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

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Abstract

Expression controls have been a common practice of thought control on citizens in authoritarian regimes. However, the short- and long-term societal impacts of such free speech restrictions remain unclear. In 18th-century Qing China, individuals faced severe punishment if their speech was interpreted as offensive to the regime ("the literary inquisition"). By investigating the impact of the literary inquisition on Qing China, we provide novel 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 50%–58% in affected regions and negatively affected the long-term land tax revenue in these regions in the Qing Dynasty. These findings provide novel insights into Chinese history, particularly regarding 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: N00, O00, H11

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1. Introduction

In the civilized world, freedom of speech is widely regarded as a universal value and a fundamental human right, protected by the constitutions in most countries. However, even today, citizens in most authoritarian regimes are not fully entitled to this right. In these regimes, expression is tightly controlled, and unfavorable remarks on the government are strictly forbidden. Understanding how such controls on expression affect society, particularly concerning the spirit of innovation in the short term and economic development in the long term, is an important empirical issue. Scholars have established that thought controls, such as those during the Counter-Reformation in European history, can have long-lasting adverse effects on society (e.g., Becker et al., 2021; Blasutto and de la Croix, 2023; Drelichman et al., 2021). However, direct empirical evidence on the effect of expression controls is limited. This study attempts to provide a rigorous empirical analysis on the comprehensive effects of expression controls on society.

The literary inquisition in China's Qing Dynasty (1644–1911) provides an ideal natural experiment to empirically study this issue. As defined by Fu (1993), literary inquisition refers to "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." From the Kangxi to Qianlong reigns (1711–1788), the emperors implemented the notorious literary inquisition. During this period, if someone's speech was interpreted as offensive to the Qing regime, they would be executed by dismemberment, and their entire family or clan could also be severely punished.

Such extreme controls on expression created a climate of fear among citizens in the Qing Dynasty and profoundly affected society, particularly in the development of science and technology (S&T). This period saw intellectuals adopting cautious approaches to communication and writing. A notable example is Shizheng Liang, an intellectual in the Qianlong reign, who advised, "Never communicate with others through written words, and always promptly destroy any scratch paper with words" (Jin, 2012). This widespread fear likely stifled communication among intellectuals, discouraging them from writing and publishing works on all subjects, including S&T.

Since books were the primary medium for disseminating and sharing ideas on S&T at the time, the literary inquisition could have significantly impeded progress in these fields.

This study examines the impact of the literary inquisition in Qing China on society, addressing two fundamental puzzles in Chinese history: (1) Although China was the global leader in 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?

China had made remarkable achievements in S&T in the premodern period, maintaining a considerable lead over the Western world in most major fields for an extended 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 poses the challenging and fundamental question based on his research into China's S&T history: Although China had been more advanced than other civilizations in S&T for a long time, why did the Industrial Revolution not originate in China? This question, later known as the "Needham puzzle," has been widely discussed, but without reaching a consensus.

The literature notes that the development of modern science, particularly the surge in scientific and technological innovations, was a pivotal catalyst for the Industrial Revolution (Mokyr, 2002; 2009; McCloskey, 2010). Therefore, the key to solving the Needham puzzle lies in understanding China's decline in S&T during this critical period.

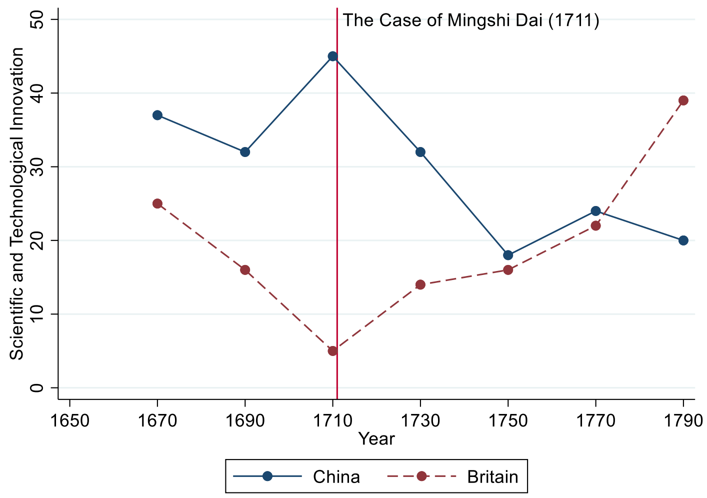
This study posits that the literary inquisition may have stifled the spirit of innovation in Qing Dynasty society, contributing to China's sharp decline in S&T. The case of Mingshi Dai, investigated in 1711, was the first literary inquisition case in the Kangxi period, marking a pivotal shift in Qing rulers' policies on free expression.

To illustrate the potential impact of the literary inquisition on innovation, we present several figures. Figure 1 plots the number of scientific and technological innovations in China and Britain from 1670 to 1790, with each point representing the total innovations in the country over the past two decades.[3] The dividing line represents the year 1711, when Emperor Kangxi initiated the investigation of the first literary inquisition case. Before 1711, China had a clear advantage over Britain in terms of

[3] Section 3 discusses the data on innovation in China and Europe in history. Appendix A2.1 provide more information on the corresponding data.

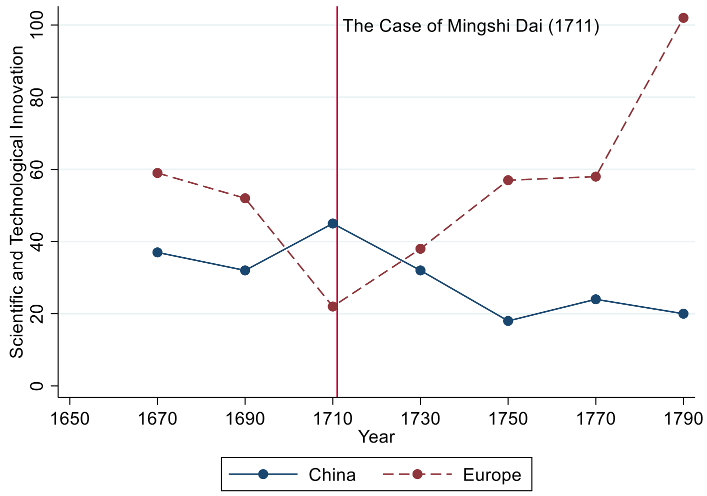
innovation. However, following 1711, China experienced a dramatic decline in innovation, while Britain saw significant growth. By 1750–1770, during the early stages of the Industrial Revolution, Britain surpassed China in innovation, and China continued to lag behind in subsequent years.

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



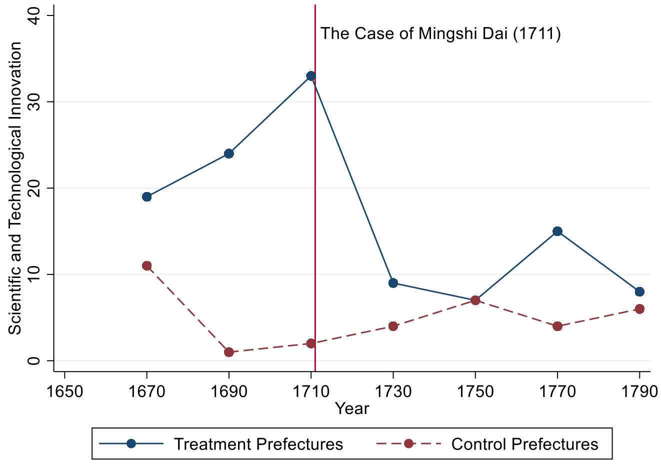
Notes: Data on scientific and technological innovations in China and Britain are from Ai and Song (2006) and Ito et al. (1984), respectively.

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



Notes: 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 2 plots the number of scientific and technological innovations in China and Europe from 1670 to 1790, conveying similar insights. The implementation of the literary inquisition in China in 1711 appears to be the turning point in the country's decline in S&T, which may not be merely a coincidence.

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

Although the Qing rulers began implementing the literary inquisition after 1711, different regions were exposed to it to varying degrees. Some prefectures were directly affected earlier, while others were impacted later. Employing a difference-in-differences (DID) strategy, we exploit the variation in the occurrence of literary inquisition cases across regions and over time to compare scientific and technological innovation in the treatment prefectures (those directly exposed to the literary inquisition) with that in the control prefectures (those not directly affected) before and after the event. Our estimates indicate that the literary inquisition reduced the number of scientific and technological innovations by at least 50%–58% in the treatment prefectures, compared to their potential values had they not been exposed to the literary inquisition. Furthermore, it had a negative effect on the long-term land tax revenue, a key indicator of economic development at the time.

A natural concern is that the occurrence of literary inquisition cases could be correlated with regional characteristics, presenting a typical case of endogeneity. Specifically, because developed regions had more intellectuals—who were the primary targets of the literary inquisition—these regions were more susceptible to this policy. However, Xue (2021) highlights that the location and timing of literary inquisition cases were also influenced by idiosyncratic factors. The subtle and ambiguous nature of the Chinese language meant that any expression could be interpreted in multiple ways. Moreover, there were no standardized legal criteria for what constituted offensive speech, leaving significant room for personal discretion by officials. Lastly, the emperor had the final say in all literary inquisition cases, and his decisions could be highly subjective and arbitrary. As a result, similar cases could lead to vastly different outcomes. These factors introduced idiosyncratic variation in the occurrence of literary inquisition cases across regions and over time. As we will later show, literary inquisition cases were generally evenly distributed across the country, supporting this argument.

