Freedom of Speech, Spirit of Innovation, and Long-term Economic Development: Evidence from the Qing Dynasty of China

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July 2023

Abstract

Expression controls have been common practice of thought control on citizens in authoritarian regimes. However, how such controls on free speech affect society in the short and long terms remains unclear. With the literary inquisition in the Qing Dynasty of China as a natural experiment, we empirically study the impacts of extreme speech controls on society. Our empirical investigation provides novel yet compelling explanations for two fundamental puzzles in Chinese history: (1) Although China was the global leader in science and technology (S&T) over a long time, why did this advantage not lead to an Industrial Revolution (the Needham puzzle)? (2) why did China decline in the late Qing Dynasty? We first present suggestive evidence that the literary inquisition may have led to China's sharp decline in S&T after 1700. Further difference-in-differences estimates indicate that the literary inquisition reduced the number of scientific and technological innovations by at least 40%–70% in affected regions and also had a negative effect on the long-term land tax revenue in these regions in the Qing Dynasty. These findings provide novel insights into Chinese history, particularly China's decline due to extreme expression controls in the Qing Dynasty.

Keywords: Freedom of speech, spirit of innovation, economic development, literary inquisition

JEL codes: N0, O0, H11

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1. Introduction

In the civilized world, freedom of speech has been accepted as a universal value and a basic human right, protected by the constitutions in most countries. However, even in the modern world, citizens are not fully entitled to the right of free expression in some authoritarian regimes, where speech controls are common and unfavorable remarks against the government are strictly forbidden. How such restrictions on free expression affect society in the short and long terms, specifically, how they affect the spirit of innovation and economic development in the short and long terms, respectively, forms an important empirical issue. Despite the evident importance of the issue and given the immense difficulty in empirically identifying the causal effects of expression controls on innovation and economic development, such empirical study has been lacking. To fill this gap in the literature, we attempt to provide a rigorous empirical analysis on the comprehensive effects of expression controls on society.

The literary inquisition in the Qing Dynasty of China provides a unique natural experiment to empirically study the aforementioned issue. Literary inquisition is defined as a "legal punishment for criminal acts committed through speech and written words expressed in various forms, including conversations, letters, essays, poems, pamphlets, books, dramas, novels, and diaries" (Fu, 1993). Literary inquisition had existed in imperial China for a long time, and the earliest case can be traced back to the Zhou Dynasty around 1000 BC. In the earlier period, literary inquisition was usually used by emperors or bigwigs as a tool to eliminate their political opponents; thus, typical literary inquisition cases of the time generally reflected political struggles among political elites and had little to do with commoners (Yang, 1999). By contrast, the literary inquisition in the Qing Dynasty became the rulers' crucial instrument of thought control on citizens to consolidate the Qing regime, and most victims were commoners. From Kangxi to Qianlong reigns of the Qing Dynasty (1711–1788), the emperors implemented the notorious literary inquisition that significantly changed society of the time in many ways. In this period, if an individual's speech was interpreted as offensive to the Qing regime, then he would be executed by dismembering the body and his entire family or clan would also be sentenced to death or exiled.

Although literary inquisition appears similar to censorship, the two concepts are different in many ways. Censorship is defined as "the practice of officially examining books, films etc. and suppressing the unacceptable parts" (Pearsall et al., 2007). This practice is common in authoritarian regimes and aims to prevent the spread of regime-threatening information among citizens. By keeping citizens in ignorance, censorship is considered as the key to the popular support and stability of authoritarian regimes (Ford, 1935). By contrast, instead of pre-examining books or other forms of expression and

eliminating unfavorable parts in advance, the literary inquisition re-examines published books and punishes authors severely if their expressions were interpreted as offensive to the regime. Such a policy aims to deter potential opposition by sending strong messages to citizens that people who dare to oppose to the regime would face severe punishment. In brief, censorship makes citizens supportive of the regime by keeping them in ignorance via information control, while the literary inquisition forces citizens to be obedient to the regime by threatening to kill them otherwise.

Both the literary inquisition and censorship are instruments of thought control on citizens for rulers to consolidate the authoritarian regimes. Nevertheless, the literary inquisition is the more unreasonable one, which makes citizens feel insecure and dare not to express their ideas or engage in any potentially risky activities. Such extreme controls on expression created a terrifying atmosphere among citizens in the Qing Dynasty and had profound effects on society.

By investigating the impacts of the literary inquisition in the Qing Dynasty, we attempt to contribute to the explanations for two fundamental puzzles in Chinese history: (1) Although China was the global leader in science and technology (S&T) over a long time, why did this advantage not lead to an Industrial Revolution (the Needham puzzle)? (2) why did China decline in the late Qing Dynasty?

Indeed, China had made remarkable achievements in science and technology (S&T) in the premodern period, and it had a considerable lead over the Western world in most of the major areas of S&T over a long period (Lin, 1995). However, China was overtaken by the West in S&T and fell behind of the world in many ways later. Needham first comes up with the following challenging yet fundamental question based on his research on the history of S&T in China: Although China had been more advance than other civilizations in S&T over a long time, why did not the Industrial Revolution originate in China? This question was later known as the "Needham puzzle" and has been widely discussed but a consensus has yet to be reached.

The literature has noted that the development of modern science, particularly the surge of scientific and technological innovations was the crucial catalyst for the Industrial Revolution (Mokyr, 2002; 2009; McCloskey, 2010). Therefore, the key to explaining the Needham puzzle is to explain China's decline in S&T at the time.

This study argues that the literary inquisition may have stifled the spirit of innovation of the Qing Dynasty society and led to China's sharp decline in S&T. We will show that the time of the implementation of the literary inquisition was also the turning point in China's decline in S&T. The case of Mingshi Dai in 1711 was the first the literary inquisition case in the Kangxi period, marking the turning point in the Qing rulers' policy on free expression. Before this case, Emperor Kangxi was

tolerant of intellectuals' expressions, and free speech was generally allowed.[1] After this case, citizens received strong messages that "inappropriate" speech in any form could spell disaster for the entire family. Mingshi Dai was a famous intellectual at the time. In 1711, his published book titled *nan shan ji* was reported to Emperor Kangxi as containing offensive expressions to the Qing regime. Thereafter, the book was investigated and Emperor Kangxi was infuriated by a letter included in the book that Dai wrote to a friend. Dai was found guilty and was later executed; over 100 people involved were punished. This sensational case of literary inquisition had a huge impact on society, particularly on intellectuals, who were shocked to learn that free speech had become a golden memory. Later, the literary inquisition became the emperors' common instrument of thought control on citizens.

We plot several figures to demonstrate the potential effects of the literary inquisition on innovation in the Qing Dynasty. Figure 1 shows the number of scientific and technological innovations in China and Britain in 1670–1790, in which each point represents the total number of innovations in the country in the past two decades.[2] The dividing line indicates the year of 1711, when Emperor Kangxi initiated the investigation of the first literary inquisition case. Evidently, China had a clear advantage over Britain in innovation before 1711. However, China experienced a dramatic decline in innovation after 1711, whereas Britain achieved considerable growth in innovation. Unsurprisingly, Britain exceeded China in innovation in around 1750–1770, when the Industrial Revolution started in the former. Thereafter, China fell behind Britain in many ways. China began to implement the literary inquisition in 1711, which also appears to be the turning point in its decline in S&T. This development may not be simply a coincidence.

Figure 2 plots the number of scientific and technological innovations in China and Europe in 1670–1790, which conveys similar information. Innovations in China showed an increasing trend before 1711, and China still dominated Europe in innovation that year. However, China experienced a sharp decline thereafter, while Europe enjoyed an explosive growth in innovation. Consequently, China fell considerably behind Europe in innovation after 1750. Again, 1711 emerges as the turning point in China's decline and Europe's rise in S&T. The dramatic decline in innovation in China after 1711 marked the end of its era in S&T, and such a sharp decline probably resulted from a certain huge shock on innovation in the country.

In Figure 3, we compare the number of scientific and technological innovations in the treatment prefectures (those exposed to the literary inquisition) and control prefectures (those unaffected by it) within China from 1670 to 1790. Given that the literary inquisition cases were primarily concentrated

[1] In imperial China, intellectuals generally refer to the literati (*xiucai*), who passed the entry level exam of the civil service exam system and entered the lower class of gentry.
[2] The Appendix provides more information on scientific and technological innovations in China and Europe in 1670–1790.

in developed regions with a higher concentration of intellectuals, treatment prefectures generally had a clear advantage over control prefectures in S&T before the literary inquisition. Figure 3 shows that the treatment prefectures had an overwhelming advantage over the control prefectures in the number of innovations before 1711. However, innovation in the treatment prefectures plummeted after 1711, reaching a level similar to that of the control prefectures. Such a significant decline in innovation in treatment prefectures was probably caused by a certain huge negative shock on innovation in these regions. This study attempts to empirically prove that the literary inquisition was exactly such a shock on innovation that led to China's sharp decline in S&T.

Figures 1–3 present a big picture of the potential effects of the literary inquisition on innovation in the Qing Dynasty of China, based on which we perform our empirical analysis. With a difference-in-differences (DID) strategy, by exploiting the variation of the literary inquisition across regions and over time, we find that the literary inquisition reduced the number of scientific and technological innovations by at least 40%–70% in the treatment prefectures compared with the control ones. Furthermore, it also had a negative effect on the long-term land tax revenue, an important indicator of economic development at the time. We also address recent econometric concerns about the reliability of the staggered DID strategy and present a variety of alternative estimators to confirm the robustness of our results.

A natural concern arises that the occurrence of the literary inquisition cases could be correlated with regional characteristics, presenting a typical case of endogenous issue. Figure 3 also indicates that treatment prefectures were generally much more developed than control prefectures. Given that there were more intellectuals in developed regions who were the primary targets of the literary inquisition, these regions were thus more susceptible to this policy. However, Xue (2021) points out that the location and timing of literary inquisition cases were also shaped by idiosyncratic factors. In particular, Chinese languages are subtle and ambiguous, and thus any expression can be interpreted in different ways. Furthermore, there were no general rules in the legal system concerning the criteria of offensive expressions, and the officials' personal discretion mattered to a large extent. Lastly, it was the emperor that made the final sentence of all investigated literary inquisition cases, and such decisions could be extremely subjective and arbitrary. Unsurprisingly, two very similar cases could end up with completely different outcomes. Therefore, these facts generate idiosyncratic variations in the occurrence of the literary inquisition cases across regions and over time.

The DID strategy exactly exploits such idiosyncratic variations in the literary inquisition, thereby facilitating the identification of its effect on innovation. We find that innovation in treatment and control prefectures share a common trend prior to the literary inquisition. However, this common trend disappeared after the literary inquisition, with the number of innovations in treatment prefectures

decreasing sharply compared with that in control prefectures. Such results present strong evidence of the treatment effect of the literary inquisition on innovation. Furthermore, we adopt the propensity score matching approach to construct a sample in which treatment and control prefectures were similar prior to the treatment. For this matched sample, we still find that treatment prefectures experienced a sharp decrease in innovation after being exposed to the literary inquisition compared with control prefectures. This result further indicates that the literary inquisition may have a considerable negative effect on innovation in affected regions.

Our findings indicate that the literary inquisition precipitated China's decline in science and, subsequently, its economy. Naturally, an essential question arises: Why could the literary inquisition have such destructive effects on the Qing Dynasty society? We can uncover the potential answers by contrasting the Enlightenment in Europe and the literary inquisition in China in the 1700s.

The Age of Enlightenment, which blossomed in Europe in the 18th century, paved the way for the Industrial Revolution (Mokyr, 2009; Jones, 2017). The Enlightenment, which was promoted by philosophes who challenged the authority of institutions deeply rooted in society and aimed to reform society with tolerance, science, and skepticism, was most known for its political achievements. These accomplishments include advocating for such political ideals as freedom, equality, basic human rights, religious tolerance, and democracy (Bristow, 2017). Following the Enlightenment, Europe gradually fostered an institutional environment tolerant of heterodoxy and deviancy, catalyzing the development of a free market for ideas where creative people were highly rewarded for their innovative activities (Mokyr, 2005; 2007). Ultimately, this tolerant institutional environment and idea market led to the technological and institutional changes crucial for the Industrial Revolution.

While the Enlightenment's core ideology was widely accepted in Europe in the 1700s, the Qing government in China was enforcing extreme expression controls to consolidate its authoritarian regime. Under the oppressive climate of the literary inquisition, the formation and development of a tolerant institutional environment and a free market for ideas were impossible, and citizens refrained from engaging in innovative yet potentially risky activities. Thus, the significant difference in the impact of the Enlightenment and the literary inquisition on society may partially account for Europe's rise and China's decline after 1700. The literature has noted that civil liberties and dignities invigorate society, and freedom fosters economic prosperity (McCloskey, 2010; Phelps et al., 2013). Conversely, extreme speech controls can sap a society's vigor and vitality, undermining its capacity for future progress.

