

CQH Working Paper Series

No. 0005

2025

Telegraph, Media, and State Information Capacity: Evidence from Late Imperial China

Yu Hao

Peking University

Yuxiang Wang

Southwestern University of Finance and Economics

The impact of modern information technology on state capacity is relatively under-researched. Most literature on state capacity in the pre-modern context focus on the “extractive” side rather than the “expenditure” side. In addition, little is known about the role of private media in historical state building. This paper explores the introduction of the telegraph in the late 19th-century China, the purpose of which were mostly military, to quantify the impact of information technology on state’s capacity to obtain local information about natural disasters and to provide famine relief. The results show that telegraph connection increased the probability of officials’ disaster reporting by 0.36 percentage points (31% of the mean of the dependent variable). It also improved the accuracy of reported information. Furthermore, the telegraph enhanced the capacity of private media to collect, transmit, and disseminate local information, thereby pressuring local officials to report disasters more truthfully. The impact was stronger in cases with competing information channels within state institutions and greater opportunity costs of misreporting. As a result, the telegraph improved public good provisions, stabilized grain prices, and mitigated social unrest. This paper underscores the complementarity between technology and institutions by showing how telegraph activated multiple informational channels internal and external to the bureaucracy.

Telegraph, Media, and State Information Capacity: Evidence from Late Imperial China

Yu Hao Yuxiang Wang *

May 27, 2025

Abstract

The impact of modern information technology on state capacity is relatively under-researched. Most literature on state capacity in the pre-modern context focus on the “extractive” side rather than the “expenditure” side. In addition, little is known about the role of private media in historical state building. This paper explores the introduction of the telegraph in the late 19th-century China, the purpose of which were mostly military, to quantify the impact of information technology on state’s capacity to obtain local information about natural disasters and to provide famine relief. The results show that telegraph connection increased the probability of officials’ disaster reporting by 0.36 percentage points (31% of the mean of the dependent variable). It also improved the accuracy of reported information. Furthermore, the telegraph enhanced the capacity of private media to collect, transmit, and disseminate local information, thereby pressuring local officials to report disasters more truthfully. The impact was stronger in cases with competing information channels within state institutions and greater opportunity costs of misreporting. As a result, the telegraph improved public good provisions, stabilized grain prices, and mitigated social unrest. This paper underscores the complementarity between technology and institutions by showing how telegraph activated multiple informational channels internal and external to the bureaucracy.

*Hao: Peking University (e-mail: maxhao1003@pku.edu.cn); Wang: Southwestern University of Finance and Economics (e-mail: wangyx@swufe.edu.cn)

1 Introduction

The impact of modern information technology—such as the telegraph—on market integration and economic development has been well studied (Hoag, 2006; Steinwender, 2018; Gao and Lei, 2021; Lin et al., 2021; Hao et al., 2022). In contrast, its influence on state capacity remains underexplored. On the other hand, most literature on state capacity in the pre-modern context focus on the “extractive” side rather than the “expenditure” side (Besley and Persson, 2009; Dincecco, 2009; Gennaioli and Voth, 2015; Johnson and Koyama, 2014; Sng and Moriguchi, 2014; Cantoni et al., 2024). In addition, little is known about the role of private media in the historical state building process.

In pre-modern settings, severe information asymmetries within multitiered bureaucratic hierarchies limited the state’s ability to acquire local information, collect taxes, and deliver public goods (Kiser and Schneider, 1994; Ma and Rubin, 2019; Sng, 2014). To mitigate such principal-agent problems, the state established competing information channels within the bureaucracy to incentivize truthful reporting of local information. On the other hand, private media imposed minimal constraints on the state due to their limited capacity to access information. Could modern information technology enhance the information capacity of the state by activating multiple informational channels internal and external to the bureaucracy?

This paper explores a unique historical incident—the introduction of the telegraph in late 19th-century China—to quantify the impact of information technology on the state’s capacity to obtain local information and to provide public goods. Prior to the telegraph, the bottom-up transmission of disaster reports, an important task of local officials, was often inefficient and distorted (Will, 1990; Zhang, 2023; Li, 2022). For military purposes, the Qing government began constructing telegraph lines in the 1880s. The routes and timing of construction were primarily shaped by geopolitical and military considerations, rather than by the need to improve disaster reporting (Gao and Lei, 2021). As shown in Figure 1, the telegraph network expanded rapidly: by the end of the Qing dynasty, 63.8% of prefectures in China proper were connected to the telegraph system. The adoption of the telegraph

not only accelerated the transmission of local information by officials but also reduced their incentive to conceal it. On the one hand, it lowered the cost of cross-verification across competing information channels within the bureaucracy (Xia, 2009, 2012). On the other hand, it strengthened the capacity of private media to collect, transmit, and disseminate local information, thereby creating an additional verifiable information channel for the central government (Xia, 2008; Deng, 2013; Lin et al., 2021).

[Figure 1 about here]

To evaluate the impact of telegraph access on state’s information capacity, we construct a county-year panel dataset that combines a disaster reporting indicator, telegraph connection status, and measures of disaster shocks from 1865 to 1911 across China Proper. We exploit the exogenous variation in telegraph construction to identify casual effects.¹ Using a difference-in-differences (DID) model, we find that telegraph access increased the probability of disaster reporting by local officials by 0.36 percentage points, equivalent to 31% of the mean reporting probability. Exploring the dynamics of impacts, we find parallel trends between the treated and untreated groups before telegraph connection, supporting the assumption of parallel trends and the exogeneity of telegraph rollout. The baseline specification controls for disaster severity, the frequency of wars, treaty port status, county fixed effects, and time-invariant county features interacted with year fixed effects.

Our results are robust to a range of alternative specifications. These include using different subsamples, controlling contemporaneous technological changes, using the number of disaster reports as the dependent variable, and adopting a staggered DID robust framework. To further address concerns that telegraph network distribution and disaster reporting by officials may be influenced by unobserved confounders, we employ an instrumental variable approach. Specifically, we use the shortest distance from each prefecture to a hypothetical

¹ It is often challenging to disentangle the effects of information technology from those of transportation technology, as telegraph lines were frequently constructed alongside railways (Nonnenmacher, 2001). However, in the context of this study, less than 10% of prefectures were connected by railways, facilitating a clearer identification of the telegraph’s impact independent of transportation infrastructure.

military trunk line as an instrument for telegraph station distribution. The IV estimates are consistent with the baseline DID results, although they suggest a larger effect of telegraph access on disaster reporting.

Additionally, we find evidence that telegraph improved the quality of information reported by local officials. First, we compare disaster reports submitted by local officials with records in local gazetteers. The results show that only in counties connected to the telegraph network is there a positive correlation between the severity of disasters reported by officials and the severity recorded in the gazetteers. Moreover, telegraph access increased the likelihood that detailed information in disaster reports, such as life loss and property damage, matched the corresponding records in the gazetteers. Second, we examine grain price misreporting, defined as instances where the reported monthly highest price remained constant for at least five consecutive months, signaling potential information distortion.² We find that telegraph access reduced the likelihood of such misreporting by 8%, equivalent to 12% of the mean misreporting rate.

We further explore the role of private media in amplifying the impact of the telegraph on bureaucratic disaster reporting. First, we find that the telegraph enhanced media coverage of disasters. Following the arrival of the telegraph in a county, the likelihood of a disaster being reported by *Shen Bao*, China's largest private newspaper, increased by 1.1 percentage points, representing 27% of the mean reporting rate. Second, we analyze instances where *Shen Bao* reported disasters *before* official reports were filed. After the introduction of the telegraph, such cases rose by 1 percentage point (26% of the mean), suggesting that the telegraph enhanced the media's capability to gather information from non-bureaucratic sources. Moreover, telegraph access increased the likelihood of recruiting *Shen Bao* reporters

² Marks (1998) conducted a statistical analysis of the repetition rate of monthly rice prices in Guangdong and Guangxi between 1738 and 1795 to assess the authenticity of the rice price data. Among the 35,674 rice price observations he collected, 83% differed from the prices of the adjacent months, 8% were identical for two consecutive months, 4% remained the same for three consecutive months, and only 5% were repeated for more than four months. This analysis aligns with the general level of data authenticity for rice prices during the same period. In the late Qing Dynasty, however, instances of price records remaining unchanged for several consecutive months became more frequent, indicating a gradual decline in information quality (Li, 2022).

and establishing *Shen Bao* newsstands by 3 and 9 percentage points, respectively.

Then, we test whether the impact of telegraph access on disaster reporting was amplified by media coverage. Our analysis reveals that in instances where disasters were covered by *Shen Bao*, the likelihood of reporting disaster increased by 1.3 percentage points, four times higher than in cases without such media coverage. Additionally, we examine whether public sentiment related to disasters, as proxied by fundraising reports published in *Shen Bao*, influenced official reporting. The results indicate that telegraph access increased the probability of disaster reporting by 4.3 percentage points when fundraising reports were present, suggesting that heightened public attention strengthened the telegraph's effect on officials' information disclosure.

In addition to the media coverage, we also test if the telegraph affected disaster reporting through incentives provided by the state institutions. The first set of incentives concerns the presence of competing information providers. We find that the impact of telegraph access was greater in counties with informants, mid-level officials authorized to report directly to the central government without passing through provincial governors. Furthermore, the effect was stronger in counties with higher *shengyuan* quotas, reflecting a larger local elite class capable of serving as additional information channels. The second set of incentives involves the opportunity costs of concealing disasters. Our results indicate that the telegraph's impact on disaster reporting was significant in the cases of floods (not in case of droughts), consistent with the fact that the center was more likely to punish officials for concealing flood-related disasters. Additionally, we observe that the telegraph's effect was significant among officials with examination degrees (not so among those with purchased degrees), who had greater prospects for promotion and longer career horizons.

Finally, we assess the downstream consequences of telegraph access and find that it significantly enhanced public goods provision, stabilized grain prices, and mitigated social unrest. Specifically, conditional on disaster occurrence, telegraph access increased the frequency of tax relief by 0.28 times (58% of the mean), reduced the likelihood of grain price hikes by

3.4 percentage points (378% of the mean), and lowered the probability of tax revolts by 0.4 percentage points (57% of the mean). These findings suggest that the telegraph also improved public goods provision and enhanced social welfare.

This paper contributes to the literature on the development of state informational capacity. Building on the influential work of [Scott \(1998, 2010\)](#), which emphasizes the state's pursuit of legibility through standardized administrative practices, scholars have examined how geography (e.g., size, diversity, agricultural output) and communication structures influence a state's ability to monitor local agents ([Sng, 2014](#); [Sng and Moriguchi, 2014](#); [Mayshar et al., 2017, 2022](#); [Zhang, 2023](#)). The study most closely related to ours is [Zhang \(2023\)](#), which demonstrates that a competitive and flat communication structure enhances the state's capacity to provide disaster relief. Both [Zhang \(2023\)](#) and our paper draw on theoretical models of multiple informants leading to fully revealing equilibria ([Gilligan and Krehbiel, 1989](#); [Gibbons, 1998](#); [Krishna and Morgan, 2001](#); [Battaglini, 2002](#); [Gentzkow and Kamenica, 2017](#); [Sobel, 2013](#)) to explore how competition among information providers can ensure accurate reporting by self-interested officials. Our research highlights the complementarity between technology and institutional structures by showing that the telegraph alone had limited effect on promoting truthful reporting without the presence of competing information sources within the bureaucracy. Furthermore, we investigate the social origins of state informational capacity by demonstrating how modern information technology empowered private media, thereby incentivizing officials to provide high-quality information.

Second, this paper contributes to the studies on the relationship between media and bureaucracy. Prior research indicates that media coverage generally enhances bureaucratic accountability ([Besley and Burgess, 2002](#); [Snyder Jr and Strömberg, 2010](#)). For example, positive media attention can motivate officials to act proactively to claim credit ([Mayhew, 1974](#); [Fiorina, 1977](#); [Maor, 2011](#); [Gilad et al., 2016](#); [Nielsen and Moynihan, 2017](#)). Conversely, media coverage of scandals may lead to strategic silence to avoid punishment ([Weaver, 1986](#); [Hood, 2007, 2010](#); [Hong, 2019](#)) or prompt responsive actions to restore reputation ([Maor,](#)

2011; Busuioc and Lodge, 2016; Puglisi and Snyder Jr, 2011; Berlinski et al., 2012; Hirano and Snyder, 2012; Camerlo and Pérez-Liñán, 2015; Nyhan, 2015, 2017). Our findings align with this literature, suggesting that the impact of media coverage on bureaucratic behavior is contingent. *Only* with telegraph could media obtain information from independent sources with greater quality and less delay, and could its coverage of disasters incentivize bureaucrat's disaster reporting.

Lastly, this paper also contributes to the expanding quantitative literature on the impacts of telegraph adoption. Previous studies have primarily examined its economic and financial effects, including enhancing grain market efficiency (Gao and Lei, 2021), fostering the development of modern banking systems (Lin et al., 2021), integrating grain and capital markets (Hoag, 2006; Steinwender, 2018; Hao et al., 2022; Hao and Wang, 2024), and promoting industrialization and commercialization (Li et al., 2024). In contrast, the political and social consequences of telegraph expansion remain underexplored. Wang (2025) finds that mid-19th century U.S. access to telegraphed news from Washington increased political participation, as measured by voter turnout in national elections. To the best of our knowledge, our paper is the first to empirically demonstrate how the introduction of telegraph enhanced state information capacity.

The remainder of the paper is organized as follows. Section 2 reviews the historical background. Section 3 describes the data source. Section 4 outlines the empirical strategy and presents the baseline results. Section 5 conducts robustness checks, provides instrumented estimates, and examines information quality. Section 6 investigates the impact of the telegraph on the information capacity of private media and its role in constraining state agents. Section 7 discusses the role of competing state information providers and the opportunity costs associated with concealing disasters. Section 8 analyzes the effects on government disaster relief and social stability. Section 9 concludes.

2 Historical Background

This section begins by demonstrating the disaster reporting system in the Qing dynasty. Then we introduce the adoption of the telegraph in Qing China and explain how this information technology could have a critical bearing on disaster reporting by local bureaucrats.

