southern states. Furthermore, lynching was a major form of racial violence during the post-Civil War period. Lynching is the public killing of an individual who has not received any due process, and it was a violent public act that white people used to terrorize African American people. I obtain lynching records from Seguin and Rigby (2019). Whether a county had lynchings whose victims were African Americans before 1900 is a measure of political attitude toward African Americans. Therefore, I focus on veterans in a county with lynching.

I summarize the regression results in Table 3.8. In columns 1, 2, and 3, I use the data from 1870, 1880, and 1900. In the upper panel, the regression only includes the veterans who stayed in a county where lynching occurred. In the lower panel, the regression only includes

the veterans who stayed in a Southern state. In both panels, when I focus on a subsample of veterans who possibly faced greater hostility, the effect of wartime social networks is not larger than the baseline results in Table 3.3.

I further investigate the heterogeneous effects of wartime social networks for literate veterans and veterans in good health condition. I use a dummy for literacy to represent education and a BMI dummy (=1 if $18.5 < \text{BMI} < 25$) as a proxy for a veteran's health condition. I summarize the regression results in Table 3.9. In columns 1, 2, and 3, I use the data from 1870, 1880, and 1900. In the upper panel, the regression only includes the literate veterans. In the lower panel, the regression only includes the veterans whose BMI dummy equals 1. In both panels, the effect of wartime social networks is larger than the baseline results in Table 3.3.

There is no evidence that veterans who faced greater hostility would have a stronger incentive to live with their wartime friends. Meanwhile, literacy and good health condition are complements to the social network. Literate veterans and veterans in good health condition had a stronger incentive to move to the location of their wartime friends. The effect of wartime social networks is not mainly driven by the specific "push" factors, that is the hostility that African American veterans faced in the South. These findings are consistent with previous studies showing that education and health are strong predictors of migration and are compliments to social networks (Logan, 2009).

3.5 Robustness Analysis

In this section, I conduct a series of additional analyses to rule out potential problems in the main findings. In Subsection 3.5.1, I discuss the selection problem. In Subsection 3.5.2, I show that common military experiences cannot explain the effect of wartime social networks. In Subsection 3.5.3, I focus on veterans from companies with a high level of heterogeneity in age or birthplace, as they were less likely to have similar location preferences. In Subsection

3.5.4, I use "weak" wartime social networks as the instrument to rule out the competing explanation that the veterans' similar preferences mainly drive the effect of wartime social networks.

3.5.1 Data Linkage and Selection Problem

There were originally 20,002 veterans from 169 companies originally, but only some veterans were successfully linked to pension records and census data to obtain location information and other individual information. The relatively low linkage rate could lead to a selection problem in the main findings. For instance, veterans who lived with more wartime friends could be more likely to apply for federal pensions since information about pension eligibility may be passed on by word of mouth. Therefore, veterans who lived with more wartime friends could be more likely to be observed in the data since they were more likely to file pension applications.

To deal with the selection problem, I first show the results from limiting the analysis to the companies with a relatively high linkage rate. A total of 12,620 of 20,002 veterans were successfully linked to their pension records, making it possible to obtain their year of death. Of the 169 companies, the rates of veterans successfully linked to pension records ranged from 35.9% to 81.8%, with a median value of 63.4%. I only keep the veterans belonging to the companies whose rates of linkage are above the median. The results for these veterans are less likely to be affected by the selection problem.

Among the 12,620 veterans whose death years are known, 7,660 veterans were alive in 1870, and 7,183 and 4,805 were alive in 1880 and 1900, respectively. Most of the living veterans could be further linked to the census data. In 1880, 85.4% of the 7,183 living veterans were linked to the census data.[6] The rates of living veterans successfully linked to the census data ranged from 36.1% to 87.8% in the 169 companies, with a median value

[6] In 1870, 71% of the 7,660 living veterans were linked to the census data. In 1900, 84.3% of the 4,805 living veterans were linked to the census data.

of 67.5%.[7] I also only keep the veterans belonging to companies whose rates of linkage to census data are above the median.

I summarize the regression results in Table 3.10. In columns 1, 2, and 3, I use the data from 1870, 1880, and 1900. In the upper panel, the regression only keeps the veterans belonging to companies whose rates of veterans successfully linked to pension records are above the median. In the lower panel, the regression only focuses on the veterans in companies whose rates of living veterans successfully linked to the census data are above the median. In both panels, when I focus on a subsample that is less affected by the selection problem, the results are only slightly different from the baseline results in Table 3.3.

Second, I further include the interaction of a dummy of having a pension and wartime social networks WSN_{ij} into the conditional logistic regression. If the veterans who lived with more wartime friends were also more likely to file pension applications, the location choice of the veterans who had a pension should be more correlated with their wartime social networks. The veterans filed pension applications for themselves. Meanwhile, the dependents of the veterans, including the veterans' parents, widows, and children, could also file applications and receive pensions. In the upper panel in Table 3.11, I include the interaction of wartime social networks WSN_{ij} and a dummy of veterans having a pension for themselves. In the lower panel, the regression includes the interaction of wartime social networks WSN_{ij} and a dummy of veterans having a pension for themselves or their dependents. As shown in Table 3.11, the odds ratios of the interaction of wartime social networks WSN_{ij} and a dummy of having a pension are not significant. Compared with other veterans, the veterans who had pensions for themselves or their dependents were not more likely to live in a place with more wartime friends. These results suggest that the main findings about the effect of wartime social networks on location choice are unlikely to be driven by the selection problem.

[7] In 1870, the rates of living veterans successfully linked to the census data ranged from 27.8% to 78% in the 169 companies, with a median value of 59%. In 1900, the rates of living veterans successfully linked to the census data ranged from 27.3% to 79.5% in the 169 companies, with a median value of 49.3%.

3.5.2 Military Experience

Veterans from the same wartime company had common military experiences. A potential explanation for the main findings is that these common experiences provided location information to all veterans in a given military company during the war and led some veterans to share the same post-war location choice. In this case, veterans were sorted to live with more wartime friends because of receiving the same location information during the war instead of social interactions.

The location information that veterans could obtain during their military experiences included the states they stayed in during the war, especially their discharge states. In Table 3.3, to control the effect of common military experiences, I include a dummy for whether county j is located in veteran i's discharge state and a dummy for whether county j is located in a state in which veteran i had stayed during the war. In this subsection, I further deal with this problem by excluding the veterans who chose to live in a place relating to their military experiences. In the veteran sample of 1880, 16.9% of veterans lived in their discharge states while 29.2% lived in states in which they had stayed during the war.[8] I exclude these veterans, as they were more likely to be affected by common military experiences.

I summarize the regression results in Table 3.12. In columns 1, 2, and 3, I use the data from 1870, 1880, and 1900. In the upper panel, the regression only keeps the veterans who lived in a county outside the states in which they had stayed during the war. In the lower panel, the regression only focuses on the veterans who lived in a county outside their discharge state. In both panels, when I focus on veterans who were less affected by common military experiences, the results do not change much from the baseline results in Table 3.3. Therefore, there is no evidence that the main finding of the effect of wartime social networks on location choice can be explained by the common military experiences.

[8] In the veteran sample of 1870, 17.6% of veterans lived in their discharge states, while 30.9% lived in states in which they had stayed during the war. In the veteran sample of 1900, 16.1% of veterans lived in their discharge states, while 27% of veterans lived in states in which they had stayed during the war.

3.5.3 The Effect in Heterogeneous Companies

In the main findings, although the effect of wartime social networks on location choice is very large, it may include both the *endogenous effect* and the *contextual effect*. The *endogenous effect* is social interaction: veterans were more likely to live in a county because their wartime friends chose the county. The *contextual effect* is from similar preferences in the same company. As the company assignment is not fully random, the variable of wartime social networks may also capture a similar preference. Therefore, the main problem that could bias the estimation of the *endogenous effect* is the *contextual effect* from the unobserved characteristics (preference) correlated with the variable WSN_{ij}.

To clarify the problem, I write the error term in the following form: δ_j is unobserved county utility common to all veterans; δ_{jc} is unobserved county utility specific to the veterans from company c; and υ_{ij} is veteran-specific preference shock for county j. The conditional logistic model assumes that the error term υ_{ij} is i.i.d. from Type I Extreme Value distribution. To have a consistent estimation for the coefficient of WSN_{ij}, I need to assume that δ_j and δ_{jc} are uncorrelated with WSN_{ij}. This assumption may be problematic because, if δ_{jc} is higher for some counties, WSN_{ij} should also be higher for that county. In that way, the coefficient of WSN_{ij} could capture the effect of similar preferences from δ_{jc}.

$$\varepsilon_{ij} = \delta_j + \delta_{jc} + \upsilon_{ij} \tag{3.5}$$

Although the same logic could also apply to δ_j, the potential bias from δ_j can be controlled by the total number of veterans who choose to live in county j. To deal with the bias from δ_{jc}, I first show the results from limiting the analysis to companies with a high level of heterogeneity. The high heterogeneity within a company could partly eliminate the problem of similar preferences among some soldiers. Men in the same military company who enlisted or were born in different places could be less likely to have similar preferences. I measure heterogeneity by age standard deviation and birthplace fragmentation. I

compute the S.D. of the veterans' age within companies. In the 169 companies, the within-company standard deviation of age ranges from 3.6 to 14.1 years. The median value is 7 years. I only keep the observations belonging to the companies whose standard deviation of age is above the median. I also compute the birthplace fragmentation for all the companies. The birthplace fragmentation is defined as below, where s_k is the share of the veterans born in state k. A higher level of birthplace fragmentation means that more of the veterans in the company were born in different states. The birthplace fragmentation ranges from 0.07 to 0.93, and the median value is 0.7. I only keep the observations for veterans in the companies whose birthplace fragmentation is above the median.

$$birthplace\ fragmentation = 1 - \sum_k s_k^2 \tag{3.6}$$

I summarize the regression results in Table 3.13. In columns 1, 2, and 3, I use the data from 1870, 1880, and 1900. In the upper panel, the regression only keeps the veterans belonging to the companies whose standard deviation of age is above the median. The regression only analyzes the veterans in companies whose birthplace fragmentation is above the median in the lower panel. The results do not change very much in the upper panel. However, the results are much larger in the lower panel than the baseline results in Table 3.3.

Based on these results, there is no evidence showing that a large part of the effect of WSN_{ij} is from the *contextual effect*. The effect of wartime social networks does not become smaller when I restrict the sample to veterans from companies with a high level of heterogeneity (who were less likely to share similar preferences). For veterans in companies with a high level of birthplace fragmentation, the effect of wartime social networks is even larger. In 1880, one additional man from the same military company living in county j can increase the probability of choosing county j by 21.4%. This result is consistent with the finding that the veteran's human capital and acquisition of information was most improved by

serving in heterogeneous companies (Costa and Kahn, 2006). The veterans in heterogeneous companies had larger incentives to live together after the war since the benefits might be larger.

3.5.4 Instruments: "Weak" Wartime Social Networks

To deal with the *contextual effect*, I further use a veteran's "weak" wartime social networks as the instrument. A veteran's "weak" wartime social networks are defined as his wartime friends who were born or enlisted in different states. Veterans in the same company who were born in other states or enlisted in different places were less likely to have similar unobserved county utility (δ_{jc}). The variable $Weak\ WSN_{ij}$ is defined as the number of men from the same company as veteran i living in county j who were born in different states or enlisted in different states from veteran i. The assumption is that the "weak" wartime social networks of a veteran are uncorrelated with the unobserved county utility common to all veterans (δ_j) and the unobserved county utility common to the veterans from company c (δ_{jc}).

The first and second stage of IV regressions are summarized as follows:

$$First\ Stage: \quad WSN_{ij} = \alpha_1' Z_j + \alpha_2 \cdot Weak\, WSN_{ij} + \alpha_3' D_j + \alpha_4' d_{ij} + \nu_{ij} \tag{3.7}$$

$$Second\ Stage: \quad P_{i,\,j} = \frac{e^{\,\gamma_1' Z_j + \gamma_2 \cdot WSN_{ij} + \gamma_3' D_j + \gamma_4' d_{ij} + \theta\widehat{\nu}_{ij}}}{\sum_{j=1}^{J} e^{\,\gamma_1' Z_j + \gamma_2 \cdot WSN_{ij} + \gamma_3' D_j + \gamma_4' d_{ij} + \theta\widehat{\nu}_{ij}}} \tag{3.8}$$

In the first stage, I regress WSN_{ij} on $Weak\ WSN_{ij}$ and compute the residuals. In the second stage, I use the control function approach, which instrument WSN_{ij} with $Weak\ WSN_{ij}$ by controlling the residuals $\widehat{\nu}_{ij}$, which I have computed in the first stage. I use the bootstrap method with 200 replications to correct standard errors.

The regression results from the IV estimation are summarized in Table 3.4. In columns 1, 2, and 3, I use the data from 1870, 1880, and 1900. In the upper panel, I instrument WSN_{ij} with the number of men from the same company as veteran i living in county j who were born in different states. In the lower panel, I instrument WSN_{ij} with the number of

men from the same company as veteran i living in county j who enlisted in different states. The results of the first stage are summarized in Table 3.5.

Table 3.4: Social Networks and Location Choice, With Instruments

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
IV1: number of men from the same war company as veteran i living in county j who were born in other states from veteran i			
WSN_{ij}	1.1808	1.2651	1.5630
	(0.036)***	(0.038)***	(0.096)***
$Veteran\ Number_j$	1.0234	1.0125	1.0201
	(0.003)***	(0.002)***	(0.003)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	11624306	14200210	9262350
Number of veterans	5437	6134	4050
IV2: number of men from the same war company as veteran i living in county j who enlisted in other places from veteran i			
WSN_{ij}	1.3769	1.3028	1.6159
	(0.068)***	(0.055)***	(0.148)***
$Veteran\ Number_j$	1.0158	1.0113	1.0191
	(0.003)***	(0.002)***	(0.004)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	11624306	14200210	9262350
Number of veterans	5437	6134	4050

This table reports estimation results of equation (3.8). Bootstrapped standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

The effect of wartime social networks is much larger when it is instrumented by the "weak" wartime social networks. In column 2, one additional wartime friend living in county j increases the probability of choosing county j by 26.5% and 30.3% in 1880. The explanation for this could be a larger local average treatment effect. The instrumented odds ratios of WSN_{ij} capture the *endogenous effect* induced by the "weak" wartime social networks, while the "weak" wartime social networks could create a larger incentive for veterans to choose

the county. As discussed in Subsection 3.5.3, veterans benefit more from heterogeneous companies, i.e., from more wartime friends who were unfamiliar before the war. The "weak" wartime social networks could allow veterans to learn more about migration and occupation opportunities and thus have a larger effect on their location choice. Meanwhile, there is no evidence showing that the *contextual effect* is as large or important as the *endogenous effect*.

Table 3.5: Social Networks and Location Choice, First Stage

odds ratio	WSN_{ij}		
	(1)	(2)	(3)
	1870	1880	1900
$Weak\ WSN_{ij}$	1.0568	1.1142	1.1128
	(0.040)***	(0.040)***	(0.059)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	11624306	14200210	9262350
Number of veterans	5437	6134	4050
	WSN_{ij}		
	(1)	(2)	(3)
	1870	1880	1900
$Weak\ WSN_{ij}$	0.8658	0.8254	0.7658
	(0.050)***	(0.040)***	(0.044)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	11624306	14200210	9262350
Number of veterans	5437	6134	4050

This table reports estimation results of equation (3.7). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. In the upper panel, $Weak\ WSN_{ij}$ is defined as the number of men from the same company as veteran i living in county j, who were born in different states. In the lower panel, $Weak\ WSN_{ij}$ is defined as the number of men from the same company as veteran i living in county j, who enlisted in different states.

3.6 Benefits from Social Networks

In this section, I show how veterans benefit from wartime social networks. I use individual-level data and find that the quality of the wartime social network mattered. In Subsection

3.6.1, I show that choosing a county with more social networks cannot lead to a higher income level. In Subsection 3.6.2, the results show that choosing a county with wartime friends who had higher income led to a higher income level. In Subsection 3.6.3, I find that choosing a county with wartime friends who had higher income would increase the probability of a veteran's children being literate.

3.6.1 The Effect of More Wartime Friends

In this subsection, I focus on the effect of wartime social networks on veterans when having more wartime friends living in the same county. More wartime friends may bring more chances to learn about occupational opportunities and more support for starting a business. I use the occupation income score as the measure of income level and exclude the veterans with missing or zero occupation income scores. The following equation estimates the effect of more wartime friends:

$$OIS_{ij} = \beta_1 \cdot WSN_{ij} + \beta_2' X_{ij} + \beta_3' Z_{ij,1870} + \beta_4' Z_{ij,1880} + \varepsilon_{ij} \tag{3.9}$$

I use the 1880 veteran sample, and each observation is a veteran i who lives in county j. The dependent variable OIS_{ij} is veteran i's occupation income score. The key explanatory variable WSN_{ij} is the number of men from the same company as veteran i who live in county j. Therefore, β_1 describes how the veteran can benefit from more wartime friends.

The regression results are summarized in Table 3.6. In column 1, I control for individual characteristics, including a dummy for literacy, a BMI dummy (=1 if $18.5 < \text{BMI} < 25$) for health condition, a dummy for illness or wound, the enlistment period, a dummy for whether the veteran was an officer during the war, and age. In column 2, I control for state-fixed effects of where veterans lived. In column 3, I include the urban population share (%) and the per capita manufacturing output for the county in which veteran i lived in 1870 and 1880. A higher urbanization rate and manufacturing output were related to more high-earning

occupations. Therefore, I control for any changes in a veteran's income due to migration between counties with different levels of economic development. Another potential problem is that the counties in which African American veterans had higher incomes could also be where all African American people had better access to high-earning occupations. Therefore, I control the measures of race-specific economic opportunity for the county in which veteran i lived in 1870 and 1880. I include the average occupation income score for the male African American population, the literacy for the male African American population, and the African American population share (%). In column 4, I control the total number of veterans living in county j. In column 5, the dependent variable is the logistic value of veteran i's occupation income score.

The benefits of more wartime friends living in the same county are insignificant and very small. A veteran would not have a higher income due to having more wartime friends living in the same county.

Table 3.6: Benefits from Social Networks on Income, More Wartime Friends

	occupation income score (1880)				
	(1)	(2)	(3)	(4)	(5) log
WSN_{ij}	0.0283	0.0419	-0.0034	0.0065	0.0004
	(0.017)*	(0.018)**	(0.018)	(0.020)	(0.001)
$Veteran\ Number_j$				-0.0045	-0.0002
				(0.004)	(0.000)
veteran individual controls	YES	YES	YES	YES	YES
state FE	NO	YES	YES	YES	YES
county characteristics, lived in 1870	NO	NO	YES	YES	YES
county characteristics, lived in 1880	NO	NO	YES	YES	YES
Obs.	4086	4086	4086	4086	4086
R-squared	0.029	0.091	0.149	0.149	0.143

This table reports the estimation results of equation (3.9). Coefficients are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

3.6.2 The Effect of Wartime Friends With Higher Income

In this subsection, I investigate the effect of wartime social networks when having wartime friends with higher income living in the same county. I measure the quality of social networks by computing the mean occupation income score of veteran i's wartime friends in the same county. When computing the mean, instead of the occupation income score in the current period (1880), I use the values in the last period (1870). Since I use the veteran's current occupation income score as the dependent variable, the mean occupation income score of the current value could be highly correlated with the error term. Using the values in the last period could partly solve this problem, as wartime friends living in the same county in 1880 might not live together in 1870. The *endogenous effect* captures how the average occupation income score of a veteran's wartime friends affects his income level.

The *contextual effect* would be important if the veterans in a county had a higher income level because veterans with higher ability were sorted into the same place. Education and health condition are important individual characteristics related to income. I use a dummy of literacy to represent education and a BMI dummy (=1 if $18.5 < \text{BMI} < 25$) as a proxy for a veteran's health condition. I compute the average value of literacy and the BMI dummy for a veteran's wartime friends living in the same county in 1880.

The effect of wartime friends with higher income on a veteran's income level is estimated by the following equation:

$$\begin{aligned} OIS_{ij} = \beta_1 \cdot \overline{OIS}_{i,j,1870} + \beta_2 \cdot \overline{OIS}_{i,-j,1870} + \beta_3' X_{ij} + \beta_4' \overline{X}_{i,j,1870} + \\ \beta_5' \overline{X}_{i,-j,1870} + \beta_6' Z_{j,1870} + \beta_7' Z_{j,1880} + \varepsilon_{ij} \end{aligned} \tag{3.10}$$

I use 1880 veteran data, and each observation is a veteran i who lives in county j. The dependent variable OIS_{ij} is the veterans' occupation income score in 1880. $\overline{OIC}_{i,j,1870}$ is the mean occupation income score in 1870 for the men from the same company as veteran i who lived in the same county as veteran i in 1880 (veteran i is excluded). $\overline{OIC}_{i,-j,1870}$ is the

mean occupation income score in 1870 for the men from the same company as veteran i who lived in a county other than county j in 1880. I control veteran i's individual characteristics X_{ij}.