This study presents a novel yet compelling explanation for the Needham puzzle. Previous studies have provided several hypotheses to explain the decline of S&T in imperial China. (1) Political Bureaucracy Hypothesis: China's imperial system, particularly the civil service exam system and the criteria of promotion in the bureaucratic system, hindered human capital investment necessary for

modern scientific research and led to China's decline in science (Lin, 1995; Cantoni and Yuchtman, 2013; Brandt et al., 2014). (2) Culture Hypothesis: China's traditional Confucian cultural values suppressed the spirit of free inquiry, hindered the formation and development of an open and competitive market for ideas, and thus impeded the development of modern science (Weber, 1951; Landes, 2006; Mokyr, 2009; 2017). (3) Institution Hypothesis: The lack of property rights protection locked imperial China in an agricultural economy and hindered scientific progress (Huang, 1997; Edwards, 2005; Zhang and Gao, 2005; Landes, 2006).

Although the preceding explanations provide important insights into the aforementioned issue, they have evident limitations. Given that China had been the global leader in S&T over a long time and those claimed adverse factors had always existed in imperial China, why they only became obstacles to innovation after 1700 is not easy to explain. As discussed above, China's sharp decline in S&T after 1700 was more likely due to a certain huge negative shock on innovation at the time, rather than those ever-existing factors in imperial China. Thus, our proposition that extreme expression controls after 1711 led to China's dramatic decline in S&T is not only more plausible but also more consistent with the Qing Dynasty's technological development trend. Our explanation of the Needham puzzle enriches the literature, providing novel insights into Chinese history, particularly China's decline due to extreme expression controls in the Qing Dynasty.

Our findings also contribute to the growing literature on the comprehensive effects on society of thought controls in authoritarian regimes. Becker et al. (2021) find that the Catholic censorship during the Counter-Reformation in Italy reduced the printing of forbidden authors and also had a negative effect on the diffusion of knowledge and city growth. Blasutto and Croix (2021) also find that the Catholic censorship significantly reduced publications by scholars in Italy. Drelichman et al. (2021) show that the Spanish Inquisition implemented between 1480 and 1820 had long-term negative effects on the economic performance, educational attainment, and trust in affected regions. Koyama and Xue (2015) first study the literary inquisition in the Qing Dynasty of China and find that it had a substantial long-term negative effect on human capital accumulation, and such effects even persist in modern China. Xue (2021) further studies this issue and finds that the literary inquisition had a negative effect on social capital, such as charities and trust, in affected regions. We study the effect of the literary inquisition from a novel perspective and also obtain important findings with broader implications. These findings shed light on the interplays among civil liberties, spirit of innovation, and economic prosperity in the modern world.

2. Historical Background

This section briefly introduces the historical background of the literary inquisition from the Kangxi to Qianlong reigns (1661–1796).

The Ming Dynasty collapsed in 1644, and the Manchus invaded Beijing thereafter and established the Qing Dynasty. The Ming–Qing transition involved massacres and a high degree of tension between the Manchu conquerors and the Han population (Wakeman, 1985). Such a tension persisted for a long time and became eased only after Emperor Kangxi began to govern the country in 1667.

The first recorded literary inquisition in the Qing Dynasty was the case of History of the Ming Dynasty, which was investigated in 1661. In this year, Emperor Shunzhi died and his son Kangxi inherited the throne at the age of 8. At that time, Kangxi was still too young to govern the country and four ministers assisted (or substituted) him to make decisions. Tinglong Zhuang, a Han intellectual organized people to compile a book on the history of the Ming Dynasty and published it in 1660. In 1661, some people reported to the central government that this book was offensive to the Qing regime. The four ministers in charge of the government thought that it was a serious case and comprehensively investigated the book. The book was interpreted as cherishing and praising the Ming Dynasty and showing immense disrespect of the Qing regime. Consequently, in 1663, over 70 people related to the book were executed and over 1000 were punished (Yan, 2016).

This case was sensational at the time and intensified the tension between the Qing rulers and Han intellectuals. It also reflected the Manchus' insecurity of the legitimacy of their regime. However, the case only had a limited impact on the Qing Dynasty society for the following reasons.

First, the case was more of the Qing rulers' fight against the anti-Qing activities. Compiling a book on the history of the Ming Dynasty in the sensitive period of the Ming–Qing transition can be easily interpreted as not supporting the new regime by the Qing rulers. In fact, many people involved in the case used to participate in the activities of rebelling the Qing and rebuilding the Ming Dynasty. Thus, they deserved the punishments to some extent. The Qing rulers sent a clear message to citizens on what they should not do via this case. Individuals obedient to the new regime were generally safe. Thus, the case only had a limited impact on citizens' activities that were unrelated to the anti-Qing movement.

Moreover, the case occurred in a very special period when the four ministers were in power and made the decision. When Emperor Kangxi took over the reign at the age of 14 in 1667, he adopted completely different policies towards the Han population, particularly the Han intellectuals. Thereafter, free expressions were generally allowed. Therefore, the case of History of the Ming Dynasty was more of an accident, and its effects on society, if any, lasted for only a very short period.

When Emperor Kangxi took over the power in 1667, the country was devastated by wars, the economy was in a slump, and people lived in destitution. Many of the Han Chinese, which accounted for 95% of the total population at the time, were still resistant to the Manchu rulers, posing another potential threat to the Qing regime. To promote the economy and consolidate the regime, Emperor Kangxi adopted the conciliation policy towards the Han population to win their support. In particular, he conducted special examinations *(bo xue hong ru*) to select the Han elites to work for the government. The selected Han intellectuals were generally assigned to important positions. Emperor Kangxi himself visited some famous Han intellectuals to persuade them to serve the Qing regime. Even though several refused to meet him, Emperor Kangxi was not angered and still informed them that they were welcome whenever they were willing to work for the government. His attitude towards the Han, particularly the intellectuals, was appreciated by the Han population and won their support for the Qing regime.

Emperor Kangxi was also tolerant of intellectuals' free expressions. In an examination selecting the Han elites, one examinee expressed the idea that Manchus were barbarians, which clearly violated taboos of the Qing regime. However, Emperor Kangxi thought that the statement was not a big deal and let it pass (Yan, 2016). He also introduced a rule that previously published books containing words that violated taboos of the Qing regime should not be banned and could be republished in their original versions (Yan, 2016). Emperor Kangxi also organized intellectuals to compile a book on the history of the Ming Dynasty, which officially announced that writing books on the Ming Dynasty became legal and virtually overturned the conviction of the previous case of History of the Ming Dynasty. In 1707, an intellectual named Fuxiang Zhang wrote a poem to satirize Emperor Kangxi's extravagant inspection tour to the Chiangnan, where local officials tried their best to please the emperor by spending huge amounts of money to build palaces. Such expressions showed great disrespect to Emperor Kangxi but he did not investigate the case (Yan, 2016).

Emperor Kangxi's conciliation policy significantly eased the tension between the Qing rulers and the Han population and won the support of the majority of the Han Chinese. Moreover, his tolerance for free expressions and other enlightened policies injected vitality into society and inspired people to contribute to society with initiatives. Historians argue that Emperor Kangxi's conciliation policies towards intellectuals were critical in stabilizing society and also boosting the economy, and such policies were the key factors that initiated the "Ages of Prosperity", or the "Kangxi–Qianlong Great Ages" in the Qing Dynasty (Yan, 2016).

The turning point in Emperor Kangxi's policy towards free expression was the case of Mingshi Dai (or the case of *nan shan ji*), which was investigated in 1711. Mingshi Dai was a famous intellectual at the time. In 1711, a government official reported to Emperor Kangxi that a book titled *nan shan ji* written by Mingshi Dai, contained contents that were wildly arrogant and clearly offensive to the Qing

regime. Emperor Kangxi examined the articles in the book and was infuriated by one letter that Dai wrote to a friend. In the letter, Dai praised a book written by the scholar Xiaobiao Fang, who used to serve the rebel army of Sangui Wu, whom Emperor Kangxi hated considerably. The emperor then assumed that Dai belonged to the same group of people (e.g., Fang) opposed to the Qing regime. Dai also commented in the letter that the team that Kangxi organized to compile the book on the history of the Ming Dynasty was terrible and hopeless. Thus, he had to write a decent treatise on the previous dynasty by himself, further infuriating Emperor Kangxi.

Dai was found guilty and executed in the capital Beijing in 1713; the descendants of Xiaobiao Fang were also punished severely. The case was sensational at the time and had a huge impact on society, particularly on intellectuals, who received a strong message that personal expressions, even those in private letters, may be investigated by the government and result in severe punishments.

Then a natural question emerges: Given that Kangxi was tolerant of citizens' free expressions before 1711, why did he suddenly become sensitive to intellectuals' speech and initiate the literary inquisition in 1711? Some historians argue that the case of Mingshi Dai may only be an accident. For a long time, Emperor Kangxi's sons had been fighting fiercely for the right to inherit of the throne over a long time, and the crown prince was deprived of the right of succession owing to his evil behavior for a second time in 1711. At the time, Emperor Kangxi was extremely angry and sad at the time, and the scandals about internal struggles within the royal court appealed to the public too, possibly further causing political instability. Historians speculate that Kangxi intended to make a sensational case of the literary inquisition to divert the public's attention from the scandals of the royal court (Guo and Lin, 1990). Furthermore, China had reached its zenith of prosperity up to 1711, and there were no external and internal threats to the Qing regime at the time. As founder of this great age of prosperity, Kangxi was also at the peak of his power and authority, and he did not have to treat intellectuals well to win their support anymore and could do whatever he wanted. Therefore, it is not surprising that Emperor Kangxi decided to punish Dai severely when he was infuriated by the latter's offensive speech, considering that the emperor was in a bad mood at the time.

After the case of Mingshi Dai, the literary inquisition became the Qing rulers' common instrument of thought control on citizens. As successors of Emperor Kangxi, the Emperors Yongzheng and Qianlong considerably admired the former, leading them to continue or even strengthen the literary inquisition.

Given that Chinese languages are subtle and ambiguous, any writings could be interpreted as offensive to the regime. As described by Wang (2002):

"Rash fortune-telling and discussion of military strategy could be offenses, as could poetic works with 'excessive anger' or 'excessive hate,' or even expressions of 'sorrow' regarding specific episodes

in history. It was a crime to call oneself a non-collaborator, an expression used to refer to adherents of the former dynasty living under a new one without serving it. Use of taboo words and phrases, or even nonsensical expressions like 'a dog's wild bark' were offenses… Careless use of such words as 'Han,' 'Great Enterprise,' 'Ch'ing (Qing),' 'sun and moon' (the components of the character for 'Ming'), 'barbarian,' 'Ming,' and similar words also could be punishable."

Xue (2021) summarizes the features of the literary inquisition and concludes that it was extremely arbitrary and unreasonable. It was impossible to anticipate what speech or writing may result in a literary inquisition. It was the emperor who made the final decisions on the literary inquisition, and such decisions could be substantially arbitrary and subjective. For instance, two cases that are similar in many ways may end up with completely different punishments. Furthermore, the punishments were given in public, sending strong messages to citizens that people who dare to oppose the regime would be punished severely.

Xue (2021) also examines all book titles related to the literary inquisition and finds that most books belong to the genres of poetry and literary commentary, which have nothing to do with politics. Her findings are consistent with historians' views that the culprits of the literary inquisition were not clearly treasonous or even critical of the regime. That is, they may only be the victims of the Qing rulers' arbitrary and unreasonable policy of thought control on citizens.

Although the literary inquisition may appear irrational or unreasonable, the use of arbitrary punishments serves as a signal of state power, which could deter future opposition (Xue, 2021). Actually, the literary inquisition was implemented during the Kangxi–Qianlong Great Ages when China was prosperous and the Qing regime was stable without visible external or internal threats. Moreover, its emperors were among the most powerful in Chinese history. Therefore, the goal of the literary inquisition appears not to purge opponents of the regime, and it may only be a way of building the absolute authority of the Emperor and nurturing consciousness of unconditional obedience to the Qing regime among citizens.

3. Data

Data on the literary inquisition are from *Qingdai wenziyu dang (Zengding Ben)* (Qing Literary Inquisition Archives (Updated Edition)) (Shanghai Bookstore Publishing House, 2011). The book is a revised edition of *Qingdai wenziyu dang ji* (1934), which was produced by historians with the Qing Imperial Archives in the 1930s. The book records 88 cases of literary inquisition from 1661 to 1788.

We exclude these cases in which the emperor finally deemed the implicated speech to be innocuous and subsequently acquitted the accused. Eventually, we obtain a final sample of 69 cases.[3]

Similar to Xue (2021), we examine the effect of the literary inquisition in the culprits' home prefectures, where their identities were lodged and their families and clans resided. In a typical case of literary inquisition, the culprits were executed, and their entire families and even clans were punished severely. Therefore, information on the literary inquisition cases spread rapidly in the culprits' hometown, and the cases could have acted as a deterrent to residents in these regions. We define the treatment as a prefecture's first exposure to the literary inquisition case: when the hometown of the culprits of the literary inquisition cases turned out to be a prefecture for the first time.