2.1 Disaster Reporting in the Qing Dynasty

Disaster relief was a crucial mechanism through which the Qing government maintained social stability. Effective relief efforts depended on the central government's ability to promptly and accurately collect information on local disasters, making information gathering a vital component of Qing governance. The primary information system in the Qing dynasty was the routine memorial reporting system. Local officials at all levels were required to submit regular reports on governance matters, including natural disasters, public security, and other public affairs (Wu, 1997). These reports were initially sent to the provincial government, with direct reporting to higher authorities being prohibited. Provincial governors, governors-general, and senior officials reviewed and discussed the issues raised in the reports. The documents were then revised, accompanied by the suggestions or requests of provincial officials, and sent to the Transmission Office in the capital, where the format and content were thoroughly checked. Afterward, the routine memorials were forwarded to the Grand Secretariat, a high-level central agency, where grand secretaries drafted preliminary resolutions. Ultimately, the memorials, along with the proposed resolutions, were submitted to the emperor for final decisions.

Although the central government set up bureaucratic rules to punish local officials for underreporting disasters, local officials had incentives to conceal such information, especially when they had insufficient administrative or fiscal resources. This is because once the local officials reported the disaster, they took the full responsibility of mobilizing resources to provide relief to the victims, even though they were in lack of necessary resources (Ch'u,

1962). Moreover, late Qing relief measures prioritized tax exemptions over direct financial aid from the above, diminishing opportunities for officials to benefit from taxation, thereby decreasing their incentive to truthfully report (Will, 1990).³ As a result, the traditional routine reporting system suffered from systemic underreporting of disasters by local officials.

To mitigate the principal-agent problem inherent in disaster reporting, the Qing state established two complementary information channels to incentivize truthful local reporting, as illustrated in Figure 2. First, in 1722, the *Yongzheng* Emperor established the secret reporting system, allowing a group of mid-ranking officials to report directly to the emperor, bypassing the traditional bureaucratic hierarchy.⁴ Second, local elites known as *shengyuan*, who were primary recipients of relief efforts alongside farmers, had strong incentives to report local disasters to authorities. In certain cases, they could directly correspond with high-ranking officials from their home regions, ensuring that local issues received attention at higher administrative levels (Fei and Chou, 1953).

[Figure 2 about here]

Despite the establishment of multiple competitive information channels, the effectiveness of Qing dynasty officials in promoting truthful reporting was constrained by traditional communication technologies. Before the introduction of the telegraph, information transmission relied heavily on couriers and messengers, resulting in slow and often unreliable communication. This hindered the timely and accurate reporting of disasters, making it challenging for the emperor to cross-verify information from different sources and effectively oversee local officials' disaster reporting.

³ While overreporting to embezzle relief funds was also possible, this was less prevalent in the post-Taiping Rebellion period, when the central finance was strained and direct aid from the center was limited (Ni and Uebele, 2019).

⁴ For instance, in 1738, *Gao Bin*, Governor of the *Jiangnan* River Conservancy, submitted a confidential memorial detailing relief effort in *Jiangsu* and *Anhui* provinces (*The First Historical Archives of China, henceforth* FHAC).

2.2 Telegraph and Disaster Reporting

The telegraph was introduced to China in the early 1860s, shortly after its invention by Morse in 1844. During the subsequent two decades, the Qing government prohibited large-scale construction of telegraph lines and poles, despite persistent lobbying efforts by Western powers.⁵ It was not until the 1880s that the Qing authorities began developing a national telegraph network, primarily for the rapid transmission of military information.⁶ In 1881, the first north–south telegraph line was constructed to connect Shanghai and Tianjin and facilitate military coordination. The next two decades saw a rapid expansion of the telegraph across the country. As shown in Figure 1, no prefectures were connected before 1881. The pace of expansion accelerated during the *Sino-French War* (1883–1885), slowed during the 1890s, and rose again following the *Boxer Uprising* in 1900. By 1911, approximately 50,000 kilometers of telegraph lines had been laid, and 503 telegraph stations had been established, covering 63.8% of prefectures in China Proper ([Traffic History Compilation Committee, 1936](#)).

Telegraph construction in the late Qing dynasty provides an ideal setting for our empirical analysis for several reasons. First and foremost, the spread of telegraphs can be viewed as a quasi-experiment. The Qing government generally determined the locations of major telegraph stations based on military considerations, and linked them in straight lines to minimize costs ([Xia, 2012](#)). As illustrated in Figure 3, the initial telegraph lines were established along the eastern coast, as well as the southwestern and northwestern frontiers. Second, the staggered rollout of the telegraph network across different regions and time periods provides substantial spatial and temporal variation, which is essential for identifying the

⁵ Initially, the Qing government resisted establishing a nationwide telegraph network for three primary reasons ([Xia, 2012](#)). First, there were concerns that losing control over the information system could undermine national sovereignty. Second, permitting foreign entities to construct telegraph lines risked diplomatic disputes between China and other nations. Third, the construction of telegraph lines across mountains and fields could disrupt homes and ancestral tombs, potentially inciting public unrest and uprisings.

⁶ Although telegraph lines were initially constructed for military purposes, their high efficiency and convenience in transmitting information led to widespread adoption by local officials and news media for disaster reporting.

effects of information technology. The adoption of the telegraph shortened the long-distance message delivery times to mere hours. Third, the telegraph network expanded rapidly across the country before most regions were connected by railroads, allowing us to disentangle the effects of information technology from those of transportation infrastructure.

[Figure 3 about here]

The establishment of telegraph networks significantly enhanced long-distance communication capabilities in China. Previously, messages were delivered via boats or horseback, leading to considerable delays. For instance, despite the relatively short distance of 650 kilometers between *Chongqing* and *Yichang*, a round trip for message delivery typically spanned 40 to 50 days (Peng, 2015). The advent of the telegraph drastically reduced information transmission costs, thereby facilitating more efficient cross-verification of information across various channels.⁷ For example, in October 1906, when a severe flood devastated northern *Anhui* province. In response, *En Ming*, the provincial governor of Anhui, promptly reported the disaster to the Qing central government via telegraph, requesting the allocation of 100,000 taels of silver from the provincial treasury for relief efforts. The central government approved this request in the same month through a return telegram (FHAC, 2005).

2.3 Telegraph and Private Media

Beyond the disaster reporting channels within state institutions, media coverage emerged as a significant source of disaster information for the central government following the establishment of *Shen Bao* in 1872. As the most influential newspaper in contemporary China, *Shen Bao* dedicated considerable attention to disaster reporting from its inception. Its coverage included disaster situations, government relief efforts, interventions by Western organizations, charitable activities, and public donations. However, prior to the introduction of the

⁷ The Qing government prioritized the dispatch of disaster-relief telegrams by implementing two specific measures: (1) classifying these telegrams as top-priority express messages, and (2) charging them at half the standard rate (Traffic History Compilation Committee, 1936).

telegraph, media outlets faced limitations in directly accessing information from distant regions. Moreover, their reports had limited influence on governmental actions due to high verification costs and a constrained ability to shape public opinion. For instance, on December 16, 1876, *Shen Bao* reported that officials in *Qingzhou* and *Laizhou* Prefectures of *Shandong* Province had concealed local drought and locust disasters, resulting in delayed relief efforts and massive famine-related deaths. Despite the severity of the report, it failed to elicit timely attention from the central government, and the negligent officials were not held accountable.

The adoption of the telegraph significantly enhanced *Shen Bao*'s capacity to report disasters with greater speed and frequency (Xia, 2008; Deng, 2013). This technological advancement facilitated more timely dissemination of information and improved coordination of relief efforts within the private media sector (Li, 2006). On September 30, 1887, the Yellow River breached its bank near *Zhengzhou* city of *Henan* province. By October 2, *Shen Bao* had already featured an "Urgent Telegram on the Yellow River Breach" on its front page. Over the subsequent three days, the newspaper published successive telegrams detailing the expanding breach, the progression of floodwaters, and the ongoing relief efforts.⁸

The disaster reporting by *Shen Bao* potentially enabled the central government to receive direct information about local calamities, thereby pressuring local officials to report disasters truthfully. During the late Qing dynasty, *Shen Bao* extensively covered major disasters, including the 1887 Yellow River breach, the 1906 Yangtze River flood, the 1909 drought of *Gansu* province, and the 1911 Northeast plague (Du, 2015). These reports not only informed the public but also served as a mechanism to hold local authorities accountable for their disaster response efforts.

Moreover, if disaster relief efforts were organized across regions, they attracted significant public attention, which in turn encouraged local officials to proactively report disasters and

⁸ The *Shanghai–Tianjin* telegraph wire had opened in 1881, followed by the completion of the *Shanghai–Hankou* and *Hankou–Zhengzhou* lines in 1884. This network enabled disaster-related telegrams to be transmitted directly from affected areas through Tianjin to Shanghai, where newsrooms could promptly dispatch them as "first-class express" messages.

prompted the central government to provide timely assistance. In the spring and summer of 1906, Hunan Province experienced a catastrophic flood unprecedented in two centuries. In response, *Shen Bao* initiated a relief campaign in April of the same year and began publishing lists of donations from May 9 onward (*Shen Bao*, 1906). This fundraising effort activated rapid responses from local officials. Governor-General *Pang Hong* transmitted the disaster information reported by local officials to the Qing court via telegram. On May 13, the central government issued an imperial decree granting 100,000 taels of silver for disaster relief and instructing Pang to promptly report subsequent relief progress without delay (FHAC, 2005).

3 Data and Variables

To investigate the effect of telegraph adoption on disaster reporting by officials, we construct a county-year panel dataset that combines a binary indicator for disaster reporting, telegraph connection status, and records of disaster shocks from 1865 to 1911 across China Proper. Summary statistics are presented in Table 1. We begin our sample in 1865, following the end of the Taiping Rebellion. Post-rebellion, the Qing dynasty faced significant financial constraints, compelling local officials to independently raise relief funds. Moreover, officials were ineligible for promotions until they successfully completed their disaster relief assignments. These conditions potentially incentivized underreporting of disasters. The sample concludes in 1911, marking the fall of the Qing dynasty and the end of imperial rule in China.

[Table 1 about here]

3.1 Disaster Reporting

Disaster reporting by local officials (0/1). We constructed a county-year-level indicator of disaster reporting by local officials, the dependent variable in our baseline analysis. The data were sourced from *the First Historical Archives of China* (FHAC), which houses digitized Qing dynasty memorials, official documents submitted by local officials to the emperor.

We employed disaster-related keywords (e.g., drought, flood, famine, relief, tax exemption) to filter relevant memorials and matched them to specific counties and years. Through textual analysis of memorial titles, we identified whether a disaster was reported in a given county-year. This process yielded a binary variable indicating disaster reporting for 1,620 counties from 1865 to 1911.

Disaster reporting in *Shen Bao* (0/1). To analyze the mechanisms underlying disaster reporting, we construct a county-year dummy capturing media exposure through disaster reports in *Shen Bao*, the most influential national daily newspaper in modern China. Due to its extensive publication period and significant influence, *Shen Bao* has been widely utilized in studies of modern Chinese history. Notably, it played a crucial role in disseminating disaster information, making it particularly pertinent to our research. We conducted textual analysis on *Shen Bao*, utilizing its full-text digitization completed by the Green Apple Center in 2010. Employing the same disaster-related keywords as previously mentioned (e.g., drought, flood, famine, relief, tax exemption), we identified relevant articles and matched them to specific counties and years. This process yielded a binary variable indicating the presence of disaster reporting in *Shen Bao* for each county-year observation. Moreover, to capture public sentiment, we define a county-year-level dummy variable by filtering memorials containing keywords related to public sentiment on disasters, such as report on disaster relief funds, request for relief, starving people, and severe famine.

3.2 Telegraph Construction

Data on telegraph adoption were collected from *Jiaotongshi Dianzhengbian* (Traffic History: Telecommunications) and local gazetteers from the sample regions (see Appendix C for details of these sources).⁹ We started by obtaining a list of prefectures in which telegraph

⁹ Local gazetteers have long been integral to the study of Chinese history. In imperial China, local literati maintained a tradition of documenting major political, economic, and cultural events. This practice evolved into the creation of local gazetteers, serving as encyclopedias of regional conditions and customs. Given China's climatic variability, natural disasters were a focal point in these records, resulting in detailed accounts of such events, particularly during the Qing dynasty.

lines were constructed before 1913 from *Jiaotongshi Dianzhengbian*. From local gazetteers, we then pinned down the dates when these telegraph stations began operations. Our analysis focuses on 276 prefectures within China Proper, across 18 provinces, for which telegraph construction information is available. The temporal trends and spatial distribution of the telegraph network are shown in Figure 1 and 3.

3.3 Disaster

We sourced disaster data from the *Comprehensive Compilation of Weather Records for the Last Three Millennia of China* (Zhang, 2004), which compiles weather-related events documented in thousands of local gazetteers. We manually collected information on each recorded disaster from 1865 to 1911, including the date, type, severity, and consequences of the event. The dataset contains 16,105 natural shocks—including droughts, floods, storms, hail, plagues, freezing disasters, and so on—averaging 11.06 events per county in this period. Over 40% of these shocks caused life loss or property damage, and more than 15% led to crop failure or famine. We aggregated these records into a county-year panel dataset for analysis.

To better capture the magnitude of each disaster beyond frequency, we constructed a weighted disaster index based on four dimensions of impact: (1) house collapses, (2) destruction of public infrastructure, (3) damage to crops and livestock, and (4) human fatalities. Each dimension was assigned an integer value from 1 to 4, respectively. For example, if a county experienced two shocks in a given year, one causing public infrastructure damage and the other affecting agricultural production, the resulting disaster index would be 4 (1+3). It's important to note that natural shocks do not always result in catastrophes; famines often reflect failures in timely and effective government intervention rather than the severity of the shock itself.