$\overline{X}_{i,j,1870}$ are defined as the mean values of individual characteristics in 1870 for the men from the same company as veteran i living in county j in 1880 (veteran i is excluded). $\overline{X}_{i,-j,1870}$ are defined as the mean values of individual characteristics in 1870 for the men from the same company as veteran i living in a county other than county j in 1880. I also control characteristics of the county in which veteran i lived in 1870 and 1880, $Z_{ij,1870}$ and $Z_{ij,1880}$.

β_1 captures the *endogenous effect* of wartime social networks from having wartime friends with higher income. In the regression, I use a dummy of literacy and a BMI dummy (=1 if 18.5 $<$ BMI $<$ 25) to compute and represent the mean values of individual characteristics in 1870 for wartime friends. $\beta_4^{'}$ captures the *contextual effect*. I expect β_2 and $\beta_5^{'}$ to be insignificant since wartime friends living in other counties should not affect veteran i's income.

The regression results are summarized in Table 3.7. In column 1, I control the individual variables, including a dummy for literacy, a BMI dummy (=1 if 18.5 $<$ BMI $<$ 25), a dummy for illness or wound, the enlistment period, a dummy for whether the veteran was an officer during the war, and age. In column 2, I control the state-fixed effects of where veterans lived. In column 3, I include the urban population share (%) and the per capita manufacturing output for the county in which veteran i lived in 1870 and 1880. A higher urbanization rate and manufacturing output were related to more high-earning occupations. Therefore, I control any changes in a veteran's income due to migration between counties with different levels of economic development. Another potential confounder is that the counties in which African American veterans had higher incomes could also be where all African American people had better access to high-earning occupations. Accordingly, I control the measures of race-specific economic opportunity for the county in which veteran i lived in 1870 and 1880.

I include the average occupation income score for the male African American population, literacy for the male African American population, and the African American population share (%). In column 4, I include $\overline{literacy(=1)}_{i,j,1870}$, the mean values of literacy in 1870 for wartime friends of veteran i living in county j in 1880, and $\overline{BMI(=1)}_{i,j,1870}$, the mean values of the BMI dummy in 1870 for wartime friends of veteran i living in county j in 1880. As discussed above, this variable should capture the *contextual effect* of wartime social networks. I also include $\overline{OIC}_{i,-j,1870}$, $\overline{literacy(=1)}_{i,-j,1870}$, and $\overline{BMI(=1)}_{i,-j,1870}$ to test whether wartime friends living in other counties can affect a veteran's income.

Table 3.7: Benefits from Social Networks on Income, Wartime Friends with Higher Income

	occupation income score (1880)				
	(1)	(2)	(3)	(4)	(5) log
$\overline{OIS}_{i,j,1870}$	0.2425	0.1913	0.0766	0.0607	0.0030
	(0.026)***	(0.026)***	(0.028)***	(0.029)**	(0.002)*
$\overline{OIS}_{i,-j,1870}$				0.0059	-0.0001
				(0.082)	(0.005)
literacy (=1)	0.7608	0.4390	0.3475	0.2818	0.0062
	(0.262)***	(0.263)*	(0.256)	(0.266)	(0.016)
$\overline{literacy(=1)}_{i,j,1870}$				-0.0060	0.0012
				(0.451)	(0.027)
$\overline{literacy(=1)}_{i,-j,1870}$				0.8943	0.0542
				(1.357)	(0.080)
BMI (=1 if <18.5 or >25)	-0.3132	-0.1046	-0.0671	-0.0496	-0.0029
	(0.332)	(0.328)	(0.319)	(0.331)	(0.019)
$\overline{BMI(=1)}_{i,j,1870}$				0.3625	0.0179
				(0.510)	(0.030)
$\overline{BMI(=1)}_{i,-j,1870}$				-2.3052	-0.1177
				(1.634)	(0.096)
veteran individual controls	YES	YES	YES	YES	YES
state FE	NO	YES	YES	YES	YES
county characteristics, lived in 1870	NO	NO	YES	YES	YES
county characteristics, lived in 1880	NO	NO	YES	YES	YES
Obs.	2268	2268	2268	2134	2134
R-squared	0.058	0.106	0.164	0.160	0.147

This table reports the estimation results of equation (3.10). Coefficients are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

In Table 3.7, $\overline{OIS}_{i,j,1870}$ has a significant effect on a veteran's occupation income score. In column 4, the coefficient is 0.0607, which means that if the wartime friends' annual income is \$100 higher, the veteran's income would be \$6.07 higher in 1880. The standard error of

$\overline{OIS}_{i,j,1870}$ is 5.93. With one S.D. higher in $\overline{OIC}_{i,j,1870}$, the effect is about \$36 in annual income. The *endogenous effect* should induce a large part of the effect. In columns 3 to 4, where I include $\overline{literacy(=1)}_{i,j,1870}$ and $\overline{BMI(=1)}_{i,j,1870}$ to capture the *contextual effect*, their coefficients are not significant, and the results do not change too much. Meanwhile, when I include $\overline{OIS}_{i,-j,1870}$, it shows that wartime friends living in other counties do not affect a veteran's income. In column 5, the dependent variable is the logistic value of veteran i's occupation income score.

The quality rather than the quantity of wartime friends is what mattered. Veterans would have a higher income level if living in the same county with wartime friends who had a higher income. Meanwhile, there is no evidence that veterans with higher ability were simply sorted into the same place and therefore had a higher income at the same time.

3.6.3 The Effect on Children Education

In this subsection, I study whether wartime social networks could have an intergenerational impact on the literacy of veterans' children. Living with wartime friends who had higher incomes, could affect a veteran's educational investment in his children. The greater the educational investment, the higher the probability of the children being literate.

I am able to obtain information on the veterans' children because the veteran data is linked to the census data. If a veteran was the head of a household or the spouse to the head of a household, I can find the children of the veteran by having all the children in the household in the census data. I focus on the 1900 census data because most children of veterans were adults and alive in 1900. I find 3,198 children of 1,296 veterans. To measure the outcome of educational investment, I use the literacy of the children in 1900. About 1,300 children's fathers lived with at least one wartime friend in 1880.

The effect of wartime friends with higher income on the literacy of a veteran's children is estimated by the following equation:

$$Literate_{ikj} = \beta_1 \cdot \overline{OIS}_{i,j,1870} + \beta_2 \cdot \overline{OIS}_{i,-j,1870} + \beta_3' X_{ij} + \beta_4' Y_{ikj} + \beta_5' \overline{X}_{i,j,1870} + \beta_6' \overline{X}_{i,-j,1870} + \beta_7' Z_{j,1870} + \beta_8' Z_{j,1880} + \varepsilon_{ikj} \quad (3.11)$$

Each observation is a child k of veteran i who lives in county j. The dependent variable $Literate_{ikj}$ is a dummy indicating whether the child was literate. $\overline{OIC}_{i,j,1870}$ is the mean occupation income score in 1870 for the men from the same company as veteran i who lived in the same county as veteran i in 1880 (veteran i is excluded). β_1 captures how having wartime friends with higher income affects the literacy of a veteran's children.

The regression results are summarized in Table 3.14. In column 1, I control the veteran's individual variables, including a dummy for literacy, a BMI dummy (=1 if BMI < 18.5 or $>$ 25), a dummy for illness or wound, the enlistment period, a dummy for whether the veteran was an officer during the war, and age. I also control the children's individual variables, including age and gender. In column 2, I control the state-fixed effects of where veterans lived. In column 3, I include the urban population share (%), the per capita manufacturing output, the average occupation income score for the male African American population, the literacy for the male African American population, and the African American population share (%) for the county in which veteran i lived in 1870 and 1880. In column 4, I control $\overline{literacy(=1)}_{i,j,1870}$, the mean values of literacy in 1870 for wartime friends of veteran i living in county j in 1880, and $\overline{BMI(=1)}_{i,j,1870}$, the mean values of the BMI dummy in 1870 for wartime friends of veteran i living in county j in 1880. As discussed above, this variable should capture the *contextual effect* of wartime social networks. I also include $\overline{OIC}_{i,-j,1870}$, $\overline{literacy(=1)}_{i,-j,1870}$ and $\overline{BMI(=1)}_{i,-j,1870}$ to test whether wartime friends living in other counties can affect a veteran's children's literacy. I use the Probit model in columns 1–4 and the Logit model in column 5.

In Table 3.14, $\overline{OIS}_{i,j,1870}$ has a significant effect on the probability of a veteran's child being literate. In column 4, the coefficient is 0.027, and the corresponding marginal effect

is about 0.007. If the wartime friends' annual income is $100 higher, it would increase the probability of being literate by about 0.7%. The standard error of $\overline{OIS}_{i,j,1870}$ is 5.93. A one S.D. increase in $\overline{OIC}_{i,j,1870}$ increases the probability of being literate by about 4%. The *endogenous effect* should induce a large part of the effect. In columns 3 to 4, where I include $\overline{literacy(=1)}_{i,j,1870}$ and $\overline{BMI(=1)}_{i,j,1870}$ to capture the *contextual effect*, the results do not change much. Meanwhile, when I include $\overline{OIS}_{i,-j,1870}$, I find that wartime friends living in other counties did not affect the literacy of a veteran's child.

The quality of wartime friends could have an intergenerational impact on veterans' children. Living with wartime friends who had higher incomes could increase a veteran's educational investment in his children and lead to a higher probability of the children being literate.

3.7 Conclusion

This paper shows that temporary social networks, formed by spending two years of life in the same wartime company, had persistent effects on veterans' location choice and income for a long period after the war. Wartime social networks, which are defined as the wartime friends from the same military company, had a significant effect on the veteran's choice of the county in which to live after the war. I further show that veterans could benefit from living together. A veteran could earn more when he has higher-income wartime friends living in the same county.

The paper provides empirical evidence regarding the effect of temporary social networks and shows that the lack of social networks could help explain the low mobility of the African American population in 1870–1900.

3.8 Appendix Tables

Table 3.8: Social Networks and Location Choice, in Different Regions

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
veterans in a county having lynching			
WSN_{ij}	1.1003	1.0992	1.0001
	(0.022)***	(0.026)***	(0.054)
$Veteran\ Number_j$	1.0386	1.0239	1.0509
	(0.004)***	(0.004)***	(0.007)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	1721090	1914505	1335608
Number of veterans	805	827	584
veterans in a Southern state			
WSN_{ij}	1.1271	1.1307	1.1975
	(0.018)***	(0.023)***	(0.035)***
$Veteran\ Number_j$	1.0374	1.0224	1.0356
	(0.002)***	(0.002)***	(0.003)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	8173574	9961445	6300685
Number of veterans	3823	4303	2755

This table reports estimation results of equation (3.1). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

Table 3.9: Social Networks and Location Choice, Education and Health

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
literate veterans			
WSN_{ij}	1.1581	1.1568	1.2050
	(0.024)***	(0.027)***	(0.041)***
$Veteran\ Number_j$	1.0195	1.0142	1.0343
	(0.002)***	(0.002)***	(0.002)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	2834988	3970225	3441935
Number of veterans	1326	1715	1505
veterans in good health			
WSN_{ij}	1.1435	1.1484	1.2091
	(0.018)***	(0.022)***	(0.035)***
$Veteran\ Number_j$	1.0256	1.0170	1.0313
	(0.002)***	(0.002)***	(0.002)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	6103990	8634950	6844991
Number of veterans	2855	3730	2993

This table reports estimation results of equation (3.1). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

Table 3.10: Social Networks and Location Choice, Linkage Rate

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
the rate of veterans linked to pension records $\geq$ median			
WSN_{ij}	1.1425	1.1402	1.1845
	(0.020)***	(0.028)***	(0.039)***
$Veteran\ Number_j$	1.0267	1.0152	1.0307
	(0.003)***	(0.002)***	(0.002)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	6061230	7553845	4873597
Number of veterans	2835	3263	2131
the rate of alive veterans linked to census $\geq$ median			
WSN_{ij}	1.1310	1.1360	1.2339
	(0.022)***	(0.024)***	(0.052)***
$Veteran\ Number_j$	1.0266	1.0146	1.0302
	(0.003)***	(0.002)***	(0.003)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	6809530	8227510	5308127
Number of veterans	3185	3554	2321

This table reports estimation results of equation (3.1). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

Table 3.11: Social Networks and Location Choice, Having Pension

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
pension for veterans			
WSN_{ij}	1.1384	1.1356	1.1896
	(0.017)***	(0.022)***	(0.035)***
$Veteran\ Number_j$	1.0257	1.0175	1.0330
	(0.002)***	(0.001)***	(0.002)***
WSN_{ij} * personal pension (=1)	0.9927	1.0174	1.0049
	(0.034)	(0.040)	(0.019)
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	11624306	14200210	9262350
Number of veterans	5437	6134	4050
pension for veterans and their dependents (parents, widows, and children)			
WSN_{ij}	1.1370	1.1346	1.1902
	(0.017)***	(0.022)***	(0.034)***
$Veteran\ Number_j$	1.0257	1.0175	1.0330
	(0.002)***	(0.002)***	(0.002)***
WSN_{ij} * personal/dependent pension (=1)	1.0209	1.0195	1.0187
	(0.031)	(0.035)	(0.056)
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	11624306	14200210	9262350
Number of veterans	5437	6134	4050

This table reports estimation results of equation (3.3). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

Table 3.12: Social Networks and Location Choice, Military Experience

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
veterans who lived in a county outside the states in which they had stayed			
WSN_{ij}	1.1497	1.1344	1.1756
	(0.023)***	(0.030)***	(0.052)***
$Veteran\ Number_j$	1.0242	1.0167	1.0328
	(0.002)***	(0.002)***	(0.002)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	8004672	10123495	6778668
Number of veterans	3744	4373	2964
veterans who lived in a county outside their discharge states			
WSN_{ij}	1.1312	1.1345	1.1863
	(0.019)***	(0.024)***	(0.039)***
$Veteran\ Number_j$	1.0249	1.0168	1.0324
	(0.002)***	(0.002)***	(0.002)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	9501272	11790295	7766652
Number of veterans	4444	5093	3396

This table reports estimation results of equation (3.1). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

Table 3.13: Social Networks and Location Choice, in Heterogeneous Companies

odds ratio	=1 if veteran i lives in county j =0 otherwise		
	(1)	(2)	(3)
	1870	1880	1900
within company age S.D. $\geq$ median			
WSN_{ij}	1.1268	1.1270	1.1442
	(0.021)***	(0.032)***	(0.056)***
$Veteran\ Number_j$	1.0298	1.0223	1.0404
	(0.003)***	(0.002)***	(0.004)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	5725564	6840825	4306421
Number of veterans	2678	2955	1883
birthplace fragmentation $\geq$ median			
WSN_{ij}	1.1636	1.2135	1.3405
	(0.038)***	(0.040)***	(0.106)***
$Veteran\ Number_j$	1.0261	1.0194	1.0442
	(0.002)***	(0.002)***	(0.004)***
County-specific controls	YES	YES	YES
Veteran- and county-specific controls	YES	YES	YES
Obs.	5625078	6819990	4384179
Number of veterans	2631	2946	1917

This table reports estimation results of equation (3.1). Standard errors are clustered at the company-level. Odds ratios are reported with standard errors in round brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels. The variable WSN_{ij} is defined as the number of men from the same wartime company as veteran i in county j. $Veteran\ Number_j$ is the total number of veterans in county j.

Table 3.14: Benefits from Social Networks on Children's Education, Wartime Friends with Higher Income

	=1 if attend school, =0 otherwise				
	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Logit
$\overline{OIS}_{i,j,1870}$	0.0495	0.0332	0.0245	0.0270	0.0483
	(0.009)***	(0.010)***	(0.012)**	(0.012)**	(0.022)**
$\overline{OIS}_{i,-j,1870}$				-0.0076	-0.0081
				(0.033)	(0.056)
literacy (=1)	0.5256	0.3855	0.4362	0.4022	0.7432
	(0.086)***	(0.095)***	(0.099)***	(0.105)***	(0.184)***
$\overline{literacy(=1)}_{i,j,1870}$				0.0444	0.1779
				(0.202)	(0.362)
$\overline{literacy(=1)}_{i,-j,1870}$				-0.1874	-0.1995
				(0.560)	(1.000)
BMI (=1 if <18.5 or >25)	-0.1876	-0.0684	-0.0934	-0.1077	-0.2392
	(0.135)	(0.144)	(0.149)	(0.154)	(0.274)
$\overline{BMI(=1)}_{i,j,1870}$				-0.0405	-0.0971
				(0.221)	(0.399)
$\overline{BMI(=1)}_{i,-j,1870}$				1.3546	2.4891
				(0.747)*	(1.322)*
veteran individual controls	YES	YES	YES	YES	YES
children individual controls	YES	YES	YES	YES	YES
state FE	NO	YES	YES	YES	YES
county characteristics, lived in 1870	NO	NO	YES	YES	YES
county characteristics, lived in 1880	NO	NO	YES	YES	YES
Obs.	1333	1199	1199	1138	1138
Pseudo R-squared	0.091	0.148	0.168	0.167	0.171

This table reports estimation results of equation (3.11). Coefficients are reported with standard errors in brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

Chapter 4

Temple Destruction, School Construction, and Modern Human Capital in 20th Century China

4.1 Introduction

Modern human capital is long regarded as a crucial factor that paves the way from stagnation to sustained economic development (Kuznets, 1973; Mokyr and Voth, 2010). However, traditional societies generally lack the economic resources to effectively modernize their existing education systems (Chaudhary et al., 2012). Meanwhile, they do not often have the incentives to do so, given the potential obstruction by powerful vested interests and the cost of harming traditional culture (Mariscal and Sokoloff, 2000; Go and Lindert, 2010; Cantoni and Yuchtman, 2013; Chaney, 2019). Therefore, to understand the process of economic modernization, it is critical to carefully examine the political and economic factors that allow modern human capital to emerge and thrive in traditional societies.

In this paper, we shed new light on this question in the context of early 20th century China, when the country abandoned its 13-century old civil service exam system, and rapidly established a modern education system nationwide (Gao, 2018). Specifically, we focus on a historical episode known as the "Temple Destruction Movement" (TDM), in which local governments were encouraged to confiscate the assets of Buddhist and Taoist temples to support modern education in the local areas. Leveraging detailed historical records from

various sources, we first quantify the central role of the TDM in the emergence of modern human capital in traditional Chinese society. We then discuss the underlying political-economic conditions that forced the repressive policy on traditional culture and enabled such secularization of religious assets for modernization.

Our results suggest that before the TDM started, the regional initial stock of temple assets was orthogonal to the levels and trends of human capital development. However, after the TDM started, areas with higher initial stocks of temple assets started to construct more modern schools, enroll more students in modern education programs, and produce more modern elites (top university alumni). A back of the envelope calculation suggests that the TDM could account for nearly 70% of the modern school construction during our sample period, which is consistent with numerous case studies compiled from historical archives (Xu, 2010).

We provide additional evidence on the political-economic mechanisms behind the secularization of religious assets. First, we find that only public temples were "taxed" to support modern education, while clan temples (ancestral halls controlled by local clan families) were completely immune to the process. Second, we find that the TDM was more effective in regions with stronger state capacity. Third, we find that the TDM was more effective in regions with a stronger civil society. Together, these findings suggest that in order to secularize religious assets to support modernization, the religious sector had to be relatively weak compared to the state. A strong local government would repress the religious sector and confiscate more temple assets. The development of human capital was at the cost of traditional culture and religion. At the same time, in order to ensure that the confiscated religious assets would indeed be used to support modern education (rather than being captured by the state), the presence of a strong civil society provided critical checks and balances.

To rule out alternative interpretations of our main findings, we conduct a series of additional analyses. First, we conduct a synthetic control test to show that, in areas that

had rich stocks of temples but were excluded from the TDM due to historical coincident, few schools were constructed, suggesting that our findings are indeed driven by the appropriation of temple assets for school construction, rather than other confounding factors that are correlated with the presence of temple assets. Second, the effects cannot be explained by the distribution of temple buildings at present; this suggests that the power of local governments and civil society to direct temple assets to modern education, rather than cultural or geographical attributes related to temple distribution, was the driving force behind modern education expansion during the TDM. Third, we find that in places where temples were razed before the TDM due to the Taiping Rebellion in the 1850s, the initial stock of temple assets (measured using data from 1820) has little predictive power on school construction during the TDM period, again suggesting that the investment of physical temple assets in education was the main mechanism behind our findings.

Our study speaks to three strands of literature. First, it adds to the economic history literature on modern human capital in traditional societies. Although an extensive literature has long argued that modern human capital is essential for the transition toward sustained economic growth (Kuznets, 1973; Mokyr, 2005; Mokyr and Voth, 2010; Galor, 2011; Becker and Woessmann, 2009; Becker et al., 2011; Squicciarini and Voigtländer, 2015), how modern human capital could actually emerge in a traditional society is relatively under-researched. The handful of papers studying the emergence of modern human capital mainly focus on Europe (Becker and Woessmann, 2009; Cantoni and Yuchtman, 2014), and the human capital modernization process in other economies is much less well-understood. In this paper, we add to this literature by focusing on 20th century China, and demonstrate how the government's appropriation of religious assets helped initiate the massive modernization of human capital.