The DID strategy exploits the idiosyncratic variation in the literary inquisition to identify its effect on innovation. Our event study results show that innovation in the treatment and control prefectures exhibited no significant difference prior to the literary inquisition. However, after the literary inquisition, innovation in the treatment prefectures decreased sharply compared to the control prefectures. These results suggest that the common trend assumption holds, and that the literary inquisition likely had a significant impact on innovation in the treatment prefectures. To further address endogeneity concerns, we adopt a propensity score matching approach to construct a more comparable sample between the treatment and control prefectures. For this matched sample, the event study figure is even more compelling, and the DID estimates become larger, providing robust evidence of the literary inquisition's negative effect on innovation.

We also examine the effects of other concurrent historical events (e.g., tax reforms and changes to the civil service examination system) on innovation. Our findings remain robust even after accounting for these potential confounders, consistent with our expectations. While we acknowledge that other events may have influenced innovation in the Qing Dynasty, it is unlikely that these events were systematically correlated with the occurrences of the literary inquisition across regions and over time. Theoretically, if every time a prefecture was exposed to the literary inquisition another adverse shock on innovation occurred simultaneously, our DID estimates would be confounded by such concurrent shocks. However, given the significant variation in exposure to the literary inquisition across regions and over time—shaped by random factors—this scenario is improbable. Therefore, as long as the common trend assumption holds, we need not be overly concerned about other potential confounders contaminating our DID estimates.

The literary inquisition did not directly target scientific and technological activities, so why could innovation in these politically neutral fields be affected? The pervasive and arbitrary nature of the inquisition could have had a substantial deterrent effect on intellectual activities. Our heterogeneous analysis shows that innovations documented in books and disseminated through text were much more affected compared to technological inventions produced in practice. Further mechanism analysis suggests that, following the inquisition, intellectuals may have shifted their focus to safer, non-innovative activities, contributing to a stagnation in S&T during this period.

This study provides a novel and compelling explanation for the Needham puzzle. Previous research has suggested that China's decline in S&T was due to factors such as its political bureaucracy system (Lin, 1995; Cantoni and Yuchtman, 2013; Brandt et al., 2014), traditional Confucian cultural values (Weber, 1915; Landes, 2006; Mokyr, 2009; 2017), and imperfect institutions (Huang, 1997; Edwards, 2005; Zhang and Gao, 2005; Landes, 2006). While these explanations offer valuable insights, they have evident limitations. Given that China had been the global leader in S&T for an extended period 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 previously discussed, China's sharp decline in S&T after 1700 is more plausibly attributed to a substantial negative shock to innovation during that time, rather than to persistent factors in imperial China. Therefore, we propose that the extreme expression controls implemented after 1711 led to China's dramatic decline in S&T, which is more plausible and consistent with the Qing Dynasty's S&T development trend. Our findings provide novel insights into Chinese history, particularly regarding the country's decline due to extreme expression controls in the Qing Dynasty.

Our findings also contribute to the growing literature on the broader societal impacts of thought control in authoritarian regimes. Previous research has shown that the Counter-Reformation in Europe, particularly in Italy and Spain following the 15th century, had negative effects on knowledge diffusion, human and social capital, and economic development in affected regions (Becker et al., 2021; Blasutto and de la Croix, 2023; Drelichman et al., 2021). This study will delineate the differences between the Qing literary inquisition and the European Counter-Reformation, highlighting why the former had more severe consequences. Additionally, a recent study by Chen and Yang (2019) suggests that media censorship in modern China can be effective among citizens with a low demand for uncensored information. However, the social costs of this practice remain unclear. This study comprehensively investigates these costs.

Our study significantly differs from other working papers on the literary inquisition in Qing China. Studies by Koyama and Xue (2015) and Xue (2021) document substantial adverse effects of the literary inquisition on human capital accumulation and social capital, including charity and trust, in affected regions, with some effects persisting into modern China. Our study diverges by focusing on the impacts of the literary inquisition on S&T and economic development in the Qing Dynasty. More importantly, our examination of the literary inquisition's effects provides novel and compelling explanations for the Needham puzzle. Furthermore, our study casts light on present-day China, where the tightening of expression controls over the past decade has culminated in widespread public discontent, epitomized by the White Paper Revolution in November 2022. This historical moment, marked by heightened tensions between state-imposed speech restrictions and the populace's demand for free expression, draws global attention to China's future path. Thus, our findings have broad implications, shedding light on the intricate interplays among civil liberties, social vitality, and economic prosperity in the modern world.

2. Historical Background

2.1 The Literary Inquisition in Qing China

Literary inquisition has a long history in imperial China for a long time, with the earliest known case dating back to the Zhou Dynasty around 1000 BC. In earlier periods, literary inquisition was usually used by emperors or bigwigs to eliminate their political opponents, with typical cases reflecting struggles among political elites and having little impact on the general populace (Yang, 1999). However, during the Qing Dynasty, the literary inquisition evolved into a critical tool for rulers to control public thought and consolidate their regime, with commoners becoming the primary victims. This shift explains why the Qing literary inquisition had such a profound effect on society.

This section provides a brief overview of the historical background of the literary inquisition during the Kangxi to Qianlong reigns (1661–1796). See Appendix A1.1 for more detailed information.

The Ming Dynasty collapsed in 1644, and the Manchus invaded Beijing thereafter and established the Qing Dynasty. The Ming-Qing transition was marked by significant unrest, including widespread massacres and heightened tensions between the Manchu conquerors and the Han population (Wakeman, 1985, Xue, 2021). Such tensions persisted for a long time, posing a threat to the stability of the Qing regime. When Emperor Kangxi assumed power in 1667, he implemented conciliation policies aimed at winning the support of the Han population by treating them well and showing notable tolerance toward intellectuals' free expression (Guo and Lin, 1990; Yang, 1992).

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 expression and other enlightened policies injected vitality into society and inspired people to contribute to society with initiatives (Guo and Lin, 1990). Historians argue that Emperor Kangxi's conciliation policies toward 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 toward 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 (Yan, 2016). 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 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.

While the case of Mingshi Dai might initially be viewed as an isolated incident, the Qing Dynasty’s approach to the literary inquisition underwent significant evolution during the reigns of Emperors Yongzheng and Qianlong. These successors of Emperor Kangxi held him in high regard and were influenced by his legacy. They continued and intensified the literary inquisition. Consequently, the literary inquisition became the Qing rulers’ common instrument of thought control on citizens later.

In a typical literary inquisition case, if someone’s speech was deemed as offensive to the Qing regime, they could face execution by dismemberment, and their entire family or clan might also suffer severe punishment. Given the subtlety and ambiguity of the Chinese language, almost any expression could be interpreted as offensive to the regime (Xue, 2021). As Wang (2002) describes, "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 entirely different punishments. Furthermore, the punishments were given in public, sending strong messages to citizens that people who dared to oppose the regime would be punished severely.

Although the literary inquisition may appear irrational or unreasonable, using arbitrary punishments signals 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 the consciousness of unconditional obedience to the Qing regime among citizens.

2.2 The Literary Inquisition and Scientific and Technological Innovation in Qing China

Given that the literary inquisition aimed to punish citizens' offensive speech against the Qing regime, people may wonder why innovative activities in politically neutral fields such as physics and mathematics could be affected. Indeed, the literary inquisition was not designed to restrict scientific innovation directly, and few were penalized for their scientific and technological investigations. However, the pervasive and arbitrary nature of the inquisition could exert a substantial deterrent effect on innovative activities in these fields.

As previously discussed, the subtleness and potential ambiguities in the Chinese language meant that any expression could be interpreted as offensive to the Qing regime. Furthermore, given the arbitrary and capricious nature of the literary inquisition, it was impossible for individuals to predict what expressions or writings might lead to punishment. This uncertainty meant that the content of any original work, be it pertained to literature or S&T, risked being interpreted as subversive, placing the authors in jeopardy.

Consequently, the literary inquisition fostered a climate of fear among the populace at the time. For instance, during the peak of the literary inquisition under the Qianlong reign, an intellectual named Shizheng Liang advised, “Never communicate with others through written words, and always promptly destroy any scratch paper with words” (Jin, 2012), reflecting the pervasive fear of the literary inquisition. This atmosphere likely hindered effective communication among intellectuals, diminishing their willingness to write and publish works on all subjects, including S&T. Considering that books were the primary medium for disseminating and sharing ideas in S&T at the time, the literary inquisition could have significantly hampered progress in these areas. Consistent with this hypothesis, our results indicate that innovations documented in books and disseminated through text were more significantly affected by the literary inquisition.

Section 5.7 further explores the mechanisms through which the literary inquisition impacted scientific and technological innovation in Qing China. Our analysis indicates that, in the wake of the literary inquisition, intellectuals may have shifted their focus to non-innovative but safer activities, contributing to a stagnation in S&T during this period.

2.3 The Qing Literary Inquisition and the Age of Enlightenment in Europe

To better understand the destructive effects of the literary inquisition on Qing Dynasty society, we now examine the issue from a broader perspective, contrasting the Enlightenment in Europe with the literary inquisition in China during the 1700s. This comparison helps to illuminate the differing impacts of intellectual and cultural movements on societal development in these regions.