Figures 4A and 4B present the time and spatial distributions of the literary inquisition cases in the 18th century. Evidently, most literary inquisition cases were investigated after 1750 in the Qianlong reign. Thus, most treatment prefectures were exposed to the literary inquisition in this period. As previously shown in Figures 1–3, the number of scientific and technological innovations in China declined significantly after 1711, when the first literary inquisition case was investigated. However, this case concerned only several prefectures at the time. Then a natural question arises: Given that most prefectures were not directly exposed to the first case of the literary inquisition, why did the number of innovations of the entire country decline sharply after this case?

It is not difficult to explain such facts. As previously discussed, the case of Mingshi Dai was sensational across China at the time, and citizens, particularly intellectuals, received strong messages that free speech was no longer allowed. Consequently, intellectuals throughout the country may no longer be willing to participate in any creative but potentially risky activities. Therefore, the effects of the literary inquisition were not confined to the directly implicated prefectures but also spilled over to other regions that acquired information on the cases.[4] In brief, although the initial literary inquisition only affected several prefectures directly, it still signifies a crucial turning point in China's decline in scientific and technological advancements.

We empirically estimate the effect of the literary inquisition on scientific and technological innovations and long-term economic development in affected regions. Data on innovation are from the *Zhongguo kexue jishu shi: nianbiao juan* (History of Science and Technology in China: Chronological Volumes) (Ai and Song, 2006). This book documents important events of scientific and technological activities in Chinese history, including notable innovations or advancements in various disciplines,

[3] As previously discussed, the case of History of the Ming Dynasty in 1661 was more of the Qing rulers' fight against the anti-Qing activities in the earlier period of the Qing Dynasty. After 50 years, the second the literary inquisition case in the Qing Dynasty (i.e., the case of Mingshi Dai) was investigated in 1711, which marked that the Qing rulers began to implement extreme expression controls on citizens to consolidate the regime. Thus, we focus on the literary inquisition cases that followed the case of Mingshi Dai.

[4] In Section 4.5 will empirically investigate the potential spillover effects of the literary inquisition on innovation.

such as mathematics, physics, printing, agriculture, and medicine. The record of each innovation contains extensive information, including the author, time, and site where the innovation was made.[5]

We focus on innovation in the Qing Dynasty of China in the 18th century (1700–1800), during which the literary inquisition was implemented and China began to decline in science and technology, and in the middle of which the Industrial Revolution began in Britain.[6] There are 102 recorded scientific and technological innovations in China in this period, among which 93 were made by intellectuals (over 91%), 4 were initiated by the central government, and 5 were introduced by Western missionaries. Undoubtedly, intellectuals were the main contributors of innovation at the time. Unsurprisingly, extreme expression controls on intellectuals could have considerable negative effect on innovation in the Qing Dynasty of China. Given that innovations initiated by the government or imported from foreign countries were unlikely affected by the literary inquisition, we only include innovations made by intellectuals in our sample, which were likely affected directly by extreme speech controls.[7]

To examine the impact of the literary inquisition on long-term economic development, we employ land tax revenue as a measure of economic performance at the prefectural level. As Wang (1973) points out, the land tax was the most important source of public revenue in the Qing Dynasty. For instance, it accounted for 73.5% of the total tax revenues of the Qing government in 1753. Data on land tax revenue at the prefectural level are sourced from the General Records (*tong zhi*) of various provinces at different times. The General Records provide a record of important events in the province, including land tax revenue across all prefectures. We read through the General Records of all provinces in the Qing Dynasty to collect information on the land tax revenue of all prefectures. Eventually, we construct a decadal panel data set of land tax at the prefectural level for 1680–1850. See the Appendix for additional details on the data.

Our empirical analysis also includes a set of geographic and economic characteristics as controls. In particular, geographic characteristics include the agricultural suitability of different crops and three dummy variables: coast (whether a prefecture is situated on the coast), major river (whether a prefecture includes at least one major river), and north (whether a prefecture is in Northern China). We also control for the language polarization index, which reflects the degree of cultural integration in one region. Economic and human capital characteristics (prior to the literary inquisition) include the population density in 1630, which reflects the level of economic prosperity at the time; and the number of *jinshi* or "presented scholars" (candidates who passed the national level civil service exam and were

[5] We exclude a small percentage of records (approximately 6%) in which the time or location of the innovation is unclear.
[6] We can extend the examined period to 1660–1800 or even longer to 1660–1820, and the estimation results remain similar.
[7] See the Appendix for additional details on innovation data.

selected for high-level government positions) in 1600–1710, which reflects the human capital level prior to the literary inquisition. When we investigate the effect of the literary inquisition on land tax revenue, we also control for additional geographic characteristics, such as land area and fragmentation of basins (basin HHI), which may directly affect agricultural production. Table 1 presents the data sources and summary statistics for the main variables.

4. The Effect of the Literary Inquisition on Innovation in Qing China

This section estimates the effect of the literary inquisition on scientific and technological innovation (at the prefectural level) in the Qing Dynasty of China.

4.1 Empirical Strategy

As shown in Figure 3, the number of scientific and technological innovations in the control prefectures is relatively stable and remains at a low level over time. However, the number decreases significantly in the treatment prefectures after 1711 (i.e., when the case of Mingshi Dai was investigated), which presents suggestive evidence of the treatment effect of the literary inquisition on innovation. We now provide a rigorous empirical analysis of the effect of the literary inquisition on innovation in affected regions at the time.

We employ a staggered difference-in-differences (DID) strategy to identify the effect of the literary inquisition on innovation. Specifically, we construct a prefectural-level panel in the 1700–1800 period with a five-year time interval between observations, with each observation representing the number of innovations during each five years in a prefecture. The treatment is a prefecture's first exposure to the literary inquisition case. In practice, we estimate the following two-way fixed-effect (TWFE) model:

$$\#Innovation_{pt} = \beta Literary\ Inquisition_{pt} + \theta X_p \times \gamma_t + \lambda_p + \gamma_t + \delta_{prov} \times \gamma_t + \epsilon_{pt}, \quad (1)$$

where $\#Innovation_{pt}$ is the number of scientific and technological innovations in prefecture p in period t (during the past 5 years), $Literary\ Inquisition_{pt}$ is a dummy indicating whether prefecture p was exposed to the literary inquisition in period t, X_p includes a set of prefectural characteristics, γ_t and λ_p represent time and prefecture fixed effects, respectively, δ_{prov} represents a province fixed effect and thus $\delta_{prov} \times \gamma_t$ is a provincial-specific trend, and ϵ_{pt} is an error term. We estimate Equation (1) using ordinary least squares (OLS) and cluster standard errors at the prefectural level.

Given that the trial of the first literary inquisition case (e.g., the case of Mingshi Dai) was implemented in the then capital city Beijing, where Dai was finally executed. The case was sensational

in Beijing, from where information on the case spread to the entire country. Undoubtedly, Beijing was also considerably affected by the case. Therefore, we also include Beijing in the sample of treatment prefectures after 1711 in our empirical analysis.

The staggered DID strategy carries the following underlying assumptions. (1) In the absence of the literary inquisition, the number of scientific and technological innovations in the treatment and control prefectures would have experienced parallel trends. (2) Prefectural-level average treatment effects are homogenous across treated prefectures and over time. If all the assumptions hold, then the coefficient of interest β in Equation (1) identifies the average treatment effect on the treated (ATT) of the literary inquisition on innovation.

The first assumption that the innovation levels in the treatment and control prefectures share a common trend if the literary inquisition were not implemented is likely to hold. As shown in Figure 3, there were considerably more innovations in the treatment prefectures than that in the control prefectures before 1711. However, the gap in innovation between the two groups is relatively stable in the pretreatment period, providing suggestive evidence that the common trend assumption probably holds. In our empirical investigations, we estimate a fully dynamic version of Equation (1) to directly test the common trend assumption. In addition, we further confirm the robustness of our results by obtaining the alternative estimators introduced by De Chaisemartin and d'Haultfoeuille (2020); Borusyak, Jaravel, and Spiess (2021); Callaway and Sant'Anna (2021); and Sun and Abraham (2021).

Recent econometrics literature has shown that the TWFE models for staggered treatment cases can only deliver consistent estimates under strong assumptions that the treatment effects are homogenous across treated groups and over time (Sun and Abraham 2021). However, if the treatment effects are heterogenous across groups or over time, then we cannot obtain consistent estimates for the ATT from the TWFE model. Thus, we further replicate our results using the robust estimators proposed by De Chaisemartin and d'Haultfoeuille (2020); Borusyak, Jaravel, and Spiess (2021); Callaway and Sant'Anna (2021); and Sun and Abraham (2021), which deliver consistent estimates even if the treatment effects are heterogeneous across groups or over time.

4.2 Baseline Results

To directly test the common trend assumption and examine the dynamics of the treatment effects of the literary inquisition on innovation, we first estimate an event-study version of the TWFE model (Equation (1)). In practice, we estimate the following specification:

$$\#Innovation_{pt} = \sum_{\tau=-(30+),\tau\neq-5}^{20+} \beta_\tau literary\ inquisition_{p\tau} + \theta X_p \times \gamma_t + \lambda_p + \gamma_t + \delta_{prov} \times \gamma_t + \epsilon_{pt}. \quad (2)$$

Equation (2) is similar to Equation (1), except that the variable $literary\ inquisition_{p\tau}$ is a set of indicator variables that equals 1 if it has been τ years since a prefecture's first exposure to the literary inquisition, where $\tau \in \{-(30+), -30, -25, -20, -15, -10, 0, 5, 10, 15, 20, 25+\}$. We define τ=0 as the period when a prefecture was first exposed to the literary inquisition, and we treat the groups five years before a prefecture's first exposure to the literary inquisition as the reference groups.

Figure 5A demonstrates the event-study figure. Evidently, the coefficients are relatively small and never significant prior to the literary inquisition, and it decreases considerably after the treatment and becomes significantly negative soon. These results indicate that the treatment and control prefectures may share a common trend in innovation before the treatment. Such a common trend disappears following the literary inquisition, with the treatment prefectures experiencing a sharp decline in innovation. Such results suggest that the literary inquisition may have had a considerable negative effect on innovation in the treatment prefectures.

Given that the fully dynamic version of the TWFE model (i.e., Equation (2)) produces consistent estimates only when the treatment effects are homogeneous across groups and over time (Sun and Abraham 2021), we further present the event-study figures generated by a set of recently developed robust estimators even in the presence of treatment heterogeneity (De Chaisemartin and d'Haultfoeuille, 2020; Borusyak, Jaravel, and Spiess, 2021; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021). Figure 5B demonstrates the obtained results. For all robust estimators, the coefficients on the groups prior to the literary inquisition are close to zero and exhibit no discernable pretrends. Furthermore, all coefficients decrease significantly after the treatment and become significantly negative soon. In summary, both the OLS and alternative robust estimators indicate that the common trend assumption holds, and the literary inquisition may have a significant negative effect on innovation in affected regions.

We next estimate Equation (1) and report the estimates of β in Table 2. Columns (1) to (4) of Table 2 show that as we gradually add control variables in the regression, the DID estimators change little and are always significant, indicating that our estimates are largely robust. After controlling for all relevant variables, Column (4) presents that the coefficient is approximately -0.038, which indicates that the literary inquisition reduces the number of innovations within a five-year span in the treatment prefectures by 0.038. Given that the mean of the number of innovations for all prefectures

in 1700–1800 is approximately 0.018, such an estimate indicates a huge negative effect of the literary inquisition on innovation in the treatment prefectures. Specifically, the mean of the number of innovations in the treatment prefectures after treatment is approximately 0.057. This estimate indicates that the corresponding value would be 0.095 if these prefectures were not affected by the literary inquisition. That is, the literary inquisition reduced the number of innovations in the treatment prefectures from the potential value 0.095 to the actual 0.057, indicating a reduction of 40%. Such results indicate that the literary inquisition had a detrimental effect on innovation in the affected regions, confirming the information presented in Figure 3.

One possible concern is that the literary inquisition may not necessarily reduce the number of innovations. Instead, the recorded innovations merely declined owing to underreporting following the inquisition. Indeed, the underreporting could present a potential pathway through which the literary inquisition affected scientific and technological activities. Specifically, following the inquisition, some intellectuals may have withheld their innovations from the public, leading to a decrease in recorded innovations. Nevertheless, this situation does not pose a problem for interpreting our results. The literature has demonstrated that knowledge diffusion is critical for S&T advancement (Ma, 2021). Therefore, if some innovations were kept secret and not utilized practically, then they could not stimulate scientific and technological progress or catalyze an industrial revolution. In essence, whether the decline in recorded innovations after the literary inquisition was due to a reduction in innovations or a decrease in the public release of innovations does not affect the interpretation of our results.