Second, our paper contributes new evidence to the literature on secularization and development. Specifically, existing work on this topic mainly focuses on investigating the relationship between the Reformation, secularization, and historical development (Rubin, 2017; Cantoni et al., 2018), with some work making comparisons between Europe and the

Islamic world (Chaney, 2008; Kuran, 2012). Our paper adds to this literature by providing the first empirical evidence on secularization and development in the context of historical China, documenting how Buddhist and Taoist temple assets were used to modernize human capital across the country. The political-economic mechanisms for secularization in our setting also differ from those in the case of the Reformation. We find that the state had to be strong relative to the religious sector in order to ensure the confiscation of religious assets, and that the civil society had to be strong relative to the state to prevent political elites from capturing the secularized assets.

Third, this study relates to a growing literature on the persistence of human capital through history. It has been shown that mass human capital accumulation in history can have persistent effects on today's levels of education (Huillery, 2009; Nunn, 2009; Wantchekon et al., 2015; Rocha et al., 2017). We add another piece of evidence to this literature, by documenting the persistence of modern human capital in 20th century China. A paper closely related to ours is Chen et al. (2020), which shows that the presence of more traditional elites under the old civil service exam system could lead to higher levels of human capital today. Our paper complements Chen et al. (2020) by investigating the persistence of modern (rather than traditional) human capital, which emerged mostly after the civil service exam was abolished and the TDM was implemented.

The remainder of this paper is organized as follows. Section 4.2 documents the historical background of modern human capital formation in China and introduces the TDM. Section 4.3 explains the data and presents descriptive statistics. Section 4.4 discusses the effects of the TDM on modern human capital formation. In Section 4.5, we investigate the political-economic mechanisms behind the baseline findings. Section 4.6 discusses the short-run and long-run significance of the TDM. Section 4.7 concludes.

4.2 Historical Background

For over 1300 years, China's civil society was fundamentally shaped by its civil service exams (Ho, 1962; Elman et al., 2000). At various levels, tutors, schools, and academies trained students in Confucian classics, including the Four Books and Five Classics (*Sishu Wujing*), which were the official materials assigned by the government. To prepare for the civil service exams, students had to fully devote themselves to writing poems and eight-legged essays (*Baguwen*), leading to the academic tradition of valuing humanities over science and technology (Huff, 2017).

It is believed that the traditional education system had mixed impacts on historical China. On the one hand, the Confucian classics helped maintain political stability in the local areas (Kung and Ma, 2014), and the civil exams, as a meritocracy system, effectively provided upward social mobility (Bai and Jia, 2016) and affected a region's long-run economic development (Yang, 2017). On the other hand, the traditional education system discouraged the cultivation of modern human capital and "practical" knowledge, which explains why China failed to modernize its institutions and economy in the 19th century (Lin, 1995).

After China's consecutive military defeats against the western powers and Japan in the late 19th century, the imperial government and traditional elites realized the urgency of adopting modern technologies and education systems. However, the public provision of modern education required tremendous financial support, which was not affordable for the late Qing government: after the Sino-Japanese war in 1894, the deficit of the Qing government reached 15 million tael of silver, which further increased to 80 million in 1910 (Zhang, 1999)[1]. As a result, the central government decided to fund only some small and elite education programs, such as establishing a handful of public universities and sending elite youngsters to study abroad, while leaving the entire responsibility of providing mass modern education to the local governments and local elites.

[1] Tael is a Chinese traditional unit of weight, 1 tael $\approx$ 1.33 ounce.

In 1898, one of the most powerful Chinese politicians at the time, Zhang Zhidong, wrote a famous proposal (*Quanxue Pian*) to the Emperor Guangxu and Empress Dowager Cixi, suggesting that the government should confiscate the assets of the country's over two million Buddhist and Taoist temples, and use that money to support modern education nationwide. As part of the comprehensive 1898 national reform plan (*Wuxu Bianfa*), the government accepted this advice. This massive program approved by the Qing government, commonly known as the Temple Destruction Movement (TDM)[2], aimed to convert 70% of the country's temples into primary schools, and confiscate 70% of their assets as local education budgets (Shi, 1974; Xu, 2010).[3] However, the 1898 national reform only lasted 104 days, before six of the major designers of the reform were sentenced to death and the emperor himself was imprisoned in the Forbidden City. As a result, the vast majority of the innovative new policies issued during the reform were suspended by the central government, including the TDM[4].

In 1905, Japan won the Russo-Japanese War, which was the first major military victory by an Asian power over a European nation in the modern era. The traditional elites in China attributed Japan's success to the Meiji restoration and modernization reform. This set an example for the Qing dynasty, and facilitated a new round of education reforms. In the same year, the Qing government abolished the civil service exam and the traditional education system, and required primary and secondary schools to teach modern curricula instead of Confucian classics (Franke, 1960; Borthwick, 1983). The modern education system included six years of primary school and six years of secondary education. The primary and secondary school curricula taught students about foreign languages, math and sciences at introductory levels.

Under this pressure to replace the old education system with a modern one, between

[2] Some historical studies name this program as the "Temple Expropriation Movement."

[3] Indeed, imperial China had a long-standing historical tradition that governments solve their fiscal crises by seizing temple assets, which might have inspired Zhang's idea (Shi, 1974).

[4] The only exception is Peking University, which was founded during the reform and remains the top university in China today.

1900 and 1905, some local elites urged the local governments to restart the TDM program, and some local officials indeed enforced these programs spontaneously (Shi, 1974; Katz, 2014). However, following strong resistance from the local Buddhist and Taoist leaders, the central government officially discouraged such initiatives.[5] In April 1905, the Qing government explicitly re-emphasized that the TDM policy remained illegal in the country. The official statement of the Qing government, combined with the strong resistance from Buddhist and Taoist leaders, significantly limited the scope of the TDM (and the modernization of education) in the late Qing era (Xu, 2010). The limited scope of TDM enforcement during the late Qing era is also supported by the fact that the "initial stock of temples" is uncorrelated with the levels and trends of "modern school construction" during this period, as we will discuss in greater detail in Section 4.4.

In 1912, the Qing government was overthrown by Republican revolutionaries, and the Republic of China was founded. Motivated by the spirit of "eradicating superstition and promoting modernization," the Republican government immediately decided to stop protecting the temples. Specifically, in 1913, President Yuan Shikai issued the interim version of "Thirty-One Rules of Temple Administration," which officially activated the aggressive enforcement of the TDM by empowering the local officials to legally confiscate temple assets to support local modern education.[6] Following the declaration of the "Thirty-One Rules" in 1913 and its formalization in 1915, local officials and elites quickly seized the opportunity to appropriate temple assets, and the TDM soon thrived nationwide.

[5] In April 1905, the central government officially required that "the local officials shall protect temple assets from the confiscation of local governments and elites" (Shoupeng Zhu. The chronicle of the Qing dynasty (*Guangxu chao donghua lu*), pp. 5321).

[6] Specifically, the "Thirty-One Rules" offered a few guidelines for TDM enforcement. First, the Republican government asked the local officials to distinguish between "superstition" and "religion." It was required that temples related to "religion" should be protected, while temples related to "superstition" could be freely confiscated for modern education. Second, the Republican government required that "privately funded" temples (e.g., clan temples) should be protected, while "publicly funded" temples could be confiscated for modern education. Third, all temples were required to get registered, so that the government could collect a "religious tax." While the central government promised to protect those "religious temples" and "privately funded temples," these features were not clearly defined, which left the local governments with substantial discretion in implementing the TDM.

In the 1930s, the Republican party (*Kuomintang*) re-established centralized state power, and a series of additional policies were strictly enforced to help further confiscate remaining temple assets for school construction. Specifically, local governments were required to conduct detailed surveys of all the temple assets within their jurisdictions, so that they could confiscate all the valuable properties accordingly. As documented by historical studies, the TDM reached its peak between 1928 and 1938 (Goossaert and Palmer, 2011). In 1949, the People's Republic of China was established, and the TDM was officially terminated by the new government.[7]

Buddhist and Taoist temples were targeted for confiscation during the TDM because they had accumulated tremendous wealth in the form of buildings, land, antiques, artworks, gold and silver, etc. Despite the lack of accurate administrative records, some historical studies estimate temple assets based on various archives. Xu (2010), for example, estimates that about two million Buddhist and Taoist temples existed in the late Qing dynasty, collectively owning about 16 million buildings, 13,000 square kilometers of land and millions of tael of silver.

While causing the greatest disaster for Buddhism and Taoism in Chinese history[8], the TDM is believed to have contributed significantly to China's modern education system. In Table 4.9, we summarize the county gazetteer data collected by Xu (2010), which covers eight different counties across China. Based on this information, between 1910 and 1930, roughly 70% of modern schools in these counties were established with temple assets.[9] In addition to financing school construction, temple assets also helped sustain the operation of these schools during wartime: throughout the Republican era, many local governments imposed substantial "religion taxes" on temples and their land holdings, which contributed

[7] For more information on the implementation of the TDM policy in the first half of the 20th century, see Katz (2008, 2012, 2014) and Shi (1974).

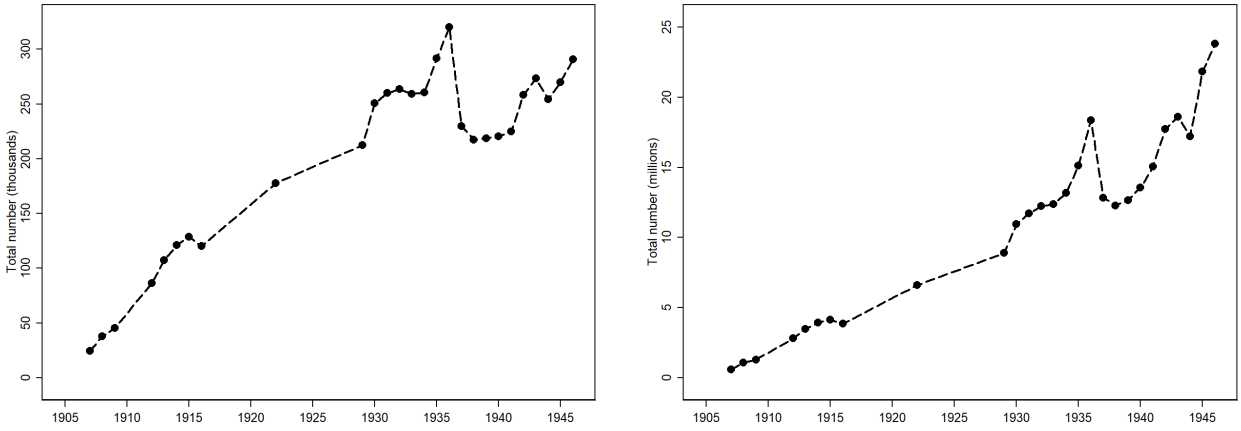
[8] There were four similar events of confiscating temple assets in Chinese history, referred to by the Buddhists as the "four great disasters" (*Sanwu Yizong Fanan*), but it has been documented by historians that none of them could compare to the TDM in terms of magnitude (Duara, 1991; Shi, 1974; Goossaert, 2006; Goossaert and Palmer, 2011).

[9] The most common form of using temple assets was to confiscate the real estate assets and build schools in temples.

greatly to the provision of modern education in that era (Xu, 2010).

With adequate resources confiscated from temples, modern education thrived nationally during the TDM (Shang, 2001; Su, 2007). As shown in Figure 4.1, in the first half of the 20th century, the development of modern education was boosted twice: first in the 1910s, and again in the 1930s. During these two decades, the number of modern schools and students increased drastically, concurring with the periods in which the TDM was initiated and reinforced by the central government. These patterns are consistent with historical case studies suggesting that the TDM was the predominant driving force behind China's construction of its modern education system.

Figure 4.1: Total Number of Primary Schools and Students, 1907–1946



(a) Primary Schools

(b) Primary Students

4.3 Data and Variables

In this study, we put together what is, to our knowledge, the most comprehensive and disaggregated dataset on the development of education in early 20th century China, and combine it with rich information on historical temple distributions, and other important historical socio-economic characteristics.

4.3.1 Main Dataset

4.3.1.1 Historical Data on Modern Education

We digitize historical records on modern education for six historical periods ranging from 1907 to 1930, including detailed information on the number of schools and students, types of schools, and education budget at the county level. For the first five periods (1907, 1908, 1909, 1915, 1916), our data are digitized from the five rounds of the *Statistical Chart of Education* (*Jiaoyu Tongji Tubiao*) collected by the Ministry of Education of the Republican government.[10]

After 1916, due to increasing civil conflicts, the central government could no longer maintain a nationwide survey of education at the county level. Therefore, we instead search for the records of surveys conducted independently by different provincial authorities and try to match them to form a comprehensive national dataset. We are able to find education survey results for 10 provinces ranging between 1925 and 1935, and we merge these separate datasets into one cross-sectional dataset in 1930. The above surveys have been validated by historians as credible sources of information (Shang, 2001; Su, 2007). By digitizing all these survey data, we are able to construct a disaggregated and comprehensive education dataset for early 20th century China. Table 4.10 presents a detailed list of the historical archives used to construct this dataset.

We then perform three important adjustments to the dataset. First, we drop the 1916 data because of the large number of missing values and outliers. Second, we only keep counties within the "China proper," the core regions of China where Han people inhabited. Third, since county-level boundaries within each prefecture frequently changed between 1907 and 1930 and historical GIS maps at the county level are unavailable, we are unable to keep a panel dataset at the county level. Therefore, we aggregate the county-level dataset at

[10] This survey was initiated in 1907 by the Minister of Education Zhang Zhidong, who was also the initiator of the TDM. The details of this survey have been carefully documented by historians such as Guan (1999) and Wang (2010).

the prefecture level based on the 1820s map from CHGIS (2016).[11] Since county boundary changes rarely happen across different prefectures, this aggregation allows us to construct a prefecture-level panel dataset covering five years, with 264 prefectures from 1907 to 1915, and 135 prefectures in 1930.

4.3.1.2 Top University Alumni

From the official alumni books of the top two universities in China (Peking University and Tsinghua University), we are able to identify 16,439 students who graduated from these two institutions between 1910 and 1950.[12] We divide the era into eight five-year periods to smooth the trends and, for each prefecture, we count the number of students enrolled in the top two universities in each period.

4.3.1.3 Temple

The information on temple assets is documented in the *Imperial Encyclopedia of the Qing Empire* (*Daqing Yitong Zhi*), released in 1842, which was a comprehensive archive that took the Qing government more than 150 years to compile. For each prefecture, we count the number of important Buddhist and Taoist temples documented in the encyclopedia (as of 1820) and use this as the indicator for the prefecture's initial stock of temple assets before the TDM. We also collect the number of clan temples for each prefecture from the same source, by counting the number of important private temples that belong to those local clan families. In addition, for robustness checks, we collect an alternative measure of the number of Buddhist and Taoist temples from another, independent historical archive, the *Encyclopedia of Geographic Books* (*Gujin Tushu Jicheng Dilizhi*), which contains detailed physical and human geographic information for most Chinese prefectures in the 18th century. For each prefecture, we count its total number of important Buddhist and Taoist temples as

[11] The China Historical Geographic Information System provides a prefectural-level GIS map for 1820.

[12] Tsinghua University was established in 1911, while the PR China was established in 1949, and thus we only collect data between 1910 and 1950. For more details on the alumni data, see Hao (2021).

of 1776, which is more than 130 years before the TDM.

We also collect the number of Buddhist and Taoist temples in 2006. The GIS map from Wu (2016) provides the specific locations of all the 18,938 major Chinese temples in 2006.

4.3.1.4 Historical Control Variables

We also make use of a rich set of historical control variables, including population, land area, the importance of the local prefecture (as defined by the central government), whether the prefecture had a treaty port, the caloric suitability index post 1500, the number of *Jinshi*, and the number of Protestant missionaries and churches. We further collect the civil service exam quota, the local crop prices, the number of social conflicts in late Qing, the local tax revenue, the number of charity organizations, and the number of modern factories in 1916.

First, we collect prefecture-level information on the local population from the Population History of China by Ge (2000), which uses rich historical records to recover China's population distribution from 200 BC to 1953 AD. For the Qing dynasty, the Republic of China, and the PR China, Ge (2000) construct a prefecture-level population dataset for six years: 1776, 1820, 1850, 1880, 1910, and 1953. This dataset is recognized as providing reliable demographic records for historical China, and has been widely used by economic historians.

Second, we calculate the administrative area for each prefecture based on the 1820 China GIS map from CHGIS (2016).

Third, we construct a group of four variables to measure the administrative characteristics of every prefecture. Liu (1993) summarizes the designation of every prefecture, which indicates whether a prefecture belongs to any of the four categories: *chong* (important in transportation/communication), *fan* (important in public affairs), *pi* (difficult to gather taxes), and *nan* (high crime rate). We digitize this information and create a dummy variable for each category. In the Qing dynasty, the central government defined a prefecture's importance based on whether it belongs to none, one, two, three, or

all of these four categories. In the same way, we define the variable of prefectures' importance level as equal to 0, 1, 2, 3, or 4, where a higher value represents a higher level of administrative importance.

Fourth, some regions, known as the "treaty ports," were forced by western countries to open for international trade after the first opium war (1839–1842). Since these prefectures experienced very different development paths (Jia, 2014a), we digitize this information from the *Selected Statistical Materials on Modern Chinese Economic History* and construct a dummy variable for treaty ports (Yan, 1955).

Fifth, we measure the agriculture suitability by the Caloric Suitability Indices (CSI) constructed by Galor and Özak (2016). The CSI data provides the maximum potential caloric yield attainable in each cell of 5 longitude arc-degrees by 5 latitude arc-degrees. We use the maximum potential caloric yield attainable in the cells, given the set of crops that are suitable for cultivation in the post-1500 period. For each prefecture, we compute the average value of this index.

Sixth, the civil exam in the Qing dynasty (1644–1911) operated at different administrative levels, and there existed explicit quotas for each jurisdiction for each level of exam. Throughout the 268 years of the Qing dynasty, 26,849 successful candidates (*Jinshi*) passed the exam at the highest level and became government officials. From the *Official Records of Jinshi in the Qing Dynasty* (*Qingchao Jinshi Timing Lu*), we identify each successful candidate's prefecture of origin and aggregate to construct a prefecture-level dataset of successful candidates. We also collect the quota assigned to each prefecture for the prefecture-level exam, which was strictly regulated by the central government to control the number of candidates for the upper-level exams. We digitalize the exam quota from the *Imperially Established Institutes and Laws of the Great Qing Dynasty* (*Qinding Daqing Huidian Shili*). The number of *Jinshi* and the exam quota measure the levels of traditional elite human capital in each prefecture.

Seventh, we collect data on Protestant activities in China in 1920 from a statistical

report that was compiled and published by the China Continuation Committee, the central organization of Protestant churches in China at the time. In 1918, the China Continuation Committee conducted a three-year county-level survey on the status of Protestant activities in China. The statistical report, *The Christian Occupation of China: A General Survey of the Numerical Strength and Geographical Distribution of the Christian Forces in China* was published in 1922 with various measures of Protestant activities. From the report, we collect the numbers of Protestant missionaries and churches for each prefecture in 1920.

Eighth, the Database of Grain Prices in the Qing dynasty recorded prefecture-level monthly grain prices during 1736–1911, including the lowest and highest prices in each prefecture in each month for each crop (Wang, 2013b). We compute the standard score (z-score) of grain prices for each prefecture and for each year between 1902 and 1911.[13]

Ninth, we collect data on various types of social conflicts in 1902–1911, including protests, strikes, revolts, and riots from Ding and Zhang (1982). We calculate the average number of social conflicts at the prefecture level.

Tenth, during the Qing dynasty, the local governments were required to collect fixed amounts of silver and grain as the agricultural tax, which contributed to about 40% of the national fiscal income in the 1900s. We compute the agricultural tax burden in each prefecture based on (Liang, 1980).

Eleventh, the GIS map constructed by Wang (2013a) contains information on all the 5,412 major charity organizations in the Qing dynasty (as of 1820). We count the number of charity organizations in each prefecture and match this information with our prefecture-level dataset.

Finally, Chang (1989b) and Du (1991) summarize the information of the newly constructed modern factories between 1840 and 1937, including the founding year, location, industry, assets and owners. We count the total number of newly constructed modern factories before 1916 in each prefecture.

[13] The standard score (z-score) of raw variable X is $Z = \frac{X-\mu}{\sigma}$, where μ is the mean of X and σ is the standard deviation of X.

4.3.2 Summary Statistics and Balance Tests

Table 4.1 summarizes all the variables used in this study, including their definitions, sources, and basic descriptive statistics. We discuss the construction of these variables as follows.

Average Temple

Ideally, to proxy for temple assets, we would like to have detailed information on the number of temples in each prefecture along with measures for the scale and wealth of each temple. However, as discussed in Subsection 4.3.1.3, the *Imperial Encyclopedia of the Qing Empire* lists only important temples and omits the smaller ones; it also has little detailed information on the wealth level of each temple. Therefore, we proxy for the average initial stock of temple assets using the average number of important temples in 1820 in each prefecture, which is defined as the number of important temples in 1820 divided by the local population in 1820. Since 1820 is long before the start of the TDM, this proxy is pre-determined and would not have been affected by the TDM itself.