The Age of Enlightenment, which flourished in 18th-century Europe, laid the groundwork for the Industrial Revolution (Mokyr, 2009; Jones, 2017). The Enlightenment, promoted by philosophes who challenged the authority of deeply entrenched institutions and sought to reform society with tolerance, science, and skepticism, is best known for its political achievements. These include advocating for political ideals such as freedom, equality, basic human rights, religious tolerance, and democracy (Bristow, 2023). 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 individuals were highly rewarded for their innovative efforts (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 core ideology of the Enlightenment was widely embraced in Europe during 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. 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 drain a society of its vigor and vitality, undermining its capacity for future progress. Thus, the stark contrast between the impact of the Enlightenment in Europe and the literary inquisition in China may partially explain for Europe's rise and China's decline after 1700.

In Appendix A1.3, we discuss the differences between the literary inquisition in Qing China and media censorship in modern world. We also compare the Qing China's literary inquisition with the European Counter-Reformation to highlight their differing impacts on China and Europe. Specifically, the Qing literary inquisition could have led to China's sharp decline in S&T and its ultimate decline in economy, whereas the European Counter-Reformation was a comparatively minor obstacle in the continent's ascent in S&T and economic progress.

3. Discussions: When did China Begin to Decline in S&T?

While Figures 1 and 2 suggest that China may have begun declining in S&T after 1711, this evidence is far from conclusive. In fact, the literature has not reached a consensus regarding the exact timing of China's S&T decline. From a broader perspective, diverse scholarly views exist concerning the timeframe of China's decline and Europe's rise in S&T. This section seeks to analyze these controversies and unify various perspectives within the literature.

Needham (1981) posits that China maintained its lead over Europe in S&T from the 2nd to the 15th centuries, with Europe overtaking China during its 16th-century Scientific Revolution. Mokyr (1992) notes that China's technological progress slowed down after 1400 and eventually came to a full stop. He observes that "in 1600, their (China's) technological backwardness was evident to most European visitors." However, Needham and Mokyr base their arguments on anecdotal evidence, leaving room for further investigations. A recent project by Huang (2023) traces China's decline in S&T back to the Sui Dynasty (581–619), further intensifying the controversy.

We reexamine this issue by collecting data on scientific and technological advancements in historical China and Europe. Our data sources include Ai and Song (2006) for China and Ito et al. (1984) for Europe, both of which document significant events in the history of scientific and technological activities in these regions.[4] 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. These innovations span various disciplines, including mathematics, physics, chemistry, printing, agriculture, medicine and others. See Appendix A2.1 for more information on the data sources.

To examine whether a specific period in history marks a divergence in S&T between China and Europe, we extend the time horizon of Figure 2 to 100–1900 to cover the period from 100 to 1900 in Figure 4. The figure shows a consistent decline in China's innovations after 600, aligning with Huang's findings. However, this period does not signify the divergence of China's decline and Europe's rise in S&T. Notably,

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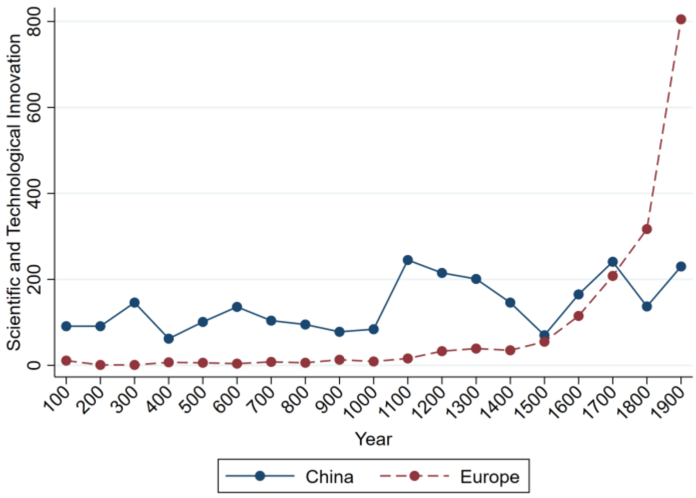
[4] The innovations considered include only original ones, excluding those introduced by foreigners.

China experienced an innovation surge after 1000,[5] while Europe's innovation levels remained relatively low. Furthermore, consistent with Needham and Mokyr's arguments, China's innovation level was relatively low around 1500. However, China's innovations began to increase after 1500 and paralleled Europe's progress in the following two centuries, indicating that 1500 was not the point of divergence either.

Figure 4: Number of Scientific and Technological Innovations in China and Europe (100–1900)



Notes: Similar to Figure 2, data on scientific and technological innovations in China and Europe are from Ai and Song (2006) and Ito et al. (1984), respectively.

The only discernable divergence point is 1700, characterized by a significant upsurge in Europe's innovations and a steep decline in China's. Despite some recovery in China's innovations after 1800 following the termination of the literary inquisition, China had fallen irretrievably behind Europe in S&T and had no chance to catch up again. Therefore, if a divergence point in S&T exists between China and Europe during 100–1900, it is likely around 1700.

People may be concerned whether the data sources for Figure 1–4 are credible or reliable enough to draw a conclusion on this issue. Specifically, people may wonder whether and to what extent the data on scientific and technological innovations in China and Europe are comparable, and whether the definitions of innovations are consistent across the board.

[5] The invention of the movable type printing in 1041 may have contributed to China's subsequent significant increase in innovation. China later experienced a sharp decrease in innovation after 1300. Historians argue that the peak of feudal autocracy, reached with the establishment of the Ming Dynasty in the 1300s, may have contributed to this decline in S&T over the following two centuries (Du and Jin, 2003).

To address these concerns, we conducted a detailed examination of our data sources. We compare the scientific and technological event records in the two books and find that they are similar in many ways. Both books chronologically record significant scientific and technological advancements in their respective histories. Our detailed comparison of these records reveals no significant differences in the definitions of innovations across the two regions. See more discussions in Appendix A2.1.

Although proving conclusively that the definitions of innovations in the two books are identical is difficult, discrepancies in definitions do not necessarily pose a problem for our analysis. Our primary goal is to identify the timing of the S&T divergence between China and Europe over a historical timeline, rather than comparing the absolute levels of S&T in the two regions at any specific time. Given that the definitions of innovation in both regions are derived from the same source, they are likely to remain consistent over time within each region. Thus, Figure 4 could still reflect the development trends of S&T in Chinese and European history. In other words, China's steep decrease and Europe's significant increase in innovations after 1700 presented in Figure 4 are unlikely driven by the disparate definitions of innovation in the two regions. In summary, provided constant definitions of innovation in both regions over time, Figure 4 remains informative regarding the timing of the S&T divergence between China and Europe.

Moreover, our focus on the quantity of S&T innovations, without considering their quality, may raise concerns about the reliability of our conclusions. If the quality of European S&T innovations declined substantially after 1700, while that of Chinese innovations improved significantly, then the inferred divergence around 1700 would be questionable. While direct measurement and comparison of S&T innovation quality over time are difficult, the available evidence suggests that the quality of European S&T innovations did not deteriorate after 1700, nor did the quality of Chinese S&T innovations notably improve.

In Europe, the 18th century has witnessed numerous significant scientific and technological breakthroughs. These include James Watt's improvement of the steam engine in 1765, Hargreaves' invention of the Spinning Jenny in 1767, the first application of the steam engine in spinning machinery in 1785, and Lavoisier's introduction of the earliest table of elements in 1789 (Ito et al., 1984). These innovations, particularly the improved steam engine and developments in spinning technology, were instrumental in triggering the Industrial Revolution (Pomeranz, 2000). These key S&T breakthroughs indicate no significant decline in the quality of European innovations during this period.

In China, evidence suggests that the quality of S&T innovations did not significantly improve in the 18th century and may have even declined considerably. Jin (1998) documents the biographies of 77 distinguished scientists from 400 BC to 1900 AD, pivotal in the progression of S&T in Chinese history. The records show a steep decrease in the number of notable scientists in the 18th century, dropping from nine in the 17th century to two in the 18th century. This reduction in the number of distinguished scientists implies a decline in innovations with significant contributions, suggesting that the quality of Chinese S&T innovations in the 18th century likely did not escalate significantly and may have diminished.

Thus, even considering the quality of S&T innovations, the conclusion that China and Europe began diverging in S&T development during the 18th century remains substantiated. This divergence is not solely based on the quantity of innovations but is also supported by the evidence of relative quality within each region.

We acknowledge that our data on innovation includes only notable advancements in S&T, as only these were recorded in history. However, this limitation may not be a problem for our analysis. Given that revolutionary innovations are crucial catalysts for the Industrial Revolution, focusing on trends in major innovations over time helps to explain the Needham Puzzle—why the industrial revolution did not originate in China.

In conclusion, our findings bridge differing viewpoints in the literature on the Great Divergence, suggesting that the pivotal period for China's decline and Europe's rise in S&T is the 18th century. This conclusion itself represents a significant contribution to the literature.

4. Data

Data on the literary inquisition are from *Qingdai wenziyu dang (zengding ben)* (Qing Literary Inquisition Archives (Updated Edition)) (Wanyan, 2011). This updated edition revises Qingdai wenziyu dang ji (Qing Literary Inquisition Archives) (Zhang, 1934), adding 25 previously unrecorded cases. The updated book documents 90 cases from

1711 to 1788; after excluding one case with unidentified culprits, we are left with a final sample of 89 cases. In contrast, Xue (2021) uses *Qingdai wenziyu an* (Qing Literary Inquisition Cases) (Zhang and Du, 1991), analyzing 86 cases. Despite the slight difference in sample size, our data source offers several advantages, and our results remain robust regardless of the data source used. See further details and results in the Appendix A2.2.