3.4 Information Quality

We constructed two indicators to measure information quality. First, we created a dummy for concealing disaster. This variable takes the value 1 when local officials failed to report a disaster that actually occurred within their jurisdiction. Reported-disaster data were obtained from FHAC, whereas records of actual disasters were drawn from [Zhang \(2004\)](#).

Second, we captured information-quality deficiencies indirectly by identifying grain-price misreporting. Specifically, we constructed a price-misreport dummy that equals 1 when the monthly peak price of grain remained unchanged for an extended spell (e.g., 5, 7, 9 consecutive months).¹⁰ Persistent nominal grain prices may signal poor information quality for two reasons. For one, grain markets normally exhibit seasonal volatility that mirrors planting and harvest cycles; therefore, a prolonged flat price path suggests deliberate under-reporting by local officials ([Marks, 1998](#); [Li, 2022](#)).¹¹ For another, natural disasters typically trigger sharp price increases, so officials seeking to conceal a calamity may also suppress reports of local price spikes.¹² The data on grain prices were sourced from the Qing Dynasty Grain Price Database ([Institute of Modern History, 2014](#)).

3.5 Other variables

Reporter and Newsstand of *Shen Bao*. We built prefecture-year level dummy variables for the presence of a *Shen Bao* reporter and of a *Shen Bao* newsstand by combining data

¹⁰ A nationwide grain price reporting system was instituted during the reign of the Qianlong Emperor (1736–1795), mandating that local governments at all administrative levels submit monthly reports on the prices of major grain types within their jurisdictions. This system remained operational until the fall of the Qing Dynasty in 1911, resulting in the compilation of a prefecture-month panel dataset encompassing grain prices across 319 prefectures in 20 provinces over approximately 200 years.

¹¹ [Wang and Huang \(1999\)](#) investigated the relationship between natural disasters and grain price fluctuations during the Qing dynasty. Their study revealed that in the Yangtze River Delta, grain price peaks predominantly occurred in years marked by frequent natural disasters. Specifically, price fluctuations from 1641 to 1720 and 1741 to 1830 were largely associated with droughts, while those from 1831 to 1880 corresponded primarily to floods.

¹² Given the significant impact of climate conditions on grain production, successive Chinese governments established a disaster reporting system to collect climate information nationwide. This system served to predict and verify grain price data from various regions, enabling proactive measures to address potential crises arising from reduced grain output due to natural disasters ([Li, 2022](#)).

from [Song \(1996\)](#) and the *Shen Bao Digital Archive*. These indicators allow us to investigate the micro-level channel through which the telegraph enhanced *Shen Bao*'s capacity for direct information acquisition.

Incentive within Bureaucratic System. To capture heterogeneity in bureaucratic incentives, we assembled three prefecture-year variables. First, we used [Zhang \(2023\)](#) to identify informant officials who were permitted to bypass provincial superiors and report directly to the emperor, thereby acting as internal monitors. Second, we employed the *shengyuan* quota compiled by [Bai and Jia \(2016\)](#) to proxy the size of the locally embedded elite, which could provide additional information to the center. Third, we classified officials' qualifications by matching their examination degrees, recorded in the Register of Gentry (*Jinshenlu*). These variables allowed us to test whether stronger internal monitoring or higher career stakes amplified the effect of telegraph access on truthful disaster reporting.

Consequences of Disaster Reporting. We assembled a set of consequence variables to gauge the effects of disaster reporting. Government assistance was proxied by the annual frequencies of tax relief and cash or grain relief, which we hand-coded from the Veritable Records of Qing (*Qingshilu*). Social stability was captured with two indicators. First, we collected a grain-price spike dummy from [Zhang \(2004\)](#). Second, we recorded a tax-revolt dummy based on incidents extracted from the Veritable Records of Qing. These measures allowed us to investigate if improved information flows of disasters translated into stronger state relief and lower incidence of social unrest.

Control Variables. We constructed several control variables to account for potential confounding factors. First, we measured foreign military pressure by counting the number of incursions at the prefecture-decade level, based on data from *A Chronology of Warfare in Dynastic China* compiled by [China's Military History Editorial Committee \(2003\)](#). Second, we determined treaty port status using information from *Selected Statistics of the Early Modern China* compiled by [Yan \(2012\)](#). Third, we identified geographic and administrative features, such as provincial capitals, main rivers, and *chong* (transportation hubs), using

data from [Bai and Jia \(2016\)](#). Finally, for robustness checks, we incorporated information on railroad presence from [Ma \(1983\)](#).

4 Baseline Results

This section investigates the impact of telegraph adoption on bureaucratic responsiveness to disasters. Section 4.1 demonstrates the DID estimation strategy. Section 4.2 presents the baseline results, examining how telegraph access influenced local officials' propensity to report disasters. Section 4.3 explores the dynamic effects of telegraph construction over time and tests the parallel trends assumption underlying the DID framework.

4.1 Estimation Strategy

Our baseline specification employs a DID strategy that compares the local officials' propensity of reporting disasters in telegraph-connected prefectures to those without telegraph connections before and after they gained access to telegraphs. The regression equation is as follows:

$$DR_{it} = \alpha + \beta Telegraph_{it} + \phi' \mathbf{Z}_{it} + \theta' \mathbf{X}_i \times \omega_t + \gamma_i + \omega_t + \epsilon_{it} \quad (1)$$

where DR_{it} denotes the local officials' disaster reporting dummy of county i in year t . The variable $Telegraph_{it}$ is a dummy that indicates whether county i in year t had telegraph access, which equals 1 from the year of the arrival of telegraph onward. In our preferred specification, we control for time-invariant characteristics (e.g., geographical features) of county by including county fixed effects γ_i , and we account for shocks common to all counties (e.g., nationwide policies) by adding year fixed effects ω_t . We also include $\mathbf{Z}_{it}$, a vector of time-varying controls such as disaster severity and determinants of telegraph adoption (e.g., frequency of external wars, treaty port status). Additionally, we incorporate $\mathbf{X}_i \times \omega_t$ to control time-invariant determinants of telegraph introduction (i.e., province capital status,

main river dummy, and presence of transportation hubs).¹³ Standard errors are clustered at the prefecture level to account for spatial correlation.

4.2 Baseline Results

Table 2 presents the baseline regression results. Column 1 shows that the telegraph adoption significantly increased the likelihood of reporting disasters by local officials by 0.27 percentage points, controlling for county and year fixed effects. In column 2, after accounting for potential confounders, such as disaster severity, frequency of external wars, and treaty port status, the estimated effect remains stable. Our preferred specification, shown in column 3, further includes interactions between time-invariant county features (i.e., province capital status, main river dummy, and presence of transportation hubs) and year fixed effects. The results suggest that telegraph access increased the probability of disaster reporting by 0.36 percentage points, representing approximately 31% of the mean of the dependent variable.

[Table 2 about here]

4.3 Dynamic Impacts

To investigate the effect of the telegraph adoption over time and check the parallel trend assumption for the DID strategy, we allow for a more flexible specification and conduct a dynamic analysis by replacing $\beta Telegraph_{it}$ with $\sum_{m=-G}^M \beta_m D_{i,t+m}$, where $D_{i,t+m}$ is an indicator that equals 1 if county i was connected by telegraph m periods before time t ; and β_m captures telegraph's effect of m periods after time t . We set the pre-event period bin as 9 years and the post-event period bin as 6 years to create symmetric event window.¹⁴ This approach allows us to directly test the parallel trends assumption by examining whether

¹³ See Table A1 for detailed results on the relationship between prefectural characteristics and the timing of telegraph arrival.

¹⁴ To account for the possibility that telegraph might arrive at some regions in the later months of the year, we define the year of arrival and the subsequent year as period 0 to assess the immediate impact of the telegraph connectivity.

the pre-treatment coefficients (β_m for $m < 0$) are statistically indistinguishable from zero. Additionally, it enables us to observe the dynamic impact of telegraph adoption on disaster reporting by local officials over time.

Figure 4 presents the differences in the likelihood of disaster reporting by local officials between counties connected to the telegraph and those not connected, over nine periods: four pre-treatment periods, one reference period, and four post-treatment periods. The results indicate no significant increase in disaster reporting during the four years prior to telegraph access, supporting the parallel trends assumption. There is a sharp growth in disaster reporting once the telegraph was introduced, and the upward trend was persistent over time. A marked increase occurred in the period of telegraph introduction (period 0), with disaster reporting rising by 0.49 percentage points, representing 42% of the sample mean. Although the effect in period 1 is statistically insignificant, the impact resurfaces in periods 2 and 3, both showing an increase of approximately 0.5 percentage points and remaining statistically significant. These dynamic effects reinforce the baseline findings, suggesting that the observed increase in disaster reporting following telegraph adoption is unlikely to be driven by unobserved time-varying confounders.

[Figure 4 about here]

In addition, a common concern with the conventional two-way fixed effect (TWFE) estimator in staggered DID settings is the potential bias arising from heterogeneous treatment effects across time periods or units. In such cases, some units might receive negative weights when aggregating outcomes, leading to biased estimates (De Chaisemartin and d’Haultfoeuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021; Borusyak et al., 2024; Callaway and Sant’Anna, 2021). To address this issue, we re-estimate the dynamic effects using the method proposed by Cengiz et al. (2019). This approach consists of the following steps. 1. We create cohort-specific panel datasets, where each dataset contains a single treated cohort along with all never treated units. These never treated units make up the “clean

controls”. 2. We stack these datasets and line them up according to the relative time indicators. 3. We conduct a dynamic analysis on this stacked dataset, interacting fixed effects with dataset indicators. Standard errors are clustered two-way at the prefecture and dataset indicator levels. Panel a of Figure 5 shows that these estimates are similar in magnitude and significance to our standard TWFE estimates. In addition, we apply the method proposed by Sun and Abraham (2021), which accounts for treatment effect heterogeneity in event studies. As shown in Panel b of Figure 5, our dynamic results remain robust. Therefore, we proceed with the standard TWFE estimates in the remainder of the article.

[Figure 5 about here]

5 Robustness Checks

This section presents the results of robustness checks. Section 5.1 conducts a series of robustness checks. Section 5.2 provides instrumented results. Section 5.3 shows the impact of telegraph connection on information quality.

5.1 Robustness Checks

Sub Samples. In our baseline regression, we focused on the period following the suppression of the Taiping Rebellion (1865–1911). To ensure that our results are not influenced by the Nian Rebellion, we further restricted the sample to the post-Nian period (1869–1911). The results, presented in column 2 of Table 3, indicate that this stricter sample restriction does not alter our baseline findings. To enhance the comparability between the treatment and control groups, we employed a Coarsened Exact Matching (CEM) approach (Iacus et al., 2012).¹⁵

We matched counties based on the five variables that can influence telegraph construction:

¹⁵ This approach has been increasingly adopted in recent economic studies (e.g., Aneja and Xu (2022); Bo et al. (2023)). Compared to controlling for confounders, the Coarsened Exact Matching (CEM) method reduces statistical bias with less model dependence. Moreover, CEM outperforms commonly used matching methods, such as propensity score matching and Mahalanobis matching, in reducing imbalance, model dependence, and estimation error (Iacus et al., 2012).

four dummy variables indicating whether a prefecture was a province capital, treaty port, strategic military location (*chong*), or located along a main river, and one variable measuring war frequency. Using the matched sample, we replicated the baseline regression and found that the positive effect of telegraph connection on disaster reporting remained virtually unchanged, as shown in column 3 of Table 3. This suggests that our main results are robust to potential confounders related to treatment assignment.¹⁶ Additionally, we excluded natural disasters that are unlikely to cause serious harm and thus may not necessitate official reporting, such as thunder, fog, haze, and snow. The results in column 4 demonstrate that the baseline findings remain largely consistent even after this exclusion.

Additional Controls. We controlled for the impacts of the contemporaneous advancements in information and transportation technologies. To eliminate the potential confounding impacts of the wireless telegraph, which was first employed by the Qing government in 1905, we restricted our sample to the period before 1905. As shown in column 5 of Table 3, the positive effect of telegraph arrival on disaster reporting remains virtually unchanged, indicating that our baseline result is unlikely to be driven by the introduction of wireless telegraphs. Additionally, we included a railroad dummy, set to 1 if a county was connected by railroads prior to the arrival of the telegraph. The results, presented in column 6, demonstrate that our main findings remain stable, suggesting that the observed effects are not confounded by the expansion of railroad infrastructure.

Alternative Dependent Variable. We then use the frequency of disaster reporting as the dependent variable and also find that telegraphs contribute to the disaster reporting (column 7, Table 3). Specifically, the frequency of disaster reporting in counties with

¹⁶ For the first four binary variables, we applied the default binning algorithm (Sturges' rule), which resulted in exact balance. The remaining continuous variable was coarsened based on its range by defining custom bins. Using this matching strategy, we successfully matched 50,214 out of 50,610 treated events across 16 distinct strata. We assessed the matching quality using the multivariate L1 distance metric (Iacus et al., 2012), which quantifies differences between treated and control groups. Prior to matching, the L1 distance was 0.268; post-matching, it decreased sharply to 0.000, indicating high matching quality. Balance checks in Table A2 reveal that, before matching, the treatment group had greater military and political significance compared to the control group. However, in the CEM-matched sample, both the mean differences and L1 distances for each covariate were substantially reduced.

telegraph access is 0.0055 times higher than in counties without telegraph access (34% of the mean). This indicates that the telegraph affects officials' disasters reporting not only on the extensive margin but also on the intensive margin. In addition, our baseline results are robust to alternative fixed effects, standard errors, and data level. See Table A3 for results of these additional robustness checks.

5.2 Instrumented Evidence

We employ an instrumental variable (IV) approach to further address the concern that the telegraph network and officials' disaster reporting may be influenced by unobserved confounders. As detailed in Section 2.2, the Qing government constructed a military telegraph network between the 1880s and 1890s to strengthen defense (Figure 3). This network eventually formed the early trunk of China's telegraph system. Later, short-distance lines were added as extensions to reach peripheral areas. To eliminate the possible influence of local economic conditions on the location of the telegraph trunk lines, we construct a hypothetical military telegraph trunk network (HMTN) and use the shortest distance from a prefecture to the HMTN as the instrumental variable (henceforth, distance to HMTN).