The Appendix presents four alternative DID estimators that are robust to treatment effect heterogeneity (De Chaisemartin and d'Haultfoeuille, 2020; Borusyak, Jaravel, and Spiess, 2021; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021). All the estimates are similar to those presented in Table 2, further confirming the robustness of our results.

4.3 Investigating the Impacts of Other Historical Events

Apart from the literary inquisition, other policies or historical events in the 18th century in Qing China may have also had negative impacts on scientific and technological innovation. We have accommodated such effects from other potential shocks in our DID strategy, provided that these shocks were not systematically correlated with the incidences of the literary inquisition across regions and over time. We now examine the impacts of other concurrent historical events on innovation, and determine whether our findings remain consistent after accounting for these potential confounders.

The first notable historical event is the expulsion of the Jesuits in the 1720s. Specifically, Emperor Yongzhen launched a policy in 1723 to expel the Jesuits, which may also have negatively impacted scientific and technological activities in China at the time. Ma (2021) highlights that Jesuit scientists

introduced European science to China from 1580 onward, resulting in a significant increase in scientific works within prefectures hosting Jesuit scientists. However, this knowledge diffusion in China facilitated by the Jesuits ceased in the 1720s, when the emperor began to expel them owing to the Chinese Rites Controversy with the Pope. Undoubtedly, the expulsion of the Jesuits may have also hindered knowledge diffusion and scientific and technological innovations at the time. We now control for the potential impact of this expulsion policy on innovation in our DID framework.

Ma (2021) categorizes the Jesuits in China into two groups. (1) Jesuit scientists engaged in scientific activities while preaching. (2) Jesuit priests exclusively conducted missionary work. Presumably, only the former would have fostered scientific advancements in the regions they influenced. Following Ma's approach, we include a series of control variables in Equation (1), comprising interaction terms between the variables of Jesuit scientists and a dummy variable representing the period of Jesuit expulsion (1721–1780). By doing so, we largely control for the potential impact of the Jesuit expulsion on innovation. In particular, variables associated with Jesuit scientists encompass their presence and number. The former indicates whether Jesuit scientists were present in a prefecture, while the latter is the aggregation of all Jesuit scientists for the decades of their presence in a prefecture preceding the Jesuit expulsion. To further control for the potential impact of the Jesuit expulsion, we also control for interaction terms between the variables of Jesuit priests and Jesuit expulsion dummy. The corresponding estimates of β in Equation (1) with these controls are presented in Table 3. Columns (1)–(4) of Table 3 show that the estimates change little compared with the baseline results in Table 2 as we add the aforementioned controls in the regressions. These results indicate that the Jesuit expulsion does not contaminate our DID estimates of the effects of the literary inquisition on innovation in the treatment prefectures.

Another significant event is the sea ban policy implemented by the Qing government after 1650, which may also have affected domestic scientific and technological activities. The Qing rulers began to strictly enforce a ban on maritime trade from 1655, and coastal regions were profoundly impacted by this policy. The ban was initiated to cut off communication between domestic residents and overseas anti-Qing forces and to consolidate the Qing regime. Three decades later, Emperor Kangxi abolished the sea ban policy when anti-Qing forces were defeated and the Qing regime was consolidated (Guo, 1984). However, the rapid development of international trade worried the Qing rulers that such uncontrolled maritime trade may threaten the Qing regime, leading them to reimpose the sea ban policy in the 18th century. In 1717–1727, the Qing government implemented the sea ban policy in Guangdong and Fujian provinces, banning residents there to go to sea and trade with other countries. In 1757, the Qing government began to ban all maritime trade throughout the country, and only kept Guangzhou

port as a window to foreign countries. Consequently, maritime trade in 1757–1842 was strictly forbidden across the country except for Guangdong Province.

We control for the potential impact of the sea ban policy in the 18th century on innovation by adding corresponding controls in Equation (1). Specifically, we control for interaction terms between the dummies of the two periods of the sea ban policy (i.e., 1717–1727 and 1757–1800) and dummies of the corresponding affected regions in these periods to absorb the potential effects of the policy on innovation (i.e., "Coast I× Sea Ban (1717–1727)" and "Coast II× Sea Ban (1757–1800)"). The variable "Sea Ban (1717–1727)" is a dummy of 1717–1727 period, when the sea ban policy was enforced. "Coast I" is a dummy of coastal prefectures in Guangdong and Fujian provinces affected by this policy. This interaction term is supposed to capture the potential impact of the sea ban policy during 1717–1727 on innovation in the affected regions. Similarly, "Sea Ban (1757–1800)" is a dummy of the 1757–1800 period, when the other sea ban policy was in place. "Coast II" is a dummy of coastal prefectures (excluding Guangzhou) affected by this policy. This interaction term is intended to capture the potential impact of the post-1757 sea ban policy on innovation in the affected regions. Column (5) of Table 3 presents that our DID estimator remains similar to the baseline results after including the two interaction terms.

Unsurprisingly, our DID estimates are largely robust after controlling for the potential effects of other historical events on innovation. We acknowledge that other events could have also affected innovation in the Qing Dynasty. However, these events are unlikely systematically correlated with the incidences of the literary inquisition across regions and over time. Theoretically, if whenever a prefecture was first exposed to the literary inquisition, another adverse shock on innovation occurred simultaneously, then our DID estimates of the effects of the literary inquisition on innovation in the treatment prefectures would be confounded by the effects of such concurrent shocks. However, given the large variation in exposure to the literary inquisition across regions and over time, which is also exogenous to some extent, it is highly unlikely that a prefecture would simultaneously experience another adverse shock on innovation each time it was exposed to the literary inquisition. Therefore, if the common trend assumption holds, we do not need to worry too much that other potential confounders could contaminate our DID estimators.

4.4 Further Robustness Check: A Propensity Score Matching Approach

Our analysis so far demonstrates that the literary inquisition appears to be a plausible exogenous shock on innovation in treatment prefectures. These prefectures experienced a significant decrease in the number of innovations after exposure to the literary inquisition, thereby providing strong evidence of the treatment effect. As discussed earlier, the emperor made the final decisions for the literary

inquisition cases and such decisions could be arbitrary and subjective. Therefore, the occurrence of literary inquisition cases could be exogenous to some extent. However, given that the literary inquisition cases mainly occurred in developed regions with a higher concentration of intellectuals, who were the primary targets of the literary inquisition, an inherent difference exists between the treatment and control prefectures. Such disparities may evolve over time, leading to potential concerns that the differences in innovation between these two groups might not solely be driven by the literary inquisition.

Given that the treatment and control prefectures differ in many ways, it is difficult to completely exclude the possibilities that other omitted time-varying factors may affect the two groups differently and lead to significantly negative DID estimators. For instance, if a substantial gap in innovation initially existed between the treatment and control prefectures and they began to converge after the literary inquisition, then we would also obtain negative DID estimators. However, these estimators should not be misinterpreted as evidence of the destructive effects of the literary inquisition on innovation in the treatment prefectures.

To alleviate the aforementioned concerns, we further employ matching to reduce heterogeneity in the sample. After matching, systematic differences between treatment and control prefectures prior to the treatment no longer exist, thereby making the DID estimators more likely to capture the treatment effect of the literary inquisition on innovation. In this scenario, the literary inquisition serves as a plausible natural experiment for identifying the effects of expression controls on innovation. Specifically, if all prefectures in the matched sample were initially similar and some were randomly selected for exposure to the literary inquisition, and if the number of innovations in these treatment prefectures decreases sharply compared with that in the control prefectures after the treatment, then a reasonable conclusion would be that the literary inquisition has a non-negligible negative effect on innovation in the treatment prefectures.

We match the treatment prefectures with the control ones on a range of covariates using propensity score matching. In practice, we generate a propensity score for each prefecture by estimating:

$$Prob\big(Literary\ Inquisition_p = 1\big) = F(X_i), \tag{3}$$

where $Prob$ is the probability that a prefecture was exposed to the literary inquisition and X_i is the vector of covariates.

We include all baseline controls in Column (4) of Table 2 in our set of covariates. To reiterate, the literary inquisition primarily affected developed regions with a higher concentration of intellectuals and more scientific and technological innovations. As such, the number of innovations prior to the

literary inquisition can be a potent predictor for whether a prefecture was exposed to the literary inquisition. Hence, we also select the number of innovations preceding the literary inquisition as a covariate when performing the matching.

In practice, we adopt the single nearest-neighbor match strategy and match the treatment prefectures with corresponding control prefectures that have similar propensity scores.[8] Table 4 presents the balance of the geographical, economic, and human capital characteristics across the treatment and control prefectures, both before and after matching. Panel A of Table 4 clearly shows significant differences in these observable characteristics between the two groups before matching. However, as shown in Panel B of Table 4, we obtain a balanced sample with no observable differences between the treatment and control prefectures after matching. We now use this matched sample, in which the treatment and control prefectures are similar prior to the treatment, to estimate the effects of the literary inquisition on innovation in the treatment prefectures.

We first perform the event-study analysis and estimate Equation (2) using the OLS with this matched sample. The obtained results are presented in Figure 6A, which visualizes the dynamic effects of the literary inquisition on innovation in the treatment prefectures. Figure 6A shows that prior to the literary inquisition, all the coefficients are close to 0 and insignificant. By contrast, after the literary inquisition, the coefficients sharply decrease and become significantly negative soon. Given the similarity between treatment and control prefectures prior to the literary inquisition, this sharp decrease in the coefficients after the literary inquisition presents compelling evidence of the treatment effect of the literary inquisition on innovation in the treatment prefectures.

Similar to Figure 5B, Figure 6B presents the event-study figures generated by a set of robust estimators in the presence of treatment heterogeneity. As shown in Figure 6B, the coefficients for groups prior to the literary inquisition are close to zero and exhibit no discernable pretrends. Moreover, all coefficients significantly decrease after the treatment and remain at the low level thereafter. Therefore, both the OLS and alternative robust estimators indicate that the common trend assumption holds, and the literary inquisition may have a significant negative effect on innovation in the affected regions.

We next estimate the TWFE model (Equation (1)) using the OLS with the matched sample. Table 5 presents the estimates of β in Equation (1), which generally resemble those obtained from the full sample shown in Table 2, though they are somewhat larger. Columns (1)–(4) of Table 5 show that, with the control variables being gradually added in the regressions, the DID estimators do not change substantially and are always significant at the 1% level. When all control variables are included, the

[8] See the Appendix for additional details of the matching process.

DID estimator is as large as -0.065 (Column (4) of Table 5), which is larger than the corresponding estimate (-0.038) obtained from the full sample presented in Column (4) of Table 2. Given that the mean of the number of innovations in the treatment prefectures after treatment is approximately 0.028, the corresponding value would be 0.093 had these prefectures not been exposed to the literary inquisition. That is, the literary inquisition reduced the number of innovations in the treatment prefectures from a potential value of 0.093 to the actual value of 0.028, signifying a 70% reduction. This estimate is considerably larger than that obtained from the full sample. Considering that the estimates obtained from the matched sample are more likely to capture the treatment effect of the literary inquisition on innovation, such results present compelling evidence that the literary inquisition may have had a huge negative effect on innovation in the treatment prefectures.

Our results are robust to a large extent, given that the DID estimators obtained from both the full and matched samples are highly consistent. In summary, the literary inquisition could have stifled the spirit of innovation of society, particularly among intellectuals who were the primary drivers of scientific and technological advancements at the time. Consequently, the number of innovations sharply declined in the treatment prefectures following their exposure to the literary inquisition.

4.5 The Spillover Effect of the Literary Inquisition on Innovation

In the preceding empirical analysis, we assume that the literary inquisition only affected innovation in the treatment prefectures, thereby allowing the use untreated prefectures as controls. The obtained DID estimators are supposed to capture the treatment effect of the literary inquisition on innovation in those treatment prefectures. However, in reality, all prefectures, including the control ones, could have been affected by the literary inquisition. Note that the Qing rulers implemented the literary inquisition as a deterrent, and it sent strong messages to citizens that people who dared to oppose to the regime would be punished severely. Therefore, the information on the literary inquisition cases could spread throughout the country, and thus a literary inquisition case could have a deterrent effect on innovation at the national level. That is, the literary inquisition may have had a substantial negative impact on innovation in the treatment prefectures and also a spillover effect on innovation in other regions, where people acquired the information on the literary inquisition cases.

We now examine the potential spillover effect of the literary inquisition on innovation in the control prefectures that were not directly exposed to it. Intuitively, people in the control prefectures that were close to the treatment prefectures were more likely to hear about the literary inquisition cases occurred in their neighbors. Thus, innovation in such control prefectures may also be affected to some extent. By contrast, given that people in the control prefectures located further away from the treatment prefectures may not be able to acquire the information on the literary inquisition cases that occurred

far away, innovation in these prefectures may be less affected by those cases. Therefore, we can compare the estimates of the effect of the literary inquisition on innovation obtained from two subsamples (i.e., treatment and closely located control prefectures and treatment and distant control prefectures) to infer the potential spillover effect.

