On Determinants of State Capacity: Wars and Public Goods

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Abstract

This paper investigates the causal impacts of public goods on the development and intensification of central state capacity in historical China. Two forms of public goods are examined: national defense and hydraulic management. Random shifts in the Yellow River course and changes in foreign war frontlines are used as exogenous shocks to the localities' needs for public goods. The findings demonstrate a positive impact of public goods on state capacity, with national defense being the most significant factor. Moreover, the presence of local institutions, such as ethnic minority groups, lineages, and religious organizations, weakens the sensitivity of state capacity to public goods. These results align with a state-locality bargaining model, emphasizing the importance of demand-side factors in the development of state capacity.

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1. Introduction

While traditional economics has long emphasized ways to curb the state's predatory behavior, more recent developments in the field also acknowledge the crucial importance of state capacity in promoting development. However, the path to a capable state is neither automatic nor guaranteed. The successes of the East Asian Tigers and the disappointing developmental outcomes in other parts of the world, such as Sub-Sahara Africa, highlight not only the importance of state building but also the puzzle of unequal development of state capacity.[1]

Attempts to address this puzzle have a long history. Several theories have been proposed, including classic works such as Tilly (1990) on external warfare, North and Weingast (1989) on political regime and executive constraint, and Wittfogel (1957) on hydraulic management. Many of the early studies focus on macro-level country characteristics. These country characteristics tend to affect the central state's willingness to invest or ability to serve, thereby shifting the supply of state capacity. Recently, some scholars have shifted their focus to within-country variations. This bottom-up approach enables them to examine factors that shift the demand for state capacity from the locality's perspective (De La Sierra, 2018; Fenske, 2014; Heldring, Allen, and Bertazzini, 2019; Acemoglu, García-Jimeno, and Robinson, 2015; Dincecco and Wang, 2021; among others). This demand-side story complements theories that emphasize coercion and top-down supply-side state formation.

This paper joins this recent effort and investigates the impact of public goods on the intensification of central state capacity in historical China. The paper amasses a large amount of historical data, covering a geographical area roughly corresponding to that of the contemporary People's Republic of China, and creates a panel spanning from the 2nd century BC until the end of the imperial period in early 1900. To obtain a more comprehensive evaluation of state capacity from both an administrative and a fiscal perspective, multiple indicators are obtained, including the density of administrative centers, road networks, and tax per capita.

Casual identification on state capacity can be challenging. This paper employs changes in foreign war frontlines and random shifts of the Yellow River course as the source of exogenous shocks. Proximity to foreign war hotspots approximates local demand for national defense. Presumably, the location of foreign war hotspots depends on macro-level shocks to international relations as well as local characteristics of the hotspot cities, and it should be unrelated to features of the locality under study.[2] For the second factor of hydraulic public goods, I use proximity to the Yellow River as a measure of local demand for hydraulic management. Grid cell and century fixed effects are controlled throughout the paper to account for time-invariant local characteristics, such as geography, and common time shocks, such as dynasty effects. Various permutations of the benchmark model are included as robustness checks, such as a dynamic panel model to address history dependence, a panel with local trends to allow for time-varying regional heterogeneity, and a spatial lag model to control for potential spatial correlations.

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[1] For the importance of state capacity in the development of East Asian Tiger countries, see (see, e.g. Johnson, 1982; Evans, 1995). For state capacity and development in Sub Sahara Africa, see (see, e.g. Herbst, 2000; Bates, 2008; Acemoglu and Robinson, 2012).

[2] To address the issue of potential non-randomness in the location of foreign war hotspots, I also limit the analysis to a subsample of regions far away from the foreign war frontlines (distance greater than 100 km or 500km) as a robustness check in the Appendix, and the results remain largely unchanged.

The findings illustrate a strong impact of public goods on state capacity intensification. Proximity to foreign wars significantly and consistently increases all five measures of state capacity throughout various specifications. Proximity to the Yellow River, on the other hand, has a slightly positive impact on state capacity, but the magnitude is much smaller. These results are consistent with predictions of a state-locality bargaining model, where a higher value of public goods increases state capacity in the locality.