To construct the HMTN, we first identified 21 military centers from the late Qing period. Eight of these were cities where governors-general were stationed, while the remaining thirteen were towns of military importance.¹⁷ These military centers were then linked along paths that minimized construction costs. They were calculated based on topographical and hydrological indices, scaled to 1×1 km grid cells. Topography and hydrology data were obtained from the Shuttle Radar Topography Mission (SRTM). As shown in Figure 6, the distribution of the HMTN closely aligns with that of the actual trunk lines.

[Figure 6 about here]

¹⁷ Military centers included Baoding, Jiangning, Fuzhou, Guangzhou, Yunnan Fu, Chengdu, Wuchang, Lanzhou, Beijing, Yongping, Taiyuan, Kaifeng, Ji'nan; Tianjin, Dengzhou, Songjiang, Xi'an, Jiujiang, Yongchang, Tai-ping, and Lianzhou.

We formally examine the effect of the distance to HMTN on the distribution of the telegraph in column 1 of Table 4. Consistent with expectations, greater distance to the trunk network is associated with a significantly lower likelihood of telegraph adoption. This finding supports the relevance of our instrumental variable. Importantly, the distance to HMTN is plausibly exogenous to officials' disaster reporting. The 21 military centers that form the basis of the HMTN were established in the late 17th century, well before our sample period. This historical context suggests that the instrument is unlikely to be correlated with unobserved factors affecting disaster reporting. We employ the two-stage least squares (2SLS) method to estimate the effect of the telegraph on disaster reporting.

We use the telegraph connection status in specific years (1895, 1900, 1905) as the key independent variable, disaster reporting by officials after these years as the dependent variable, and the distance to HMTN as the instrumental variable to re-estimate the impact of the telegraph on disaster reporting by officials. Under this specification, the positive effect of the telegraph on disaster reporting by officials remains consistent (columns 2–4, Table 4). Furthermore, the results in column 1 and the corresponding F-statistic values suggest the weak instrument concerns are unlikely to affect our regression.

[Table 4 about here]

5.3 Evidence on Information Quality

The empirical results above indicate that the telegraph effectively promoted the likelihood of disaster reporting by officials. We proceed to investigate whether telegraph adoption improved information quality. First, we compare the detailed information provided in disaster reports with that recorded in local gazetteers. The result shows that only with telegraph connection is the disaster severity reported by local officials positively correlated with the disaster severity recorded in the local gazetteers (column 1, Table 5). Moreover, the results in columns 2 and 3 show that the introduction of the telegraph reduced the likelihood of officials concealing disasters, regardless of whether the disaster caused severe damage.

Second, we examine grain price misreporting, characterized by instances where the reported monthly highest price remained constant over several consecutive months (e.g., 5, 7, or 9 months), indicating a lack of information quality. The results in column 4–6 of Table 5 show that the telegraph significantly reduced the likelihood of misreporting the highest grain prices by 8%, 6%, and 5.4%, respectively (12%–15% of the mean). In contrast, the lowest grain prices were less likely to reveal disaster conditions, providing local officials with little incentive to conceal them. Consequently, the introduction of the telegraph would not improve the reporting accuracy of the lowest grain prices. As a placebo test, we find that telegraph access had no significant impact on the misreporting of the lowest local grain prices (see Table A4 in Appendix A for details). Additionally, we find that the telegraph significantly shortened the delay in disaster reporting (see Appendix B for details).

[Table 5 about here]

6 The Role of Private Media

In this section, we proceed to discuss how the adoption of the telegraph enhanced private media’s capacity to collect and disseminate information, and how this, in turn, incentivized bureaucratic disaster reporting.

6.1 The Telegraph’s Role in Facilitating Media Disaster Reporting

There are two potential channels through which the telegraph strengthened private media’s informational capacity. First, the telegraph improved the authenticity and quality of government information, thereby benefiting the media. Second, the telegraph may have enabled media outlets to directly obtain information from distant locations, reducing their reliance on government sources.

To test this hypothesis, we first examine whether the telegraph increased media exposure of disasters. The results in column 1 of indicate that following the arrival of the telegraph

in a county, the likelihood of *Shen Bao* reporting a disaster increased by 1.1 percentage points (27% of the mean). Next, we categorize these disaster reports into two groups: those published before official disaster reports and those after. Columns 2 and 3 of Table 6 show that the telegraph facilitated the former but did not affect the latter. This suggests that the telegraph enhanced the media's ability to directly obtain information from non-bureaucratic channels, rather than merely benefiting from improved official information. We further investigate the mechanisms through which the telegraph enhanced *Shen Bao*'s capacity for direct information acquisition. Columns 4 and 5 reveal that prefectures connected to the telegraph were 3 and 9 percentage points more likely, respectively, to recruit *Shen Bao* reporters and establish *Shen Bao* newsstands compared to those without telegraph access.¹⁸ This expansion strengthened its ability to collect, transmit, and disseminate information through non-governmental channels.

[Table 6 about here]

6.2 The Role of Media Disaster Reporting in Promoting Official Disaster Reporting

Disaster reporting in *Shen Bao* could incentivize local officials to report disasters through two primary mechanisms. The first is **the cross-verification effect**, wherein disaster reports by *Shen Bao* might enable the central government to directly access disaster information via the newspaper, increasing the risk of local officials being exposed for concealing disasters and thereby prompting them to report truthfully. The second is **the public sentiment effect**: when a disaster remains undisclosed, grassroots officials may collude with local leaders, or even the central government, to ignore it.¹⁹ However, once *Shen Bao* discloses the disaster and it garners public attention, local officials can no longer feign ignorance and are compelled

¹⁸ See Figure A1 in Appendix A for the dynamic impacts of telegraph adoption on disaster report in *Shen Bao*.

¹⁹ The severe fiscal constraints during the late Qing dynasty increased the likelihood of collusion among various levels of government to underreport or disregard natural disasters.

to report it to the central government.

We empirically tested these mechanisms. First, we examine cases where official disaster reports were dated *after Shen Bao's* disaster reports. Column 1 of Table 7 shows that following the introduction of the telegraph, such instances increased by 0.3 percentage points (43% of the mean). Furthermore, conditional on Shen Bao reporting a disaster in a county, telegraph connection raised the likelihood of official disaster reporting by 1.3 percentage points, four times higher than in counties without such media reports (Table 7, column 2). Interestingly, we find that media exposure enhanced disaster reporting *only* in counties connected to the telegraph. Without the telegraph, media exposure may be too delayed to constraint local officials and or serve as timely information channel to the central government. Finally, we test whether disaster-related public sentiment, as measured by fundraising reports published in *Shen Bao*, affected local disaster reporting. In counties with such fundraising reports, the telegraph raised the likelihood of official disaster reporting by 4.3 percentage points (Table 7, column 3).²⁰ Overall, the telegraph facilitated media exposure of disaster, and their interaction incentivized bureaucratic disaster reporting by providing independent and verifiable information sources.

[Table 7 about here]

7 Heterogeneities

In this section, we investigate whether the telegraph influenced disaster reporting through incentives embedded within the bureaucratic system. The first set of incentives concerns competing information channels within the bureaucracy, which increased the likelihood of agents getting caught for deception. The second set involves factors affecting the opportunity costs of concealing disaster information.

²⁰ Similarly, in the absence of telegraph communication, fundraising via media may reduce the incentive to report disaster, as societal disaster relief could substitute for governmental assistance.

7.1 Competition among Multiple Information Providers

While the telegraph reduced the costs of information transmission, it also potentially facilitated vertical collusion among higher and lower officials within a single information channel. However, in areas with multiple information channels, such collusion was more likely to break down, as the telegraph significantly lowered the costs of verifying information authenticity across different channels. Therefore, we hypothesize that the impact of the telegraph was greater in counties with multiple information channels compared to those relying solely on routine channels.

We first examine the role of informants, middle-ranked officials authorized to report directly to the central government without passing through provincial governors or central ministries. As is shown in Table 8, column 1 and 2, telegraph connectivity raised the likelihood of disaster reporting by 0.6 percentage points in prefectures with at least one informant (approximately 180% of the baseline effect). In contrast, the impact was only 0.3 percentage points in prefectures without informants.

[Table 8 about here]

Additionally, we discuss the role of lower examination degree holders, who served as supplementary information providers from local societies. As is shown in column 3 and 4 of Table 8, telegraph connection increased the likelihood of disaster reporting by 0.9 percentage points in prefectures where the number of lower degree holders, proxied by the *shengyuan* quota, was above the median. In contrast, the effect was 0.2 percentage points and statistically insignificant in prefectures where the *shengyuan* quota was below the median.

In conclusion, the impact of the telegraph was more pronounced in counties with greater access to alternative information channels, suggesting that telegraph connectivity heightened local officials' exposure to competition from information providers such as informants and lower examination degree holders.

7.2 Opportunity Costs of Concealing Information

Officials' incentives to truthfully report disasters are influenced by the opportunity costs associated with concealment. Compared to droughts, floods often cause more rapid and severe damage. Without timely disaster relief, floods are more likely to incite social unrest. Consequently, central governments tend to focus more on reports and relief efforts related to flooding (Will, 1990). As shown in columns 1 and 2 of Table 9, the impact of telegraph adoption was significant only in the case of floods (not droughts), where timely reporting was more essential and concealing information would result in more severe punishment.

[Table 9 about here]

In addition, officials with greater prospects for promotion and longer career horizons had stronger incentive to report disasters truthfully. While concealing disasters might offer short-term convenience, it could severely damage their reputations, which played a crucial role in their promotion prospects (Li, 1993).²¹ Consistent with this argument, the impact of the telegraph was significant only for officials with examination degrees, not for those with purchased degrees (Table 9, column 3 and 4). On average, officials with examination degrees achieved their first promotion approximately five years earlier, were about ten times more likely to be promoted to provincial-level positions, and enjoyed political careers approximately twelve years longer than those with purchased degrees (Chen, 1982; Wong, 1997; Huang, 2001; Elman, 2013).

²¹ The Qing Code (*Da Qing Lv Li*), the most important comprehensive legal code of the Qing dynasty, contained explicit provisions regarding the reporting, assessment, and relief of disasters by officials. Moreover, the Qing government treated officials' performance in disaster relief as a key criterion in political evaluation. For instance, Tian Wenjing, Zhu Yingrong, and Shen Yungong were promoted for their meritorious relief efforts, while officials such as Kabai, Deyin, and Jiang Sheng were demoted or dismissed for concealing disasters. Similarly, Wen Chenghui, Wang Wenyong, and Qian Gui were demoted or dismissed due to delays in disaster relief (Li, 1993).

8 Further Consequences

We proceed to explore the consequences of increased disaster reporting resulting from telegraph adoption. First, we test whether telegraph connection would improve disaster relief efforts. Column 1 of Table 10 shows that the counties with telegraph connection received 0.28 more tax-exemption events from central government during disaster periods, representing 58% of the mean. However, telegraph access had no significant effect on the amount of grain or money relief received by counties during disasters (Table 10, column 2). The discrepancy aligns with historical accounts of the Qing dynasty's declining fiscal capacity. Given the weak fiscal capacity, granting tax exemptions was more feasible than providing direct grain or monetary aid.²²

[Table 10 about here]

We further examine if the telegraph contributed to stabilizing grain prices during disasters, considering the role of disaster relief in mitigating such shocks. As shown in column 3 of Table 10, telegraph connectivity reduced the likelihood of grain price hikes by 3.4 percentage points during disaster periods, amounting to 378% of the mean. Subsequently, we assess whether telegraph arrival enhanced social stability following disasters. Results in column 4 indicate that, given a disaster occurred, the telegraph decreased the likelihood of tax revolts by 0.4 percentage points (57% of the mean). Overall, by alleviating principal-agent problems within the bureaucracy, the telegraph promoted public good provisions, enhanced social stability, and improved social welfare.

9 Conclusion

This paper investigates the causal effect of information technology on the state's capacity to collect disaster information from local officials by exploiting a quasi-experiment—the

²² Natural disasters often damage transportation infrastructure, increasing the costs associated with transporting money and grain. Consequently, tax exemptions serve as a disaster relief measure with lower implementation costs compared to monetary or grain aid.

construction of the telegraph during the late Qing Dynasty. The military purpose of the telegraph introduction provides an ideal setting for identifying the impact of information technology on the state's information-gathering capabilities.

The main findings of this paper are as follows: (i) the introduction of the telegraph increased the likelihood of disaster reporting by local officials, improved the quality of reported information, and reduced reporting delays; (ii) the telegraph amplified the role of the media in information disclosure and public opinion mobilization, thereby strengthening the state's information capacity; (iii) the telegraph's effect on information capacity was more pronounced when the bureaucratic system could provide stronger institutional incentives; (iv) as consequences, the telegraph improved public good provisions, stabilized grain prices, and mitigated social conflicts during disaster periods.