We divide all control prefectures into two categories on the basis of their proximity to the treatment prefectures: (1) close ones, which were within 50 km from the border of the treatment prefectures; and (2) distant ones, which were beyond 50 km from the border of the treatment prefectures.[9] We then construct two sub-samples to perform the DID analysis: Sub-sample I, which includes all treatment prefectures and closely located control prefectures; and Sub-sample II, which comprises all treatment prefectures and distant control prefectures. Given that the control prefectures that were distant to the treatment prefectures may be generally unaffected by the literary inquisition, they serve as a better control group for the treatment prefectures. By contrast, the control prefectures close to the treatment prefectures may also be affected by the literary inquisition to some extent, and thus they do not form a perfect control group for the treatment prefectures. Therefore, if a spillover effect of the literary inquisition on innovation exists, then we would anticipate the DID estimators obtained from Sub-sample II to be larger (in absolute value) than those obtained from Sub-sample I.

We first estimate Equation (1) with the Sub-samples I and II constructed from the full sample and report the results in Columns (1) and (2) in Table 6. Both estimates are significant, and the estimate obtained from Sub-sample II (-0.055) is slightly larger (in absolute value) than that obtained from Sub-sample I (-0.038). However, the difference between the two estimates is not statistically significant (with the p value being approximately 0.39). Thus, the estimates obtained from the full sample only present relatively weak evidence of the spillover effect.

We then estimate Equation (1) with the Sub-samples I and II constructed from the matched sample, in which the treatment and control prefectures are more comparable. The results are reported in Columns (3) and (4) of Table 6. Both estimates are significant, and the estimate obtained from Sub-sample II (-0.112) is larger (in absolute value) than that obtained from Sub-sample II (-0.063). Furthermore, the difference between the two estimates is significantly different from 0 (with the *p* value being approximately 0.036), which presents compelling evidence of the spillover effect.

[9] We choose a distance of 50 km as the cutoff between the close and distant control prefectures because such a one-day-walk distance might be reasonable for information spread at the time. Our results are not sensitive to the selection of this cutoff distance, and they remain robust if we select 30 km or 70 km as the cutoff. Alternatively, we can simply select those control prefectures adjacent to the treatment ones (where the distance equals 0) as the close control prefectures and other non-adjacent prefectures as the distant ones. However, the cost of such a practice is that for the matched sample, close control prefectures consist of only a few prefectures. In particular, there are only 59 treatment prefectures and 35 control ones for the matched sample, and only a few control prefectures are adjacent to the treatment prefectures, making it difficult to identify the potential spillover effect for this sample. Thus, we do not impose the strict restriction that the close prefectures must be adjacent to the treatment ones.

If the spillover effect exists, then the DID estimates provide a lower bound for the deterrent effect of the literary inquisition on innovation in the treatment prefectures. Specifically, if both the treatment and control prefectures were affected by the literary inquisition, with the treatment prefectures being affected to a larger extent, then a significant DID estimator indicates that innovation in the treatment prefectures decreased more sharply than that in the control prefectures, which presents strong evidence of the treatment effect. In other words, if the control prefectures were completely unaffected by the literary inquisition, then innovation in the treatment prefectures would decrease to a larger extent compared with that in the control prefectures, and the DID estimators would also be even more negative. Therefore, the existence of the spillover effect makes our results more convincing.

In particular, the existence of the spillover effect implies that the repercussions of the literary inquisition were far-reaching, extending beyond the treatment prefectures into the control ones. Such a spillover effect suggests a widespread chilling effect on innovation due to fear of punishment, stifling the intellectual spirit throughout the country. Therefore, our results demonstrating a decrease in innovation in the treatment prefectures understate the actual impact of the literary inquisition. Indeed, if the control prefectures were entirely unaffected, then the relative decline in innovation would be more severe in the treatment prefectures, leading to an even larger negative DID estimator.

4.6 The Mechanism: The Decline of *Shixue* and the Rise of the *Puxue*

We now briefly analyze the potential mechanism through which the literary inquisition could have affected scientific and technological innovation at the time. We previously posit that the intellectuals may have been unwilling to engage in creative yet potentially risky activities following the literary inquisition, thereby leading to S&T stagnation. We present some direct evidence to substantiate this claim.

Prior to the literary inquisition, the academically dominant school among the Chinese intellectuals was the *shixue*. This school of thought emphasized statecraft and advocated for the application of classics to present use. Recognizing the drawbacks of the feudal autocracy, some intellectuals also incorporated anti-autocracy sentiments and equality notions into the core values of *shixue*. Advocates of *shixue* aimed to use their knowledge and talents to stimulate social progress and economic development. Such ethos prevailed throughout the country before the onslaught of the literary inquisition (Huang, 2003).

However, circumstances dramatically altered following the investigation of the case of Mingshi Dai. Intellectuals were astonished to learn that talking about statecraft could be interpreted as offensive to the regime and induce severe punishments. Moreover, the core values of *shixue*, such as anti-autocracy and equality, stood in stark contrast to the thought control policies that the Qing rulers

implemented following the literary inquisition. Consequently, the statecraft ideology embedded in *shixue* dissipated and even perished following the literary inquisition. The study of classics, considered safe and impervious to the literary inquisition, experienced a resurgence (Huang, 2003).

The rise of the *puxue* school, which focused extensively on studying and re-examining the Confucian classics, was particularly notable. This discipline comprised three main elements: *jiaozhu* (annotation and collation of classical texts), *bianwei* (identification of errors within these classics), and *jiyi* (collection and compilation of lost classics). *Puxue* developed rapidly after the literary inquisition, peaking during the Qianlong reign when the enforcement of the literary inquisition was also at its zenith (Du and Jin, 2003).

Figure 7 presents the number of *puxue* masters in the Qing Dynasty over time, providing a representation of the evolution of *puxue* in China. Note that prior to the first case of the literary inquisition, the number of *puxue* masters was modest. However, it underwent a sharp increase after 1711 and reached the peak around 1770. Furthermore, the number drastically declined after 1790, coinciding with the cessation of the literary inquisition, and returned to its previous low levels. Such a pattern is consistent with historians' views on the rise and fall of *puxue* in the Qing Dynasty. That is, *puxue* rose quickly following the literary inquisition and declined soon after its termination.

People may wonder why other politically neutral subjects such as mathematics and physics, which appear as impervious to the literary inquisition as *puxue*, declined immediately and only *puxue* developed rapidly following the literary inquisition. The corresponding explanation lies in the unpredictability of the literary inquisition. Note that it was impossible for citizens to anticipate what expressions could induce punishments, and any original works, whether they pertained to literature or science and technology, could be interpreted as offensive to the regime and spell disaster for the authors. By contrast, *puxue*, which studied the Confucian classics, was encouraged and supported by the Qing government even after the literary inquisition, marking it as an absolutely safe pursuit.

In imperial China, the Confucianism served as the cornerstone of the traditional political culture and the ideological foundation of the feudal regime (Jin, 1999). Qing Dynasty emperors also advocated the learning and studying of Confucian classics among citizens. In 1745, Emperor Qianlong issued a decree to command the ministers to recommend those that were proficient in the Confucian classics, and assign them to important government positions (Chen, 2000). Proficiency in the classics was considered as a virtue and also a qualification for government officials at the time. Given that the emperors explicitly supported and even rewarded the study of the Confucian classics, *puxue* was considered by the intellectuals as the only safe and most rewarding school and developed rapidly after the literary inquisition.

We do not argue that *puxue* was completely useless to society at the time. However, if the majority of intellectuals abandoned themselves to studying the Confucian classics to sidestep the punitive risks associated with more innovative endeavors, the development of modern science and technology was inevitably bound to halt. Therefore, the mechanism through which the literary inquisition affected innovation becomes evident: it catalyzed a shift in the intellectuals' interests from innovative activities with practical applications to less risky yet uncreative pursuits. Hence, if intellectuals, who were the main contributors of innovation in the Qing Dynasty, were no longer willing to participate in innovative activities, then China's decline in science and technology would be inevitable.

5. The Effect of the Literary Inquisition on China's Economic Development in the Qing Dynasty

We have shown that the literary inquisition may have stifled the spirit of innovation among citizens at the time, leading to a significant decrease in the number of innovations in the affected regions. We now extend our investigation to examine the potential impact of the literary inquisition on China's economic development in the Qing Dynasty, particularly in the long term.

Innovation is generally considered the primary engine driving the economic development of a country. Therefore, if the literary inquisition thwarted innovation, then it could ultimately impede the economic development of China in the Qing Dynasty. However, note that the literary inquisition was implemented during the period of the "Kangxi–Qianlong Great Ages" when China enjoyed high economic prosperity. Apparently, the literary inquisition did not immediately destroy China's predominantly agricultural economy at the time. Nonetheless, the literary inquisition could stifle a society's innovative spirit and undermine its capacity for progress, ultimately hampering the long-term economic development of the country.

Our previous discussions have highlighted a significant decline in China's scientific and technological innovation after 1700. Despite this decline, China continued to prosper in this period, with economic downturns only observed after 1800. Apparently, China's decline in S&T did not have an immediate destructive effect on the economy, at least in the short term. However, this decline could be a crucial determinant in the eventual loss of China's global power status in the late Qing Dynasty. Specifically, if China missed out on the Industrial Revolution due to its decline in S&T, then it was bound to fall behind Europe in economy during the industrial era. Thus, we can generally explain China's ultimate decline in economy in the late Qing Dynasty by proving that the literary inquisition had led to the country's decline in S&T prior to the Industrial Revolution. However, understanding how extreme controls on expression, such as the literary inquisition, impact the long-term economic

development of a society remains a fundamental and interesting issue. Thus, we provide empirical evidence of the potential effects of the literary inquisition on the long-term economic development of China in the Qing Dynasty.

We employ the index of land tax revenue at the prefecture level as a measure of each prefecture's economic performance in the Qing Dynasty. Note that land tax was the primary revenue source for the Qing government, and the total land tax revenue reflected the agricultural output level at the time. Therefore, land tax revenue can serve as a reliable indicator of economic development in the Qing Dynasty when agriculture was the dominant industry, contributing a significant portion to the total output.

We construct a panel data set of land tax revenue for the 1680–1850 period. The observation is at the prefectural level with a decadal time interval. The treatment is also defined as a prefecture's first exposure to the literary inquisition. We first estimate an event-study version of the TWFE model to examine the dynamic effects of the literary inquisition on land tax revenue. In practice, we estimate the following equation similar to Equation (2):

$$ln\,(LandTax_{pt}) = \sum_{\tau} \beta_{\tau} literary\ inquisition_{p\tau} + \theta X_p \times \gamma_t + \lambda_p + \gamma_t + \epsilon_{pt}\,, \quad (4)$$

where $ln\,(LandTax_{pt})$ is the logarithm of land tax revenue in prefecture p in time t, $literary\ inquisition_{p\tau}$ is a set of indicator variables that equals 1 if it has been τ years since a prefecture's first exposure to the literary inquisition, where $\tau \in \{-(60+), -60, -50, -40, -30, -20, 0, 10, 20, 30, 40, 50, 60, 70+\}$. Same as before, we define τ=0 as the period when a prefecture was first exposed to the literary inquisition. Moreover, we treat the groups 10 years before a prefecture's first exposure to the literary inquisition as the reference groups. Other variables are similar to these in Equation (2), and β_{τ} is the parameter of interest.

Figure 8 demonstrates the event-study results. Prior to the literary inquisition, the estimates of β_{τ} are close to 0 and not significant. By contrast, after the literary inquisition, the coefficients begin to decrease and become significantly negative 30 years later and continue to decrease thereafter. Such results indicate that the literary inquisition may have a nonnegligible negative effect on the land tax revenue in the treatment prefectures, particularly in the long term.

Table 7 presents the coefficients visualized in Figure 8. From 20 years after the literary inquisition, the estimates become significantly negative and continue to decrease. The significant estimates range from -0.038 to -0.109, suggesting that the literary inquisition reduced the land tax revenue in the treatment prefectures by 3.8%–10.9%. Such results indicate that the negative effect of the literary inquisition on land tax revenue is modest, particularly in the short term.

In the Appendix, we present the baseline DID estimates of the effect of the literary inquisition on land tax revenue and more robust DID estimators proposed by De Chaisemartin and d'Haultfoeuille (2020); Borusyak, Jaravel, and Spiess (2021); Callaway and Sant'Anna (2021); and Sun and Abraham (2021). All the coefficients are around -0.04, indicating that the overall negative effect of the literary inquisition on the land tax revenue in the treatment prefectures is approximately 4%, which is a modest yet nonnegligible impact.