A discussion follows, trying to interpret the results in light of potential interactions between the supply and the demand of state capacity. When a higher value of public goods leads to stronger state capacity, it does not automatically suggest a demand-side story. It is possible that a central state, recognizing the higher value of public goods, decides to invest more in these strategically important regions. Even though I am not able to fully rule out this possibility, I provide some evidence suggesting that demand-side factors are more likely to be the driving force.

First, I limit the analysis to a subsample of regions far from the foreign war frontlines, with a distance greater than 100 km or 500km. For areas so far away from the point of action, there would be much less need to build garrisons or to fulfill other military functions. A positive coefficient identified in this case is more likely to be driven by demand-side factors.

Second, I interact the variable proximity to war with land elevation. The presumption is that localities with higher elevations are harder to attack, making them more attractive candidates to be included in the state's defense line. Regions on a flat plain, on the other hand, are vulnerable and should have higher demands for state protection once they move closer to the frontline. Therefore, if localities with lower elevations demonstrate a more sensitive response to war, it would be evidence for the demand-side story. Otherwise, if localities with higher elevations are more sensitive, it is likely to be driven by national interest and strategic defense planning. The result I find, a negative coefficient on the interaction between proximity to war and land elevation in this case, seems to confirm a demand-side story.

Lastly, I interact the variable proximity to war with the strength of local institutions. Many scholars on China have acknowledged the critical role that local elites and gentries played in the state-locality dynamics. Some argue that the local elites facilitate tax collection and help contribute to the state army in times of need (Chang, 1962; Shi and Xu, 2008; Dincecco and Wang, 2021). Even if the local elites are not automatically pro-state, regions with stronger elites tend to be better organized, making it easier to mobilize resources in these regions. If state expansion in my sample is primarily driven by the supply, one would expect state capacity to rise more in localities with stronger local elites. Alternatively, the local elites can also serve as a substitute for the state in providing public goods. Hence, if state expansion is driven by the need of the locality, the presence of local elites should weaken the impact of public goods on state capacity. The robustness check section examines three kinds of local elites that are believed to be influential in China's context –ethnic minority groups, lineages, and religious organizations. Consistent with the demand-side story, the result shows that a stronger presence of local elites reduces the state capacity's sensitivity to public goods.[3]

[3] Admittedly, the effect of local elites could be confounded by other unobserved socioeconomic characteristics correlated with both local institutions and state capacity. A notable case in point is economic prosperity. I control for this possible omission with two approaches. First, population density is employed throughout the paper as a proxy for economic development. Secondly, this paper examines three different measurements of local institutions. To the extent that these three measurements could have opposite relationships with economic prosperity (with a

The contribution of the paper lies in two folds. First, it contributes to the state-building literature by causally estimating and quantitatively comparing the effects of two determinant factors on the development of state capacity. Causal identification on state capacity is still relatively rare due to data limitations and the tendency of state capacity to evolve only in the long run. Second, the paper highlights a demand perspective on state capacity, which compliments the dominant view in the literature that emphasizes top-down supply-side state formation.

The remainder of the paper proceeds as follows. Section Two reviews the related literature. Section Three provides a quick tour of the historical backgrounds and geographic conditions of China that are relevant to my empirical estimation. Section Four provides explanations for the variables and the dataset. Section Five presents the main results, while Section Six discusses the supply and the demand-side explanations and examines the interaction of public goods with several additional variables. The last section concludes and presents some broader implications of the findings. A simple theoretical framework to discuss the assumptions and the hypotheses is provided in the Appendix A.2.

2. Literature Review

Several theories have been proposed to explain the uneven development of state capacity.

External warfare: Most famously, Tilly (1990) claims that "the origins of the modern European state lay in war and preparations for war." Many scholars have emphasized the importance of external wars in state building.[4] Decentralized polities inevitably encounter a collective action problem when faced with a threat of foreign war. A centralized state with sufficient state capacity to raise revenue and coordinate military tactics among local elites provides a solution to the problem. According to this theory, wars are capable of unifying disparate populations and increasing the benefits of a well-financed centralized state (Huntington 1968; Besley and Persson 2009, 2011; Gennaioli and Voth, 2015). Especially during the emergence of modern states, innovations in military technology, training, and tactics in the early modern era favored centralized organizations with greater fiscal capacity (Gennaioli and Voth, 2015). Such innovations required a single ruling body to oversee them in a way that personal networks of local elites, which preceded the emergence of the state, could not.