For this to be a good proxy, we also need to assume that the (unobservable) overall temple assets are positively correlated with the number of important temples, which seems to be reasonable. Further, since whether a temple is listed as "important" or not is a subjective judgment call made by the authors of the *Imperial Encyclopedia of the Qing Empire*, the standards may be inconsistent across regions and lead to measurement errors. However, as long as the measurement error is not correlated with the potential for future development in modern education, it only reduces our statistical power but does not bias our estimates. Figure 4.2 illustrates the geographical distribution of the initial stock of average temples, showing that the density of temple stock is fairly scattered nationally instead of being concentrated in specific clusters, reducing the concern about confounding spatial unobservable factors.

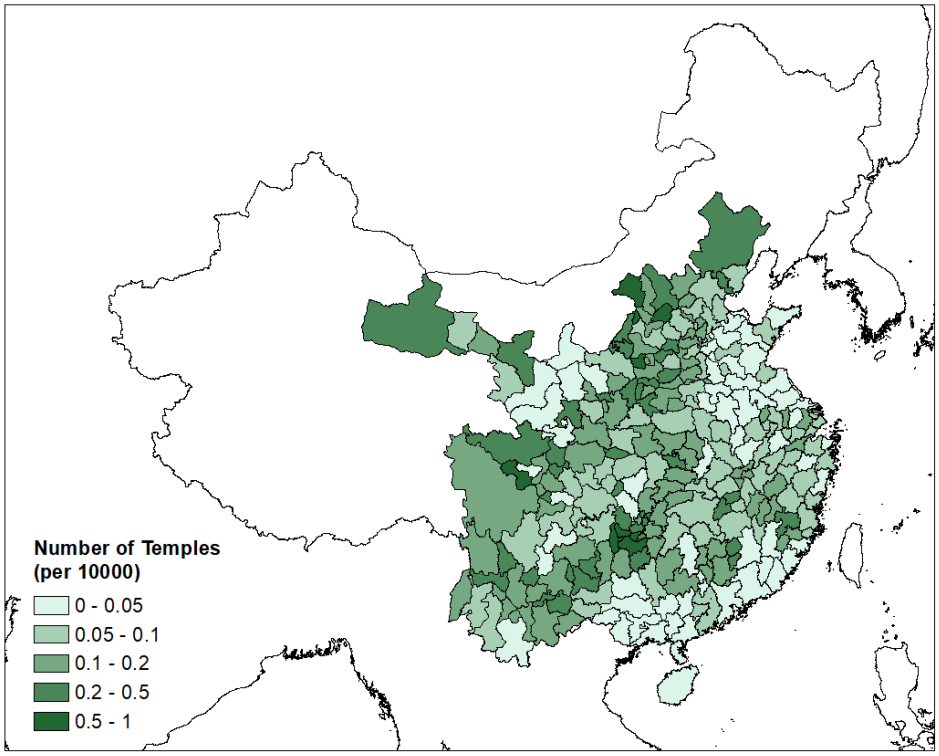
We also construct an alternative temple measure, the average number of important temples in each prefecture in 1776, which comes from another independent historical archive.

Table 4.1: Summary Statistics for Modern Education, Top University Alumni, Temples, and Control Variables

	Obs.	Mean	S.D.	Source
Modern Education				
Average Primary Schools	1152	2.57	4.41	1
Average Primary Students	1152	88.65	172.80	1
Average Secondary Schools	1152	0.01	0.02	1
Average Secondary Students	1152	0.98	3.02	1
Top University Alumni				
Average Top University Alumni	2640	0.03	0.05	2
Temple				
Average Temple	264	0.14	0.13	3
Average Temple in 1776	264	0.95	0.95	4
Average Temple in 2006	264	0.64	1.71	5
Average Clan Temple	264	0.35	1.11	3
Control Variables				
1820 Population (10,000)	264	143.68	128.69	6
1910 Population (10,000)	264	154.32	141.54	6
Area (squared km)	264	15914.78	19272.74	7
Importance Level (= 0,1,2,3,4)	264	2.34	1.14	8
Whether Treaty Port (= 0,1)	264	0.19	0.39	9
CSI (average caloric suitability index post 1500)	264	1905.24	511.59	9
Average *Jinshi* (# of civil exam graduates per 10,000)	264	0.63	0.88	10
Average Missionary (# of Protestant missionaries per 10,000)	264	0.24	0.29	11
Average Church (# of Protestant churches per 10,000)	264	0.17	0.30	11
High Grain Price (z-score of grain price)	256	1.40	1.06	12
Low Grain Price (z-score of grain price)	257	1.09	1.07	12
Average Civil Exam Quota (# of civil exam quotas per 10,000)	264	0.93	0.81	13
Average Social Conflicts (# of social conflicts per 10,000)	264	0.03	0.05	14

1: **Average Primary and Secondary Schools/Students** are constructed from the *Statistical Chart of Education* and the population data (Ge, 2000). 2: **Average Top University Alumni** is constructed from the official alumni Books of Peking University and Tsinghua University and the population data (Ge, 2000). 3: **Average Temple** and **Average Clan Temple** are constructed from the *Imperial Encyclopedia of the Qing Empire* and the population data (Ge, 2000). 4: **Average Temple in 1776** is constructed from the *Encyclopedia of Geographic Books* and the population data (Ge, 2000). 5: **Average Temple in 2006** is constructed from the China Buddhist GIS (Wu, 2016) and the population data (Ge, 2000). 6: **Population** is constructed from the population data (Ge, 2000). 7: **Area** is constructed from CHGIS (2016). 8: **Importance Level** is constructed from Liu (1993). 9: **Whether Treaty Port** is constructed from Yan (1955). 10: **Average *Jinshi*** is constructed from the civil exam graduate data (Jiang, 2007) and the population data (Ge, 2000). 11: **Average Missionary** and **Average Church** are constructed from the Protestant data (Stauffer, 1922) and the population data (Ge, 2000). 12: **High Grain Price** and **Low Grain Price** are the z-score of grain prices from Wang (2013b). 13: **Average Civil Exam Quota** is constructed from the *Imperially Established Institutes and Laws of the Great Qing Dynasty* and the population data (Ge, 2000). 14: **Average Social Conflicts** is constructed from the protest data (Ding and Zhang, 1982) and the population data (Ge, 2000).

Figure 4.2: Spatial Distribution of Average Temple Stock before TDM



We replicate our main analysis using this alternative measure to check for robustness with respect to the temple asset proxy variable. We can also replicate all the main results using the 1776 temples as an instrumental variable for 1820 temples to deal with measurement errors. These results are available upon request.

Average Number of Schools/Students

We use the education and population data described in Subsection 4.3.1.1 to calculate the average number of schools and students in each prefecture. For modern schools and students in 1907, 1908, 1909, and 1915, we use the population of 1910 as the denominator. For schools/students in 1930, since we only have population data for 1910 and 1953, we still use the 1910 population as the denominator because it is closer to 1930. However, to ensure this choice does not drive our results, we also use the 1953 population, as well as the average of the 1910 and 1953 populations; neither approach changes the results in any meaningful way.

Figure 4.3 illustrates the geographical distribution of the average number of primary schools in each prefecture in each year, which visualizes the dynamics of school construction in each region, as well as the reduction in sample size in 1930.

Average Top University Alumni

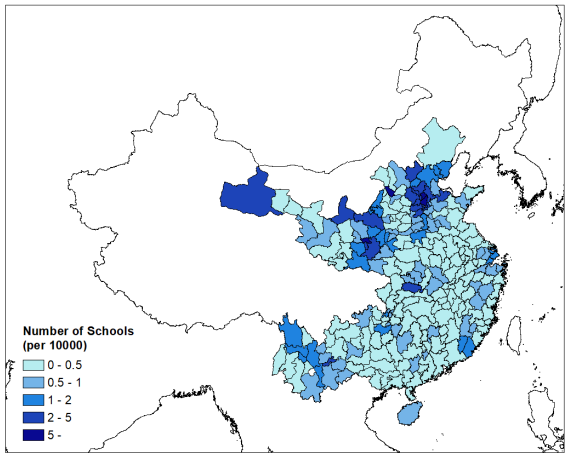
By using the alumni data from Subsection 4.3.1.2, combined with the population data, we calculate the average number of students enrolled in the top two universities in each period for each prefecture. Again we use the 1910 population as the denominator. We also use the 1953 population and the simple average of the 1910 and 1953 populations, but for all three choices, the results are essentially the same.

While our main analysis relies on a Difference-in-Differences design, which does not require the distribution of temples to be orthogonal to various socio-economic factors, we still conduct balance tests to understand the potential pre-TDM correlations between temples and different socio-economic factors. Specifically, we run cross-sectional regressions of those outcomes on the initial stock of temples, controlling for the initial levels of population and land area. Table 4.11 presents the results of these balance tests. As we can see, before the TDM, among the 12 variables examined, the only variable weakly correlated with temples is the average civil exam quota, but controlling for this variable (and its interactions with time fixed effects) in subsequent analyses will not change our main findings in any substantial way.

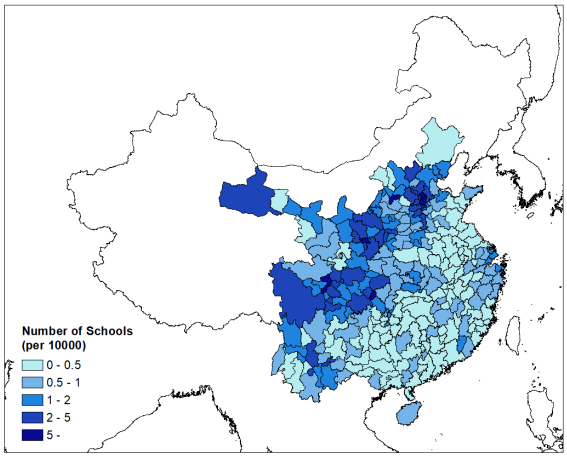
The fact that the initial stock of average temples is orthogonal to the initial levels of traditional elites (*Jinshi*) and modern primary schools or students strongly suggests no correlation between temples and human capital before the TDM. This finding suggests that any differences between areas with higher initial stocks of temples and lower initial stocks of temples after the TDM should not be attributed to differences in initial human capital stock.

Similarly, the fact that the initial average stock of temples is orthogonal to the initial

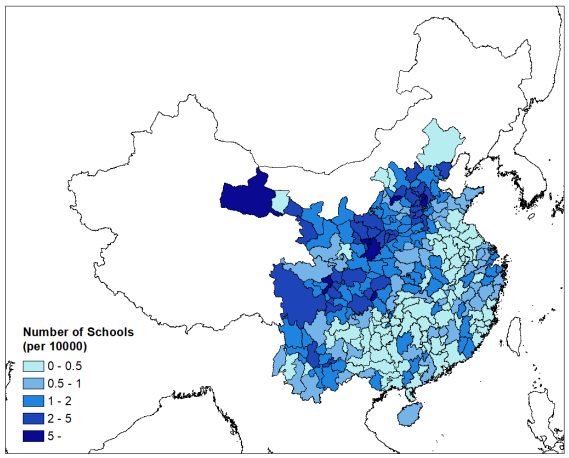
Figure 4.3: Spatial Distribution of Average Number of Primary Schools, 1907–1930



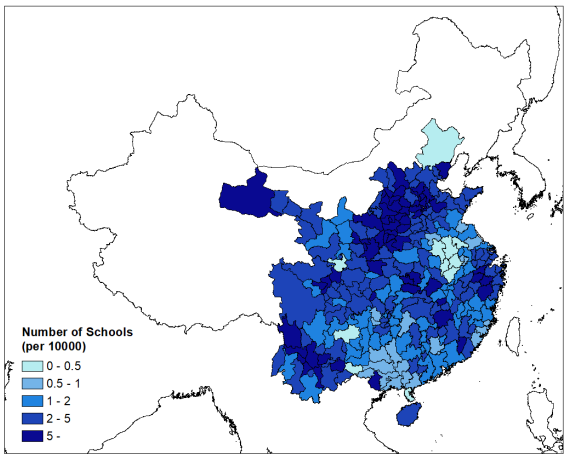
(a) 1907



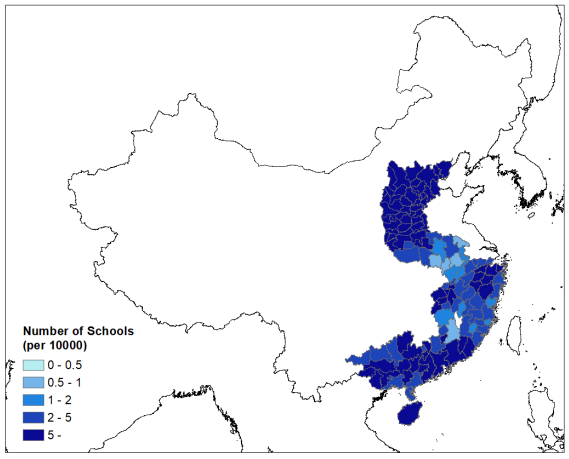
(b) 1908



(c) 1909



(d) 1915



(e) 1930

levels of tax revenue, crop prices, treaty ports, and factory establishments strongly suggests no correlation between temples and economic development before the TDM. Also, as pointed out by Galor and Özak (2016), caloric suitability is an important pre-condition for local development and urbanization. We find that this indicator is not correlated with temples either.

Finally, the fact that the initial average stock of temples is uncorrelated with the average number of local charity organizations suggests that areas with more temples did not have higher levels of altruism, which helps rule out altruistic public good provision as a potential confounding mechanism.

4.4 TDM Impacts on Short-run Human Capital Accumulation

In this section, we investigate the short-run effects of the TDM on modern human capital accumulation using a Difference-in-Differences (DiD) approach.

In Subsection 4.4.1, we present the baseline effects of the TDM on mass modern human capital accumulation, as measured by the average number of modern primary schools and students. In Subsection 4.4.2, we conduct a series of additional robustness checks. In Subsection 4.4.3, we investigate various alternative interpretations of the baseline findings, and discuss the robustness of our results.

4.4.1 TDM and Mass Human Capital Accumulation

After the TDM started, prefectures with higher initial stocks of temple assets suddenly obtained easier access to funding for modern education, which could potentially lead to increased modern school construction and student enrollment in these areas. We investigate this relationship using a DiD model:

$$School_{i\tau} = \sum_{\tau} \alpha_{\tau} \times Temple_i \times Year_{\tau} + X'_{i\tau} \times \beta + Year_{\tau} + \mu_i + \varepsilon_{i\tau} \tag{4.1}$$

where $School_{i\tau}$ is defined as the number of primary schools per 10,000 people in prefecture i in year τ, where $\tau \in \{1908,\ 1909, 1915,\ 1930\}$. $Temple_i$ is defined as the number of Buddhist and Taoist temples per 10,000 people in prefecture i (measured in 1820). $Year_{\tau}$ is the time fixed effect. $X_{i\tau}$ is a set of control variables that vary both across prefectures and over time, μ_i is the time-invariant effect unique to prefecture i, and $\varepsilon_{i\tau}$ is the error term distributed independently of μ_i and $Year_{\tau}$. The year 1907 is omitted for comparison. To address the serial correlation of the error term, we cluster our standard errors at the prefecture level.

Since the TDM was activated in 1912 (and formally legalized in 1913), the changes between 1907 and 1909 should be interpreted as "pre-TDM trends," while the changes between 1909 and 1930 should be interpreted as "post-TDM trends." As explained in Section 4.2, a potential concern is that some regions did implement the TDM prior to 1912, albeit in limited scopes due to the opposition of the central government. We conduct two tests to investigate whether the extent of "pre-1912 spontaneous TDM enforcement" would potentially affect the validity of our DiD strategy.

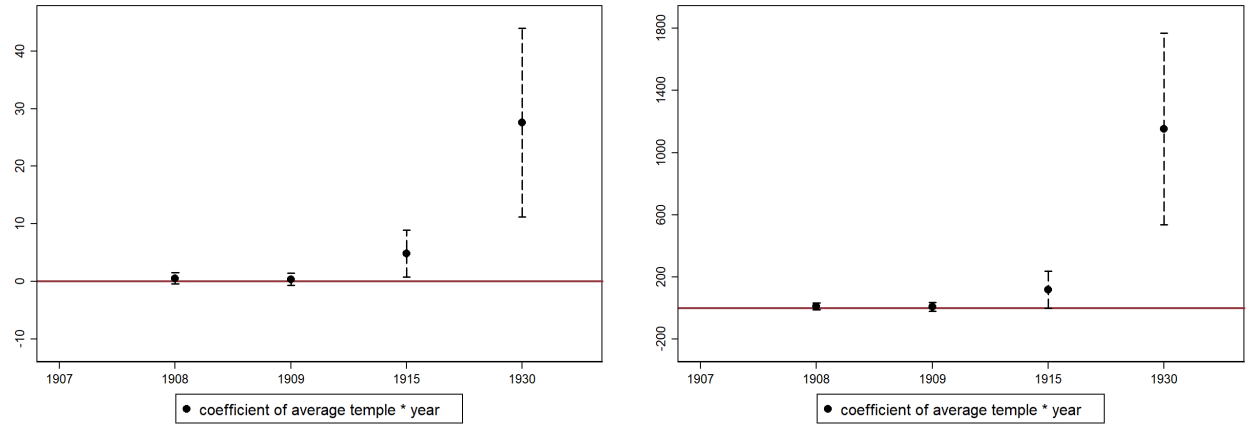
First, we directly test the "parallel pre-trends" assumption: before the TDM, the initial stock of average temple assets should be uncorrelated with the trends of school construction. As shown in Table 4.2, across all specifications, the interaction terms between "average temples in 1820" and "year dummies for 1908 and 1909" are always precisely estimated and not statistically distinguishable from zero, which is consistent with the "parallel trends" assumption.

Second, we also investigate the correlation between "initial temple stocks" and "number of modern schools in 1907," which quantifies the prevalence of spontaneous TDM implementation in the late Qing era. As shown in column 1, the amount of initial temples is uncorrelated with the number of modern schools in 1907, confirming that any

spontaneous TDM implementation in the late Qing era was limited in scope, and would not drive our main findings.

In contrast, as can be seen from panel (a) in Figure 4.4, while temples were uncorrelated with modern school construction prior to 1909, they could strongly predict modern school construction afterwards. To quantify such "break-in-trends" after the TDM was activated, in column 2 of Table 4.2, we present the baseline DiD results, and find the interaction terms "Temples*1915" and "Temples*1930" to be positive and significant. In columns 3 and 4, we further control for different historical variables including the dynamic impacts of population, area, average number of *Jinshi*, average number of missionaries and churches, administrative characteristics, caloric suitability, and treaty ports. We find the baseline results to be highly robust. To the extent that the common confounding factors would likely be correlated with some of these historical control variables, the fact that the inclusion of these variables barely changes the baseline coefficients supports our interpretation of the baseline findings.

Figure 4.4: Dynamic Impacts of Average Number of Temples on Average Numbers of Primary Schools and Students, 1907–1930



(a) Primary Schools

(b) Primary Students

Column 4 is our preferred specification, as it uses the full sample and controls for the dynamic impacts of the relevant historical covariates we have collected. The coefficients suggest that between 1909 and 1915, a 1 standard deviation (S.D.) increase in the average temples leads to a 0.14 S.D. increase in the average number of primary schools; between 1915

Table 4.2: TDM and Primary School Construction

	Average Primary School			
	(1)	(2)	(3)	(4)
Average Temple × 1907	-0.298			
	(0.439)			
Average Temple × 1908	0.339	0.782	0.583	0.563
	(0.719)	(0.413)*	(0.460)	(0.478)
Average Temple × 1909	0.154	0.740	0.401	0.379
	(0.754)	(0.480)	(0.524)	(0.543)
Average Temple × 1915	4.640	6.128	5.245	4.864
	(2.047)**	(1.943)***	(2.040)**	(2.068)**
Average Temple × 1930	28.419	37.772	29.055	27.597
	(8.770)***	(7.512)***	(7.194)***	(8.303)***
Population × Year FE	YES	NO	YES	YES
Area × Year FE	YES	NO	YES	YES
Importance Level × Year FE	YES	NO	YES	YES
Treaty Port × Year FE	YES	NO	YES	YES
Caloric Suitability Index × Year FE	YES	NO	YES	YES
Average *Jinshi* × Year FE	YES	NO	NO	YES
Average Missionary × Year FE	YES	NO	NO	YES
Average Church × Year FE	YES	NO	NO	YES
Year FE	YES	YES	YES	YES
Prefecture FE	NO	YES	YES	YES
R-squared	0.580	0.745	0.772	0.777
Num. of Prefecture	264	264	264	264
Obs.	1152	1152	1152	1152

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

and 1930, a 1 S.D. increase in the average stock of temple assets leads to another 0.81 S.D. increase in the average number of primary schools. These effects are huge in magnitude, which is consistent with the findings in the historical case studies that more than 70% of primary schools in Republican China were constructed using temple assets (Xu, 2010).