Figure 5A: Number of Literary Inquisition Cases over Time (1700–1800)

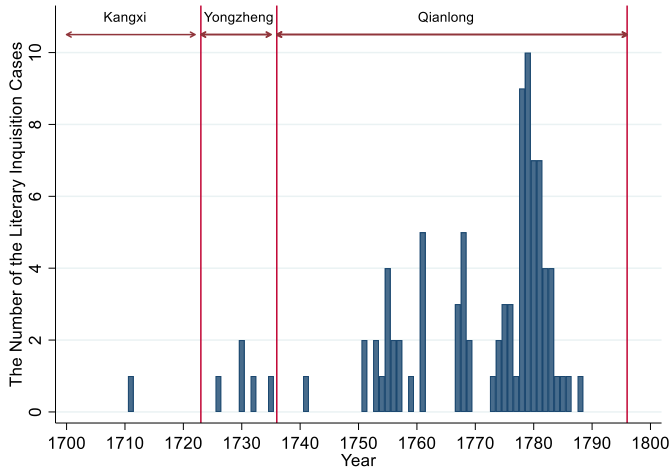


Figure 5B: Spatial Distribution of Prefectures Exposed to the Literary Inquisition (1700–1800)

(a) Kangxi Reign (1700–1722) (b) Yongzheng Reign (1723–1735) (c) Qianlong Reign (1736–1795)

Notes: Figure 5B 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.

Figures 5A and 5B present the time and spatial distributions of the literary inquisition cases in the 18th century. 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. Moreover, literary inquisition cases were generally evenly distributed across the country, and even some remote and underdeveloped regions were affected. These results strongly align with our previous statement that the occurrence of literary inquisition was shaped by idiosyncratic factors.

Figures 1–4 show that 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 literary inquisition case, why did the number of innovations of the entire country decline sharply after this case?

This decline can be explained by the widespread impact of the case. As previously discussed, the case of Mingshi Dai was sensational across the country, sending a strong message to citizens, particularly intellectuals, that free speech was no longer tolerated. As a result, intellectuals throughout the country may have become reluctant to engage in any creative but potentially risky activities. This chilling effect from the initial literary inquisition may have stifled intellectual activity and led to a sharp decline in scientific and technological innovation across the country, especially in the treatment prefectures with high levels of innovation.

The effects of the literary inquisition were not confined to the directly implicated prefectures but also spilled over to other regions that learned about the cases.[6] While such spillover effects are not captured by our DID estimates, they do not undermine the validity of our significant findings. Even though many prefectures experienced a considerable decline in innovation due to these spillovers, the innovation levels could continue to decline significantly in regions directly exposed to the literary inquisition.

Data on innovation are from the *Zhongguo kexue jishu shi: nianbiao juan* (History of Chinese Science and Technology: 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, such as mathematics, physics, printing, agriculture, and medicine. The record of each

[6] Section 5.6 empirically investigates the potential spillover effects of the literary inquisition on innovation.

innovation contains extensive information, including the author, time, and site where the innovation was made.[7]

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.[8] 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.[9]

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 A2.3 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

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[7] We exclude a small percentage of records (approximately 6%) in which the time or location of the innovation is unclear.

[8] We can extend the examined period to 1660–1800 or even longer to 1660–1820, and the estimation results remain robust.

[9] See the Appendix A2.1 for additional details on innovation data.

agricultural suitability of different crops and two dummy variables: coast (whether a prefecture is situated on the coast) and major river (whether a prefecture includes at least one major river). We also control for the language polarization and fragmentation indices, which reflect the degree of cultural integration within a 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 selected for high-level government positions) in 1600–1710, which reflects the human capital level prior to the literary inquisition.

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

	Sources	Obs.	Mean	S.D.
Panel A: 1701-1800				
Prefectural Level				
Outcome				
The number of scientific and technological innovations	1	248	0.375	1.457
Treatment				
Whether a prefecture was exposed to the literary inquisition	2	248	0.286	0.453
Difference-in-Difference Regressions				
Outcome				
The number of scientific and technological innovations	1	4,960	0.019	0.185
Treatment				
Whether a prefecture was exposed to the literary inquisition	2	4,960	0.098	0.298
Panel B: 1680-1850				
Prefectural Level				
Outcome				
Logarithm of land tax revenue	3	171	14.252	1.555
Treatment				
Whether a prefecture was exposed to the literary inquisition	2	171	0.386	0.488
Difference-in-Difference Regressions				
Outcome				
Logarithm of land tax revenue	3	3,078	11.270	1.646
Treatment				
Whether a prefecture was exposed to the literary inquisition	2	3,078	0.188	0.391

Source: 1.Ai and Song (2003).
2.Wanyan (2011).
3.The General Records of all provinces at different times. See the Appendix A2.3 for more details.

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. Furthermore, given that the tax reform *Tandingrumu* (transitioning from a poll tax to a property tax) during 1723–1728 may also affect land tax revenue, we also control for its potential impact in the regressions.[10]

Table 1 presents the data sources and summary statistics for the main variables,[11] and Table A15 in the Appendix provides the corresponding statistics for the control variables.

5. 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.

5.1 Empirical Strategy

We employ a staggered DID strategy to identify the effect of the literary inquisition on innovation. Following established practice in the literature (e.g., Koyama and Xue, 2015; Xue, 2021), we focus on the culprits' home prefectures, where their identities were lodged and where their families and clans resided. In typical cases of literary inquisition, the culprits were executed, and their entire families, and even clans, were punished severely. Consequently, information about these cases spread rapidly in the culprits' hometowns, potentially acting as a deterrent to residents in these regions. We define the treatment as a prefecture's first exposure to the literary inquisition: when the hometown of the culprits of the literary inquisition cases was identified as a prefecture for the first time.

This definition of the treatment group may not be perfect, as the effects of the literary inquisition could extend beyond the culprits' hometown prefectures. For instance, the culprits' residential prefectures and the prefectures where executions occurred may also be affected. Therefore, we include these regions in the treatment group in an alternative analysis. As shown in Appendix A3, our results remain robust with this expanded definition of the treatment group.

[10] See more discussions about the *Tandingrumu* policy in Appendix A4.3.

[11] Table 1 shows that the sample of prefectures in the land tax analysis is smaller than that in the innovation analysis. This discrepancy arises because the two analyses are based on different regional administrative divisions —1680 for land tax and 1820 for innovation. For a detailed discussion, see Appendix A2.3.

Our identification does not require the strong assumption that the literary inquisition had no impact on the control prefectures. Instead, we assume that the treatment prefectures (the culprits' hometowns) were more significantly affected than the control prefectures. A significant DID estimate aims to capture the more pronounced effect of the literary inquisition on the treatment prefectures compared to the control ones.

In our DID framework, 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:

$$\#Innovation_{pt} = \beta Literary\ Inquisition_{pt} + \rho Treat_p \times After1790_t + \theta X_p \times \gamma_t + \lambda_p + \gamma_t + \delta_{prov} \times \gamma_t + \epsilon_{pt}, \quad (1)$$

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*; $Treat_p$ is a dummy indicating whether prefecture *p* was ever treated, $After1790_t$ is a dummy that equals 1 when observations were after 1790, 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 effects; $\delta_{prov} \times \gamma_t$ 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.

We include an interaction term $Treat_p \times After1790_t$ as a control variable in the Equation (1) to improve the precision of our identification. This term is intended to account for the potential rebound in innovation within the treatment prefectures during the decade following the literary inquisition's termination (1790–1800). As shown in Table A16 in the Appendix, our findings remain robust regardless of whether this specific control is included or excluded from the regressions. Nevertheless, to accurately estimate the immediate impact of the literary inquisition on innovation and to explain the sharp decline in innovation across China in the 1700s during its enforcement, it is imperative to incorporate this control into our regression models.

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.

We estimate a fully dynamic version of Equation (1) to directly test assumption (1), the common trend assumption. In addition, to address assumption (2), 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).

5.2 Baseline Results

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

$$\#Innovation_{pt} = \sum_{\substack{\tau=-(30+),\\ \tau\neq-5}}^{20+} \beta_\tau literary\ inquisition_{p\tau} + \rho Treat_p \times After1790_t$$

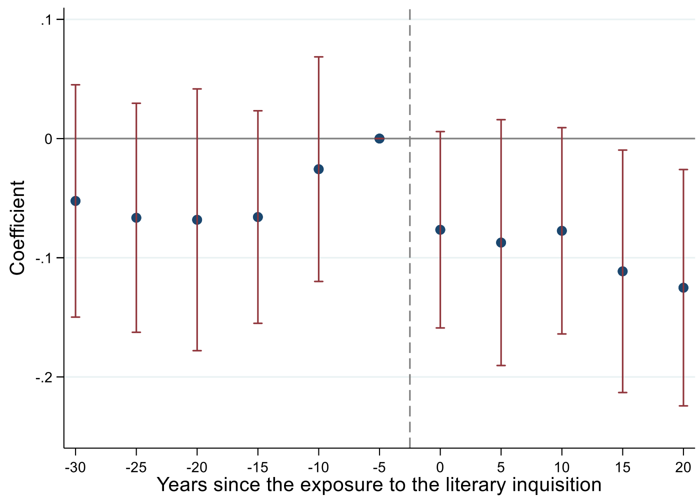
$$+\theta X_p \times \gamma_t + \lambda_p + \gamma_t + \delta_{prov} \times \gamma_t + \epsilon_{pt}. \quad (2)$$

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 6 demonstrates the event-study figure. Although the pre-treatment coefficients are imprecisely estimated, none are statistically different from zero, suggesting that innovation in the treatment prefectures did not significantly differ from that in the control prefectures prior to the treatment. More importantly, the coefficients decrease considerably after the treatment, becoming significantly negative soon after. The event-study results confirm our pre-trend assumption and suggest that innovation in the treatment prefectures declined more sharply than in the control prefectures following their exposer to the literary inquisition. Figure A5 in the Appendix presents the results using four alternative robust estimators, which are similar to those presented in Figure 6.