References

- Aneja, A. and G. Xu (2022). The costs of employment segregation: Evidence from the federal government under woodrow wilson. *The Quarterly Journal of Economics* 137(2), 911–958.
- Bai, Y. and R. Jia (2016). Elite recruitment and political stability: the impact of the abolition of china’s civil service exam. *Econometrica* 84(2), 677–733.
- Battaglini, M. (2002). Multiple referrals and multidimensional cheap talk. *Econometrica* 70(4), 1379–1401.
- Berlinski, S., T. Dewan, and K. Dowding (2012). *Accounting for ministers: Scandal and survival in British government 1945-2007*. Cambridge University Press.
- Besley, T. and R. Burgess (2002). The political economy of government responsiveness: Theory and evidence from india. *The quarterly journal of economics* 117(4), 1415–1451.
- Besley, T. and T. Persson (2009). The origins of state capacity: Property rights, taxation, and politics. *American economic review* 99(4), 1218–1244.
- Bo, S., C. Liu, and Y. Zhou (2023). Military investment and the rise of industrial clusters: Evidence from china’s self-strengthening movement. *Journal of Development Economics* 161, 103015.
- Borusyak, K., X. Jaravel, and J. Spiess (2024). Revisiting event-study designs: robust and efficient estimation. *Review of Economic Studies* 91(6), 3253–3285.
- Busuioc, E. M. and M. Lodge (2016). The reputational basis of public accountability. *Governance* 29(2), 247–263.
- Callaway, B. and P. H. Sant’Anna (2021). Difference-in-differences with multiple time periods. *Journal of econometrics* 225(2), 200–230.
- Camerlo, M. and A. Pérez-Liñán (2015). Minister turnover, critical events, and the electoral calendar in presidential democracies. *The Journal of Politics* 77(3), 608–619.
- Cantoni, D., C. Mohr, and M. Weigand (2024). The rise of fiscal capacity: Administration and state consolidation in the holy roman empire. *Econometrica* 92(5), 1439–1472.
- Cengiz, D., A. Dube, A. Lindner, and B. Zipperer (2019). The effect of minimum wages on low-wage jobs. *The Quarterly Journal of Economics* 134(3), 1405–1454.
- Chen, X. (1982). Jindai zhongguo shehui de xincheng daixie (the social metabolism of modern chinese society).
- China’s Military History Editorial Committee (2003). *Zhongguo Lidai Zhanzheng Nianbiao*

- (*A Chronology of Warfare in Dynastic China*). Beijing: Zhongguo Renmin Jiefangjun Chubanshe.
- Ch'u, T.-t. (1962). *Local Government in China under the Ch'ing*. Cambridge, MA: Harvard University Press.
- De Chaisemartin, C. and X. d'Haultfoeuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American economic review* 110(9), 2964–2996.
- Deng, S. (2013). Lun wanqing dianbao xingqi yu jindai zhongguo xinwenye de fazhan (the rise of telegraph in the late qing and the development of modern chinese journalism). *Journal of Anhui University (Philosophy and Social Sciences Edition)* 37(4), 73–80. (in Chinese).
- Dincecco, M. (2009). Fiscal centralization, limited government, and public revenues in europe, 1650–1913. *The Journal of Economic History* 69(1), 48–103.
- Du, T. (2015). Wanqing shenbao de zaihai xinwen (disaster reporting in shenbao during the late qing dynasty). *Shehui Kexue Jikan (Social Science Journal)* 03, 133–137.
- Elman, B. A. (2013). *Civil examinations and meritocracy in late imperial China*. Harvard University Press.
- Fei, X. and J.-t. Chou (1953). *China's gentry: Essays on rural-urban relations*. University of Chicago Press.
- Fiorina, M. P. (1977). *Congress, keystone of the Washington establishment: Keystone of the Washington establishment*. New Haven: Yale University Press.
- Gao, P. and Y.-H. Lei (2021, July). Communication infrastructure and stabilizing food prices: Evidence from the telegraph network in china. *American Economic Journal: Applied Economics* 13(3), 65–101.
- Gennaioli, N. and H.-J. Voth (2015). State capacity and military conflict. *The Review of Economic Studies* 82(4), 1409–1448.
- Gentzkow, M. and E. Kamenica (2017). Bayesian persuasion with multiple senders and rich signal spaces. *Games and Economic Behavior* 104, 411–429.
- Gibbons, R. (1998). Incentives in organizations. *Journal of economic perspectives* 12(4), 115–132.
- Gilad, S., S. Alon-Barkat, and A. Braverman (2016). Large-scale social protest: A business risk and a bureaucratic opportunity. *Governance* 29(3), 371–392.
- Gilligan, T. W. and K. Krehbiel (1989). Asymmetric information and legislative rules with a heterogeneous committee. *American journal of political science*, 459–490.

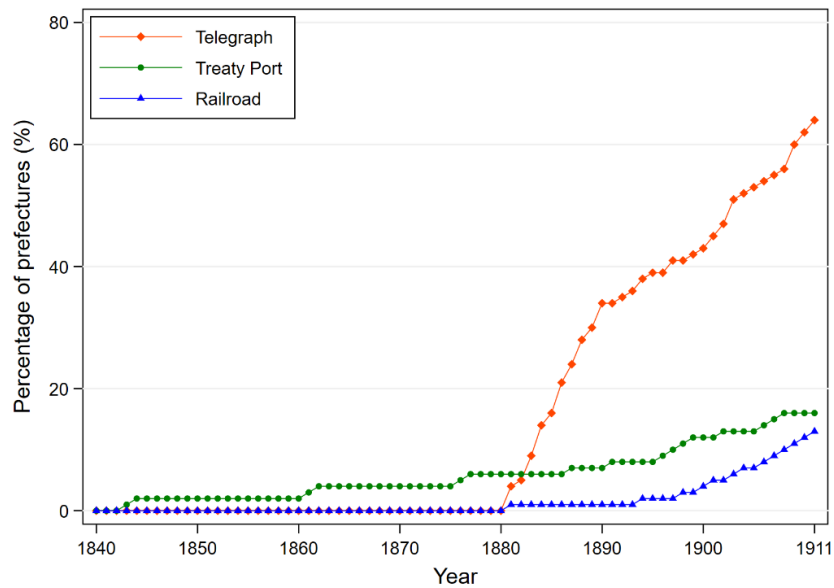
- Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of econometrics* 225(2), 254–277.
- Hao, Y., Y. Li, and J. V. Nye (2022). Wiring china: The impact of telegraph construction on grain market integration in late imperial china, 1870–1911. *The Economic History Review* 75(3), 857–880.
- Hao, Y. and Y. Wang (2024). Telegraph and capital market integration: Evidence from late imperial china. Working paper.
- Hirano, S. and J. M. Snyder (2012). What happens to incumbents in scandals? *Quarterly Journal of Political Science* 7(4), 447–456.
- Hoag, C. (2006). The atlantic telegraph cable and capital market information flows. *The Journal of Economic History* 66(2), 342–353.
- Hong, S. (2019). A behavioral model of public organizations: Bounded rationality, performance feedback, and negativity bias. *Journal of Public Administration Research and Theory* 29(1), 1–17.
- Hood, C. (2007). What happens when transparency meets blame-avoidance? *Public management review* 9(2), 191–210.
- Hood, C. (2010). The blame game: Spin, bureaucracy, and self-preservation in government.
- Huang, R. (2001). *Civil Service in Late Imperial China*. New York: Peter Lang Publishing.
- Iacus, S. M., G. King, and G. Porro (2012). Causal inference without balance checking: Coarsened exact matching. *Political analysis* 20(1), 1–24.
- Institute of Modern History (2014). The qing dynasty grain price database. <https://mhdb.mh.sinica.edu.tw/foodPrice/>. Accessed: June 5, 2022.
- Johnson, N. D. and M. Koyama (2014). Tax farming and the origins of state capacity in england and france. *Explorations in Economic History* 51, 1–20.
- Kiser, E. and J. Schneider (1994). Bureaucracy and efficiency: an analysis of taxation in early modern prussia. *American Sociological Review*, 187–204.
- Krishna, V. and J. Morgan (2001). A model of expertise. *The Quarterly Journal of Economics* 116(2), 747–775.
- Li, B. (2022). Xinxi shouji yu guojia zhili: qingdai de huangzheng xinxi shouji xitong (data vs. governance: How the qing rulers collected data during famine relief). *Journal of Capital Normal University (Social Sciences Edition)* 1, 1–8. (in Chinese).
- Li, L. (2006). Shen bao zhong wanqing jiuhuang ziliao shulue (a brief review of relief efforts

- for famine in the late qing dynasty as documented in shen bao). *Historical Archives* 1, 92–98. (in Chinese).
- Li, X. (1993). Qingdai qianqi de huangzheng yu lizhi (famine relief and bureaucratic governance in early qing china). *Journal of the Graduate School of the Chinese Academy of Social Sciences* 3, 57–62. (in Chinese).
- Li, Y., B. Zhang, and L.-A. Zhou (2024). How does transportation infrastructure affect international trade and economic development? Working paper.
- Lin, C., C. Ma, Y. Sun, and Y. Xu (2021). The telegraph and modern banking development, 1881–1936. *Journal of Financial Economics* 141(2), 730–749.
- Ma, D. and J. Rubin (2019). The paradox of power: Principal-agent problems and administrative capacity in imperial china (and other absolutist regimes). *Journal of Comparative Economics* 47(2), 277–294.
- Ma, L. (1983). *Zhongguo Tielu Jianshi: 1881–1981 (A Brief Chronological History of Chinese Railway Architecture: 1881–1981)*. Beijing: Zhongguo Tiedao Chubanshe. (in Chinese).
- Maor, M. (2011). Organizational reputations and the observability of public warnings in 10 pharmaceutical markets. *Governance* 24(3), 557–582.
- Marks, R. (1998). *Tigers, rice, silk, and silt: Environment and economy in late imperial South China*. Cambridge University Press.
- Mayhew, D. R. (1974). *Congress: The electoral connection*. Yale university press.
- Mayshar, J., O. Moav, and Z. Neeman (2017). Geography, transparency, and institutions. *American Political Science Review* 111(3), 622–636.
- Mayshar, J., O. Moav, and L. Pascali (2022). The origin of the state: Land productivity or appropriability? *Journal of Political Economy* 130(4), 1091–1144.
- Ni, Y. and M. Uebele (2019). Size and structure of disaster relief when state capacity is limited: China’s 1823 flood. *Australian Economic History Review* 59(1), 24–54.
- Nielsen, P. A. and D. P. Moynihan (2017). How do politicians attribute bureaucratic responsibility for performance? negativity bias and interest group advocacy. *Journal of Public Administration Research and Theory* 27(2), 269–283.
- Nonnenmacher, T. (2001). History of the us telegraph industry. <https://eh.net/encyclopedia/history-of-the-u-s-telegraph-industry/>. Accessed: June 5, 2022.
- Nyhan, B. (2015). Scandal potential: How political context and news congestion affect the president’s vulnerability to media scandal. *British Journal of Political Science* 45(2), 435–466.

- Nyhan, B. (2017). Media scandals are political events: How contextual factors affect public controversies over alleged misconduct by us governors. *Political Research Quarterly* 70(1), 223–236.
- Peng, K. (2015). *Cong Jiaoyi Dao Shichang: Chuantong Zhongguo Minjian Jingji Mailuo Shitan (From Trading to Market: Exploring the Context of Traditional Chinese Folk Economy)*. Zhejiang University Press, Hangzhou.
- Puglisi, R. and J. M. Snyder Jr (2011). Newspaper coverage of political scandals. *The journal of politics* 73(3), 931–950.
- Scott, J. C. (1998). *Seeing like a state: How certain schemes to improve the human condition have failed*. Yale University Press.
- Scott, J. C. (2010). *The art of not being governed: An anarchist history of upland Southeast Asia*. Yale University Press.
- Sng, T.-H. (2014). Size and dynastic decline: The principal-agent problem in late imperial china, 1700–1850. *Explorations in Economic History* 54, 107–127.
- Sng, T.-H. and C. Moriguchi (2014, September). Asia’s little divergence: state capacity in china and japan before 1850. *Journal of Economic Growth* 19(4), 439–470.
- Snyder Jr, J. M. and D. Strömberg (2010). Press coverage and political accountability. *Journal of political Economy* 118(2), 355–408.
- Sobel, J. (2013). Giving and receiving advice. *Advances in economics and econometrics* 1, 305–341.
- Song, J. (1996). *Shen Bao De Xingshuai (The Rise and Fall of Shen Bao)*. Shanghai: Shanghai Academy of Social Sciences Press. (in Chinese).
- Steinwender, C. (2018). Real effects of information frictions: When the states and the kingdom became united. *American Economic Review* 108(3), 657–696.
- Sun, L. and S. Abraham (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of econometrics* 225(2), 175–199.
- The Green Apple Data Center (2010). Shen bao database. <http://dh.ersjk.com/>. Accessed: June 5, 2022.
- Traffic History Compilation Committee (1936). *Traffic History Telecommunications*. Shanghai. (in Chinese).
- Wang, T. (2025). The electric telegraph, news coverage, and political participation. *The Journal of Economic History* 85(1), 1–32.