A potential concern is that since there were fewer schools constructed between 1907 and 1909, the previous evidence for parallel pre-TDM trends (insignificance of the 1908 and 1909 coefficients) might just be mechanically under-powered, rather than suggesting that there actually exists a break in trends after the TDM started. To address this issue, we conduct a companion test of whether the pre-trend is underpowered, by regressing the average amount of school construction and student enrollment in the pre-TDM period (1907–1909) on the average number of temples in 1820, as well as a series of relevant historical control variables. As shown in Table 4.12, while the number of temples is uncorrelated with pre-TDM school construction and student enrollment, other variables, such as food price, Caloric Suitability Index, tax revenue, and population, do strongly predict modern human capital accumulation in the pre-TDM period, which further suggests that our baseline parallel pre-trends pattern is not mechanically driven by the low amount of school construction in the pre-TDM period, but rather indeed reflects the orthogonality between temples and pre-TDM trends for human capital accumulation.

To corroborate the findings on primary schools, we also estimate the effect of the TDM on student enrollment using the same econometric model. As shown in Table 4.3, the patterns of the results are very similar to those of Table 4.2. The initial stock of temples is orthogonal to both the initial levels and the pre-TDM trends of student enrollment. After the TDM began, areas with higher initial average stocks of temples enrolled significantly more students. Again, the main findings are robust to a series of alternative specifications. Our preferred estimate in column 4 suggests that the effect of a 1 S.D. increase in average temple assets leads to a 0.09 S.D. increase in the average number of primary schools in 1915, and another 1.05 S.D. increase in 1930. These magnitudes are consistent with our findings for primary

schools. We visualize these results in panel (b) of Figure 4.4.

Table 4.3: TDM and Primary Students Enrolled in Modern Schools

	Average Primary Student			
	(1)	(2)	(3)	(4)
Average Temple × 1907	-8.367			
	(7.923)			
Average Temple × 1908	1.032	17.944	10.714	10.951
	(15.930)	(10.469)*	(11.283)	(11.882)
Average Temple × 1909	-2.014	19.026	8.649	7.906
	(17.533)	(13.053)	(13.977)	(14.462)
Average Temple × 1915	109.014	155.894	127.949	118.934
	(60.136)*	(57.788)***	(60.446)**	(60.809)*
Average Temple × 1930	1172.375	1611.914	1383.815	1152.929
	(324.014)***	(343.346)***	(381.219)***	(313.251)***
Population × Year FE	YES	NO	YES	YES
Area × Year FE	YES	NO	YES	YES
Importance Level × Year FE	YES	NO	YES	YES
Treaty Port × Year FE	YES	NO	YES	YES
Caloric Suitability Index × Year FE	YES	NO	YES	YES
Average *Jinshi* × Year FE	YES	NO	NO	YES
Average Missionary × Year FE	YES	NO	NO	YES
Average Church × Year FE	YES	NO	NO	YES
Year FE	YES	YES	YES	YES
Prefecture FE	NO	YES	YES	YES
R-squared	0.681	0.766	0.787	0.804
Num. of Prefecture	264	264	264	264
Obs.	1152	1152	1152	1152

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

4.4.2 Robustness Check

To further investigate the robustness of our baseline findings, we conduct a series of additional robustness checks, including keeping a balanced panel, exploiting alternative measures of initial temple assets, controlling for historical stock of traditional schools, etc. Our results are highly robust to these alternative specifications.

Since the variables of modern school construction and student enrollment has many missing values in 1930, one concern is that such selective attrition of the panel data might be driving our results. To address this concern, in Table 4.13, we keep only a balanced

panel (prefectures that have data in every year). In columns 1, 2 and 3, we use the average number of primary schools as the dependent variable, and rerun the specifications in column 2–4 in Table 4.2. In columns 4–6, we use the average number of primary students as the dependent variable, and rerun the specifications in column 2–4 in Table 4.3. We find that the previous results go through with even larger magnitudes, suggesting that our findings are not mechanical to the unbalanced nature of the panel dataset.

The key variable for our analysis is the stock of average temples, which is used to proxy for the average stock of temple assets in the local area before the TDM started. In our main analysis, we used prefecture-level data digitized from the *Imperial Encyclopedia of the Qing Empire*, which documents the most important temples in China. According to historical records, while China had more than 200,000 registered temples, only about the most important 1.5% were documented in this encyclopedia. For our measurement to precisely reflect the distribution of temple assets, we thus need to assume that the total stock of temple assets in a region is positively and highly correlated with its stock of large temples.

To address the potential concern that our results may be sensitive to this proxy for temple assets, we explore another source of temple data, a county-level record digitized from the *Encyclopedia of Geographic Books* (*Gujin Tushu Jicheng Dilizhi*). This source documents the relatively important temples across the country in 1776. Since no county-level population data are available, we could not conduct our main analysis at the county level. Instead, we aggregate it at the prefecture level to establish a different measure of the stock of temple assets, which covers the most important 15% of the temples in China. Figure 4.7 presents a scatter plot of these two measures. As expected, these two measures are highly and positively correlated with each other. Furthermore, we reproduce Figure 4.4 by using the new data; as shown in Figure 4.8, the patterns are similar to our main findings. In columns 3 and 6 in Table 4.14, we rerun the main specifications by using the new dataset, and all the results are qualitatively the same. Therefore, we conclude that our main findings are unlikely to be

sensitive to the measurement of temples.

Another concern about our results is that, when testing for the pre-trends of school construction and student enrollment before the TDM started, our three study periods (1907–1909) are adjacent to each other, which may limit our power to detect potentially significant differential prior trends in such a short period. If that is the case, our evidence for "parallel trends" would be weakened.

We deal with this issue using 1820 data on traditional primary schools. The traditional primary schools differ in many ways from the modern primary schools; therefore, we did not match them with our main dataset between 1907 and 1930. However, the 1820 data could be helpful for testing parallel trends; the change in primary schools between 1820 and 1909 could reflect the trend of human capital investment in the long run, which could provide us with substantial power to detect any potential divergence caused by initial differences in the stock of temples. Hence, by including 1820 data in our sample, we reproduce the figure on school construction trends. As we can see from Figure 4.9, prefectures with average temples above and below the median level had almost the same number of average schools in 1820 (statistically indistinguishable); moreover, there are no statistically significant differences in the trends of school construction in the subsequent 89 years. These results further suggest that temples are not correlated with initial human capital stock, nor are they correlated with prior trends of human capital formation. These results further confirm the "parallel trends" and "balanced initial levels" assumptions.

One additional concern is that, since geographic conditions might predict the location of both temples and schools, they may thereby confound the DiD results of temples on schools or students. In columns 1, 2, 4 and 5 in Table 4.14, we control for geographical variables, including the dynamic impacts of mountains and the dummy of coastal province, finding the baseline results to be highly robust.

4.4.3 Mechanisms

Despite the fact that the initial stock of temple assets appears to be orthogonal to the levels and trends of pre-TDM human capital accumulation, one might still have concerns about confounding mechanisms behind our DiD results. Specifically, while the parallel pre-trends condition is satisfied, some unobservable factors may be correlated with the initial stock of temples, and these factors might affect human capital accumulation differentially before and after 1912, thereby confounding our results. Obvious candidates for such omitted variables would be culture, superstition, religious beliefs, social capital, etc.

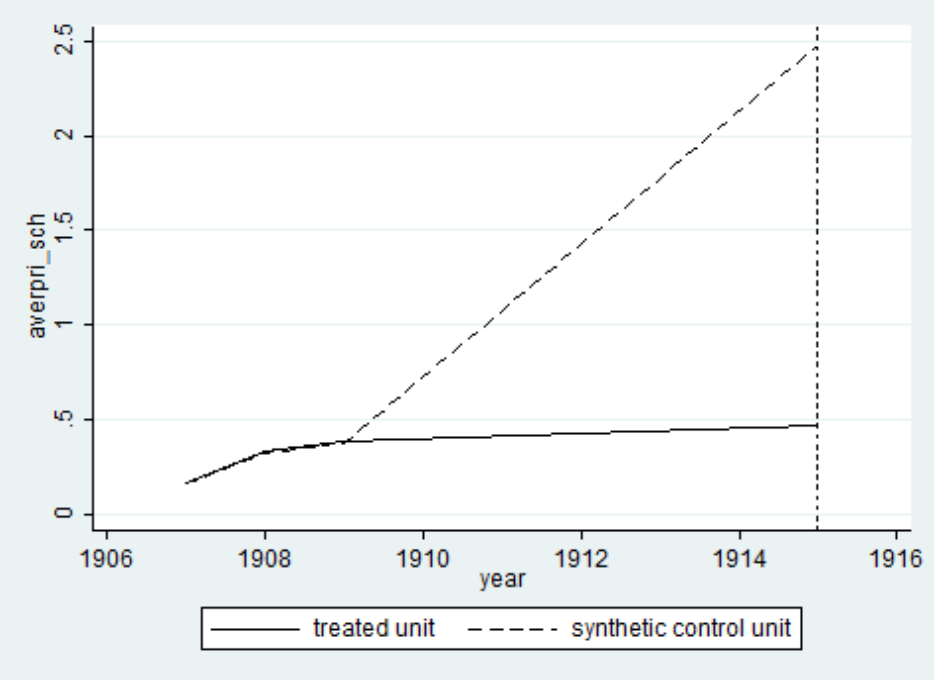
In Table 4.2 and Table 4.3, we have shown that the inclusion of a long list of historical control variables barely move the temple coefficients, which suggests that the confounding stories are unlikely to be true, to the extent that we believe the confounding factors should also likely be correlated with some of these historical control variables. In this subsection, we attempt to further address the omitted variables concern by providing four additional pieces of evidence.

First, we exploit a unique feature of the TDM: when the central government launched the TDM and encouraged local governments to confiscate temple assets for educational purposes, it clearly emphasized that some temples must be protected. One famous case was *Rehe* prefecture[14], whose initial average stock of temples ranked at the top of the country. Many of the temples in *Rehe* prefecture were royal temples, which were regarded as the private properties of the Qing royal family. During the revolution in 1911, the emperor of the Qing dynasty chose to abandon its political power in exchange for the protection of the royal family properties. Therefore, an agreement was signed by the Republican government and Qing royal family, which indicated that all the private properties of the Qing royal family, including those royal temples, must be carefully protected by the new government. This agreement was strictly enforced by the Republican government (Forêt, 2000). As a

[14] *Rehe* prefecture belongs to the "China Proper". In 1953, 93% of population in *Rehe* prefecture were Han people, as 93.7% of total population in China were Han people (Complied Statistics of the First National Population Census, 1953).

result, despite its extreme richness in temple assets, *Rehe* prefecture ranked much below the median in terms of school construction between 1909 and 1915, when its temple assets were under the protection of the Republican government. More formally, we implement a synthetic control analysis, and visualize the results in Figure 4.5.[15] It is predicted that, had the TDM not been banned in *Rehe* prefecture, its school construction would have been 26 times higher than it was in reality.[16] This placebo analysis further supports our argument that temples are unlikely to have affected school construction through channels other than the TDM.

Figure 4.5: Synthetic Control Analysis of *Rehe* Prefecture



Second, we conduct another placebo test: if the TDM is indeed driving our baseline results, then the effects on human capital accumulation in the Republican era should come from temples that were built before the TDM, rather than those built after the TDM was

[15] The prior levels and trends of primary schools, the average stock of temples, population, area, average *Jinshi* number, importance level, and the dummy variable of treaty ports are used to simulate the control group.

[16] As shown in Figure 4.5, actual school construction increased from 0.39 in 1909 to 0.47 in 1915. By contrast, counterfactual school construction increased from 0.38 in 1909 to 2.48 in 1915. Therefore, counterfactual school construction between 1909 and 1915 would be higher than reality: $x = \frac{Counterfactual_{1915} - Counterfactual_{1909}}{Actual_{1915} - Actual_{1909}} \approx 26.3$.

terminated. This means that if we control for the number of temple structures that still exist, we should expect to see the baseline coefficients of the 1820 temples remain essentially unchanged. On the other hand, if historical temples are mainly picking up the effects of confounders such as culture, social capital, or religious beliefs, given the persistence of these variables, we should expect that controlling for current temples would significantly attenuate the 1820 temple coefficients. As shown in columns 1 and 3 of Table 4.4, when we control for the interactions between current temples and year FE, the coefficients for 1820 temples barely move at all, again supporting our proposed mechanism over alternative explanations.

Third, in order to further establish that the physical temple assets (rather than other omitted variables) are driving the coefficient of 1820 temples, we exploit the historical episode of the Taiping Rebellion happened between 1851 and 1864, during which time many temples in prefectures occupied by the Taiping troops were razed to collect military funds. We hypothesize that in prefectures that were occupied by the Taiping troops, since a lot of the physical temple assets in 1820 were already razed before 1912, the amount of temples in 1820 should have much weaker (if any) predictive power on school construction and student enrollment during the TDM. This hypothesis is confirmed in columns 2 and 4 of Table 4.4: when the sample is restricted to the prefectures that were occupied during the Taiping Rebellion, 1820 temples do not have any significant impacts on human capital accumulation during the TDM, again confirming our interpretation of the baseline results.

Table 4.4: TDM and Primary Schools: Controlling for Current Temples, and Taiping Rebellion

	Average Primary School		Average Primary Student	
	(1)	(2)	(3)	(4)
Average Temple × 1908	0.535	0.930	10.298	27.046
	(0.470)	(0.739)	(11.509)	(21.213)
Average Temple × 1909	0.374	1.495	7.722	27.531
	(0.544)	(0.970)	(14.355)	(32.766)
Average Temple × 1915	4.903	5.424	119.850	150.757
	(2.081)**	(4.313)	(61.098)*	(151.149)
Average Temple × 1930	28.521	14.772	1183.118	577.243
	(7.655)***	(10.474)	(279.283)***	(543.170)
Average Temple in 2006 × 1908	0.020		0.683	
	(0.085)		(2.419)	
Average Temple in 2006 × 1909	-0.014		-0.003	
	(0.087)		(2.477)	
Average Temple in 2006 × 1915	-0.078		-1.610	
	(0.112)		(3.528)	
Average Temple in 2006 × 1930	-2.363		-76.915	
	(0.756)***		(31.052)**	
Controls × Year FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.787	0.849	0.811	0.901
Num. of Prefecture	264	46	264	46
Obs.	1152	219	1152	219

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

4.5 Political Economic Conditions for Secularization

In this section, we investigate the political-economic conditions that can enable a traditional society to secularize its religious assets for modernization. By examining historical records on the implementation of the TDM, we hypothesize that there are two pre-conditions critical for "modernization through secularization": (1) in order to effectively appropriate local religious assets, the state needs to be strong relative to the local religious sector; (2) in order to prevent the state from capturing the confiscated religious assets and to ensure that the resources are actually used to support modernization, the presence of a strong civil society is also essential. We test these two hypotheses empirically using our TDM data.

4.5.1 Qualitative Evidence on the Implementation of the TDM

To understand the process of secularizing temple assets, we investigated various historical archives documenting cases of TDM enforcement across the country.

The first step of the TDM required that the local governments could effectively confiscate temple assets, including both relatively visible objects such as buildings and lands, as well as less observable wealth like silver and bandars notes. Since the central government allowed the local governments to confiscate as many temple assets as they could, the capacity of the local government, relative to the strength of the local religious sector, became the main binding constraint for the proportion of temple assets that each prefecture city was able to seize.

Specifically, when local governments first attempted to confiscate temple assets in the name of the TDM, local religious leaders would try to fight back, typically by filing lawsuits against the local governments for misconduct during the enforcement of the TDM. For example, as summarized in Table 4.16, around 1915, in several prefecture cities across Hunan province, local religious leaders sued the local government officials for various reasons, including selling temple-owned lands for private benefit; leveraging the help of

local gangsters to rob the temples; and misusing the appropriated temple assets for purposes other than school construction (such as setting up factories). In these cases, the local religious leaders were well organized and hired strong legal teams, while the local governments were still largely inexperienced with the modern judicial system that had been introduced only three years earlier. As a result, the central government ruled largely in favor of the local temples, and required the local governments to "re-examine their inappropriate behaviors during the TDM." In contrast, as also shown in Table 4.16, in regions with stronger local state capacity, such as *Shanghai* and *Jiangsu*, the local governments ended up winning in such lawsuits and successfully confiscated temple assets.

Another type of resistance from local religious leaders was the organization of local religious followers to protect temple assets by force, either through violent protests or direct conflicts with the schools and local governments. For instance, as reported by *Shen Pao*, the leading newspaper at the time, in August 1915, when the Shanghai government required a major Buddhist temple to clear its Buddhist statues and be converted into a school, more than 2000 local Buddhists organized themselves and committed acts of protest in the area. After a month of heated confrontations between the local government and the protesting Buddhists, police officers were sent to the area equipped with guns; they arrested the organizers of the protest, which ended the local temple's resistance to the TDM.[17]

Once the local governments had successfully confiscated temple assets, the second step of the TDM was to ensure that the appropriated assets would actually be used to support local modern education, rather than being captured by the local politicians or being used for other purposes. Such "checks and balances" for local fiscal spending often came from the local elites, who have traditionally been an important component in China's local governance system. The local elites, typically those who had succeeded in the regional civil service exams, were well-respected for their pivotal roles in the self-governance of local communities. As explained in Chang (1955), one of the important roles of the local elites was to serve as

[17] *Shen Pao*, August 19, 1915; August 20, 1915; October 31, 1915

mediators between the formal bureaucratic system and the local residents, which sometimes included negotiating with the government while representing the interests of the residents.

In the enforcement of the TDM, the local elites made significant contributions in various ways, including sitting on the board of trustees of the local modern schools, setting up modern education committees (*Jiaoyu Hui*), and sometimes serving as principals in the local modern schools (Su, 2007). In these roles, the local elites needed to lobby the local governments to secure sufficient funding for the schools, mostly by ensuring that the confiscated temple assets were indeed fully invested in modern education, as required by the central government.

Guided by the qualitative evidence on the two steps of TDM enforcement, we hypothesize that there were two pre-conditions that determined the effectiveness of secularizing temple assets for modern education: first, strong state capacity was needed to confiscate temple assets; and second, a strong civil society was required to prevent elite capture of the confiscated assets.

4.5.2 Quantitative Evidence on the Determinants of Secularization

In this subsection, we examine the two hypotheses empirically.

We measure local state capacity using the fluctuation of local crop prices. As discussed in Shiue (2004) and Jia (2014a), one of the most important functions for local governments in historical China was to stabilize local crop prices, which helped prevent potential conflicts and revolts in the local areas. Due to its importance, crop price fluctuation often served as a performance indicator when the central government conducted inter-regional comparisons of bureaucratic performance. Leveraging detailed prefectural monthly crop price data between 1902 and 1911, we estimate the standard deviation of local crop price, and use it to proxy for local state capacity: the larger the standard deviation, the weaker the local government.

To measure the strength of the local civil society, we digitize each prefecture's quota for *Shengyuan*, the number of individuals passing the entry-level civil service exam in each

cohort. As discussed in Hao et al. (2020), after obtaining *Shengyuan* status, no more than 5% of exam takers could further obtain a higher status (*Juren* or *Jinshi*), and thus the majority of *Shengyuan* end up as local elites in their home prefectures. It is estimated that *Shengyuan* accounted for only 3% of the male population, and the average income of a *Shengyuan* was 6 times that of a commoner (Chang, 1955). These local elites were highly respected by both local residents and local bureaucrats, and could exert substantial influence in the local governance process. Their social status was strengthened by several privileges, including exemptions from taxes, and voting rights in the late Qing constitutional reform. We thus measure a prefecture's strength in civil society by calculating its average quota for *Shengyuan* during the Qing dynasty.

To test our two hypotheses, we split the baseline DiD sample into four categories: "low state capacity and weak civil society;" "low state capacity and strong civil society;" "high state capacity and weak civil society;" and "high state capacity and strong civil society." We hypothesize that the fourth category should be the most effective in transforming religious assets into modern human capital. Specifically, a prefecture is considered as having "low state capacity" if its deviation in grain price is above the median value, and vice versa; a prefecture is considered as having a "strong civil society" if its *Shengyuan* quota is above the median value, and vice versa.

In Table 4.5, we estimate a DiD model separately for each subsample. As we can see, if either the state or the civil society was weak (or both), the initial stock of temple assets barely predicts the construction of schools after the initiation of the TDM, suggesting that the TDM was not effectively implemented in these areas. In stark contrast, in regions where both state capacity and civil society were strong, the initial stock of temples is significantly and positively correlated with school construction during the TDM era. These results are highly consistent with our hypothesized pre-conditions for secularization.

For robustness check, we also adopt an alternative measure of local state capacity: the average number of social conflicts in each prefecture in the late Qing era (1902–1911).

Table 4.5: Conditions for Secularization: State Capacity and Civil Society

	Average Primary School			
	(1)	(2)	(3)	(4)
State Capacity	Low	Low	High	High
Civil Society	Weak	Strong	Weak	Strong
Average Temple × Post	3.328	-0.094	1.350	15.507
	(2.274)	(2.443)	(1.990)	(5.094)***
Controls × Year FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.833	0.817	0.874	0.809
Num. of Prefecture	73	55	68	68
Obs.	307	249	285	311

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Given that local bureaucrats were tasked with maintaining social stability, the number of local conflicts is negatively correlated with local state capacity. In Table 4.15, we repeat the analysis in Table 4.5 with this alternative stratifying variable, and the main empirical patterns shown in Table 4.5 still remain.