Considering the difficulty in fully accounting for the potential differences between the treatment and control prefectures prior to the treatment, it is unsurprising that the pre-treatment coefficients are imprecisely estimated. To address this, we will later employ matching to reduce sample heterogeneity. As we will demonstrate, for the matched sample, all the coefficients are estimated more precisely, and the event-study figure shows a clearer pattern.

Figure 6: Dynamic Effects of the Literary Inquisition on 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 (Equation (2)), 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.

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−0.045, which indicates that the literary inquisition reduces the number of innovations within a five-year span in the treatment prefectures by 0.045. Given that the mean of the number of innovations for all prefectures in 1700–1800 is approximately 0.019, such an estimate indicates a substantial 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 0.045. This estimate indicates that the corresponding value would be 0.090 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 of 0.090 to the actual value of 0.045, indicating a reduction of approximately 50%. Such results indicate that the literary inquisition had a detrimental effect on innovation in the affected regions.

Table A12 in the Appendix A9.1 presents four alternative DID estimators that are robust to treatment effect heterogeneity. All the estimates are similar to those presented in Table 2, further confirming the robustness of our results.

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.

Table 2: DID Estimates of the Effect of the Literary Inquisition on Innovation

	Dependent Variable: # innovations			
	(1)	(2)	(3)	(4)
Literary Inquisition	–0.0454***	–0.0426***	–0.0441***	–0.0446***
	(0.0165)	(0.0155)	(0.0156)	(0.0157)
Prefecture FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Province FE × Time FE	Yes	Yes	Yes	Yes
Treat × After1790	Yes	Yes	Yes	Yes
Jinshi × Time FE	No	Yes	Yes	Yes
Pop density1630 × Time FE	No	Yes	Yes	Yes
Rice × Time FE	No	No	Yes	Yes
Foxmillet × Time FE	No	No	Yes	Yes
Sweet potato × Time FE	No	No	Yes	Yes
Language polarization × Time FE	No	No	No	Yes
Language fragmentation × Time FE	No	No	No	Yes
Coastal × Time FE	No	No	No	Yes
Main river × Time FE	No	No	No	Yes
Y mean	0.0187	0.0187	0.0187	0.0187
Observations	4960	4960	4960	4960
R-squared	0.103	0.128	0.133	0.158

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 effects, time fixed effects, the interaction of province and time fixed effects, and the interaction term of the treatment dummy and post-1790 dummy). In Columns (2)–(4), we gradually include a series of interaction terms of the time fixed effects and the following prefectural characteristics in the regressions: *Jinshi* (number of *jinshi* in 1600–1710), Population density (in 1630), agricultural suitability metrics for wetland rice, fox millet, and sweet potato, Language polarization index, Language fragmentation index, and two geographic dummies: Coast (whether a prefecture is situated on the coast), Main river (whether a prefecture includes at least one major river). Standard errors in parentheses are clustered at the prefectural level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

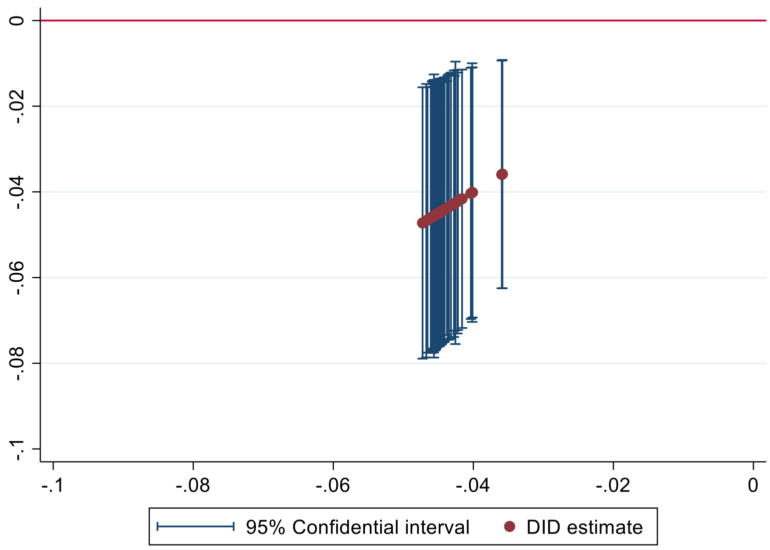
5.3 Validity of Our Identification Strategy

A major concern arises from our sample comprising only 93 recorded S&T innovations. Given that we construct a prefectural level panel spanning 1700–1800 with a five-year interval between observations, and that we have more than 200 prefectures in any given interval, most observations must be reporting zero innovation. Consequently, our results could be disproportionately influenced by events in one or two prefectures or by factors unrelated to the literary inquisition.

For instance, mathematician Zhen Dai (1723–1777) significantly contributed to S&T development in his hometown Huizhou prefecture during his lifetime. Dai died in 1777, and Huizhou was exposed to the literary inquisition in 1779. Therefore, it might have been Dai's advancing age and subsequent death, rather than the literary inquisition, that accounted for the decline in innovation in Huizhou after 1779.[12] In an extreme scenario, if innovation in Huizhou dramatically declined after 1779, while other treatment prefectures exhibited no treatment effects, a significantly negative DID estimate could still be obtained. However, such a result could not be interpreted as valid evidence of the effect of the literary inquisition on innovation in affected regions.

Therefore, we must confirm that our DID estimates are not driven by the impacts of accidental events unrelated to the literary inquisition in a few prefectures. We adopt two strategies to address these concerns.

Figure 7: DID Estimates of the Effect of Literary Inquisition on Innovation, Omitting Individual Prefectures



Notes: This figure shows the DID estimates of the effect of the literary inquisition on the number of S&T innovations, omitting individual prefectures from the estimation sample. Error bars represent a 95% confidence interval, computed from standard errors clustered at the prefectural level.

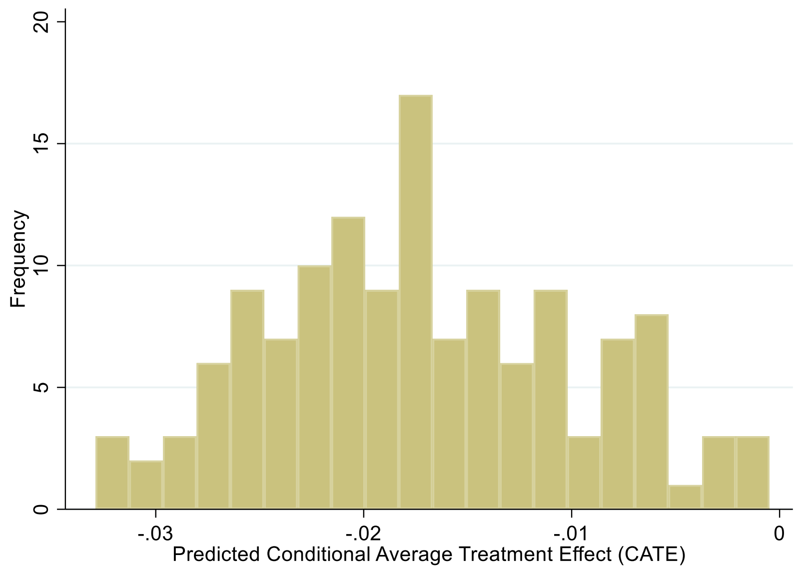
First, we directly examine whether our DID estimates are driven by any specific prefecture. Following Gross and Sampat (2023), we re-estimate Equation (1), omitting

[12] There are also cases similar to that of Zhen Dai in the control prefectures that were never exposed to the literary inquisition. Theoretically, if such cases are uniformly distributed among the treatment and control prefectures, it would not bias our DID estimates. However, given the limited number of recorded innovations in our sample, we should carefully treat this issue and provide reliable solutions.

individual prefectures, and illustrate all the obtained DID estimates in Figure 7. Figure 7 shows that all the estimates are significant and close to the baseline estimate (-0.045) in Column 4 of Table 2. Such results confirm that the result is not driven by any single prefecture.

Furthermore, we employ the causal forest method to examine the heterogeneity of treatment effect across prefectures. This method, a recently developed supervised machine learning technique, is used to predict heterogeneity in causal treatment effects (Athey and Imbens, 2016; Wager and Athey, 2018; Athey et al., 2019; Britto et al., 2022). The goal is to estimate the Conditional Average Treatment Effect (CATE) for each prefecture. CATE is defined as $E(Y_{1i} - Y_{0i}|X_i = x)$, where Y_{1i} and Y_{0i} denote the potential outcomes of interest for the ith prefecture when treated and untreated, and X is a vector of observable characteristics (Britto et al., 2022).

Figure 8: Distribution of the Predicted Conditional Average Treatment Effect



Notes: This figure shows the distribution of the predicted Conditional Average Treatment Effect (CATE). See Appendix A8 for the detailed procedure of obtaining the CATE.