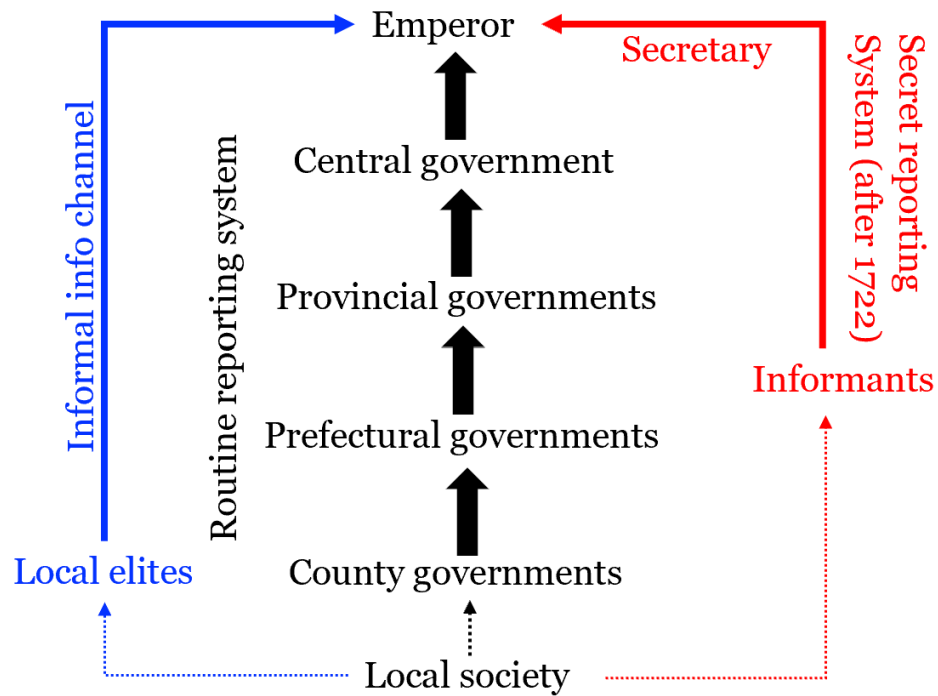
- Wang, Y. and Y. Huang (1999). Qingdai zhongguo qihou bianqian, ziran zaihai yu liangjia de chubu kaocha (a preliminary study of climate change, natural disasters, and grain prices in qing china). *Research in Chinese Economic History* 1, 3–18. (in Chinese).
- Weaver, R. K. (1986). The politics of blame avoidance. *Journal of public policy* 6(4), 371–398.
- Will, P.-É. (1990). *Bureaucracy and Famine in Eighteenth-century China*. Stanford: Stanford University Press.
- Wong, R. B. (1997). *The Politics of the Late Imperial Chinese State*. Berkeley: University of California Press.
- Wu, S. H. L. (1997). *Communication and Imperial Control in China: Evolution of the Palace Memorial System, 1693–1735*. Cambridge, MA: Harvard University Press.
- Xia, W. (2008). Qingji baokan xinwen dianxun fazhan shulun (discussion on the development of news telegraphy in qing dynasty). *Social Science Journal* 5, 144–148. (in Chinese).
- Xia, W. (2009). Wanqing dianzhi dianzou fazhan shulun (summary on the development of telegraphic edicts and communications in the late qing dynasty). *Social Science Front* 4, 124–129. (in Chinese).
- Xia, W. (2012). *Wanqing Dianbao Jianshe Yu Shehui Bianqian (The Telegraph Construction and Social Change in the Late Qing Dynasty)*. Beijing: Renmin Chubanshe. (in Chinese).
- Yan, Z. (2012). *Zhongguo Jindai Jingjishi Tongji Ziliao Xuanji (Selected Statistics of the Early Modern China)*. Beijing: Zhongguo Shehui Kexue Chubanshe. (in Chinese).
- Zhang, D. (2004). *Zhongguo Sanqiannian Qixiang Jilu Zongji (Comprehensive Compilation of Weather Records in Last Three Millenniums of China)*. Nanjing: Jiangsu Educational Press. (in Chinese).
- Zhang, X. (2023). Information foundations of state capacity: Evidence from the imperial bureaucracy of china. Working paper.

Figure 1: The spread of telegraph, treaty ports, and railroad in late Qing period



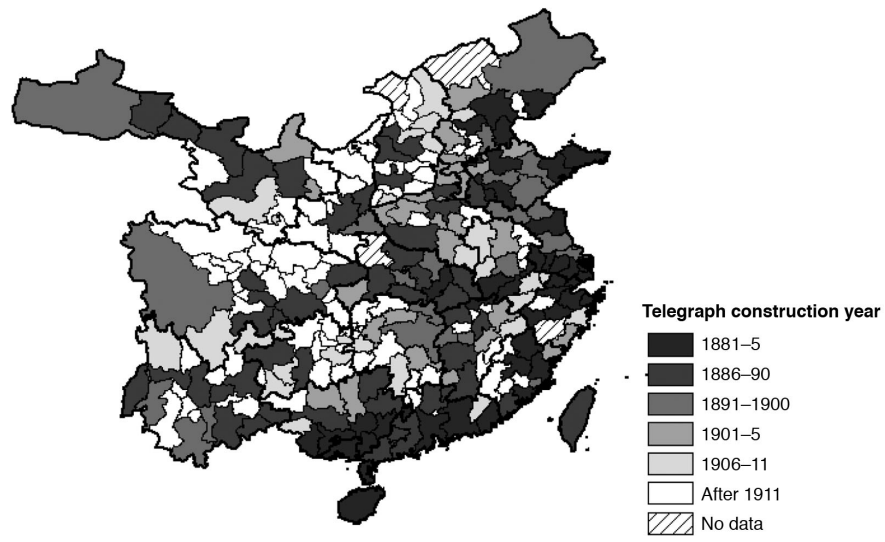
Notes: See the text for data source. The square, point and triangle lines plot the percentage of prefectures with telegraph stations, the percentage of prefectures being treaty ports, and the percentage of prefectures connected via railroads, respectively.

Figure 2: State information channels in the late Qing



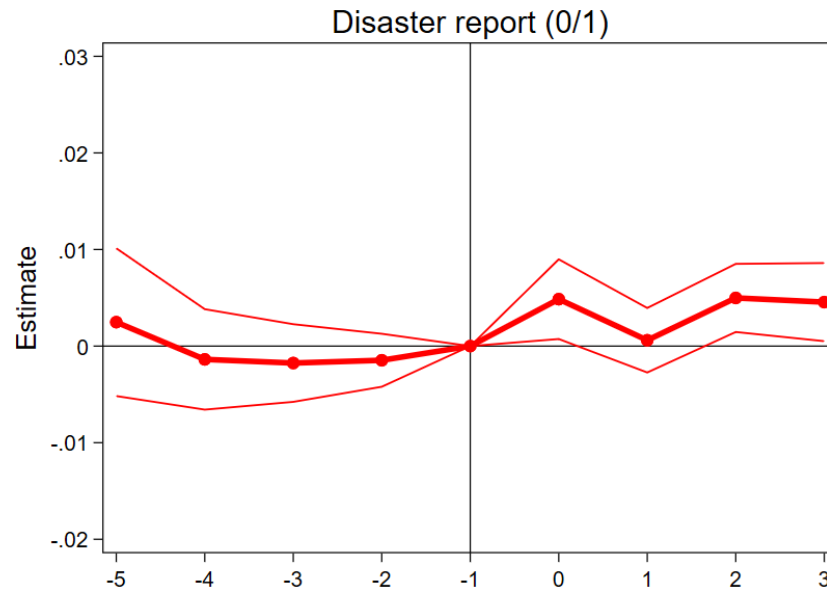
Notes: This figure summarizes the internal channels of information transmission within the bureaucratic system.

Figure 3: The evolution of telegraph in China proper, 1881–1911



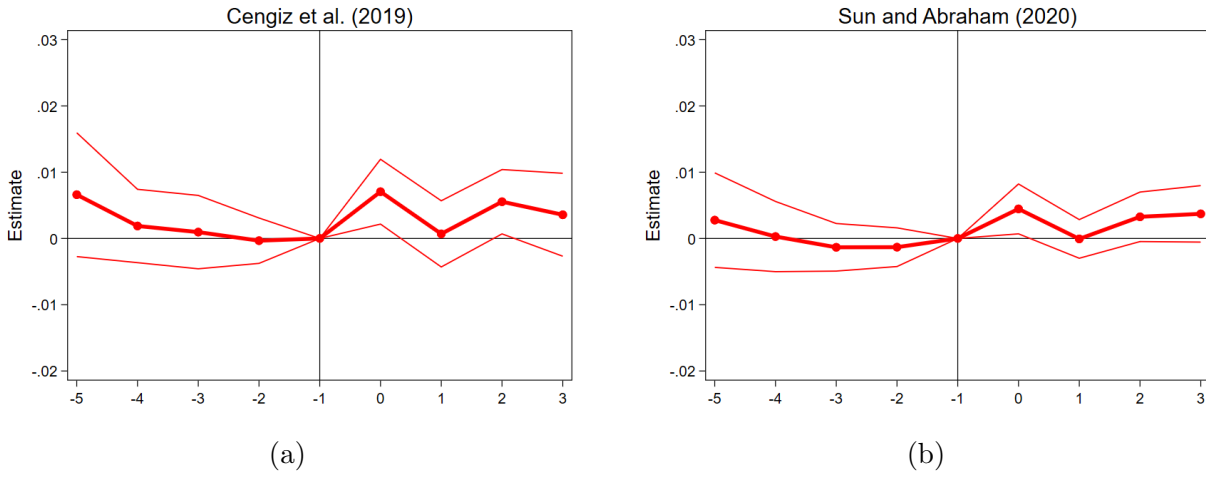
Source: Traffic History Compilation Committee, Jiaotongshi Dianzhengbian; local gazetteers.

Figure 4: The dynamic impacts of telegraph adoption on disaster report



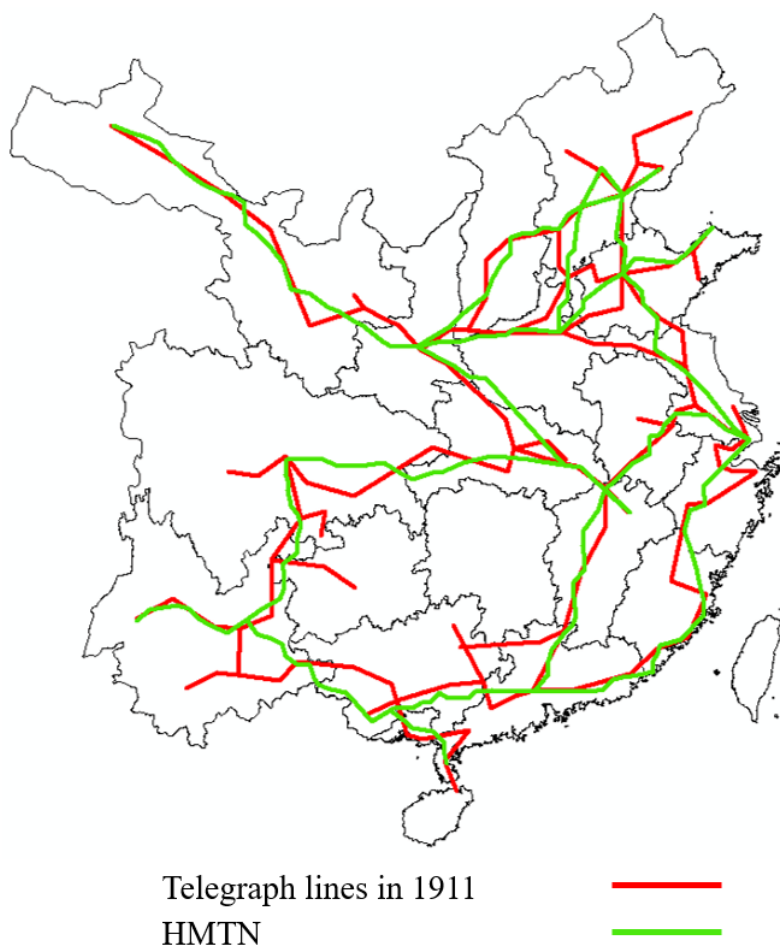
Notes: Estimated coefficients and 90% confidence intervals from a regression of the likelihood of disaster report on the interactives of treat group dummy and event periods from -5 to 3. Generally, the span of one negative period and nonnegative period is respectively 9 years and 6 years (for example, $t=-1$ indicates 1–9 years before telegraph connection; $t=1$ indicates 2–7 years after telegraph connection). Moreover, $t=0$ is 0 or 1 years after telegraph connection, which consider immediate effect; $t=-5$ is 45 or more years before telegraph connection and $t=3$ is 14 or more years after telegraph connection, which consider long-term effects. One period before the prefecture pair is connected through telegraph ($t=-1$) is the base period.

Figure 5: Dynamic impacts under different settings



Notes: Estimated coefficients and 90% confidence intervals from a regression of the likelihood of disaster report on the interactives of treat group dummy and event periods from -5 to 3. Panel (a) plots the robust estimates in [Sun and Abraham \(2021\)](#); panel (b) plots the robust estimates in [Cengiz et al. \(2019\)](#).

Figure 6: Hypothetical military telegraph trunk network



Notes: This figure shows the map of 1911 telegraph lines and the hypothetical military telegraph trunk network (HMTN) in China proper. The trunk includes 21 nodes (military centers). We link these military centers along the least construction cost path.

Table 1: Summary Statistics

	Variables	N	Mean	SD	Source
Dependent Var.	Disaster report by local officials (0/1)	76,140	0.011	0.106	1
Independent Var.	Telegraph (0/1)	76,140	0.335	0.472	2
Mechanism	Disaster report in Shen Bao (0/1)	76,140	0.041	0.198	3
	Shen Bao reporter (0/1)	9,440	0.044	0.204	3, 4
	Shen Bao newsstand (0/1)	9,440	0.088	0.284	3
	Officials' disaster report after Shen Bao (0/1)	76,140	0.007	0.085	1, 3
	Fundraising report in Shen Bao (0/1)	76,140	0.0003	0.0170	3
Heterogeneity	Shengyuan quota (per 10,000 people)	76,140	1.272	1.179	5
	Informant (0/1)	76,140	0.244	0.430	6
	Examination degree (0/1)	33,874	0.481	0.500	7
Consequences	Tax relief (#)	37,643	0.502	0.831	8
	Grain/Money relief (#)	37,617	0.022	0.158	8
	Tax revolt (0/1)	69,354	0.007	0.084	8
	Grain price hike (0/1)	69,354	0.010	0.101	9
Information Quality	Disaster severity in memorials (1–5)	3,446	1.093	0.521	1
	Concealing disaster (0/1)	4,920	0.895	0.307	1, 9
	Concealing severe disaster (0/1)	690	0.888	0.315	1, 9
	Grain price misreport (high)	39,651	0.463	0.499	10
	Grain price misreport (low)	39,651	0.499	0.500	10
Information Delay	Drought report delay by officials (month)	99	23.889	13.175	1
	Flood report delay by officials (month)	19	13.368	7.228	1
	Disaster report delay by officials (month)	138	11.688	14.540	1
Controls	Disaster index	76,140	0.300	0.985	9
	Outward war	76,140	0.033	0.227	11
	Treaty port (0/1)	76,140	0.104	0.306	12
	Province capital (0/1)	76,140	0.116	0.320	5
	Main river (0/1)	76,140	0.679	0.467	5
	Chong (0/1)	76,140	0.706	0.456	5
	Railroad (0/1)	76,140	0.001	0.038	13

Sources: 1: The First Historical Archives of China; 2: [Traffic History Compilation Committee \(1936\)](#) & Local gazetteers; 3: [The Green Apple Data Center \(2010\)](#); 4: [Song \(1996\)](#); 5: [Bai and Jia \(2016\)](#); 6: [Zhang \(2023\)](#); 7: Register of Gentry; 8: The Veritable Records of Qing; 9: [Zhang \(2004\)](#); 10: [Institute of Modern History \(2014\)](#); 11: [China's Military History Editorial Committee \(2003\)](#); 12: [Yan \(2012\)](#); 13: [Ma \(1983\)](#).