An alternative test for the role of state capacity in the process of the TDM comes from the presence of historical clan temples during the TDM. Similar to those ordinary Buddhist and Taoist temples, these clan temples are also religious spaces, and therefore could potentially reflect local characteristics, such as superstition and social capital (Tsai, 2007). However, an important difference is that the clan temples were private properties of those large local clan families, who, unlike the monks, had strong abilities to protect their assets from being appropriated by the local governments. As a result, while clan temples served similar religious and social roles as those ordinary Buddhist/Taoist temples, their assets could hardly be confiscated during the TDM, and thus they should have little impact on school construction in that period.

In Table 4.6, we present the dynamic impacts of clan temples using the our baseline DiD specification. As we can see, the regional stock of clan temples had no noticeable impact

on local modern school construction, and the result remains robust as we include rich sets of fixed effects and control variables. This finding, again, confirms the our first hypothesis that having a strong state relative to the religious sector is key to the confiscation of temple assets during the TDM.

Table 4.6: TDM and Primary Schools: Clan Temples

	Average Primary School		Average Primary Student	
	(1)	(2)	(3)	(4)
Average Clan Temple × 1908	-0.114	-0.023	10.895	-1.284
	(0.275)	(0.259)	(7.637)	(7.883)
Average Clan Temple × 1909	-0.148	-0.068	10.052	-2.497
	(0.273)	(0.259)	(7.651)	(7.901)
Average Clan Temple × 1915	-0.177	-0.096	12.125	-4.849
	(0.306)	(0.292)	(8.560)	(8.983)
Average Clan Temple × 1930	1.438	0.681	257.155	53.382
	(3.302)	(2.874)	(166.140)	(127.613)
Controls × Year FE	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.699	0.743	0.669	0.767
Num. of Prefecture	264	264	264	264
Obs.	1152	1152	1152	1152

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

4.6 Economic Significance

In this section, we discuss the economic significance of the TDM. In Subsection 4.6.1, we conduct a simple back of the envelope calculation to understand the contribution of the TDM to China's overall modernization of human capital. In Subsection 4.6.2, we present evidence on the impacts of the TDM on elite human capital formation.

4.6.1 Magnitude of the TDM

Our baseline DiD model suggests that, by 1930, one additional unit of average temple stock (as measured by the number of landmark temples per 10,000 residents) had led to about

28 additional primary schools per 10,000 residents. As shown in Table 4.1, the average prefecture had 0.14 landmark temples per 10,000 residents, and had an average population of around 1.54 million. Given that there were 264 prefectures, assuming that the treatment effect is linear, a simple calculation suggests that nearly 0.16 million primary schools were constructed because of the TDM. This is about 63% of the total number of modern primary schools in China in 1930.

To corroborate our calculation, we compare our estimates to the qualitative records documented in existing historical studies. Specifically, Xu (2010) investigated various county gazetteers during the TDM period; for eight counties, he was able to accurately count both the total number of modern primary schools and the number of primary schools built using temple assets. As summarized in Table 4.9, during the TDM era, these eight counties built 758 modern primary schools in total, among which 535 (71%) were constructed using temple assets.

While it is difficult to speak to the representativeness of the eight counties summarized in Table 4.9, the fact that these two different approaches lead to quantitatively similar conclusions is reassuring: based on existing evidence, both qualitative and quantitative, the TDM accounted for 60–70% of modern school construction in China during our sample period.

4.6.2 TDM and Elite Human Capital

Modern elites play vital roles in social and economic modernization (Mokyr, 2005; Cantoni and Yuchtman, 2014; Squicciarini and Voigtländer, 2015). In this subsection, we investigate whether the TDM, by initiating massive primary school construction and student enrollment, eventually contributed to the accumulation of elite human capital formation.

We measure elite human capital using the average number of alumni from China's top two universities (i.e., Peking University and Tsinghua University), based on information digitized from the alumni yearbooks of these two schools. We first estimate the following

equation:

$$Alumni_{i\tau} = \sum_{\tau} \alpha_\tau \times Temple_i \times Period'_\tau + X'_i \times \beta + \rho_\tau + \mu_i + \varepsilon_{i\tau} \tag{4.2}$$

where $Alumni_{i\tau}$ is the average number of alumni from the top two universities for prefecture i in the 5-year period τ. $Temple_i$ is the average stock of temples in prefecture i in 1820, $Period'_\tau$ is a group of period dummies, and $X'_{i\tau}$ is a vector of prefecture-level control variables that varies over periods and across prefectures. ρ_τ is the period fixed effect, μ_i is the prefecture fixed effect, and $\varepsilon_{i\tau}$ is the error term, which varies across both periods and prefectures. Standard errors are clustered at the prefecture level.

Figure 4.6 plots the point estimates. As discussed in Section 4.2, the TDM started to thrive after 1912. Considering the regular duration of primary and middle school education (around 10 years at that time), we would expect the effect of the TDM on top university enrollment to emerge only after 1920. As shown in Figure 4.6, this is exactly the case: before 1920, the initial average stock of temples had no real impact on the average number of students attending the top universities; after 1920, areas with higher average stocks of temples suddenly started to have significantly more students attending the top universities.

Exploiting the 1920 cutoff, we define a post-TDM dummy that equals 1 if the period is after 1920 and 0 otherwise. In equation (4.2), instead of interacting temples and periods, we now interact temples and this post-TDM dummy, in order to capture the full effect of the TDM on top university enrollment. As shown in Table 4.7, the TDM indeed boosted elite human capital accumulation: a 1 S.D. increase in the stock of average temples resulted in an about a 0.32 S.D. increase in top university alumni after the TDM started.

In our preferred specification (column 3), we control for the dynamic impacts of a rich set of historical control variables, including population, area, administrative characteristics, caloric suitability, and treaty ports. Moreover, the main effects persist when we control for the dynamic impacts of traditional elites (number of *Jinshi*) and the average number of

Figure 4.6: Dynamic Impacts of Average Number of Temples on Top University Alumni, 1900–1950

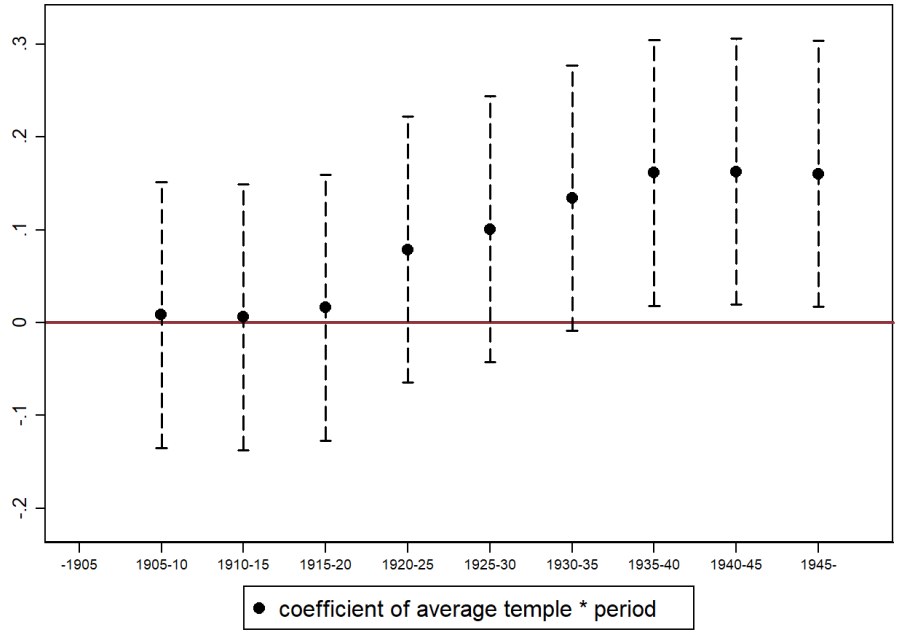


Table 4.7: Effects of TDM on Elite Human Capital

	Average Top 2 University Student		
	(1)	(2)	(3)
Average Temple × Post	0.260	0.231	0.124
	(0.040)***	(0.039)***	(0.036)***
Population × Year FE	NO	YES	YES
Area × Year FE	NO	YES	YES
Importance Level × Year FE	NO	YES	YES
Treaty Port × Year FE	NO	YES	YES
Caloric Suitability Index × Year FE	NO	YES	YES
Average *Jinshi* × Year FE	NO	NO	YES
Average Missionary × Year FE	NO	NO	YES
Average Church × Year FE	NO	NO	YES
Year FE	YES	YES	YES
Prefecture FE	YES	YES	YES
R-squared	0.514	0.568	0.646
Num. of Prefecture	264	264	264
Obs.	2640	2640	2640

This table reports estimation results of equation (4.2). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

missionaries and churches.

Why might the TDM improve elite human capital formation? One straightforward channel is that since more schools were constructed, more students were enrolled in modern schools, and thus there was a larger pool from which elites could emerge. In addition to this "quantity" explanation, another hypothesis is a "quality" one: since temple assets were used not only to construct schools, but also to finance students and teachers, the TDM may also have cultivated elites by increasing the average resources enjoyed by each enrolled student. We test this quality hypothesis by regressing the education budget per student on the average number of temples, again using a DiD model. As shown in Table 4.8, areas with more temples had a higher education budget per student, indicating that the quality of education was also better.

Table 4.8: Effects of TDM on Expenditure per Student

	Average Expenditure of Primary Student		
	(1)	(2)	(3)
Average Temple × 1915	7.348	6.421	6.637
	(2.921)**	(5.048)	(5.317)
Average Temple × 1930	10.813	12.079	16.254
	(4.225)**	(7.150)*	(8.001)**
Population × Year FE	NO	YES	YES
Area × Year FE	NO	YES	YES
Importance Level × Year FE	NO	YES	YES
Treaty Port × Year FE	NO	YES	YES
Caloric Suitability Index × Year FE	NO	YES	YES
Average *Jinshi* × Year FE	NO	NO	YES
Average Missionary × Year FE	NO	NO	YES
Average Church × Year FE	NO	NO	YES
Year FE	YES	YES	YES
Prefecture FE	YES	YES	YES
R-squared	0.279	0.345	0.377
Num. of Prefecture	264	264	264
Obs.	567	567	567

This table reports estimation results of regressing the average education fund per student on the average amount of temples. Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

4.7 Conclusion

In this study, we combine various historical datasets to document a natural experiment in early 20th century China, the Temple Destruction Movement, in which local governments were encouraged to confiscate temple assets to promote modern education.

We show that the initial average stock of temples was not correlated with various measures of human capital and economic development before the TDM started. After the TDM, regions with higher stocks of temple assets obtained higher mass human capital (constructing more schools, enrolling more students) and elite human capital (producing more top university alumni).

Further investigations into the underlying mechanisms shed light on the political-economic conditions that enabled the TDM: a strong local government was needed to appropriate assets from the religious sector, and a strong civil society was also crucial to ensure that the state actually spent the secularized assets on modernization. Our results are robust to the use of various alternative datasets and econometric specifications. Several competing explanations are also discussed and ruled out.

Our main findings are economically significant: a back of the envelope calculation suggests that nearly 70% of the construction of modern schools during our sample period can be attributed to the TDM, indicating that this movement played a pivotal role in the formation of modern human capital in China.

4.8 Appendix Tables

Table 4.9: Historical Evidence of The Temple Destruction Movement

Year	Province	County	Description	Source
1912–1916	Anhui	Taihe	11 of 21 schools were built in temples.	《安徽省太和县志》County Gazetteer of Taihe County in Anhui
1912–1916	Henan	Xinyang	38 of 45 schools were built in temples.	《河南省重修信阳县志》County Gazetteer of Xinyang County in Henan
1933	Jiangsu	Wu	47 of 146 schools were built in temples.	《上海县续志》County Gazetteer of Wu County in Jiangsu
1912–1916	Shandong	Linyi	All 108 schools were built in temples.	《山东省临沂县志》County Gazetteer of Linyi County in Shandong
1933	Shandong	Changle	All 150 schools were built in temples.	《山东省昌乐县续志》County Gazetteer of Changle County in Shandong
1918	Shanghai	Shanghai	46 of 146 schools were built in temples.	《上海县续志》County Gazetteer of Shanghai County
1912–1920	Shanxi	Yuxiang	All 120 schools were built in temples.	《山西省虞乡新志》County Gazetteer of Yuxiang County in Shanxi
1920	Zhejiang	Xinchang	15 of 22 schools were built in temples.	《浙江省新昌县志》County Gazetteer of Xinchang County in Zhejiang

Note: In this table, we compile historical evidence of the Temple Destruction Movement from case studies in Xu (2010).

Table 4.10: Sources of Education Data, 1907–1934

Year	Region	Source
1907	Nationwide	《光绪三十三年第一次教育统计图表》The First National Statistical Chart of Education
1908	Nationwide	《光绪三十四年第二次教育统计图表》The Second National Statistical Chart of Education
1909	Nationwide	《宣统元年第三次教育统计图表》The Third National Statistical Chart of Education
1915	Nationwide	《中华民国第四次教育统计图表》The Fourth National Statistical Chart of Education
1916	Nationwide	《中华民国第五次教育统计图表》The Fifth National Statistical Chart of Education
1919	Jiangsu	《江苏六十县八年度教育状况表》The 1919 Jiangsu Statistical Chart of Education
1921	Guangdong	《广东教育统计图表民国十年度》The 1921 Guangdong Statistical Chart of Education
1922	Guangdong	《广东教育统计图表民国十一年度》The 1922 Guangdong Statistical Chart of Education
1923	Guangdong	《广东教育统计图表民国十二年度》The 1922 Guangdong Statistical Chart of Education
1923	Zhili	《直隶教育统计表民国十二年度》The 1923 Zhili Statistical Chart of Education
1925	Zhili	《直隶教育统计表民国十四年度》The 1925 Zhili Statistical Chart of Education
1924	Shanxi	《山西省第九次教育统计民国十三年》The 1924 Shanxi Statistical Chart of Education
1925	Zhejiang	《中华民国十四年度浙江省教育统计图表》The 1925 Zhejiang Statistical Chart of Education
1927	Zhejiang	《中华民国十六年度浙江省教育统计图表》The 1927 Zhejiang Statistical Chart of Education
1929	Zhejiang	《中华民国十八年度浙江省教育统计图表》The 1927 Zhejiang Statistical Chart of Education
1928	Hebei (Zhili)	《河北省各县普通教育概览》The 1928 Hebei Statistical Chart of Education
1929	Hebei (Zhili)	《河北省教育统计概要民国十八年》The 1929 Hebei Statistical Chart of Education
1930	Fujian	《福建省教育统计民国十九年度》The 1930 Fujian Statistical Chart of Education
1931	Henan	《民国二十年河南省教育统计图表》The 1931 Henan Statistical Chart of Education
1931	Anhui	《安徽省教育统计民国二十年度》The 1931 Anhui Statistical Chart of Education
1932	Anhui	《安徽省教育统计民国二十一年度》The 1932 Anhui Statistical Chart of Education
1933	Anhui	《安徽省教育统计民国二十二年度》The 1933 Anhui Statistical Chart of Education
1934	Anhui	《安徽省教育统计民国二十三年度》The 1934 Anhui Statistical Chart of Education
1932	Jiangxi	《江西省教育统计民国二十一年度》The 1932 Jiangxi Statistical Chart of Education
1933	Jiangxi	《江西省各县教育概况二十二年度》The 1933 Jiangxi Statistical Chart of Education
1932	Jiangsu	《民国二十一年度江苏省教育经费统计图表》The 1932 Jiangsu Statistical Chart of Education
1933	Jiangsu	《民国二十二年度江苏省教育经费统计图表》The 1933 Jiangsu Statistical Chart of Education
1933	Guangxi	《广西省教育概况统计民国二十二年》The 1933 Guangxi Statistical Chart of Education
1934	Zhejiang	《浙江省二十三年度教育统计》The 1934 Zhejiang Statistical Chart of Education
1934	Guangdong	《广东省二十三年度教育概况》The 1934 Guangdong Statistical Chart of Education
1935	Hebei (Zhili)	《河北省教育概况民国二十四年》The 1935 Hebei Statistical Chart of Education

Table 4.11: Orthogonality of the Initial Stock of Temples

	(1)	(2)	(3)	(4)	(5)	(6)
Average Temple	0.458	0.736	0.030	0.818	-0.085	-136.333
	(0.424)	(0.384)*	(0.094)	(0.561)	(0.209)	(191.093)
Population	YES	YES	YES	YES	YES	YES
Area	YES	YES	YES	YES	YES	YES
Province Dummy	YES	YES	YES	YES	YES	YES
Obs.	264	264	264	264	264	264
R-squared	0.364	0.389	0.451	0.333	0.211	0.616
	(7)	(8)	(9)	(10)	(11)	(12)
Average Temple	-0.555	0.200	-0.427	-3.618	0.015	249.523
	(0.435)	(0.404)	(0.571)	(11.004)	(0.064)	(643.247)
Population	YES	YES	YES	YES	YES	YES
Area	YES	YES	YES	YES	YES	YES
Province Dummy	YES	YES	YES	YES	YES	YES
Obs.	257	256	237	237	264	264
R-squared	0.576	0.624	0.376	0.331	0.164	0.489

This table reports estimation results of balance tests. Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.
Column 1: Average *Jinshi*
Column 2: Average Civil Exam Quota
Column 3: Average Charity Organization
Column 4: Importance Level
Column 5: Treaty Port
Column 6: Caloric Suitability Index Post 1500
Column 7: Low Grain Price
Column 8: High Grain Price
Column 9: Average Primary School (1907)
Column 10: Average Primary Student (1907)
Column 11: Average Factories (1916)
Column 12: Average Tax Burden (1850)

Table 4.12: Effects of Average Number of Temples and Other Historical Variables on Primary Schools and Primary Students in 1907–1909

	Average Primary Schools Constructed in 1907–1909		Average Primary Students Enrolled in 1907–1909	
	(1)	(2)	(3)	(4)
Average Temple	0.471	0.120	11.723	1.158
	(0.422)	(0.469)	(11.370)	(11.899)
Area		-0.001		-0.016
		(0.000)**		(0.008)**
Population in 1910		0.000		-0.000
		(0.000)		(0.000)
Average *Jinshi* Number		0.014		0.308
		(0.055)		(1.169)
Treaty Port		-0.175		-3.446
		(0.073)**		(2.016)*
Caloric Suitability Index Post 1500		-0.000		-0.006
		(0.000)		(0.003)*
Average Tax Burden (1850)		0.000		0.000
		(0.000)**		(0.000)**
Average Rice Price (1902-1911)		-0.147		-4.097
		(0.048)***		(1.137)***
R-squared	0.006	0.070	0.007	0.126
Obs.	237	237	237	237

This table reports estimation results of prefecture-level cross-sectional data. Coefficients are reported with standard errors in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 4.13: Effects of TDM on Primary Schools and Primary Students (Balanced Panel)

	Average Primary School			Average Primary Student		
	(1)	(2)	(3)	(4)	(5)	(6)
Average Temple × 1908	1.50	1.66	1.51	39.6	24.8	23.4
	(3.08)	(2.94)	(3.36)	(116.6)	(122.9)	(122.6)
Average Temple × 1909	1.59	1.46	1.46	46.4	23.8	24.4
	(3.13)	(3.00)	(3.44)	(119.5)	(126.7)	(126.5)
Average Temple × 1915	14.49	11.67	12.05	395.6	291.4	312.3
	(3.12)***	(3.34)***	(3.11)***	(137.7)***	(159.3)*	(112.1)***
Average Temple × 1930	40.25	31.19	29.90	1684.1	1432.0	1208.5
	(7.16)***	(7.02)***	(8.12)***	(322.2)***	(365.0)***	(304.9)***
Population × Year FE	NO	YES	YES	NO	YES	YES
Area × Year FE	NO	YES	YES	NO	YES	YES
Importance Level × Year FE	NO	YES	YES	NO	YES	YES
Treaty Port × Year FE	NO	YES	YES	NO	YES	YES
Caloric Suitability Index × Year FE	NO	YES	YES	NO	YES	YES
Average *Jinshi* × Year FE	NO	NO	YES	NO	NO	YES
Average Missionary × Year FE	NO	NO	YES	NO	NO	YES
Average Church × Year FE	NO	NO	YES	NO	NO	YES
Year FE	YES	YES	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES	YES	YES
R-squared	0.733	0.762	0.767	0.758	0.780	0.798
Num. of Prefecture	123	123	123	123	123	123
Obs.	615	615	615	615	615	615

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 4.14: Effects of TDM on Primary Schools and Primary Students, Controlling for Mountains and Coastal Provinces, and Using Robust Temple Measure

	Average Primary School			Average Primary Student		
	(1)	(2)	(3)	(4)	(5)	(6)
Average Temple × 1908	0.68	0.48	0.07	13.1	9.0	2.9
	(0.46)	(0.47)	(0.28)	(11.3)	(11.7)	(10.3)
Average Temple × 1909	0.50	0.30	0.09	10.4	5.5	2.3
	(0.53)	(0.53)	(0.28)	(14.0)	(14.3)	(10.3)
Average Temple × 1915	4.66	4.57	0.55	112.7	117.6	18.6
	(2.11)**	(2.04)**	(0.28)**	(61.6)*	(60.3)*	(10.3)*
Average Temple × 1930	28.38	22.67	1.18	1260.9	1072.2	29.1
	(7.85)***	(7.34)***	(0.35)***	(339.0)***	(315.4)***	(13.0)**
Controls × Year FE	YES	YES	YES	YES	YES	YES
Average Mountain × Year FE	YES	NO	NO	YES	NO	NO
Coast Province × Year FE	NO	YES	NO	NO	YES	NO
Year FE	YES	YES	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES	YES	YES
R-squared	0.776	0.794	0.613	0.795	0.809	0.684
Num. of Prefecture	264	264	264	264	264	264
Obs.	1152	1152	1152	1152	1152	1152

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 4.15: Conditions for Secularization: State Capacity and Civil Society

	Average Primary School			
	(1)	(2)	(3)	(4)
State Capacity	Low	Low	High	High
Civil Society	Weak	Strong	Weak	Strong
Average Temple × Post	1.542	1.176	1.399	8.439
	(3.816)	(1.352)	(2.164)	(2.862)***
Controls × Year FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Prefecture FE	YES	YES	YES	YES
R-squared	0.848	0.704	0.870	0.853
Num. of Prefecture	63	69	69	63
Obs.	278	322	274	277

This table reports estimation results of equation (4.1). Coefficients are reported, with standard errors clustered at the prefecture-level in round brackets. ***, **, and * indicate significance at 1%, 5% and 10% levels.