We estimate the CATE for all prefectures using all the characteristics controlled in our baseline regressions in Table 2.[13] Figure 8 presents the distribution of the predicted CATEs. Consistent with our expectation, the predicted CATEs for all prefectures are negative, with no extreme negative values observed. Such results

[13] See Appendix A8 for the details of the estimation procedure.

indicate that our significant negative DID estimates are not driven by outliers. These estimates suggest that innovations in the treatment prefectures decrease significantly following their exposure to the literary inquisition, thereby providing strong evidence of the literary inquisition's negative impacts on innovation.

Some may still wonder how we could estimate the prefecture level trends and obtain significant DID estimates in cases where many prefectures consistently reported zero innovation. A thorough examination of the data structure reveals a notable pattern: most control prefectures, which were never exposed to the literary inquisition, indeed recorded zero innovation throughout the period. By contrast, many treatment prefectures, those exposed to the literary inquisition, showed a decline in innovation, often from one to zero after their exposure to the event. While the innovation levels in control prefectures remained consistently low, treatment prefectures demonstrated a marked decrease in innovation following their exposure to the literary inquisition. Such a differential pattern between control and treatment prefectures is crucial for the validity of our DID estimates and supports our hypothesis about the negative impact of the literary inquisition on innovation.

Given that most control prefectures never reported any innovation, and their innovation levels could not decrease further, this raises concerns about whether they serve an ideal control group for the treatment prefectures, particularly when broader factors may have been affecting innovation levels across the country. To address this, we restrict our analysis to prefectures that reported at least one innovation throughout the century. The DID estimates for this restricted sample, presented in Table A17 in the Appendix, confirm that our findings remain robust.

5.4 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 negatively impacted scientific and technological innovation. 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.

Such historical events include the expulsion of the Jesuits in the 1720s, the Qing government's implementation of the sea ban policies in the 1700s, the tax reform known as *Tandingrumu* (transitioning from a poll tax to a property tax) during 1723–1728 in the Yongzheng reign, the book banning campaign in the Qianlong reign, and changes to the civil service examination system. These changes include the assignment of prefectural level quotas for successful candidates during the Yongzheng reign and two revisions to the examination content in 1756 and 1783. In the Appendix A7, we demonstrate that our estimation results remain robust after controlling for the potential impacts of these events on innovation.

Such results are highly predictable. As discussed in the Introduction, while other events could have also affected innovation in the Qing Dynasty, they are unlikely to be systematically correlated with the incidences of the literary inquisition across regions and over time. Therefore, if the common trend assumption holds, we do not need to worry too much that other potential confounders could contaminate our DID estimates.

5.5 Further Robustness Check: A Propensity Score Matching Approach

Given that the treatment and control prefectures differed in many ways prior to the treatment, 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 effect of expression controls on innovation.

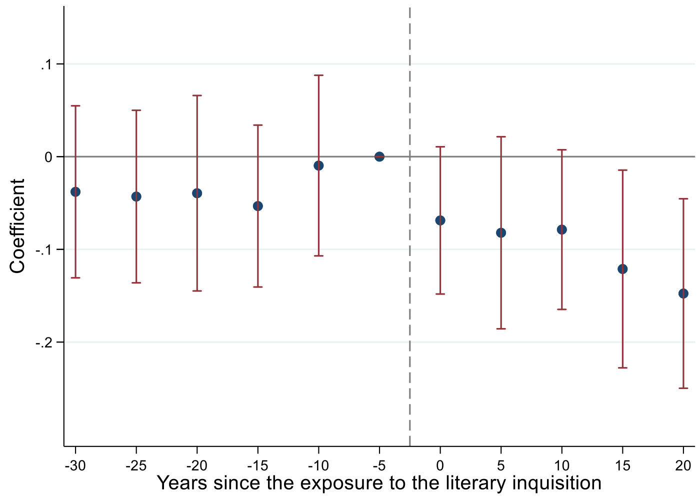
We match the treatment prefectures with the control ones on a range of covariates using propensity score matching.[14] We obtain a balanced sample with no observable differences between the treatment and control prefectures after matching. We then use this matched sample, in which the treatment and control 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 9, which visualizes the dynamic effects of the literary inquisition on innovation in the treatment

[14] See Appendix A6 for the details of the matching procedure.

prefectures. Similarly, Figure A6 in the Appendix presents the event-study figures generated by a set of robust estimators in the presence of treatment heterogeneity. Both figures show 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 the 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.

Figure 9: Dynamic Effects of the Literary Inquisition on Scientific and Technological Innovation (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 (Equation (2)), 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.

We next estimate the TWFE model (Equation (1)) using the OLS with the matched sample. Table 3 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 3 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 5% level. When all control variables are included, the DID estimator is as large as -0.063 (Column (4) of Table 3), which is larger than the corresponding estimate (-0.045) 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 0.046, the corresponding value would be 0.109 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 0.109 to an actual value of 0.046, signifying a 57.8% reduction. This estimate is considerably larger than that obtained from the full sample.

Table 3: DID Estimates of the Effect of the Literary Inquisition on Innovation (Matched Sample)

	Dependent variable: # innovations			
	(1)	(2)	(3)	(4)
Literary Inquisition	–0.0554***	–0.0584***	–0.0616***	–0.0629***
	(0.0208)	(0.0222)	(0.0225)	(0.0234)
Prefecture FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Province FE × Time FE	Yes	Yes	Yes	Yes
Treat × After1790	Yes	Yes	Yes	Yes
Jinshi × Time FE	No	Yes	Yes	Yes
Pop density1630 × Time FE	No	Yes	Yes	Yes
Rice × Time FE	No	No	Yes	Yes
Foxmillet × Time FE	No	No	Yes	Yes
Sweet potato × Time FE	No	No	Yes	Yes
Language polarization × Time FE	No	No	No	Yes
Language fragmentation × Time FE	No	No	No	Yes
Coastal × Time FE	No	No	No	Yes
Main river × Time FE	No	No	No	Yes
Y mean	0.0288	0.0288	0.0288	0.0288
Observations	2220	2220	2220	2220
R-squared	0.141	0.179	0.193	0.237

Notes: This table examines the effect of the literary inquisition on the number of innovations in the treatment prefectures for the matched sample. Specifically, it presents estimates of the coefficient β from Equation (1) for the matched sample. Control variables are the same as those in Table 2. Standard errors in parentheses are clustered at the prefectural level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Considering that the estimates obtained from the matched sample are more likely to capture the treatment effect of the literary inquisition on innovation, the above results present compelling evidence that the literary inquisition may have had a substantial negative effect on innovation in the treatment prefectures.

5.6 The Spillover Effect of the Literary Inquisition on Innovation

As previously discussed, the effects of the literary inquisition were not confined to the directly implicated prefectures but also spilled over to other regions that learned about the 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.

We divide all control prefectures into two categories based on their proximity to the treatment prefectures: (1) close ones, which were within 60 km from the border of the treatment prefectures; and (2) distant ones, which were beyond 60 km from the border of the treatment prefectures.[15] 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. While the effects of the literary inquisition in the treatment prefectures could have spilled over to the nearby control prefectures, the distant control prefectures were likely less affected. Therefore, if a spillover effect exists, 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 4. Both estimates are significant, and the estimate obtained from Sub-sample II (−0.061) is larger (in absolute value) than that obtained from Sub-sample I (−0.044). Furthermore, the difference between the two estimates is different from 0(with the *p*-value being approximately 0.21). Thus, the estimates obtained from the full sample present 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 4. Both estimates are significant, and the estimate obtained from Sub-sample II (−0.089) is larger (in absolute value) than that obtained from Sub-sample I (−0.064). Furthermore, the difference

[15] We select a distance of 60 km as the cutoff between the close and distant control prefectures, considering that this two-day walking distance might have been reasonable for information spread at the time. As shown in Appendix A7, our results are not sensitive to the choice of this cutoff distance.

between the two estimates is different from 0 (with the *p*-value being approximately 0.16), which presents slightly stronger evidence of the spillover effect.

In the Appendix A7, we define close control prefectures as those adjacent to the treatment prefectures and distant prefectures as those located more than 800 km from the treatment prefectures' borders. The results in Table A11 provide strong evidence of a spillover effect.

Table 4: 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	–0.0437***	–0.0612**	–0.0643***	–0.0886**
	(0.0164)	(0.0264)	(0.0244)	(0.0385)
Baseline Controls	Yes	Yes	Yes	Yes
p-value		0.215		0.162
Y mean	0.0227	0.0291	0.0308	0.0399
Observations	3700	2680	2080	1480
R-squared	0.176	0.276	0.242	0.360

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. We construct two sub-samples to perform the DID analysis. Sub-sample I includes all treatment prefectures and control prefectures within 60 km from the treatment prefectures' borders. Sub-sample II includes all treatment prefectures and distant control prefectures over 60 km from the treatment prefectures' borders. Baseline controls are the same as those in Column 4 of Table 2. Standard errors in parentheses are clustered at the prefectural level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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.

5.7 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 first examine the heterogeneous effects of the literary inquisition on different types of innovation. In general, innovations in S&T in our dataset can be categorized into two types: (1) Innovations documented in books and primarily disseminated through text, such as the proof of a fundamental mathematical theorem; (2) Technological inventions manifested as physical objects, such as the invention of gunpowder. The heterogeneous analysis in Table A8 of the Appendix A5 shows that the literary inquisition had a considerably more pronounced negative effect on innovations disseminated through text compared to technological inventions produced in practice. These results provide suggestive evidence of the potential mechanisms at play.