People may be confused with such a negative effect of the literary inquisition on land tax revenue. Specifically, the literary inquisition was more of a control policy on free expression and had nothing to do with agricultural production activities, then how could it affect the agricultural output and land tax revenue? The answer lies in the profound impact of the literary inquisition on society. Note that the literary inquisition created a climate of fear among citizens, conveying the message that free speech was no longer possible and that any form of expression, even in private, could be deemed offensive and cause severe consequences. Such expectations among citizens could significantly change their behaviors in many ways, which could further affect society comprehensively. For instance, the literary inquisition may demotivate people at the time and make them less willing to contribute to society with their talents and initiatives. Note that a society without civil liberties would lose its vigor and vitality, and is doomed to decline in many aspects in the long term, including agricultural production.

Given that the literary inquisition only had an indirect effect on agricultural production, we do not expect that this effect would be as large as that on innovation in the affected region. Actually, the destructive effect of the literary inquisition on innovation could be a mechanism through which it affected land tax revenue. That is, the decline in S&T may hinder agricultural development, particularly in the long term.

6. Conclusions

The "Kangxi–Qianlong Great Ages" has been widely regarded as one of the pinnacles in imperial China, marked by economic prosperity and global prominence. However, beneath the surface of peace and prosperity, there may have been hidden yet severe crises. In particular, the Qing regime implemented stringent thought controls on its citizens through the literary inquisition, creating an atmosphere of fear at the time and destroying society's foundation for progress. Although the literary inquisition did not immediately devastate the agricultural economy, the extreme expression controls could have drained society's vitality and ingenuity, undermining its capacity for future progress. Our study indicates that the literary inquisition may have stifled the spirit of innovation of society, leading to China's sharp decline in S&T in the short term and ultimately inducing its decline in economy in

the long term. Such findings, seemingly surprising yet reasonable and thought-provoking, provide important insights and prompt us to reevaluate the "Kangxi–Qianlong Great Ages" in the broader context of Chinese history. Hence, the following question must be answered: Was this perceived "Great Age" merely an illusion or perhaps the dying gasp of the totalitarian regime in imperial China?

Although our focus has been on the destructive impact of extreme expression controls on the spirit of innovation, we have to recognize that such controls can harm society in various other ways. For instance, by imposing strict restrictions on free expression, the government can effectively silence criticisms, removing the incentive to improve services to meet the citizens' needs. Consequently, the quality of governance may stagnate, and tensions between the government and its citizens may escalate over time. For authoritarian regimes, suppressing complaints seems easier than exerting effort to appease citizens. Hence, it is not surprising that restrictions on free speech are prevalent in such systems.

However, we should interpret the findings of this study with caution. Although expression controls in authoritarian regimes are widespread, extreme practices such as the literary inquisition seen in Qing China are rare and have faded in modern times. Current controls on speech are typically milder, aimed at promoting regime support by keeping citizens in ignorance. Although mild expression controls undoubtedly affect society negatively and lead to undesirable outcomes, their impacts may not be equivalent to those of extreme policies such as the literary inquisition. How such milder controls on free expression impact society in the short and long terms, whether and to what extent they undermine the societal foundations for future progress, remains unanswered questions warranting further investigations.

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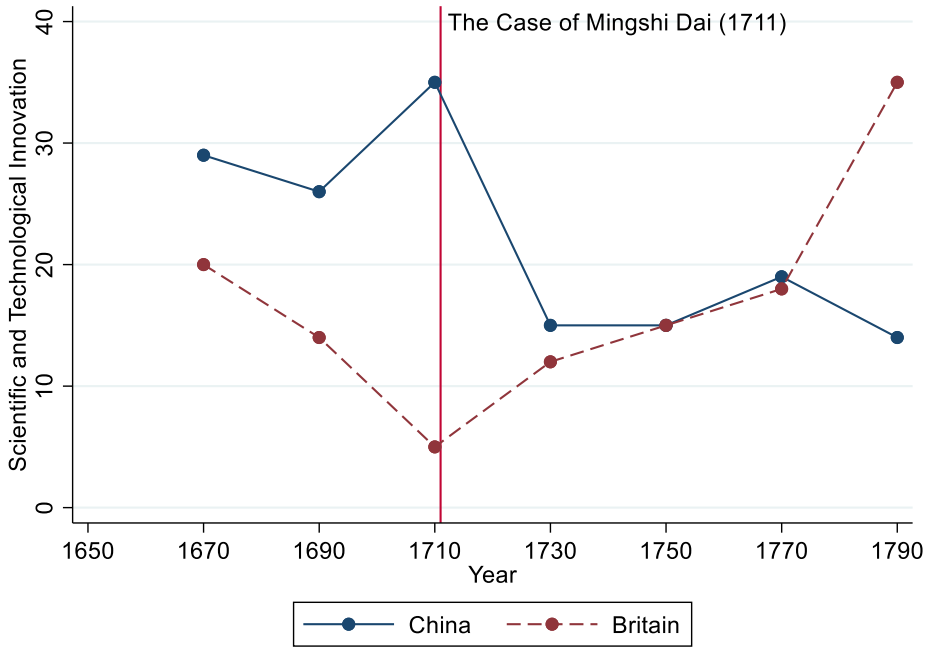
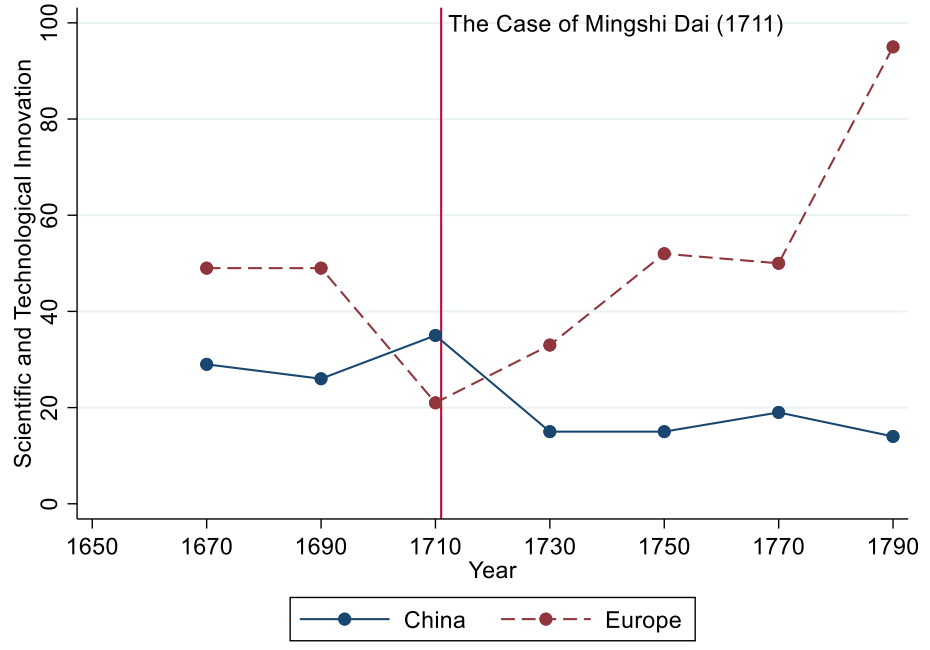
Figure 1: Number of Scientific and Technological Innovations in China and Britain (1670–1790)



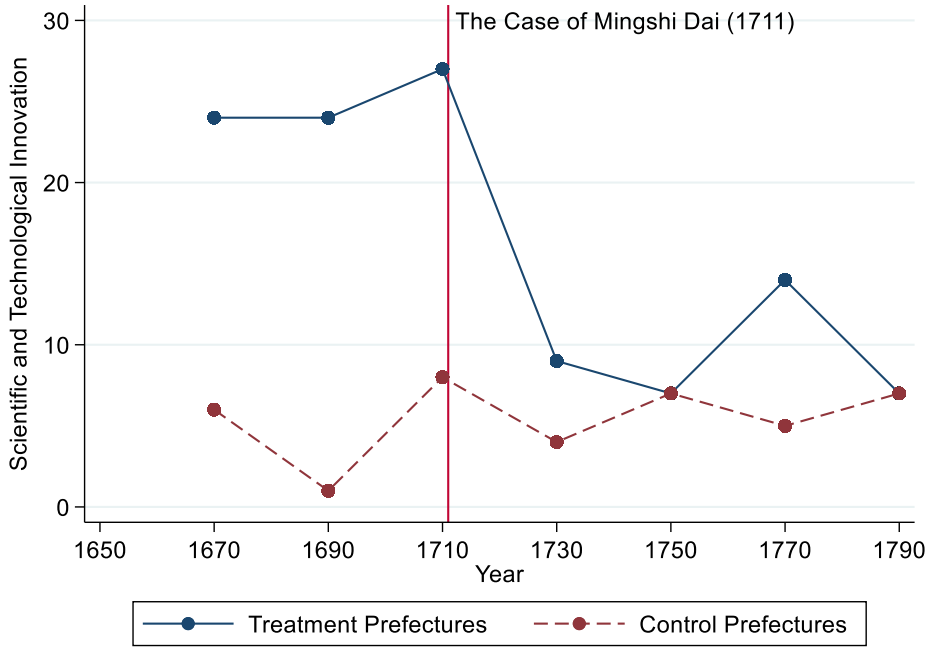
Notes: Data on scientific and technological innovations in China and Britain are from Ai and Song (2006) and Ito et al. (1984), respectively. The two books document important events of scientific and technological activities in Chinese and European history, respectively. We identify the events that reflect important advancements in S&T as innovations, such as publications of academic works on S&T and technological inventions. In general, these innovations include notable advancements in various disciplines, such as mathematics, physics, printing, agriculture, and medicine.

Figure 2: Number of Scientific and Technological Innovations in China and Europe (1670–1790)



Notes: Similar to Figure 1, data on scientific and technological innovations in China and Europe are from Ai and Song (2006) and Ito et al. (1984), respectively.

Figure 3: Number of Scientific and Technological Innovations in China, Treatment and Control Prefectures (1670–1790)



Notes: Data on scientific and technological innovations in China are from Ai and Song (2006).

Figure 4A: Number of Literary Inquisition Cases over Time (1700–1800)

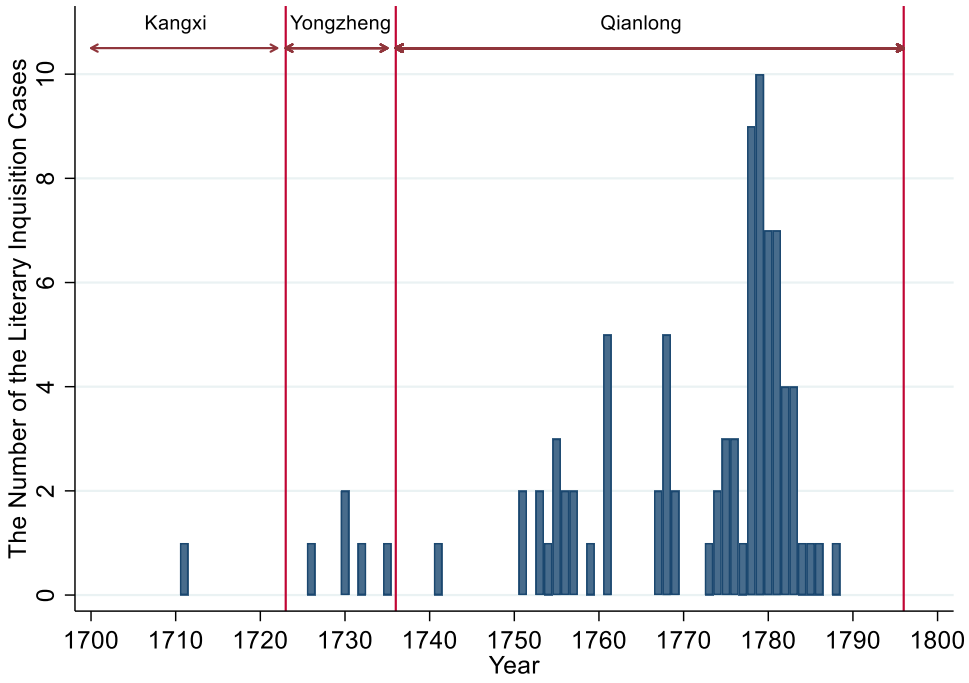
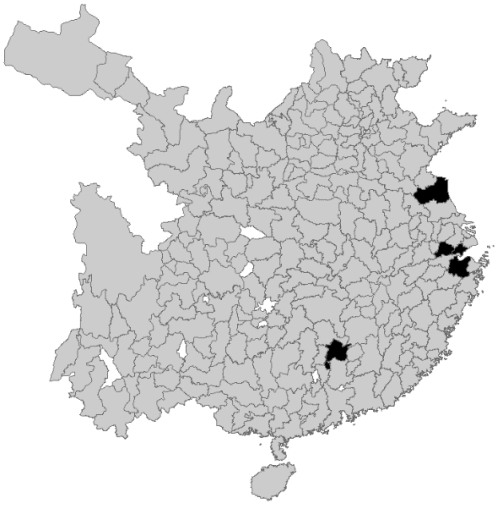