Table 4.16: Lawsuits in The Temple Destruction Movement

Province	**Prefecture Cities/ County**	**Description**	**Source**
Hunan	Changsha	Religious leaders in Gu-shan Temple sued the local government official Chang-zhi Li for robbing the temple's assets. The Department of the Interior required the local government to "reexamine the case carefully."	*Government Affairs*, No. 151, September 18, 1912
Hunan	Changsha	Religious leaders in San-guan Temple sued on the basis that the gentry Dao-yu Zhou took the temple's assets with local gangsters' help. The Department of the Interior required the local government to "reexamine the case carefully."	*Government Affairs*, No. 796, July 24, 1914
Hunan	Changsha	Religious leaders in Hong-en Temple sued on the basis that the gentry Peng-wan Wu misused the confiscated temple's assets for setting up factories. The Department of the Interior required the local government to "reexamine the case carefully."	*Government Affairs*, No. 796, July 24, 1914
Hunan	Changsha	Religious leaders in Zhun-ti Temple sued on the basis that the gentry Yun-sheng Chen took and sold the temple's assets for private benefits. The Department of the Interior required the local government to "reexamine the case carefully."	*Government Affairs*, No. 796, July 24, 1914
Hunan	Hetui	Religious leaders in Qi-shan Temple sued on the basis that the local gentry robbed and misused the temple's assets with the help of local government officials. The Department of the Interior required the local government to "reexamine the case carefully."	*Government Affairs*, No. 1201, September 10, 1915
Hunan	Changde	Religious leaders in Qian-ming Temple sued on the basis that the local gentry robbed and sold the temple's assets illegally. The Department of the Interior required the local government to "reexamine the case carefully."	*Government Affairs*, No. 1290, December 10, 1915
Shanghai		Religious leaders in De-zang Temple sued on the basis that the local gentry illegally confiscated the temple's assets, and claimed that the temple's assets were private properties, which should not be used for public school construction. After two years of trial, the local court finally rejected the religious leaders' claim.	*Shen Pao*, December 29, 1912; February 7, 1914
Jiangsu	Rugao	The principal of a local school Yuan-xi Wu took the lands and the assets of Guang-fu temple. Religious leaders in Guang-fu temple sued on the basis that the temple was a private property and should be exempted from confiscation. Under the pressure of local governments, the Department of the Interior judged that the lands and the assets of Guang-fu temple belonged to the local school.	*Government Affairs*, No. 1273, November 23, 1915

Sources: *Government Affairs* 政府公报; *Shen Pao* 申报

4.9 Appendix Figures

Figure 4.7: Correlation between Two Measures of Average Number of Temples

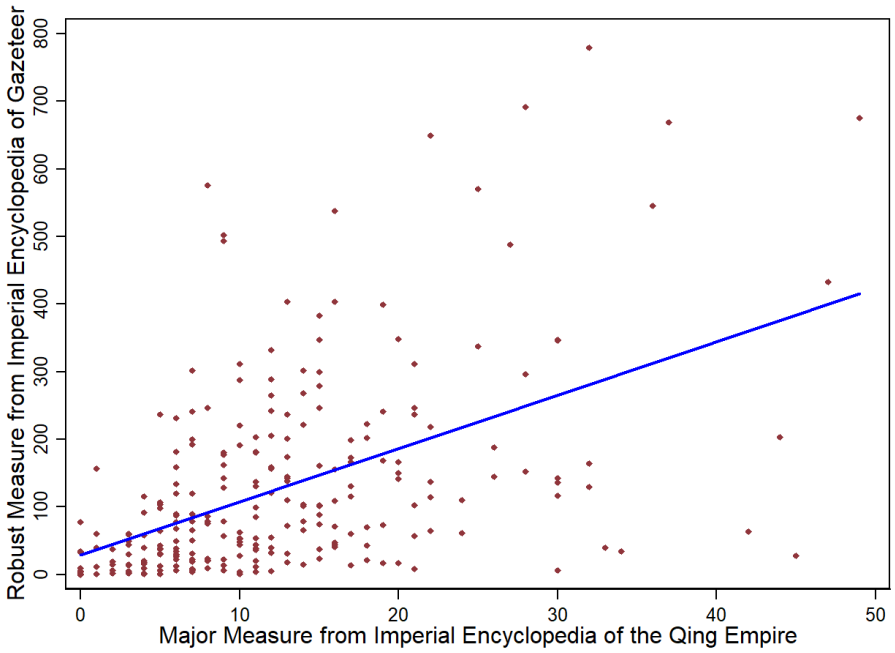
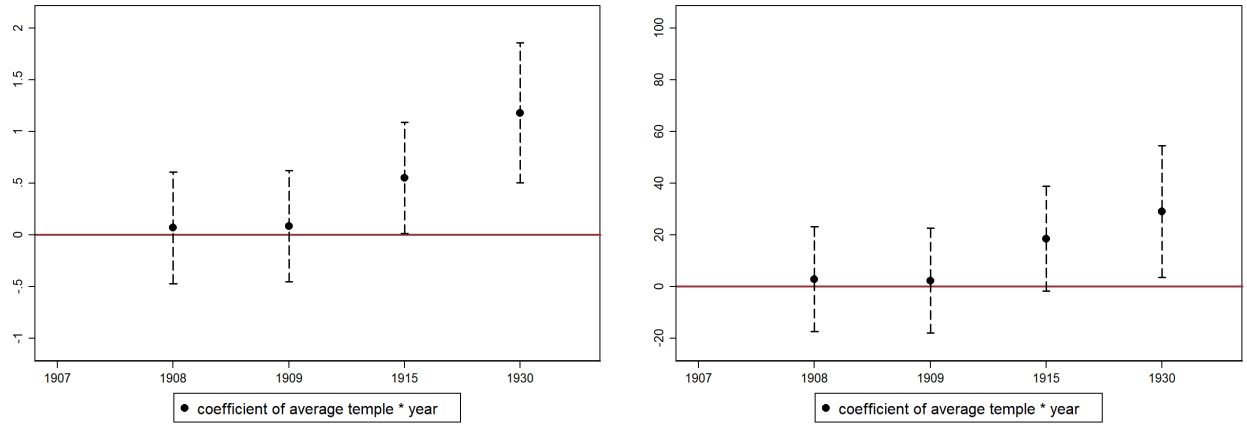


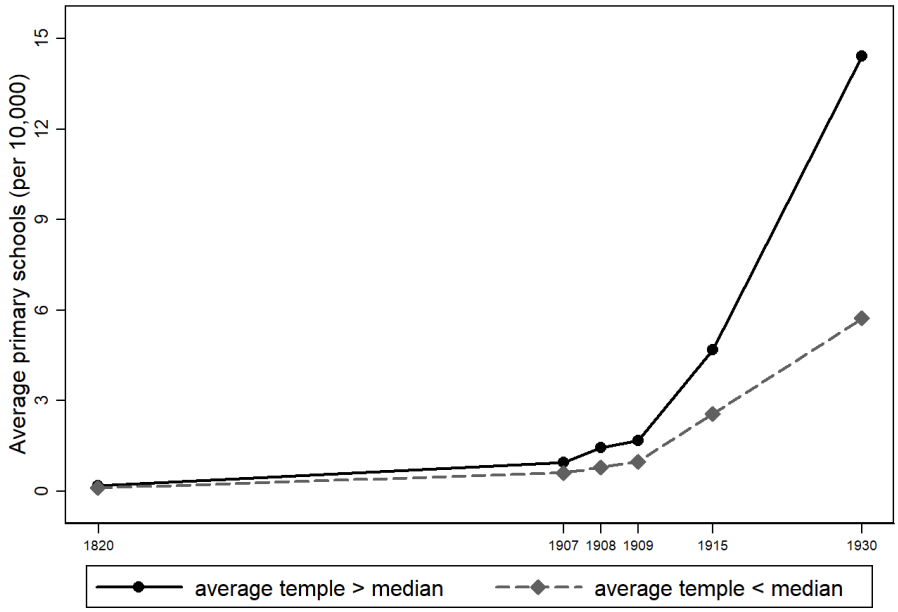
Figure 4.8: Dynamic Impacts of Average Number of Temples on Average Numbers of Primary Schools and Students, 1907–1930, With Robust Measure



(a) Primary Schools (b) Primary Students

Notes: This figure plots the dynamic impacts of the initial stock of average temples on primary school construction and primary student enrollment using the alternative temple measure.

Figure 4.9: Average Number of Primary Schools, 1820–1930



Notes: This figure plots the relative trends of school construction in prefectures with initial stock of temples above the median value, and those below the median value, by also including the traditional primary schools in 1820.

Bibliography

Academia Sinica, T. (2020). *Chinese civilization in time and space*. http://gissrv4.sinica.edu.tw/gis/cctslite.aspx.

Acemoglu, D. and Dell, M. (2010). Productivity differences between and within countries. *American Economic Journal: Macroeconomics*, 2(1):169–88.

Acemoglu, D., Gallego, F. A., and Robinson, J. A. (2014). Institutions, human capital, and development. *Annual Review of Economics*, 6(1):875–912.

Acemoglu, D., Hassan, T. A., and Tahoun, A. (2018). The power of the street: Evidence from Egypt's Arab Spring. *Review of Financial Studies*, 31(1):1–42.

Acemoglu, D., Johnson, S., and Robinson, J. (2005). The rise of Europe: Atlantic trade, institutional change, and economic growth. *American Economic Review*, 95(3):546–579.

Acemoglu, D., Johnson, S., and Robinson, J. A. (2002). Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *Quarterly Journal of Economics*, 117(4):1231–1294.

Adena, M., Enikolopov, R., Petrova, M., Santarosa, V., and Zhuravskaya, E. (2015). Radio and the rise of the Nazis in prewar Germany. *Quarterly Journal of Economics*, 130(4):1885–1939.

Allen, R. C., Bassino, J.-P., Ma, D., Moll-Murata, C., and Van Zanden, J. L. (2011). Wages, prices, and living standards in China, 1738–1925: in comparison with Europe, Japan, and India. *Economic History Review*, 64:8–38.

Ansolabehere, S., Snowberg, E. C., and Snyder Jr, J. M. (2006). Television and the incumbency advantage in US elections. *Legislative Studies Quarterly*, 31(4):469–490.

Bai, Y. and Jia, R. (2016). Elite recruitment and political stability: The impact of the abolition of China's civil service exam. *Econometrica*, 84(2):677–733.

Bai, Y. and Kung, J. K.-s. (2015). Diffusing knowledge while spreading God's message: Protestantism and economic prosperity in China, 1840–1920. *Journal of the European Economic Association*, 13(4):669–698.

Bala, V. and Goyal, S. (1998). Learning from neighbours. *Review of Economic Studies*, 65(3):595–621.

Banerjee, A., Chandrasekhar, A. G., Duflo, E., and Jackson, M. O. (2013). The diffusion of microfinance. *Science*, 341(6144).

Bardhan, P. and Mookherjee, D. (2006). *Decentralization and local governance in developing countries: A comparative perspective*. MIT Press.

Barro, R. and McCleary, R. (2003). Religion and economic growth across countries. *American Sociological Review*, 68(5):760–781.

Bastid, M. (1988). *Educational reform in early Twentieth-century China*. University of Michigan Center for Chinese.

Battisti, M., Peri, G., and Romiti, A. (2022). Dynamic effects of co-ethnic networks on immigrants' economic success. *Economic Journal*, 132(641):58–88.

Battiston, D. (2018). The persistent effects of brief interactions: Evidence from immigrant ships. *Working Paper*.

Bayer, P., Ferreira, F., and McMillan, R. (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of Political Economy*, 115(4):588–638.

Bayer, P., McMillan, R., and Rueben, K. (2004). An equilibrium model of sorting in an urban housing market. *National Bureau of Economic Research Working Paper*.

Bayer, P., Ross, S. L., and Topa, G. (2008). Place of work and place of residence: Informal hiring networks and labor market outcomes. *Journal of Political Economy*, 116(6):1150–1196.

Bayer, P. and Timmins, C. (2005). On the equilibrium properties of locational sorting models. *Journal of Urban Economics*, 57(3):462–477.

Bayer, P. and Timmins, C. (2007). Estimating equilibrium models of sorting across locations. *Economic Journal*, 117(518):353–374.

Beaman, L. (2016). Social networks and the labor market. In *Oxford Handbook of the Economics of Networks*.

Becker, S. O., Hornung, E., and Woessmann, L. (2011). Education and catch-up in the industrial revolution. *American Economic Journal: Macroeconomics*, 3(3):92–126.

Becker, S. O. and Woessmann, L. (2009). Was Weber wrong? A human capital theory of Protestant economic history. *Quarterly Journal of Economics*, 124(2):531–596.

Bentolila, S., Michelacci, C., and Suarez, J. (2010). Social contacts and occupational choice. *Economica*, 77(305):20–45.

Bils, M. and Klenow, P. J. (2000). Does schooling cause growth? *American Economic Review*, 90(5):1160–1183.

Black, D. A., Sanders, S. G., Taylor, E. J., and Taylor, L. J. (2015). The impact of the Great Migration on mortality of African Americans: Evidence from the Deep South. *American Economic Review*, 105(2):477–503.

Bleakley, H., Cain, L., and Ferrie, J. (2013). Amidst Poverty and prejudice: Black and Irish Civil War veterans. *National Bureau of Economic Research Working Paper*.

Bleakley, H. and Hong, S. C. (2021). When the race between education and technology goes backward: The postbellum decline of white school attendance in the Southern US. In *Research in Economic History*. Emerald Publishing Limited.

Blume, L. E., Brock, W. A., Durlauf, S. N., and Ioannides, Y. M. (2011). Identification of social interactions. In *Handbook of Social Economics*, volume 1, pages 853–964. Elsevier.

Borthwick, S. (1983). *Education and social change in China*. Stanford University.

Boustan, L. P. (2009). Competition in the promised land: Black migration and racial wage convergence in the North, 1940–1970. *Journal of Economic History*, 69(3):755–782.

Büchel, K., Ehrlich, M. V., Puga, D., and Viladecans-Marsal, E. (2020). Calling from the outside: The role of networks in residential mobility. *Journal of Urban Economics*, 119:103277.

Cantoni, D., Dittmar, J., and Yuchtman, N. (2018). Religious competition and reallocation: The political economy of secularization in the protestant reformation. *Quarterly Journal of Economics*, 133(4):2037–2096.

Cantoni, D., Yang, D. Y., Yuchtman, N., and Zhang, Y. J. (2019). Protests as strategic games: Experimental evidence from Hong Kong's antiauthoritarian movement. *Quarterly Journal of Economics*, 134(2):1021–1077.

Cantoni, D. and Yuchtman, N. (2013). The political economy of educational content and development: Lessons from history. *Journal of Development Economics*, 104:233–244.

Cantoni, D. and Yuchtman, N. (2014). Medieval universities, legal institutions, and the commercial revolution. *Quarterly Journal of Economics*, 129(2):823–887.

Center, M. P. (2020). *Integrated public use microdata aeries, international: version 7.3 [dataset]*. IPUMS. https://doi.org/10.18128/D020.V7.2.

Chaney, E. (2008). Tolerance, religious competition and the rise and fall of muslim science.

Chaney, E. (2019). Religion, political power and human capital formation: Evidence from Islamic history. In *Advances in the Economics of Religion*, pages 437–448.

Chang, C.-l. (1955). *Studies on their role in nineteenth-century Chinese society*. University of Washington Press.

Chang, W. H. (1989a). *Mass media in China: The history and the future*. Iowa State Press.

Chang, Y. F. (1982). *Revolutionary organizations of the Qing period (Qingji de geming tuanti)*. Academia Sinica, Institute of Modern History.

Chang, Y. F. (1989b). *Modern factories in late Qing dynasty and early Republic era (Qingmo minchu de gongchang)*. Institute of Modern History, Academia Sinica.

Chaudhary, L., Musacchio, A., Nafziger, S., and Yan, S. (2012). Big BRICs, weak foundations: The beginning of public elementary education in Brazil, Russia, India, and China. *Explorations in Economic History*, 49(2):221–240.

Chen, T., Kung, J. K.-s., and Ma, C. (2020). Long live Keju! The persistent effects of China's civil examination system. *Economic Journal*, 130(631):2030–2064.

Chen, Y., Wang, H., and Yan, S. (2013). The long-term effects of Christian activities in China. *Peking University, Unpublished Manuscript*.

Chen, Y. and Yang, D. Y. (2019). The impact of media censorship: 1984 or brave new world? *American Economic Review*, 109(6):2294–2332.

CHGIS (2016). *China historical geographic information system, version 6*. Fairbank Center for Chinese Studies of Harvard University and the Center for Historical Geographical Studies at Fudan Universitys.

Chiang, C.-F. and Knight, B. (2011). Media bias and influence: Evidence from newspaper endorsements. *Review of Economic Studies*, 78(3):795–820.

China Academy of Social Science, o. (1987). *Language atlas of China (Zhongguo yuyan ditu ji)*. Commercial Press.

China Meteorological Administration, o. (1981). *Distribution gallery of droughts and floods in the past five hundred years of China (Zhongguo jin wubai nianlai hanlao fenbu tuji)*. Cartographic Publishing Press.

Collins, W. J. and Wanamaker, M. H. (2014). Selection and economic gains in the great migration of African Americans: new evidence from linked census data. *American Economic Journal: Applied Economics*, 6(1):220–52.

Collins, W. J. and Wanamaker, M. H. (2015). The great migration in black and white: New evidence on the selection and sorting of southern migrants. *Journal of Economic History*, 75(4):947–992.

Conley, T. G. and Udry, C. R. (2010). Learning about a new technology: Pineapple in Ghana. *American Economic Review*, 100(1):35–69.

Costa, D. L. (2013). Leaders: privilege, sacrifice, opportunity, and personnel economics in the American Civil War. *Journal of Law, Economics, and Organization*, 30(3):437–462.

Costa, D. L., DeSomer, H., Hanss, E., Roudiez, C., Wilson, S. E., and Yetter, N. (2017). Union Army veterans, all grown up. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 50(2):79–95.

Costa, D. L., Fogel, R. W., Cain, L., Hong, S. C., Wilson, S., Nguyen, L., Burton, J., and Yetter, N. (2015). *The aging of US colored troops*. Center for Population Economics, University of Chicago Booth School of Business, and National Bureau of Economic Research.

Costa, D. L. and Kahn, M. E. (2003). Cowards and heroes: Group loyalty in the American Civil War. *Quarterly Journal of Economics*, 118(2):519–548.

Costa, D. L. and Kahn, M. E. (2006). Forging a new identity: The costs and benefits of diversity in Civil War combat units for black slaves and freemen. *Journal of Economic History*, 66(4):936–962.

Costa, D. L. and Kahn, M. E. (2007a). Deserters, social norms, and migration. *Journal of Law and Economics*, 50(2):323–353.

Costa, D. L. and Kahn, M. E. (2007b). Surviving Andersonville: The benefits of social networks in POW camps. *American Economic Review*, 97(4):1467–1487.

Costa, D. L. and Kahn, M. E. (2010). *Heroes and cowards: The social face of war*. Princeton University Press.

Costa, D. L., Kahn, M. E., Roudiez, C., and Wilson, S. (2018). Persistent social networks: Civil War veterans who fought together co-locate in later life. *Regional Science and Urban Economics*, 70:289–299.