Value of public goods: This view, that a state's capacity is closely related to its ability to serve the public's common good, echoes the argument of national defense. According to this view, national defense against external threats is a common interest public goods that facilitates the development of the state, but it does not have to be the only form of public goods with such an impact (Besley and Persson 2009, 2011). In fact, many other factors, such as large hydraulic projects or the maintenance of a common market, may also serve as common interest public goods and would therefore contribute to

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potentially positive relationship between economic development and lineage activities and a typically negative relationship between economic development and ethnic minorities), a consistent finding throughout the three measurements should lend more credibility to my conclusions.

[4] Studies include Ames and Rapp (1977), Bean (1973), Besley and Persson (2008), Hintze (1975), Peacock and Wiseman (1961), Rasler and Thomson (1985, 1999), Tilly (1992). For extensions of the argument to the developing countries in the modern period, see Centeno (2002), Thies (2005), and Arias (2013) for Latin America, Lustick (1997) for the Middle East, and Herbst (2000) and Bates (2001) for sub-Saharan Africa.

state building. The famous "hydraulic civilization hypothesis," first proposed by historian Wittfogel (1957), asserts that the majority of history's first civilizations, such as Ancient Egypt, Mesopotamia, China, India, and Pre-Columbian Mexico and Peru, emerged out of monopolized accesses to water resources through large state-managed hydraulic engineering projects (Wittfogel, 1957; Carneiro, 1970). The high value of hydraulic public goods in these regions likely contributed to the early rise of states.

Domestic politics: Domestic politics can have a direct impact on state capacity as well as an indirect one through interaction with other variables. Civil wars and political instability decrease state capacity by dampening the central state's incentive to invest (Besley and Persson, 2010). It also strengthens the bargaining power of the local elite, which, according to different strands of literature, may either increase or decrease state capacity. One line of literature argues that strong local elites lead to a weakening of the state. Garfias and Sellars (2021ab) and Dincecco and Wang (2021), who examined trends in sixteenth- and seventeenth-century Mexico and nineteenth-century China respectively, found that state centralization negatively correlated with the threat of rebellion and hence revealed the importance of mediation by local elites. In contrast, the literature on representative government discovers that mechanisms to constrain the power of the ruler and to strengthen the bargaining positions of the elites generally lead to enhanced fiscal capacity (North and Weingast, 1989; Dincecco, 2009; Dincecco and Katz, 2016; Garfias, 2019). My paper investigates the impact of local institutions in imperial China, who were not necessarily participants of national politics. Hence, my setting is closer to the first strand of literature and the results are in line with their argument.

Despite the abundance of theories concerning state capacity, until recently there has been little empirical evidence available. The last decade has witnessed a rise of empirical data concerning the historical origin of state capacity (Dincecco and Katz, 2016; Gennaioli and Voth, 2015; Sng and Moriguchi, 2014; Karaman and Pamuk, 2013; for a survey, see Johnson and Koyama, 2017, and Wang, 2021). Many of these studies focus on the state capacity of a country as a whole. But country-level shocks can affect state capacity in complicated and sometimes contrasting ways. For example, as Charles Tilly stressed, the connection between wars and taxation is shaped by a wide range of factors, such as domestic politics, resource endowments, and international relations (Tilly 1990; Thies, 2005). Macro-level shocks, such as foreign wars, can increase the need for fiscal revenue while simultaneously weaken the state's bargaining power vis-à-vis local elites (Dicencco and Wang, 2020; Garfias and Sellars, 2021ab). By focusing on within-country variations and holding the political regime and international environment constant, this paper avoids the complication of macro-level shocks and tries to isolate the demand-side factors from forces that shape the supply of state capacity.[5]

3. Historical Background

A critical observation for understanding politics in medieval Europe is that it was primarily an intra-elite game (North, Wallis, and Weingast, 2009; Gennaioli and Voth, 2015). In medieval Europe, warfare was largely considered the "sport of kings," a private good for kings and princes in pursuit of glory and personal power. The dissent of the masses remained a secondary concern to the elite well until the early-modern period (Acemoglu and Robinson, 2000). In this environment, state building mainly