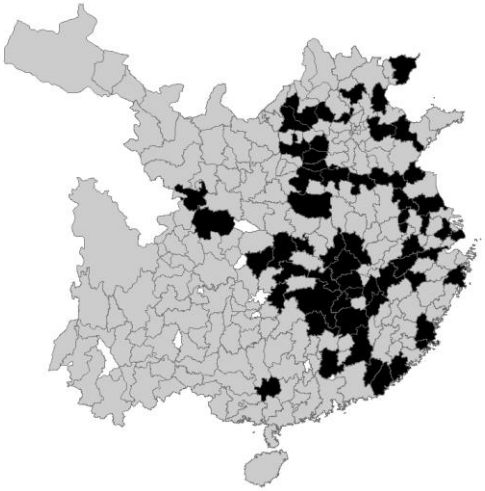
Figure 4B: Spatial Distribution of Prefectures Exposed to the Literary Inquisition (1700–1800)

(a) Kangxi Reign (1700–1722)

(b) Yongzheng Reign (1723–1735)

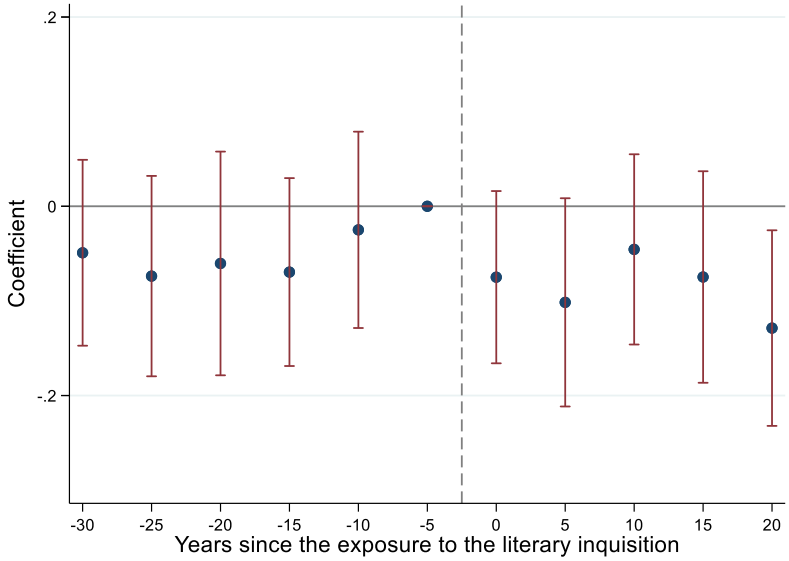


(c) Qianlong Reign (1736–1795)



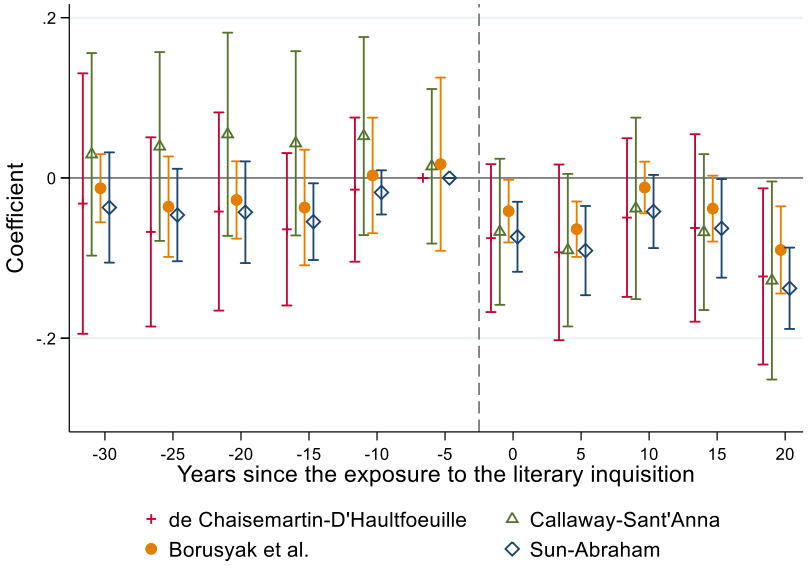
Notes: Figure 4B shows the prefectures exposed to the literary inquisition in the different periods in our sample. The dark areas represent prefectures that were first exposed to the literary inquisition in certain periods.

Figure 5A: The Dynamic Effects of the Literary Inquisition on Scientific and Technological Innovation



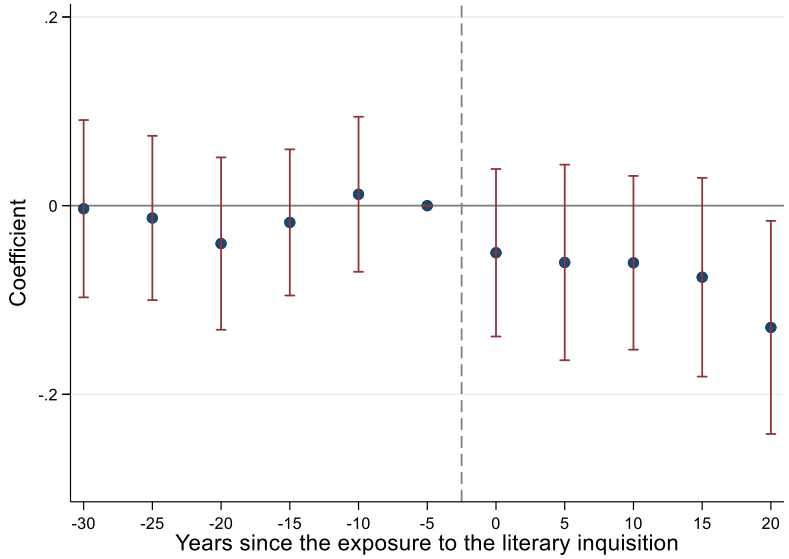
Notes: This figure visualizes the dynamic effects of the literary inquisition on innovation (OLS estimates obtained from the dynamic version of the TWFE model), using the groups just before the literary inquisition (i.e., the groups five years prior to the literary inquisition) as the reference. Control variables include all baseline controls in Column (4) of Table 2. The bars represent 95% confidence intervals. Standard errors are clustered at the prefectural level.

Figure 5B: Dynamic Effects of the Literary Inquisition on Scientific and Technological Innovation: Staggered Treatment Correction



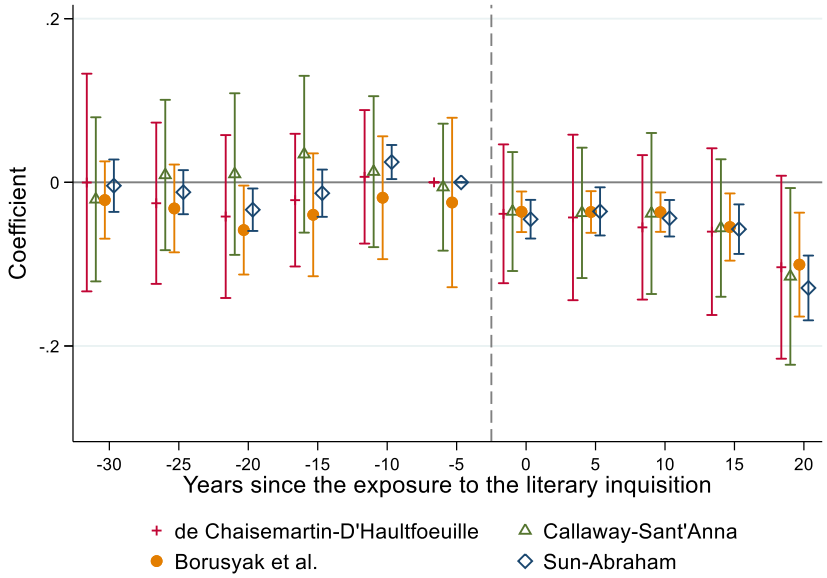
Notes: This figure overlays the event-study plots constructed using four alternative estimators: a dynamic version of Callaway and Sant'Anna (2021) (in green with triangle markers); Sun and Abraham (2021) (in blue with diamond markers); De Chaisemartin and d'Haultfoeuille (2020) (in red with cross markers); and Borusyak, Jaravel, and Spiess (2021) (in orange with circle markers). The outcome variable is the number of scientific and technological innovations (at the prefectural level), and control variables include all baseline controls in Column (4) of Table 2. The bars represent 95% confidence intervals. Standard errors are clustered at the prefectural level.

Figure 6A: Dynamic Effects of the Literary Inquisition on Scientific and Technological Innovation (the Matched Sample)



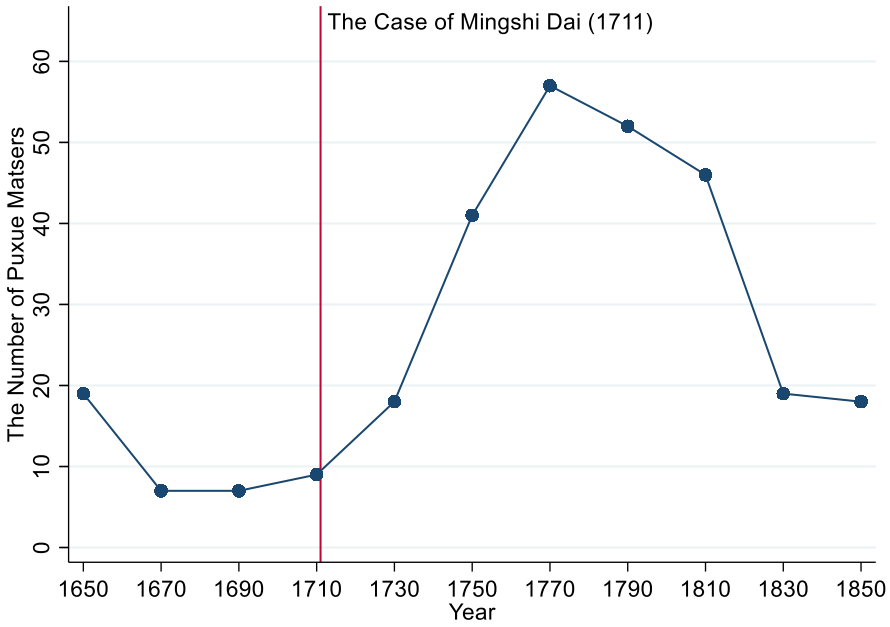
Notes: This figure visualizes the dynamic effects of the literary inquisition on innovation with the matched sample (OLS estimates obtained from the dynamic version of the TWFE model), using the group five years prior to the literary inquisition as the reference. Control variables include all the baseline controls in Column (4) of Table 2. The bars represent 95% confidence intervals. Standard errors are clustered at the prefectural level.

Figure 6B: Dynamic Effects of the Literary Inquisition on Scientific and Technological Innovation: Staggered Treatment Correction (the Matched Sample)



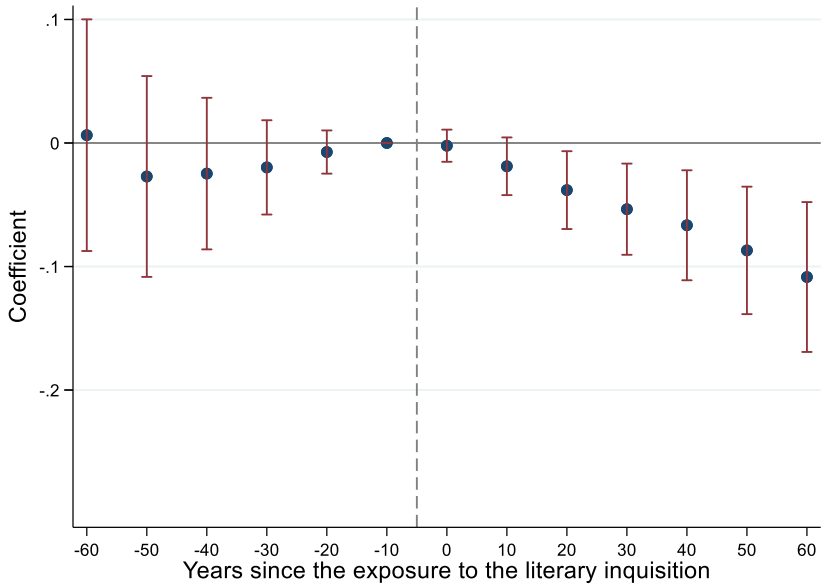
Notes: This figure overlays the event-study plots constructed using four alternative estimators (for the matched sample): a dynamic version of Callaway and Sant'Anna (2021) (in green with triangle markers); Sun and Abraham (2021) (in blue with diamond markers); De Chaisemartin and d'Haultfoeuille (2020) (in red with cross markers); and Borusyak, Jaravel, and Spiess (2021) (in orange with circle markers). The outcome variable is the number of scientific and technological innovations (at the prefectural level) and control variables include all baseline controls in Column (4) of Table 2. The bars represent 95% confidence intervals. Standard errors are clustered at the prefectural level.