Damm, A. P. (2009). Ethnic enclaves and immigrant labor market outcomes: Quasi-experimental evidence. *Journal of Labor Economics*, 27(2):281–314.

Danielson, J. J. and Gesch, D. B. (2011). *Global multi-resolution terrain elevation data 2010*. US Department of the Interior, US Geological Survey.

De la Croix, D. and Doepke, M. (2009). To segregate or to integrate: Education politics and democracy. *Review of Economic Studies*, 76(2):597–628.

DellaVigna, S., Enikolopov, R., Mironova, V., Petrova, M., and Zhuravskaya, E. (2014). Cross-border media and nationalism: Evidence from Serbian radio in Croatia. *American Economic Journal: Applied Economics*, 6(3):103–32.

DellaVigna, S. and Gentzkow, M. (2010). Persuasion: Empirical evidence. *Annual Review of Economics*, 2(1):643–669.

DellaVigna, S. and Kaplan, E. (2007). The Fox News effect: Media bias and voting. *Quarterly Journal of Economics*, 122(3):1187–1234.

Diamond, R. (2016). The determinants and welfare implications of us workers' diverging location choices by skill: 1980–2000. *American Economic Review*, 106(3):479–524.

Ding, Y. and Zhang, Z. (1982). *Chronology of civil protests in the late Qing dynasty (Qingmo minbian nianbiao)*. China Social Sciences Press.

Du, X. (1991). *Modern capitalism and Chinese government in Republic era (Minzu ziben zhuyi yu jiuzhongguo zhengfu)*. Shanghai Social Sciences Press.

Duara, P. (1991). Knowledge and power in the discourse of modernity: The campaigns against popular religion in early twentieth-century China. *Journal of Asian Studies*, 50(1):67–83.

Dustmann, C., Glitz, A., Schönberg, U., and Brücker, H. (2015). Referral-based job search networks. *Review of Economic Studies*, 83(2):514–546.

Easterly, W. and Levine, R. (2016). The European origins of economic development. *Journal of Economic Growth*, 21(3):225–257.

Edin, P.-A., Fredriksson, P., and Åslund, O. (2003). Ethnic enclaves and the economic success of immigrants: Evidence from a natural experiment. *Quarterly Journal of Economics*, 118(1):329–357.

Eli, S., Salisbury, L., and Shertzer, A. (2018). Ideology and migration after the American Civil War. *Journal of Economic History*, 78(3):822–861.

Elman, B. A. et al. (2000). *A cultural history of civil examinations in late imperial China*. University of California Press.

Engerman, S. L. and Sokoloff, K. L. (2012). *Economic development in the Americas since 1500: Endowments and institutions*. Cambridge University Press.

Enikolopov, R., Makarin, A., and Petrova, M. (2020). Social media and protest participation: Evidence from Russia. *Econometrica*, 88(4):1479–1514.

Enikolopov, R., Petrova, M., and Zhuravskaya, E. (2011). Media and political persuasion: Evidence from Russia. *American Economic Review*, 101(7):3253–85.

Esherick, J. (1976). *Reform and revolution in China: The 1911 Revolution in Hunan and Hubei*. University of California Press.

Fairbank, J. K. (1986). *The great Chinese Revolution, 1800-1985*. Harper & Row New York.

Fang, H. (1999). *A history of journalism in China (Zhongguo xinwen shiye tongshi)*. China Renmin University Press.

Fernández, R. (2011). Does culture matter? *Handbook of Social Economics*, 1:481–510.

Fogel, R. W., Costa, D. L., Wilson, S., Lee, C., Nguyen, L., Burton, J., and Yetter, N. (2004). *The aging of US colored troops*. University of Chicago Graduate School of Business, and Department of Economics, Brigham Young University.

Forêt, P. (2000). *Mapping Chengde: The Qing landscape enterprise*. University of Hawaii Press.

Franke, W. (1960). *The reform and abolition of the traditional Chinese examination system*. Brill.

Gallego, F. A. (2010). Historical origins of schooling: The role of democracy and political decentralization. *Review of Economics and Statistics*, 92(2):228–243.

Galor, O. (2011). *Unified growth theory*. Princeton University Press.

Galor, O., Moav, O., and Vollrath, D. (2009). Inequality in landownership, the emergence of human-capital promoting institutions, and the great divergence. *Review of Economic Studies*, 76(1):143–179.

Galor, O. and Özak, Ö. (2016). The agricultural origins of time preference. *American Economic Review*, 106(10):3064–3103.

Gao, P. (2018). Risen from chaos: The development of modern education in China, 1905–1948. *Australian Economic History Review*, 58(2):187–192.

García-Jimeno, C., Iglesias, A., and Yildirim, P. (2022). Information networks and collective action: Evidence from the women's Temperance Crusade. *American Economic Review*, 112(1):41–80.

Ge, J. (2000). *History of population in China (Zhongguo renkou shi)*. Fudan University Press.

Gennaioli, N., La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (2013). Human capital and regional development. *Quarterly Journal of Economics*, 128(1):105–164.

Gentzkow, M. (2006). Television and voter turnout. *Quarterly Journal of Economics*, 121(3):931–972.

Gentzkow, M. and Shapiro, J. M. (2006). Media bias and reputation. *Journal of Political Economy*, 114(2):280–316.

Gentzkow, M., Shapiro, J. M., and Sinkinson, M. (2011). The effect of newspaper entry and exit on electoral politics. *American Economic Review*, 101(7):2980–3018.

Gentzkow, M. A. and Shapiro, J. M. (2004). Media, education and anti-Americanism in the Muslim world. *Journal of Economic Perspectives*, 18(3):117–133.

Gerber, A. S., Karlan, D., and Bergan, D. (2009). Does the media matter? A field experiment measuring the effect of newspapers on voting behavior and political opinions. *American Economic Journal: Applied Economics*, 1(2):35–52.

Glaeser, E. L., La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (2004). Do institutions cause growth? *Journal of Economic Growth*, 9(3):271–303.

Glaeser, E. L. and Sacerdote, B. I. (2008). Education and religion. *Journal of Human Capital*, 2(2):188–215.

Go, S. and Lindert, P. (2010). The uneven rise of american public schools to 1850. *Journal of Economic History*, 70(1):1–26.

González, F. (2020). Collective action in networks: Evidence from the chilean student movement. *Journal of Public Economics*, 188:104220.

Goossaert, V. (2006). State and religion in modern China: Religious policy and scholarly paradigms. *Working Paper*.

Goossaert, V. and Palmer, D. A. (2011). *The religious question in modern China*. University of Chicago Press.

Granovetter, M. (1978). Threshold models of collective behavior. *American Journal of Sociology*, 83(6):1420–1443.

Guan, X. (1999). The study of ministry of education in late Qing dynasty (Qingmo jiaoyubu yanjiu). *Sun Yat-Sen University, Manuscript*.

Hall, R. E. and Jones, C. I. (1999). Why do some countries produce so much more output per worker than others? *Quarterly Journal of Economics*, 114(1):83–116.

Hao, Y. (2021). Social mobility in China, 1645–2012: A surname study. *China Economic Quarterly International*, 1(3):233–243.

Hao, Y., Liu, K. Z., Weng, X., and Zhou, L.-A. (2020). The making of bad gentry: The abolition of Keju, local governance and anti-elite protests, 1902-1911. *Working Paper*.

Hao, Y. and Xue, M. M. (2017). Friends from afar: The Taiping Rebellion, cultural proximity and primary schooling in the Lower Yangzi, 1850–1949. *Explorations in Economic History*, 63:44–69.

Ho, P.-t. (1962). *The ladder of success in imperial China*. Columbia University Press.

Hornung, E. (2014). Immigration and the diffusion of technology: The Huguenot diaspora in Prussia. *American Economic Review*, 104(1):84–122.

Huff, T. E. (2017). *The rise of early modern science: Islam, China, and the West*. Cambridge University Press.

Huillery, E. (2009). History matters: The long-term impact of colonial public investments in French West Africa. *American Economic Journal: Applied Economics*, 1(2):176–215.

i Miquel, G. P., Qian, N., Xu, Y., and Yao, Y. (2015). Making democracy work: Culture, social capital and elections in China. *National Bureau of Economic Research Working Paper*.

Ioannides, Y. M. and Datcher Loury, L. (2004). Job information networks, neighborhood effects, and inequality. *Journal of Economic Literature*, 42(4):1056–1093.

Jackson, M. O. (2011). An overview of social networks and economic applications. In *Handbook of Social Economics*, volume 1, pages 511–585. Elsevier.

Jackson, M. O., Rogers, B. W., and Zenou, Y. (2017). The economic consequences of social-network structure. *Journal of Economic Literature*, 55(1):49–95.

Jackson, M. O. and Yariv, L. (2011). Diffusion, strategic interaction, and social structure. In *Handbook of Social Economics*, volume 1, pages 645–678. Elsevier.

Jia, R. (2014a). The legacies of forced freedom: China's treaty ports. *Review of Economics and Statistics*, 96(4):596–608.

Jia, R. (2014b). Weather shocks, sweet potatoes and peasant revolts in historical China. *Economic Journal*, 124(575):92–118.

Jiang, Q. (2007). *Official records of Jinshi in the Qing dynasty (Qingchao jinshi timing lu)*. Chung Hwa Book Company.

Katz, P. R. (2008). *Divine justice: Religion and the development of Chinese legal culture*. Routledge.

Katz, P. R. (2012). Chinese religious life. *Journal of Asian Studies*, 71(3):784–787.

Katz, P. R. (2014). *Religion in China and its modern fate*. Brandeis University Press.

Kung, J. K.-s. and Ma, C. (2014). Can cultural norms reduce conflicts? Confucianism and peasant rebellions in Qing China. *Journal of Development Economics*, 111:132–149.

Kung, J. K.-S. and Wang, A. Y. (2020). Foreign education, ideology, and the fall of imperial China. *Working Paper*.

Kuran, T. (2012). *The long divergence*. Princeton University Press.

Kuznets, S. (1973). Modern economic growth: findings and reflections. *American Economic Review*, 63(3):247–258.

Lee, C. (2006). Socioeconomic differences in wartime mobility and mortality of black union army soldiers. *Seoul National University, Unpublished Manuscript*.

Lee, C. (2008). Health, information, and migration: Geographic mobility of Union Army Veterans, 1860–1880. *Journal of Economic History*, 68(3):862–899.

Lemann, N. (2011). *The promised land: The Great Black Migration and how it changed America*. Vintage.

Liang, F. (1980). *Statistics on China's historical population, cultivated land and land tax (Zhongguo lidai hukou tiandi tianfu tongji)*. Shanghai Renmin Press.

Lin, J. Y. (1995). The needham puzzle: why the industrial revolution did not originate in china. *Economic Development and Cultural Change*, 43(2):269–292.

Lin, Z. and Xu, H. (2017). Estimation of social-influence-dependent peer pressure in a large network game. *Econometrics Journal*, 20(3):S86–S102.

Lindert, P. H. (2004). *Growing public: Social spending and economic growth since the eighteenth century*, volume 2. Cambridge University Press.

Litwack, L. F. (1980). *Been in the storm so long: The aftermath of slavery*. Vintage.

Liu, C.-y. (1993). *Chong, Fan, Pi, and Nan: An exploration of the ranking of Qing administrative units (Chong, Fan, Pi, Nan: Qingdai daoting zhouxian dengji chutan)*. Institute of Modern History, Academia Sinica.

Logan, T. D. (2009). Health, human capital, and African-American migration before 1910. *Explorations in Economic History*, 46(2):169–185.

Ma, L., Lu, Y., and Wang, K. (1983). *Chronology of China's Railway Construction, 1881-1981 (Zhongguo Tielu Jianzhu Biannian Jianshi, 1881-1981)*. China Railroad Press.

Ma, M. and Lu, H. (2002). The government's statistical work and data in the Republic of China (Minguo shiqi zhengfu tongji gongzuo yu tongji ziliao lunshu). In *Thirty Years' Historical Studies of the Republic of China (1972-2002)*. Social Sciences Academic Press.

Manacorda, M. and Tesei, A. (2020). Liberation technology: Mobile phones and political mobilization in Africa. *Econometrica*, 88(2):533–567.

Manski, C. F. (1993). Identification of endogenous social effects: The reflection problem. *Review of Economic Studies*, 60(3):531–542.

Manski, C. F. (2000). Economic analysis of social interactions. *Journal of Economic Perspectives*, 14(3):115–136.

Margo, R. A. (1988). *Schooling and the Great Migration*. National Bureau of Economic Research.

Margo, R. A. (1990). *Race and schooling in the South, 1880-1950: An economic history*. University of Chicago Press.

Margo, R. A. (2002). The north-south wage gap, before and after the civil war. *National Bureau of Economic Research Working Paper*.

Mariscal, E. and Sokoloff, K. L. (2000). Schooling, suffrage, and the persistence of inequality in the Americas, 1800–1945. In *Political institutions and economic growth in Latin America: Essays in policy, history, and political economy*. Hoover Institution Press Stanford.

Marmaros, D. and Sacerdote, B. (2002). Peer and social networks in job search. *European Economic Review*, 46(4-5):870–879.

McKenzie, D. and Rapoport, H. (2007). Network effects and the dynamics of migration and inequality: theory and evidence from Mexico. *Journal of Development Economics*, 84(1):1–24.

Melander, E. et al. (2020). Transportation technology, individual mobility and social mobilisation. *Working Paper*.

Miner, L. (2015). The unintended consequences of internet diffusion: Evidence from Malaysia. *Journal of Public Economics*, 132:66–78.

Mokyr, J. (2005). The intellectual origins of modern economic growth. *Journal of Economic History*, 65(2):285–351.

Mokyr, J. (2016). *A culture of growth: The origins of the modern economy*. Princeton University Press.

Mokyr, J. and Voth, H.-J. (2010). Understanding growth in Europe, 1700-1870: Theory and evidence. *The Cambridge Economic History of Modern Europe*, 1:7–42.

Montgomery, J. D. (1991). Social networks and labor-market outcomes: Toward an economic analysis. *American Economic Review*, 81(5):1408–1418.

Moretti, E. (1999). Social migrations and networks: Italy 1889–1913. *International Migration Review*, 33(3):640–57.

Munshi, K. (2003). Networks in the modern economy: Mexican migrants in the US labor market. *Quarterly Journal of Economics*, 118(2):549–599.

Munshi, K. (2014). Community networks and the process of development. *Journal of Economic Perspectives*, 28(4):49–76.

Naidu, S. (2010). Recruitment restrictions and labor markets: Evidence from the postbellum US South. *Journal of Labor Economics*, 28(2):413–445.

Naidu, S. (2012). Suffrage, schooling, and sorting in the post-bellum US South. *National Bureau of Economic Research Working paper*.

North, D. C. and Thomas, R. P. (1973). *The rise of the western world: A new economic history*. Cambridge University Press.

Nunn, N. (2009). Christians in colonial Africa. *Unpublished Manuscript*.

Olken, B. (2009). Do television and radio destroy social capital: Evidence from Indonesian villages. *American Economic Journal: Applied Economics*, 1(4):1–33.

Peri, G. (2012). The effect of immigration on productivity: Evidence from US states. *Review of Economics and Statistics*, 94(1):348–358.

Prior, M. (2006). The incumbent in the living room: The rise of television and the incumbency advantage in US House elections. *Journal of Politics*, 68(3):657–673.

Rawski, E. S. (1979). *Education and popular literacy in Ch'ing China*, volume 6. University of Michigan Press.

Rocha, R., Ferraz, C., and Soares, R. R. (2017). Human capital persistence and development. *American Economic Journal: Applied Economics*, 9(4):105–36.

Rubin, J. (2017). *Rulers, religion, and riches: Why the West got rich and the Middle East did not*. Cambridge University Press.

Seguin, C. and Rigby, D. (2019). National crimes: A new national data set of lynchings in the United States, 1883 to 1941. *Socius*, 5.

Shang, L. (2001). *Government and society: The allocation of education funds in modern China (Zhengfu yu shehui: Jindai gonggong jiaoyu jingfei peizhi yanjiu)*. Hebei Education Press.

Shi, D. (1974). *Modern history of Chinese Buddhism (Zhongguo fojiao jindai shi)*. Dongchu Press.

Shiue, C. H. (2004). Local granaries and central government disaster relief: Moral hazard and intergovernmental finance in eighteenth-and nineteenth-century China. *Journal of Economic History*, 64(1):100–124.

Skinner, G. W., Yue, Z., and Henderson, M. (2007). *ChinaW: Cities, county Seats and yamen Units (1820–1893)*. University of California, Regional Systems Analysis Project.

Skocpol, T. and Theda, S. (1979). *States and social revolutions: A comparative analysis of France, Russia and China*. Cambridge University Press.

Snyder Jr, J. M. and Strömberg, D. (2010). Press coverage and political accountability. *Journal of Political Economy*, 118(2):355–408.

Squicciarini, M. P. and Voigtländer, N. (2015). Human capital and industrialization: Evidence from the age of enlightenment. *Quarterly Journal of Economics*, 130(4):1825–1883.

Stauffer, M. T. (1922). *The Christian occupation of China: A general survey of the numerical strength and geographical distribution of the Christian forces in China*. China Continuation Committee.

Strömberg, D. (2004). Radio's impact on public spending. *Quarterly Journal of Economics*, 119(1):189–221.

Stulz, R. M. and Williamson, R. (2003). Culture, openness, and finance. *Journal of Financial Economics*, 70(3):313–349.

Su, Y. (2007). *The emergence and growth of modern education in China (Zhongguo xinjiaoyu de mengya yu chengzhang)*. Peking University Press.

Sun, J. (2010). Building modern urban identity in hinterland China: Jining's transition during the early Republic (1912-1937). *Journal of Asian History*, 44(1):1–37.

The Max Planck Institute for the History of Science, o. and The Department of History of Shanghai Jiao Tong University, o. (2019). *Land survey maps of China: A cartographic database (MPIWG Dataset: 1885-1945, (1:50,000), the general administration of land surveys*. https://chmap.mpiwg-berlin.mpg.de.

Tilly, C. (1977). *From mobilization to revolution*.

Tobler, W. (1993). *Three presentations on geographical analysis and modeling*. Citeseer.

Topa, G. (2011). Labor markets and referrals. In *Handbook of Social Economics*, volume 1, pages 1193–1221. Elsevier.

Tsai, L. L. (2007). *Accountability without democracy: Solidary groups and public goods provision in rural China*. Cambridge University Press.

Van Duijn, M. and Rouwendal, J. (2013). Cultural heritage and the location choice of Dutch households in a residential sorting model. *Journal of Economic Geography*, 13(3):473–500.

Voigtländer, N. and Voth, H.-J. (2015). Nazi indoctrination and anti-Semitic beliefs in Germany. *Proceedings of the National Academy of Sciences*, 112(26):7931–7936.

Wakeman, F. K., Wakeman, F. E., Grant, C., et al. (1975). *Conflict and control in late imperial China*. University of California Press.

Wang, D. (2013a). *Charity organizations of the Qing dynasty, version 1*. Fudan University.

Wang, T. (2021). Media, pulpit, and populist persuasion: Evidence from Father Coughlin. *American Economic Review*, 111(9):3064–92.

Wang, Y. (2010). The study of Ministry of Education in the Republic of China (1912-1916) (Minchu jiaoyubu yanjiu). *Shaanxi Normal University, Manuscript*.

Wang, Y. (2013b). *The database of grain prices in the Qing dynasty*.

Wantchekon, L., Klašnja, M., and Novta, N. (2015). Education and human capital externalities: Evidence from colonial Benin. *Quarterly Journal of Economics*, 130(2):703–757.

Weber, M. (1930). *The Protestant ethic and the spirit of Capitalism*. Routledge.

Wu, J. (2016). *Buddhist temples, BGIS, Version 1.1*. University of Arizona.

Xu, H. (2018). Social interactions in large networks: A game theoretic approach. *International Economic Review*, 59(1):257–284.

Xu, X. (2010). Temple property in late Qing dynasty and the Republic of China (1895-1916) (Qingmo minchu miaochan wenti yanjiu). *Shaanxi Normal University, Manuscript*.

Yan, Z. (1955). *Selected statistical materials on modern Chinese economic history (Zhongguo jindai jingjishi tongji ziliao xuanji)*. Science Press.

Yanagizawa-Drott, D. (2014). Propaganda and conflict: Evidence from the Rwandan genocide. *Quarterly Journal of Economics*, 129(4):1947–1994.

Yang, C. (2017). Long-Run persistence and interrupted development: Evidence from historical China. *Working Paper*.

Young, H. P. (2009). Innovation diffusion in heterogeneous populations: Contagion, social influence, and social learning. *American Economic Review*, 99(5):1899–1924.

Yuchtman, N. (2010). An economic analysis of traditional and modern education in late imperial and Republican China.

Zhang, L. (1936). *China post (Zhongguo youzheng)*. Commercial Press.

Zhang, S. (1999). Studies of central and local government finance in late Qing dynasty (Qingmo guojia caizheng difang caizheng huafen pingxi). *History Monthly*, (1):51–55.

Zürcher, E. (2007). *The Buddhist conquest of China: The spread and adaptation of Buddhism in early medieval China*, volume 11. Brill.