As previously discussed, following the literary inquisition, intellectuals may have been unwilling to engage in creative yet potentially risky activities, thereby leading to S&T stagnation. We now present some direct evidence to support 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* (or textology) 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 A7 in the Appendix presents the number of *puxue* masters in the Qing Dynasty over time, providing a representation of the evolution of *puxue* in China. The pattern presented in Figure A7 is consistent with historians' views on the rise and fall of *puxue* in the Qing Dynasty. That is, *puxue* rose quickly due to the literary inquisition and declined soon after its termination (Zheng, 1980; Qian, 1997; Huang, 2003; Jian, 2006; Chen, 2012).

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 individuals 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.

6. The Effect of the Literary Inquisition on Economic Development in Qing China

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 a country's economic development. Therefore, if the literary inquisition suppressed innovation, it could have ultimately hindered China's economic development in the Qing Dynasty. It is important to note, however, that the literary inquisition was implemented during the period of the "Kangxi–Qianlong Great Ages," a period when China experienced significant economic prosperity. At first glance, the literary inquisition did not immediately devastate China's predominantly agricultural economy. Nonetheless, the literary inquisition may have stifled the society's innovative spirit and undermined its capacity for progress, ultimately impeding the country's long-term economic development.

Our earlier discussions have highlighted a significant decline in China's scientific and technological innovation after 1700. This decline could have been 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, it was inevitably bound to fall behind Europe economically during the industrial era. Therefore, we can largely 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. To address this, we provide empirical evidence of the potential effect of the literary inquisition on China's long-term economic development during the Qing Dynasty.

We employ the index of land tax revenue at the prefectural 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):

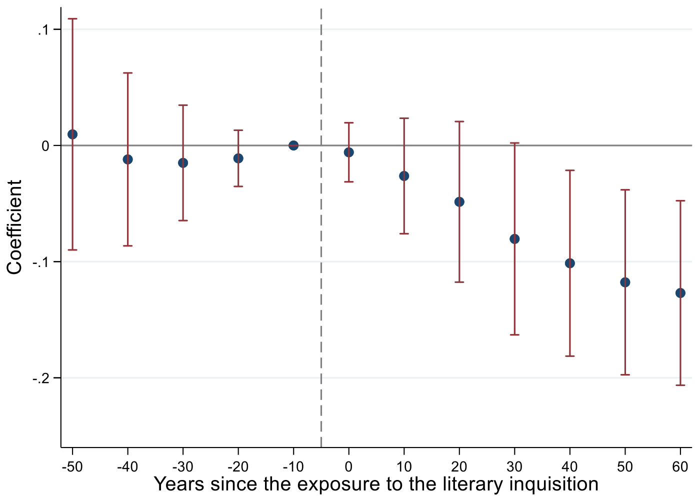
$$\ln\left(LandTax_{pt}\right) = \sum_{\tau} \beta_{\tau} literary\ inquisition_{p\tau} + \theta X_p \times \gamma_t$$
$$+\rho Tandingrumu_{pt} + \lambda_p + \gamma_t + \delta_{prov} \times \gamma_t + \epsilon_{pt}\ , \quad (3)$$

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 prefecture p's first exposure to the literary inquisition, where $\tau \in \{-(50+), -50, -40, -30, -20, 0, 10, 20, 30, 40, 50, 60, 70+\}$. 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. $Tandingrumu_{pt}$ is a dummy variable which equals 1 if prefecture p had implemented the *Tandingrumu* policy in time t, and other variables are similar to these in Equation (2). β_τ is the parameter of interest.

Figure 10 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.

Figure 10: 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 (Equation (3)), using the groups 10 years prior to the literary inquisition as the reference. Control variables include all the controls in Table A9. The bars represent 95% confidence intervals. Standard errors are clustered at the prefectural level.

Table A18 in the Appendix presents the coefficients visualized in Figure 10. From 30 years after the literary inquisition, the estimates become significantly negative and continue to decrease. The significant estimates range from -0.080 to -0.127, suggesting that the literary inquisition reduced the land tax revenue in the treatment prefectures by 8.0% to 12.7%. Such results indicate that the negative effect of the literary inquisition on land tax revenue is modest, particularly in the short term.

In Appendix A9.2, we present the baseline and robust DID estimates of the effect of the literary inquisition on land tax revenue. All the coefficients are smaller than -0.09, indicating that the overall negative effect of the literary inquisition on the land tax revenue in the treatment prefectures is no more than 9%, which is a modest yet nonnegligible impact.

One potential concern is that land tax may not be a perfect measure of economic performance in Qing China. For instance, some studies also use land tax to measure state capacity because it could also reflect the state's ability to tax (e.g., Tilly, 1990; Kung and Ma, 2014b; Dincecco and Katz, 2016). We acknowledge that finding a perfect measure of economic development in imperial China is challenging. However, given that land tax is strongly correlated with the economic development in Qing China, it is commonly used in the literature as a useful indicator of income level, economic prosperity, and agricultural productivity during that era (e.g., Ma, 2008; Kung and Ma, 2014a; Ma, 2021, 2022; Chen and Ma, 2022). Therefore, despite its limitations, land tax is one of the most reliable indicators of economic development for this historical period.

Although we have presented evidence of the literary inquisition's adverse effect on land tax revenue, the precise mechanism through which it impacted land tax revenue remains unclear. Indeed, the literary inquisition primarily functioned as a policy to control free expression, with no apparent connection to agricultural production.

However, the key to understanding this causality lies in the profound societal impact of the literary inquisition. By instilling a pervasive climate of fear, this policy could immediately diminish citizens' incentive to innovate, leading to a steep decline in S&T advancements in the short term, as suggested by Figures 1 and 2. While the literary inquisition might not have directly destroyed China's then-agricultural economy in the short term, its long-term societal consequences were far more insidious. It could gradually erode societal energy and enthusiasm, thereby demotivating people and diminishing their willingness to contribute to society with their talents and initiatives. Over time, this gradual but steady decline in social vitality and vigor could lead to a broader economic decline, including in the agricultural sector.

Hence, the literary inquisition's immediate and pronounced effects on innovation stood in contrast with its gradual yet profound impacts on the overall economy. An analogy of a frog being slowly boiled in water vividly represents the literary inquisition's insidious and escalating impact on the overall economy, with the full extent of the damage only becoming evident over an extended period. This pattern is corroborated by the trends shown in Figure 10, which depict the literary inquisition's delayed but enduring impact on the economic development in Qing China.

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

7. Conclusion

The "Kangxi–Qianlong Great Ages" has been widely regarded as one of the pinnacles of 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 may also 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.

References

Ai, Suzhen, and Zhenghai Song. 2006. *Zhongguo kexue jishu shi: nianbiao juan (History of Science and Technology in China: Chronological Volume).* Beijing: Science Press.

Athey, Susan, and Guido Imbens. 2016. "Recursive Partitioning for Heterogeneous Causal Effects." *Proceedings of the National Academy of Sciences* 113 (27): 7353–60.

Athey, Susan, Julie Tibshirani, and Stefan Wager. 2019. "Generalized Random Forests." *The Annals of Statistics* 47 (2): 1148–78.

Bai, Ying, and Ruixue Jia. 2016. "Elite Recruitment and Political Stability: The Impact of the Abolition of China's Civil Service Exam." *Econometrica* 84 (2): 677–733.

Becker, Sascha O., Francisco J. Pino, and Jordi Vidal-Robert. 2021. "Freedom of the Press? Catholic Censorship during the Counter-Reformation." Working Paper.

Blasutto, Fabio, and David de la Croix. 2023. "Catholic Censorship and the Demise of Knowledge Production in Early Modern Italy." *The Economic Journal* 133 (656): 2899–2924.

Borusyak, Kirill, Xavier Jaravel, and Jann Spiess. 2021. "Revisiting Event Study Designs: Robust and Efficient Estimation." Unpublished.

Brandt, Loren, Debin Ma, and Thomas G. Rawski. 2014. "From Divergence to Convergence: Reevaluating the History Behind China's Economic Boom." *Journal of Economic Literature* 52 (1): 45-123.

Bristow, William. 2023. "Enlightenment." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta and Uri Nodelman, Fall 2023. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/fall2023/entries/enlightenment/.

Britto, Diogo G. C., Paolo Pinotti, and Breno Sampaio. 2022. "The Effect of Job Loss and Unemployment Insurance on Crime in Brazil." *Econometrica* 90 (4): 1393–1423.

Callaway, Brantly, and Pedro H. C. Sant'Anna. 2021. "Difference-in-differences with Multiple Time Periods." *Journal of Econometrics* 225 (2): 200–230.

Cantoni, Davide, and Noam Yuchtman. 2013. "The Political Economy of Educational Content and Development: Lessons from History." *Journal of Development Economics* 104: 233-244.

Chen, Juyuan. 2000. *Qingdai puxue yu zhongguo wenxue (Puxue in the Qing Dynasty and Chinese Literature)*. Nanchang, China: Baihuazhou Wenyi Press.

Chen, Yuyu, and David Y. Yang. 2019. "The Impact of Media Censorship: 1984 or Brave New World?" *American Economic Review* 109 (6): 2294–2332.