Table 2: Baseline

	(1)	(2)	(3)
Dep. Var.	Disaster report (0/1)		
Mean of DV	0.0115		
Telegraph	0.0027* (0.0016)	0.0027* (0.0016)	0.0036** (0.0016)
Disaster index		0.0013** (0.0005)	0.0013** (0.0005)
Outward war		0.0049 (0.0053)	0.0048 (0.0052)
Treaty port		-0.0000 (0.0031)	-0.0008 (0.0030)
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
CF-Year FE			Yes
Adjusted R^2	0.189	0.189	0.189
N	76,140	76,140	76,140

Notes: Disaster index=0: no disaster; Disaster index=1: disaster happens but causes no damage; Disaster index=2: disaster happens and destroys houses; Disaster index=3: disaster happens and destroys public facilities; Disaster index=4: disaster happens and destroys crops or livestock; Disaster index=5: disaster happens and hurt people. Standard errors in parentheses are clustered at the prefecture level. *significant at 10%; **significant at 5%; ***significant at 1%. CF-Year FE is the interactives of time-invariant county features (province capital dummy, main river dummy, *chong*) and year fixed effects.

Table 3: Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	Disaster report (0/1) (Mean=0.011)						# of disaster report
Scenario	Baseline	Sub Sample			Additional Control		Alternative DV
	1865–1911	1869–1911	CEM	Heavy Disaster	Wireless Tel	Railroad	Mean=0.016
Telegraph	0.0036** (0.0016)	0.0035** (0.0016)	0.0037** (0.0016)	0.0036** (0.0016)	0.0033* (0.0019)	0.0037** (0.0016)	0.0055** (0.0026)
Adjusted R^2	0.189	0.198	0.190	0.189	0.198	0.189	0.162
N	76,140	69,660	75,584	75,417	64,800	76,140	76,140

Notes: Column 1 reports the baseline results as a reference. Disaster index, outward war, treaty port, and County and CF-Year fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Table 4: Instrumented results

	(1)	(2)	(3)	(4)
	1st Stage	2SLS		
Dep. Var.	Telegraph	Disaster report (#)		
Telegraph		0.014** (0.006)	0.011* (0.006)	0.013** (0.006)
Distance to HMTN	-0.368*** (0.047)			
K. P. F-statistic		61.739	80.899	83.576
Province FE	Y	Y	Y	Y
Disaster index	Y	Y	Y	Y
N	1,480	1,480	1,480	1,480

Notes: County-level instrumented results are presented in this table. The key independent variables are the presence of telegraph in 1890 (column 2,), 1895 (column 3,), and 1900 (column 4). Disaster report (#) is the proportion of years in which disaster is reported by local officials after the presence of telegraph. The IV is the distance from a prefecture to the HMTN. Clustered robust standard errors are reported in the parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Table 5: Telegraph and information quality

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Reported severity (1—5)	Concealing disasters (0/1)	Concealing severe disasters (0/1)	Grain price misreport (monthly high)		
Mean of DV	1.093	0.895	0.888	0.633	0.463	0.365
Telegraph	-0.186*** (0.061)	-0.033* (0.017)	-0.121** (0.087)	-0.079*** (0.019)	-0.060*** (0.021)	-0.054*** (0.020)
Telegraph × Disaster severity	0.033** (0.016)					
Disaster severity	-0.011 (0.011)					
Adjusted R^2	0.063	0.267	0.126	0.322	0.338	0.354
N	3,446	4,920	690	38,671	38,671	38,671

Notes: Disaster index, outward war, treaty port, and region and CF-Year fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses. Grain price misreport equals 1 if the reported monthly highest price stayed constant for at least 5, 7, 9 consecutive months in columns 4–6. *significant at 10%; **significant at 5%; ***significant at 1%.

Table 6: Telegraph and media disclosure of disasters

	(1)	(2)	(3)	(4)	(5)
<i>Dep. Var.</i>	Disaster report in <i>Shen Bao</i> (0/1)			<i>Shen Bao</i> Reporter (0/1)	<i>Shen Bao</i> News-stand (0/1)
	All	Before official	After official		
Mean of DV	0.041	0.039	0.001	0.044	0.088
Telegraph	0.011** (0.005)	0.010** (0.005)	0.0001 (0.0006)	0.029*** (0.011)	0.089*** (0.021)
Adjusted R^2	0.141	0.129	0.040	0.737	0.742
N	76,140	76,140	76,140	9,440	9,440

Notes: Columns 1–3 use county-year panel data; columns 4–5 use prefecture-year panel data. Outward war, treaty port, and County (or Prefecture) and CF (or PF)-Year fixed effects are controlled in all columns. Disaster index is controlled in columns 1–3. Clustered robust standard errors are reported in the parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Table 7: Telegraph, media disclosure, and disaster report

	(1)	(2)	(3)
<i>Dep. Var.</i>	Officials' disaster report after Shen Bao (0/1)		
Mean of DV	0.007		
Telegraph	0.003** (0.002)	0.003** (0.002)	0.003** (0.002)
Telegraph $\times$ DR in SB		0.013* (0.007)	
DR in SB		-0.002 (0.005)	
Telegraph $\times$ FR in SB			0.043* (0.026)
FR in SB			-0.049** (0.025)
Adjusted R^2	0.145	0.145	0.145
N	76,140	76,140	76,140

Notes: Disaster keywords: {disaster relief, tax relief, drought, flood, hunger}; Fundraising keywords: {request for relief, credit investigation, famine, starvation deaths}. “DR in SB” refers to disaster report in Shen Bao; “FR in SB” refers to fundraising report in Shen Bao. Disaster index, outward war, treaty port, and County and CF-Year fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Table 8: Heterogeneity: competing state information channels

	(1)	(2)	(3)	(4)
<i>Dep. Var.</i>	Disaster report (0/1) (Mean=0.011)			
Scenario	Informants		Shengyuan Quota	
	Yes	No	High	Low
Telegraph	0.006** (0.003)	0.003* (0.002)	0.009*** (0.003)	0.002 (0.002)
Adjusted R^2	0.133	0.205	0.172	0.157
N	18,612	57,528	32,759	31,678

Notes: Disaster index, outward war, treaty port, and County and CF-Year fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses.

*significant at 10%; **significant at 5%; ***significant at 1%.

Table 9: Heterogeneity: opportunity costs of hiding disaster

	(1)	(2)	(3)	(4)
<i>Dep. Var.</i>	Disaster report (0/1) (Mean=0.011)			
Scenario	Disaster Type		Degree Type	
	Flood	Drought	Exam	Purchased
Telegraph	0.004* (0.002)	0.003 (0.002)	0.006** (0.002)	0.0004 (0.0023)
Adjusted R^2	0.206	0.216	0.199	0.197
N	34,134	36,812	35,783	38,289

Notes: Disaster index, outward war, treaty port, and County and CF-Year fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses.

*significant at 10%; **significant at 5%; ***significant at 1%.

Table 10: Telegraph, disaster relief, and social stability

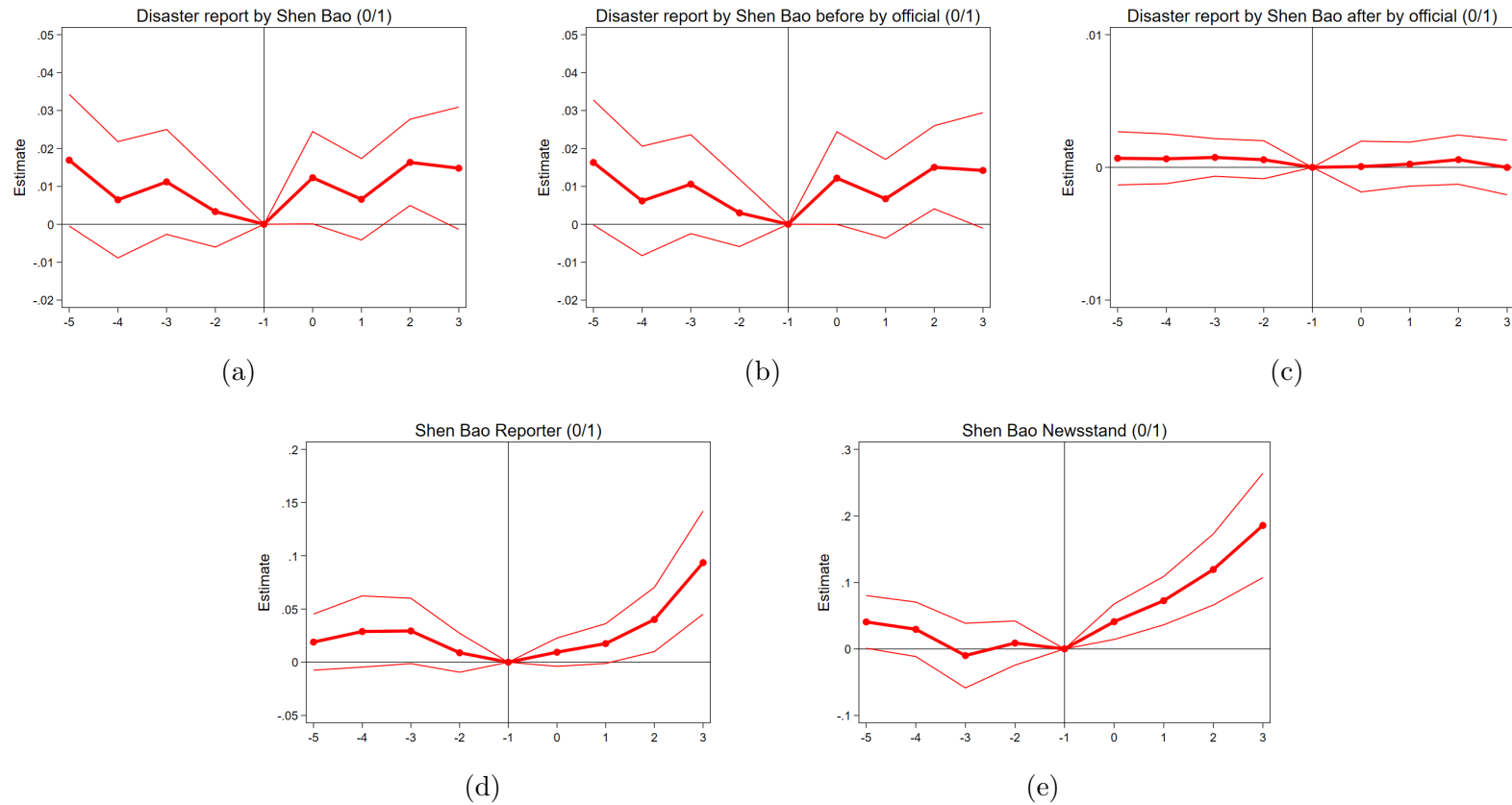
	(1)	(2)	(3)	(4)
<i>Dep. Var.</i>	Tax relief (#)	Grain/money relief (#)	Grain price hike (0/1)	Tax revolt (0/1)
Mean of DV	0.487	0.020	0.009	0.007
Telegraph $\times$ Disaster (0/1)	0.281*** (0.097)	-0.008 (0.019)	-0.034*** (0.009)	-0.004* (0.003)
Telegraph	0.122** (0.050)	0.014 (0.009)	0.004*** (0.001)	0.005* (0.003)
Disaster index	0.041*** (0.007)	0.011*** (0.002)	0.020*** (0.002)	0.000 (0.000)
Adjusted R^2	0.451	0.077	0.076	0.024
N	34,096	34,096	62,107	62,107

Notes: Standard errors are reported in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Appendix

A. Supplementary Figures and Tables

Figure A1: The dynamic impacts of telegraph adoption on disaster report by *Shen Bao*



Notes: Estimated coefficients and 95% confidence intervals from a regression of the dummies of disaster report by *Shen Bao*, *Shen Bao* reporter and *Shen Bao* newsstand on the interactives of treat group dummy and event periods from -5 to 3.

Table A1: The year of telegraph adoption and prefecture characteristics

	(1)	(2)	(3)
Dep. Var.	Telegraph adoption year		
Outward war (1880–1909)	-3.044* (1.827)	-3.845* (2.128)	-3.909** (1.963)
Outward war (1850–1879)	0.876 (1.266)	0.948 (1.219)	1.982 (1.356)
Civil war (1880–1909)	1.105 (1.362)	1.828 (1.510)	2.281 (1.594)
Civil war (1850–1879)	-0.156 (0.261)	-0.299 (0.308)	-0.157 (0.288)
Capital	-4.021* (2.182)	-2.925 (2.248)	-4.278* (2.201)
Treaty port (1880)	-7.030*** (1.713)	-6.335*** (1.770)	-4.449** (1.965)
<i>Chong</i>	-4.189** (1.743)	-3.499* (1.827)	-5.075*** (1.930)
<i>Fan</i>	0.265 (2.072)	0.366 (2.049)	-1.517 (2.200)
<i>Pi</i>	-1.801 (1.666)	-1.050 (1.717)	-0.394 (1.649)
<i>Nan</i>	-1.529 (1.689)	-1.001 (1.752)	0.638 (1.712)
Population (1880)		-0.000 (0.000)	0.000 (0.000)
Main river		-3.411** (1.656)	-3.814** (1.523)
Crop suitability for rice		-0.410 (0.662)	-1.499 (1.005)
Crop suitability for millet		0.708 (0.554)	0.726 (1.067)
Crop suitability for sweet potato		1.104 (0.832)	0.703 (1.313)
Province FE	No	No	Yes
Adjusted R^2	0.126	0.155	0.352
N	166	166	166

Notes: Standard errors in parentheses are robust. *significant at 10%; **significant at 5%; ***significant at 1%.