[5] Within this narrative, there is a relatively recent literature that focuses on within-country variation in state capacity (O'Donnell, 1993; Dell, Lane, and Querubin, 2015; Acemoglu, García-Jimeno, and Robinson, 2015; Acemoglu, Moscona, and Robinson, 2016; Michalopoulos and Papaioannou, 2013; Bandyopadhyay and Green, 2016; Fearon and Laitin 2003; Kalyvas, 2006; Heldring, Allen, and Bertazzini, 2019).

concerned the reorganization of intra-elite relations from fragmentation towards a central apparatus (North, Wallis, and Weingast, 2009).

Imperial China had a very different story. China achieved centralization very early on in 221 BC, and remained under a single, unified regime for 56 percent of the time in the following two millennia (Ko, Koyama, and Sng, 2018).[6] In addition to early centralization, imperial Chinese states differed considerably from medieval Europe in another essential way: the Chinese crown had unequivocally broken its dependence on the aristocracy by the 11th century (Elman, 1991; Tackett, 2014). Beginning in the 10th century, the imperial rulers established a series of institutions, such as the Civil Service Examination system, to keep political mobility high and to prevent the emergence of new powerbases (Ho, 1962; Huang and Yang, 2021). Rather than a landed aristocracy, emperors relied on a central bureaucracy to rule their vast territories, while uniform laws, education, and culture were promoted throughout the empire. In China's context, state building, in addition to fiscal revenue extraction and national defense, also involved establishing administrative capacity, maintaining political stability, and promoting cultural unity.

In order to achieve these goals, the imperial governments provided a wide range of services. They took the lead in defending against the nomadic groups to the north. They mobilized a tremendous amount of resources and manpower into the construction of a series of fortifications along the northern borders. The famous Great Wall of China still stands today as a demonstration of those efforts. Additionally, imperial governments regularly took on hydraulic projects, including the management of the Yellow River and the construction of the Grand Canal, which stretches over 1,100 miles from the city of Beijing to the city of Hangzhou. They built roads throughout the country to facilitate the transportation of taxes, which were largely paid in kind in the early dynasties, and the communication between various levels of government. They even established one of the world's first public school systems to promote political mobility and cultural homogeneity, first at the prefectural level during the 10th century and further down to the county level during the 14th century (Huang and Yang, 2021). From this perspective, imperial China very much resembled a modern state in its reliance on a centralized administrative bureaucracy, the wide range of services it provided, and the foundation of its revenue on regular and universal taxes.

However, despite the early rise of the central state, the development and expansion of state capacity within China was not evenly distributed. Southern China, for example, which roughly includes the contemporary provinces of Guangdong, Fujian, Zhejiang, Jiangxi, and Hunan, have been part of China's territory since at least the 1st century BC,[7] yet state capacity in these provinces remained underdeveloped for centuries when compared to northwestern provinces such as Shanxi and Gansu.[8] This paper hopes to explore factors that could have shaped this uneven spatial development of state capacity in China.

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[6] According to Ko, Koyama, and Sng (2018), between 0 AD and 1800, the landmass between the Mongolian steppe and the South China Sea was ruled by one single authority for 1008 years.

[7] Southern Zhejiang (Dong-Ou) voluntarily joined the Han dynasty in 138 BC. Guangdong (Nan-Yue), and Fujian (Ming-Yue) were conquered by the Han dynasty in 112 BC. The others have been part of China since 202 BC.

[8] For example, in 1299, these five provinces together contributed 53.8% of the imperial fiscal revenue in grains despite having a tax rate similar to other regions, but their county seats only made up 18.4% of the national total (365 out of 1985). This is author's calculations based on tax data from Liang (1980) and county seats from CHGIS database.