Chen, Zhiwu, and Chicheng Ma. 2022. "Prioritizing Stability over Productivity: How Confucianism Facilitated Population Growth in Preindustrial China." *Available at SSRN 3859796.*

Chen, Zuwu. 2012. *Qingdai xueshu yuanliu (The Origins and Development of Scholarship in the Qing Dynasty)*. Beijing: Beijing Normal University Press.

De Chaisemartin, Clément, and Xavier D'Haultfoeuille. 2020. "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects." *American Economic Review* 110 (9): 2964-96.

Dincecco, Mark, and Gabriel Katz. 2016. "State Capacity and Long - Run Economic Performance." *The Economic Journal* 126 (590): 189–218.

Drelichman, Mauricio, Jordi Vidal-Robert, and Hans-Joachim Voth. 2021. "The Long-Run Effects of Religious Persecution: Evidence from the Spanish Inquisition." *Proceedings of the National Academy of Sciences* 118 (33): e2022881118.

Du, Shiran, and Qiupeng Jin. 2003. *Zhongguo kexue jishu shi: tongshi juan (History of Science and Technology in China: General History Volumes)*. Beijing: Science Press.

Edwards, Ronald A. 2005. "The Structure of Authority, Property Rights and Economic Stagnation: The Case of China (in Chinese)." *China Economic Quarterly* 4 (2): 541-562.

Fu, Zhengyuan. 1993. *Autocratic Tradition and Chinese Politics*. Cambridge, UK: Cambridge University Press.

Gross, Daniel P., and Bhaven N. Sampat. 2023. "America, Jump-Started: World War II R&D and the Takeoff of the US Innovation System." *American Economic Review* 113 (12): 3323–56.

Guo, Chengkang, and Tiejun Lin. 1990. *Qingchao wenziyu (The Literary Inquisition in the Qing Dynasty)* Beijing: Qunzhong Press.

Huang, Aiping. 2003. *Puxue yu qingdai shehui (Puxue and Qing Dynasty Society)*. Shijiazhuang: Hebei Renmin Press.

Huang, Ray. 1997. *Zibenzhuyi yu ershiyi shiji (Capitalism and the 21st Century)*. Beijing: SDX Joint Publishing Company.

Huang, Yasheng. 2023. *The Rise and the Fall of the EAST: Examination, Autocracy, Stability, and Technology in Chinese History and Today*. Yale University Press.

Ito, Shuntaro, Kenzo Sakamoto, Keiji Yamada, and Yoichiro Murakami. 1984. *Jianming shijie kexue jishu shi nianbiao (Concise Chronology of the History of Science and Technology in the World)*. Translated by Zhenhuan Jiang and Guanxiong Ge. Harbin: Harbin Institute of Technology Press.

Jian, Bozan. 2006. *Zhongguo shi gangyao (An Outline of Chinese History)*. Beijing: Peking university Press.

Jin, Qiupeng. 1998. *Zhongguo kexue jishu shi: renwu juan (History of Science and Technology in China: Biographical Volumes)*. Beijing: Science Press.

Jin, Taijun. 1999. "On the Political Socialization Mechanism of Chinese Traditional Political Culture (in Chinese)." *CASS Journal of Political Science* 02: 49-61.

Jin, Xingyao. 2012. *Doushi wenzi re de huo: Qingdai wenziyu (The Trouble with Words: Literary Inquisitions in the Qing Dynasty)*. Beijing: The Palace Museum Press.

Jones, Peter M. 2017. *Industrial Enlightenment: Science, Technology and Culture in Birmingham and the West Midlands, 1760–1820.* Manchester, UK: Manchester University Press.

Koyama, Mark, and Melanie Meng Xue. 2015. "The literary inquisition: The persecution of intellectuals and human capital accumulation in China." Working Paper.

Kung, James Kai-sing, and Chicheng Ma. 2014a. "Autarky and the Rise and Fall of Piracy in Ming China." *The Journal of Economic History* 74 (2): 509–34.

Kung, James Kai-sing, and Chicheng Ma. 2014b. “Can Cultural Norms Reduce Conflicts? Confucianism and Peasant Rebellions in Qing China.” *Journal of Development Economics* 111 (November): 132–49.

Landes, David, S. 2006. “Why Europe and the West? Why Not China?” *Journal of Economic Perspectives*, 20 (2): 3-22.

Lin, Justin Yifu. 1995. “The Needham Puzzle: Why the Industrial Revolution Did Not Originate in China.” *Economic Development and Cultural Change* 43 (2): 269-292.

Ma, Chicheng. 2021. “Knowledge Diffusion and Intellectual Change: When Chinese Literati Met European Jesuits.” *The Journal of Economic History* 81 (4): 1052–97.

Ma, Chicheng. 2022. “Classicism and Modern Growth: The Shadow of the Sages.” *Available at SSRN 4288048*.

Ma, Debin. 2008. “Economic Growth in the Lower Yangzi Region of China in 1911–1937: A Quantitative and Historical Analysis.” *The Journal of Economic History* 68 (2): 355–92.

McCloskey, Deirdre N. 2010. *Bourgeois Dignity: Why Economics can't Explain the Modern World*. Chicago: University of Chicago Press.

Mokyr, Joel. 1992. *The Lever of Riches: Technological Creativity and Economic Progress*. Oxford University Press.

Mokyr, Joel. 2002. *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton and Oxford: Princeton University Press.

Mokyr, Joel. 2005. “Mobility, Creativity, and Technological Development: David Hume, Immanuel Kant and the Economic Development of Europe.” in A von Günter, ed., *Kreativität. XX. Deutscher Kongress für Philosophie*. Berlin, pp. 1131-1161.

Mokyr, Joel. 2007. “The Market for Ideas and the Origins of Economic Growth in Eighteenth Century Europe.” *Tijdschrift voor Sociale en Economische Geschiedenis*, vol. 4, no. 1, pp. 3-38.

Mokyr, Joel. 2009. *The Enlightened Economy: An Economic History of Britain 1700–1850*. New Haven and London: Yale University Press.

Needham, Joseph. 1981. *Science in Traditional China. Cambridge*. Massachusette：Harvard University Press.

Phelps, Edmund S. 2013. *Mass Flourishing: How Grassroots Innovation Created Jobs, Challenge, and Change.* Princeton, NJ: Princeton University Press.

Pomeranz, Kenneth. 2000. *The Great Divergence: China, Europe, and the Making of the Modern World Economy*. Princeton University Press.

Qian, Mu. 1997. *Zhongguo jin sanbai nian xueshu shi (The Academic History of China in the Last Three Hundred Years)*. Beijing: The Commercial Press.

Sun, Liyang, and Sarah Abraham. 2021. “Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects.” *Journal of Econometrics* 225 (2): 175–99.

Tilly, Charles. 1990. *Coercion, Capital, and European States, A.D. 990-1990*. First Edition. Cambridge, Mass., USA: Basil Blackwell.

Wager, Stefan, and Susan Athey. 2018. “Estimation and Inference of Heterogeneous Treatment Effects Using Random Forests.” *Journal of the American Statistical Association* 113 (523): 1228–42.

Wakeman, Frederic E. 1985. *The Great Enterprise: The Manchu Reconstruction of Imperial Order in Seventeenth-Century China,* Vol. 1. Oakland, CA: University of California Press.

Wang, Fan-Sen. 2002. “Political Pressures on the Cultural Sphere in the Ch’ing Period.” *The Cambridge History of China. Ed. by William J. Peterson* 9. Part II: 606-648.

Wang, Yeh-chien. 1973. *Land taxation in Imperial China, 1750-1911.* Cambridge, MA: Harvard University Press.

Wanyan, Shaoyuan, ed. 2011. *Qingdai wenziyu dang (zengding ben) (Archives of the Literary Inquisition Cases (Updated Edition))*. Shanghai: Shanghai Bookstore Publishing House.

Weber, Max. 1915. *The Religion of China: Confucianism and Taoism*. Glencoe Ill: Free Press. Translated in 1951.

Xue, Melanie Meng. 2021. “Autocratic Rule and Social Capital: Evidence from Imperial China.” Working Paper.

Yan, Chongnian. 2016. *Kangxi di da zhuan (The Great Biography of Emperor Kangxi).* Beijing: Zhonghua Book Company.

Yang, Qiankun. 1999. *Zhongguo gudai wenziyu (Ancient Literary Inquisitions in China)*. Shannxi: Shannxi Renmin Chubanshe.

Yang, Fengcheng. 1992. *Qian gu wenziyu — qingdai jishi (Eternal Literary Inquisition: A Record of the Qing Dynasty).* Haikou: Nanhai Publishing Company.

Zhang, Ji, ed. 1934. *Qingdai wenziyu dang ji (Archives of the Literary Inquisitions Cases (Collected Volumes))*. Beijing: The Palace Museum.

Zhang, Shucai, and Jinghua Du. 1991. *Qingdai wenziyu an (Qing Literary Inquisition Cases)*. Beijing: The Palace Museum Press.

Zhang, Yuyan, and Cheng Gao. 2005. "Overseas Silver, Initial Institutions, and the Stagnation of the Orient: A Conjecture on Why China Missed Economic Takeoff in Late Ming Dynasty (in Chinese)." *China Economic Quarterly* 4(2): 491-518.

Zheng, Tianting. 1980. *Qingshi jian shu (A Brief History of the Qing Dynasty)*. Beijing: Zhonghua Book Company.

Zhu, Yang. 2013. "The Value of 'Files of Literary Inquisition of Qing Dynasty' as Historical Data (in Chinese)." *Journal of Harbin University* 34 (06): 98–101.