Table A2: Balance checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full sample				CEM sample			
	Control group	Treated group	Difference	L1 distance	Control group	Treated group	Difference	L1 distance
Treaty port	0.041 (0.199)	0.229 (0.420)	0.188*** (0.003)	0.188	0.225 (0.417)	0.225 (0.417)	0.000 (0.005)	0
Province capital	0.083 (0.277)	0.181 (0.385)	0.097*** (0.003)	0.097	0.175 (0.380)	0.175 (0.380)	0.000 (0.004)	0
Chong	0.663 (0.473)	0.791 (0.407)	0.128*** (0.003)	0.128	0.789 (0.408)	0.789 (0.408)	0.000 (0.004)	0
Main river	0.659 (0.474)	0.719 (0.450)	0.060*** (0.004)	0.060	0.717 (0.450)	0.717 (0.450)	0.000 (0.004)	0
Outward conflicts	0.028 (0.204)	0.043 (0.266)	0.014*** (0.002)	0.008	0.030 (0.216)	0.030 (0.216)	0.000 (0.002)	0
N	50,610	25,530	76,140	76,140	50,214	25,370	75,584	75,584

Notes: This table reports the balance checks of our treatment and control sample. The results in columns 1–4 use the full sample, whereas those in columns 5–8 use the CEM sample. Smaller L1 distance represents that the treatment and control sample are more balanced.

Table A3: Additional robustness checks

	(1)	(2)	(3)	(4)
<i>Dep. Var.</i>	Disaster report (0/1) (Mean=0.011)			
Scenario	Baseline	Provincial -Year FE	Two-way Clustered	County-Month Data (Mean=0.001)
Telegraph	0.0036** (0.0016)	0.0052*** (0.0017)	0.0036** [0.0016]	0.0004** (0.0002)
Adjusted R^2	0.189	0.192	0.187	0.025
N	76,140	76,140	76,140	913,680

Notes: Column 1 reports the baseline results as a reference. Disaster index, outward war, treaty port, and County and CF-Year (Month) fixed effects are controlled in all columns. Standard errors in parentheses are clustered at the prefecture level; standard errors reported in the brackets are two-way clustered in prefecture and year. *significant at 10%; **significant at 5%; ***significant at 1%.

Table A4: Telegraph and misreport of monthly lowest grain prices

	(1)	(2)	(3)
<i>Dep. Var.</i>	Grain price misreport (monthly low)		
Periods	5	7	9
Mean of DV	0.661	0.500	0.396
Telegraph	-0.029 (0.018)	-0.007 (0.020)	-0.009 (0.019)
Adjusted R^2	0.332	0.352	0.365
N	38,671	38,671	38,671

Notes: Disaster index, outward war, treaty port, and Prefecture-Grain and PF-Year fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses. Grain price misreport equals 1 if the reported monthly lowest price stayed constant for at least 5, 7, 9 consecutive months in columns 1–3. *significant at 10%; **significant at 5%; ***significant at 1%.

B. Telegraph and Information Delay in Disaster Reporting

The timeliness of disaster reporting by local officials is as crucial as the act of reporting itself in mitigating the adverse effects of disasters. Prior to the introduction of the telegraph, the absence of advanced communication technologies hindered the prompt transmission of disaster information collected by regional bureaucrats and the subsequent relief decisions made by the emperor, thereby compromising the effectiveness of relief efforts (Will, 1990; Zhang, 2023; Li, 2022).²³ In contrast, the advent of the telegraph significantly enhanced the efficiency of disaster information transmission and relief operations during the Qing dynasty (Xia, 2009). For instance, in early May 1906, when a flood struck Hunan, the local governor, Hongshu Pang, promptly reported the disaster to the emperor via telegraph. The central government responded on May 13 through telegraph, allocating relief funds of 100,000 taels of silver and instructing the governor to provide updates on the progress of the relief efforts via telegraph.

Combining the information on the timing of disaster happening and disaster reporting by local bureaucrats, we calculated the disaster reporting delay at the disaster-county level. We first selected a specific major natural disaster i , with its occurrence time being T_i^0 . Then, we determined the earliest disaster reporting time (T_{ci}^1) for each county c affected by disaster i from the disaster reporting records in memorials. Finally, we defined the reporting delay ($Delay_{ci}$) as $T_{ci}^1 - T_i^0$. By doing so, we constructed a county-disaster dataset containing disaster reporting delay of severe droughts (i.e., the Great North China Famine (1876–1879) and the Severe Drought in Northern Shanxi (1892–1895)), severe floods (i.e., the Yangtze River Flood in 1870 and 1883), and disasters in North China Plain (1851–1911). Data on the timing of disaster reporting were obtained from FHAC, while that of disaster happening were sourced from Zhang (2004).

To assess the impact of the telegraph on disaster reporting delays, we compared (1) two major droughts, (2) two major floods, and (3) drought and flood disasters in North China. Column 1 of Table B1 compares the reporting delays of the Great North China Famine (1876–1879) and the Severe Drought in Northern Shanxi (1892–1895), revealing that the introduction of the telegraph reduced drought reporting delays by 8.9 months, equivalent to 37% of the mean delay. Column 2 compares the flood reporting delays of the Yangtze River in 1870 and 1883, indicating that telegraph adoption shortened flood reporting times by 6.7 months, or 50% of the mean delay. Due to its proximity to the capital, the North

²³ Due to the retrospective nature of many disaster reports submitted through memorials, the average delay in reporting disasters often extended over several months. Prior to the introduction of the telegraph, the reporting delay for droughts was approximately 25 months, while the delay for floods and disasters in northern China was about 15 months.

China region held a relatively higher political status. The central government placed greater emphasis on maintaining social stability in this area, making it a priority for disaster relief efforts. Column 3 examines disaster reporting delays in the North China Plain from 1851 to 1911, further confirming that the telegraph contributed to reducing reporting delays.

Table B1: Telegraph and disaster reporting delay

	(1)	(2)	(3)
<i>Dep. Var.</i>	Disaster reporting delay in memorial (months)		
	Drought	Flood	Northern China
Mean of DV	23.889	13.368	11.688
Telegraph	-8.900*** (2.578)	-6.675** (2.405)	-6.705** (3.071)
Adjusted R^2	0.015	0.102	0.381
N	99	18	128

Notes: Column 1 compares the drought reporting delays in the Great North China Famine (1876–1879) and the Severe Drought in Northern Shanxi (1892–1895); column 2 compares the flood reporting delays of the Yangtze River in 1870 and 1883; column 3 investigates the disaster reporting delays in North China Plain from 1851 to 1911. Region and period fixed effects are controlled in all columns. Clustered robust standard errors are reported in the parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

C. Supplementary Archival Sources (District Gazetteers)

- Chang, Shouxian, and Hongyan Zhou. *Xianning Records (Xian ning shi zhi)*. China Urban Publishing House, Beijing, 1992.
- Chen, Chaoqing. *Handan Records (Han dan shi zhi)*. Xinhua Publishing House, Beijing, 1992.
- Chen, Shaoxian. *Yichang Records (Yi chang shi zhi)*. Huangshan Publishing House, Hefei, 1999.
- Di, Guangqian. *Guizhou Records: Post and Telecommunications (Gui zhou sheng zhi: you dian zhi)*. Guizhou People's Publishing House, Guiyang, 1992.
- Fan, Tiesheng. *Beijing Records: Municipal Administration Volume, Telecommunications (Bei jing zhi: shi zheng juan dian xin zhi)*. Beijing Press, Beijing, 2004.
- Fujian Local Records Compilation Committee. *Fujian Records: Post and Telecommunications (Fu jian sheng zhi: you dian zhi)*. Local Records Publishing House, Beijing, 1996.
- Gao, Shizhong. *Jiaozuo Records (Jiao zuo shi zhi)*. Hongqi Publishing House, Beijing, 1993.
- Hangzhou Local Records Compilation Committee. *Hangzhou Records (Hang zhou shi zhi)*. Zhonghua Book Company, Beijing, 1995.
- He, Xigui. *Shangrao Prefecture Records (Shang rao di qu zhi)*. Local Records Publishing House, Beijing, 1997.
- He, Xiu. *Shaanxi Records: Post and Telecommunications (Shaan xi sheng zhi: you dian zhi)*. Sanqin Publishing House, Xi 'an, 1998.
- Henan Xuchang Local Records Compilation Committee. *Xuchang Records (Xu chang shi zhi)*. Nankai University Press, Tianjin, 1993.
- Hu, Fuming. *Jiangsu Records: Post and Telecommunications (Jiang su sheng zhi: you dian zhi)*. Jiangsu People's Publishing House, Nanjing, 1997.
- Huang, Chufang. *Xiaogan Records (Xiao gan shi zhi)*. Xinhua Publishing House, Beijing, 1992.
- Huang, Xizhang, and Wendao Chen. *Anyang Records (An yang shi zhi)*. Zhongzhou Ancient Books Publishing House, Zhengzhou, 1998.
- Li, Chunyang. *Yinchuan Records (Yin chuan shi zhi)*. Ningxia People's Publishing House, Yinchuan, 1998.
- Li, Hongjin. *Guangdong Records: Posts and Telecommunications (Guang dong sheng zhi: you dian zhi)*. Guangdong People's Publishing House, Guangzhou, 1999.
- Li, Kaijin. *Shashi Records (Sha shi shi zhi)*. China Economic Press, Beijing, 1992.
- Li, Yude, and Chuanming Xiong. *Xinyang Records (Xin yang shi zhi)*. Zhongzhou Ancient Books Publishing House, Zhengzhou, 2001.

- Liang, Xingsan, and Taoshan Zhao. *Xinxiang Records (Xin xiang shi zhi)*. Sanlian Bookstore, Beijing, 1994.
- Liu, Dianli, and Keyao Song. *Luoyang Records: Urban Construction, Traffic Records, Post and Telecommunications (Luo yang shi zhi: cheng shi jian she zhi, jiao tong zhi, you dian zhi)*. Zhongzhou Ancient Books Publishing House, Zhengzhou, 1997.
- Liu, Gaogao. *Hunan Records: Post and Telecommunications (Hu nan sheng zhi: you dian zhi)*. Hunan Publishing House, Changsha, 1995.
- Liu, Qiuzeng. *Shandong Records: Posts and Telecommunications (Shan dong sheng zhi: you dian zhi)*. Shandong People's Publishing House, Jinan, 2000.
- Liu, Shanqiao. *Huanggang Records (Huang gang shi zhi)*. Chongwen Publishing House, Wuhan, 2004.
- Local Records Compilation Committee of Jingmen City, Hubei Province. *Jingmen Records (Jing men shi zhi)*. Hubei Science and Technology Press, Wuhan, 1994.
- Local Records Compilation Committee of Xiangfan City, Hubei Province. *Xiangfan Records (Xiang fan shi zhi)*. China Urban Publishing House, Beijing, 1994.
- Ren, Zequan. *Records of Enshi Prefecture (En shi zhou zhi)*. Hubei People's Publishing House, Wuhan, 1998.
- Sanmenxia Local Records Compilation Committee. *Sanmenxia Records (San men xia shi zhi)*. Zhongzhou Ancient Books Publishing House, Zhengzhou, 1995.
- Shi, Dingxun. *Nanyang Records (Nan yang shi zhi)*. Henan People's Publishing House, Zhengzhou, 1989.
- Song, Jinkun. *Luohe Records (Luo he shi zhi)*. Local Records Publishing House, Beijing, 1999.
- Song, Ming. *Ganzhou Records (Gan zhou shi zhi)*. Chinese Literature and History Publishing House, Beijing, 1999.
- Suizhou Local Records Compilation Committee, Hubei Province. *Suizhou Records (Sui zhou zhi)*. China Urban Economic and Social Publishing House, Beijing, 1988.
- Sun, Fushan. *Kaifeng Records (Kai feng shi zhi)*. Beijing Yanshan Press, Beijing, 2001.
- Sun, Yongping. *Huangshi Records (Huang shi shi zhi)*. Zhonghua Book Company, Beijing, 2001.
- Wang, Guobin. *Sichuan Records: Post and Telecommunications (Si chuan sheng zhi: you dian zhi)*. Sichuan Dictionary Publishing House, Chengdu, 1993.
- Wuhan Local Chronicle Compilation Committee. *Wuhan Records: Traffic, Communications and Posts (Wu han shi zhi: jiao tong you dian zhi)*. Wuhan University Press, Wuhan, 1998.
- Yao, Xueli. *Gansu Records: Post and Telecommunications (Gan su sheng zhi: you dian zhi)*. Gansu People's Publishing House, Lanzhou, 1993.

- You, Wenyuan. *Baoding Records (Bao ding shi zhi)*. Publishing House, Beijing, 1999.
- Zhang, Guangwen. *Shanxi General Records: Post and Telecommunications (Shan xi tong zhi: you dian zhi)*. Zhonghua Book Company, Beijing, 1996.
- Zhang, Guanjian. *Jinhua Records (Jin hua shi zhi)*. Zhejiang People's Publishing House, Hangzhou, 1992.
- Zhang, Heping, and Yaling Huang. *Fuzhou Records (Fu zhou shi zhi)*. Local Chronicle Publishing House, Beijing, 2013.
- Zhang, Hongtao. *Guangxi General Records: Post and Telecommunications (Guang xi tong zhi: you dian zhi)*. Guangxi People's Publishing House, Nanning, 1994.
- Zhang, Xuming, and Jianxiong Wang. *Zhangjiakou Records (Zhang jia kou shi zhi)*. China Foreign Translation Publishing Company, Beijing, 1998.
- Zhang, Zonglin. *Yunnan Records: Post and Telecommunications (Yun nan sheng zhi: you dian zhi)*. Yunnan People's Publishing House, Kunming, 1996.
- Zhao, Li. *Zhumadian Records (Zhu ma dian shi zhi)*. Henan People's Publishing House, Zhengzhou, 1989.
- Zhoukou Local Records Compilation Committee. *Zhoukou Records (Zhou kou shi zhi)*. Zhongzhou Ancient Books Publishing House, Zhengzhou, 1994.
- Zhu, Longyu. *Anhui Records: Post and Telecommunications (An hui sheng zhi: you dian zhi)*. Anhui People's Publishing House, Hefei, 1993.