Figure 7: The Number of *Puxue* Masters in China (1650-1850)



Notes: This figure presents the number of *puxue* masters born in different periods. Each point represents the number of *puxue* masters born in the past 20 years. Data on *puxue* masters are from Zhi (1925), which records the biographical information of all *puxue* masters in the Qing Dynasty. Unfortunately, this book does not contain the information on the *puxue* masters' birth years. Thus, we further identify the *puxue* masters in another data set, i.e., Chinese Biographical Database (CBDB), and finally obtain a sample of 318 *puxue* masters with complete information.

Figure 8: The Dynamic Effects of the Literary Inquisition on Land Tax Revenue



Notes: This figure visualizes the dynamic effects of the literary inquisition on land tax revenue (OLS estimates obtained from the dynamic version of the TWFE model), using the groups 10 years prior to the literary inquisition as the reference. The bars represent 95% confidence intervals. Standard errors are clustered at the prefectural level.

Table 1: Data Sources and Summary Statistics for the Main Variables

	Sources	Obs.	Mean	S.D.
Panel A: 1701-1800				
Outcome				
Number of scientific and technological innovations	1	4960	0.0187	0.185
Treatment				
Whether a prefecture was exposed to the literary inquisition	2	4960	0.0986	0.298
Controls				
Coast	4	4960	0.137	0.344
Major river	4	4960	0.625	0.484
North (Latitude > 26.9)	4	4960	0.734	0.442
Agricultural suitability for wetland rice	4	4,960	2.008	1.061
Language polarization index	4	4,960	0.162	0.299
Number of *Jinshi* in 1600–1710	5	4960	42.62	67.20
Population density in 1630 (persons/km^2)	5	4,960	83.29	118.5
Panel B: 1680-1850				
Outcome				
Logarithm of land tax revenue	3	3,078	11.21	1.619
Treatment				
Whether a prefecture was exposed to the literary inquisition	2	3,078	0.180	0.384
Controls				
Coast	4	3,078	0.181	0.385
Major river	4	3,078	0.696	0.460
North (Latitude > 26.9)	4	3,078	0.684	0.465
Number of *Jinshi* in 1600–1710	5	3,078	61.77	89.70
Population density in 1630 (persons/km^2)	5	3,078	92.73	132.0
Agricultural suitability for wetland rice	4	3,078	2.199	1.018
Agricultural suitability for foxmillet	4	3,078	2.815	1.288
Land area (km^2)	5	3,078	20,647	19,753
Basin HHI	4	3,078	0.619	0.226

Notes: Major rivers are those ranked as first- and second-order streams in the Chinese river hierarchy.

Sources:

1. Ai and Song (2006).
2. *Qingdai wenziyu dang (Zengding Ben)* (2011).
3. National and provincial General Records at different times. See the Appendix for more details.
4. Bai and Jia (2016).
5. Ma (2021).

Table 2: Baseline Results: DID Estimates of the Effect of the Literary Inquisition on Innovation in the Treatment Prefectures

	Dependent Variable: # Innovations			
	(1)	(2)	(3)	(4)
Literary Inquisition	−0.0318**	−0.0360**	−0.0355**	−0.0375**
	(0.0156)	(0.0167)	(0.0160)	(0.0164)
Prefecture FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Province FE × Time FE	Yes	Yes	Yes	Yes
Jinshi × Time FE	No	Yes	Yes	Yes
Population density × Time FE	No	No	Yes	Yes
Rice × Time FE	No	No	No	Yes
Language × Time FE	No	No	No	Yes
Coast × Time FE	No	No	No	Yes
Main river × Time FE	No	No	No	Yes
North × Time FE	No	No	No	Yes
Observations	4960	4960	4960	4960
R-squared	0.102	0.119	0.128	0.152

Notes: This table examines the effect of the literary inquisition on the number of innovations in treatment prefectures. Specifically, it presents estimates of the coefficient β from Equation (1). In Column (1), we estimate Equation (1) without including controls (only control the prefecture fixed effect, time fixed effect, and the interaction of province and time fixed effects). In Columns (2)–(4), we gradually include a series of interaction terms of the time fixed effect and the following prefectural characteristics in the regressions: *Jinshi* (number of *jinshi* in 1600–1710), Population density (the population density in 1630), Rice (agricultural suitability for wetland rice), Language (the language polarization index), and three geographic dummies: Coast (whether a prefecture is situated on the coast), Main river (whether a prefecture includes at least one major river), North (whether the latitude of a prefecture is over 26.9). Standard errors in parentheses are clustered at the prefecture level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Robustness Checks: Controlling for the Potential Impacts of Other Historical Events

	Dependent Variable: # Innovations				
	(1)	(2)	(3)	(4)	(5)
Literary Inquisition	−0.0404**	−0.0375**	−0.0383**	−0.0375**	−0.0367**
	(0.0169)	(0.0164)	(0.0165)	(0.0164)	(0.0164)
Jesuit scientist number × Expulsion 1721–1780	Yes				
Jesuit scientist presence × Expulsion 1721–1780		Yes			
Jesuit priest number × Expulsion 1721–1780			Yes		
Jesuit priest presence × Expulsion 1721–1780				Yes	
Coast I × Sea Ban 1717-1727					Yes
Coast II × Sea Ban 1757-1800					Yes
Baseline Controls	Yes	Yes	Yes	Yes	Yes
Observations	4960	4960	4960	4960	4960
R-squared	0.154	0.152	0.155	0.152	0.152

Notes: This table presents the DID estimates of the effect of the literary inquisition on the number of innovations in treatment prefectures after controlling for the potential impacts of other historical events at the time. Specifically, it presents estimates of the coefficient β from Equation (1) with more control variables. We control for the interaction terms between the variables of Jesuit scientists and a dummy of the period of Jesuit expulsion (1721–1780) to control for the potential effect of the Jesuit expulsion on innovation. Moreover, we control for the interaction terms between the dummies of the two periods of the sea ban polices (1717–1727 and 1757–1800) and dummies of the corresponding affected regions in the two periods to absorb the potential effect of the sea ban policies. Jesuit scientist (priest) presence is a dummy that equals 1 if a prefecture had Jesuit scientists (priests) between 1581 and 1720. Jesuit scientist (priest) number is the aggregation of all the Jesuit scientists (priests) for the decades of their presence in each prefecture between 1581 and 1720. Coast I and Coast II are two dummies that indicate the affected regions in the two periods of the sea ban polices (1717–1727 and 1757–1800, respectively). Baseline controls are the same as those in Column 4 of Table 2. Standard errors in parentheses are clustered at the prefectural level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Balance of the Sample: Matching Covariates

	(a) Before Matching				
	Treatment Prefectures		Control Prefectures		
Variables	Obs.	Mean	Obs.	Mean	Diff in Mean
Coast	66	0.212	182	0.11	0.102**
Major river	66	0.667	182	0.61	0.057
North	66	0.864	182	0.687	0.177***
Jinshi	66	86.55	182	26.69	59.86***
Population density	66	152.5	182	58.195	94.305***
Innovations	66	0.909	182	0.0769	0.8321***
Rice suitability	66	2.405	182	1.864	0.541***
Language polarization index	66	0.178	182	0.157	0.021
	(b) After Matching				
	Treatment Prefectures		Control Prefectures		
Variables	Obs.	Mean	Obs.	Mean	Diff in Mean
Coast	59	0.169	35	0.237	−0.068
Major river	59	0.661	35	0.542	0.119
North	59	0.847	35	0.864	−0.017
Jinshi	59	70.03	35	59.7	10.33
Population density	59	111.7	35	126.7	−15
Innovations	59	0.356	35	0.441	−0.085
Rice suitability	59	2.422	35	2.374	0.048
Language polarization index	59	0.177	35	0.166	0.011

Notes: This table presents the differences between prefectures that were exposed to the literary inquisition and those that were not regarding their pre-treatment covariates. The covariates include three geographic dummies, namely, Coastal (whether a prefecture is situated on the coast), Main river (whether a prefecture includes at least one major river), North (whether the latitude of a prefecture is over 26.9); and other prefectural characteristics: *Jinshi* (number of *jinshi* in 1600–1710), Population density (population density in 1630), Innovations (number of innovations in 1650–1700), Rice suitability (agricultural suitability for wetland rice), and Language polarization index.

Table 5: DID Estimates of the Effect of the Literary Inquisition on Innovation in the Treatment Prefectures (for the Matched Sample)

	Dependent Variable: # Innovations			
	(1)	(2)	(3)	(4)
Literary Inquisition	-0.0468^{***}	-0.0561^{***}	-0.0585^{***}	-0.0651^{***}
	(0.0174)	(0.0199)	(0.0209)	(0.0231)
Prefecture FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Province FE × Time FE	Yes	Yes	Yes	Yes
Jinshi × Time FE	No	Yes	Yes	Yes
Pop density × Time FE	No	No	Yes	Yes
Rice × Time FE	No	No	No	Yes
Language × Time FE	No	No	No	Yes
Coastal × Time FE	No	No	No	Yes
Main river × Time FE	No	No	No	Yes
North × Time FE	No	No	No	Yes
Observations	1880	1880	1880	1880
R-squared	0.170	0.204	0.226	0.257

Notes: This table examines the effect of the literary inquisition on the number of innovations in the treatment prefectures for the matched sample. Control variables are the same as those in Table 2. Standard errors in parentheses are clustered at the prefectural level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Spillover Effect of the Literary Inquisition on Innovation

	Dependent Variable: # Innovations			
	Full Sample		Matched Sample	
	Sub I	Sub II	Sub I	Sub II
	(1)	(2)	(3)	(4)
Literary Inquisition	-0.0383^{**}	-0.0553^{*}	-0.0630^{***}	-0.112^{**}
	(0.0171)	(0.0296)	(0.0238)	(0.0474)
Baseline Controls	Yes	Yes	Yes	Yes
p-value	0.392		0.0361	
Observations	3660	2620	1780	1280
R-squared	0.170	0.267	0.258	0.346

Notes: This table examines the spillover effect of the literary inquisition on innovation for the full and matched samples, respectively. Specifically, it presents estimates of the coefficient β from Equation (1) for the two sub-samples constructed from the full and matched samples. As discussed in Section 4.5, we construct two sub-samples to perform the DID analysis to investigate the potential spillover effect. Sub-sample I includes all treatment prefectures and closely located control prefectures within 50 km from the borders of the treatment prefectures. Sub-sample II includes all treatment prefectures and distant control prefectures over 50 km from the borders of the treatment prefectures. Baseline controls are the same as those in Column 4 of Table 2. Standard errors in parentheses are clustered at the prefectural level. $*$ $p < 0.1$, $**$ $p < 0.05$, $***$ $p < 0.01$.

Table 7: The Dynamic Effects of the Literary Inquisition on Land Tax Revenue in the Treatment Prefectures

	Dependent Variable: ln (land tax revenue)			
	Years since the event	Coefficients	Years since the event	Coefficients
	[−60, −50)	0.0063	[10, 20)	−0.0188
		(0.0479)		(0.0119)
	[−50, −40)	−0.0271	[20, 30)	−0.0381**
		(0.0415)		(0.0161)
	[−40, −30)	−0.0248	[30, 40)	−0.0536***
		(0.0313)		(0.0188)
	[−30, −20)	−0.0197	[40, 50)	−0.0666***
		(0.0195)		(0.0227)
	[−20, −10)	−0.0073	[50, 60)	−0.0869***
		(0.00892)		(0.0263)
	[0, 10)	−0.0022	[60, 70)	−0.109***
		(0.0066)		(0.0310)
Prefecture FE		Yes		Yes
Time FE		Yes		Yes
Province FE × Time FE		Yes		Yes
Land area × Time FE		Yes		Yes
Basin HHI × Time FE		Yes		Yes
Rice × Time FE		Yes		Yes
Fox millet × Time FE		Yes		Yes
Jinshi × Time FE		Yes		Yes
Pop density × Time FE		Yes		Yes
Coast × Time FE		Yes		Yes
Main river × Time FE		Yes		Yes
North × Time FE		Yes		Yes
Observations		3078		3078
R-squared		0.563		0.563

Notes: This table presents the coefficients visualized in Figure 8. Except for the prefecture fixed effect, time fixed effect, and interaction of province and time fixed effects, we also control for a series of interaction terms of the time fixed effect and the following prefectural characteristics in the regressions: Land area, Basin HHI (basin fragmentation index), Rice (agricultural suitability for wetland rice), Fox millet (agricultural suitability for fox millet), *Jinshi* (number of *jinshi* in 1600–1710), Population density (population density in 1630), and three geographic dummies: Coast (whether a prefecture is situated on the coast), Main river (whether a prefecture includes at least one major river), and North (whether the latitude of a prefecture is over 26.9). Standard errors in parentheses are clustered at the prefecture level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.