Moreover, the development of state capacity is not a one-way street. It is true that China established direct rule early. But it also experienced nearly four centuries of decentralization and barbarian invasions following the collapse of the Han dynasty in the third century, similar to what happened in Europe after the fall of the Western Roman Empire (Chen, Wang, and Zhang, 2021). Even during times of unification, the vast land of China made it impossible for the emperor to always know or control what his subjects were up to. This agency problem led to de facto decentralization to some extent, which tended to exacerbate over time and caused repeated bouts of regional rebellions for a millennium until the tenth century.[9] Although the identity of the rebellion leaders changed from landed aristocracy in the early period to military generals in the Tang dynasty, the essence of the central-local dynamics remained similar.[10] After the demise of the aristocracy, frequent peasant uprisings still imposed a constant constraint on the amount of resources that the central state can extract. According to the *Catalog of Historical Wars* (2003), a total of 776 peasant uprisings (compared to 585 elite rebellions) were recorded from 221 BC to 1910 AD; and most of these uprisings had taxation and corvee labor reduction as one of their main demands. Throughout the imperial period, the central governments were in constant contention against the tendency of decentralization and regional autonomy driven by information asymmetry, administrative inefficiency, and local interests.

To summarize, unlike many other studies that examine early stages of state formation, a central state or candidates for a central state had already existed in my setting.[11] Administratively speaking, the central states in historical China typically had the ability to expand state capacity should they have the chance. On the other hand, unlike the experience of many other parts of the world, such as Africa (Herbst, 2000), the China proper region has always had a high level of agricultural productivity and population density, which was sufficient to justify any investment in state capacity. Therefore, the development of state capacity in China's setting is not constrained by high cost or low benefit; instead, it is primarily determined by the bargaining dynamics between the central state and the localities. And this paper aims to examine the impact of local demands for public goods on this state-locality dynamic and how they shaped the development of central state capacity.

4. Data and Variables

4.1. Variables of State Capacity

Since the paper aims to characterize the bargaining dynamics between the state and the localities, my measurements of state capacity are constructed based on variables that best reflect the presence of the central state.

[9] Famous regional rebellions include the Rebellion of the Seven States (154 BC), the War of the Eight Princes (291-306 AD), and the An-Lushan Rebellion (755-763 AD). Other notable rebellions during the Jin dynasty include the Rebellion of Wang Dun (322-324), the Rebellion of Su Jun (327-329), and the Rebellion of Heng Xuan (398-404). The Tang dynasty also witnessed an extended period of political decentralization during the 8th and 9th centuries.

[10] Throughout history, great empires rose and fell. China during the 3rd to 6th century faced substantial political decentralization, barbarian invasions, and extended civil wars similar to those in Western Europe following the collapse of the Roman Empire. How China escaped from a downward spiral of weak states and civil wars remains a mystery and the focus of several recent studies (Chen, Wang, and Zhang, 2021).

[11] By candidates for a central state, I refer to regional kingdoms that eventually establish unified rule over the China proper region. Notable candidates would include the three Kingdoms (220-280) and kingdoms of the North and South Dynasties (420-589).

The first measurement of state capacity is the density of administrative centers. To effectively mobilize and to accurately redistribute resources, a state must have a capable administrative apparatus to implement and to monitor its daily operations. Throughout the history of imperial China, a wide range of administrative units had been established with various degrees of central control. China before 221BC had a political system similar to European feudalism. The land was divided into vassal states and fiefs, and the power balance between the vassal states and the central government fluctuated from time to time. The Qin dynasty in 221BC was the first to establish a county-prefecture system with a central bureaucracy in charge of appointing local officials and overseeing the governance of the localities. This county-prefecture system was inherited by all subsequent dynasties as the foundation of governance, but various emperors also established other administrative units outside the county-prefecture system, which typically allowed for more local autonomy, to address specific needs of the time. Examples include autonomous regions for ethnic minorities, military bases with production and taxation autonomy, and fiefs for members of the royal family as well as generals with great military achievements. For the main results, I exclude such non-typical administrative units and focus only on the county-prefectures because this approach provides the most consistent measurement of central state capacity. Revisions of this measurement to include data from the pre-Qin period and other non-typical administrative units are examined in the robustness checks.[12]

The location of historical county and prefectural seats during the imperial China period (221 BC to 1911) are detailed in *The China Historical Geographic Information System* (CHGIS) database. I also digitized administrative centers of the pre-imperial period (1045BC to 221BC) from *The Historical Atlas of China* (Tan, 1982). The spatial distribution of the administrative centers is illustrated in Figure 1.

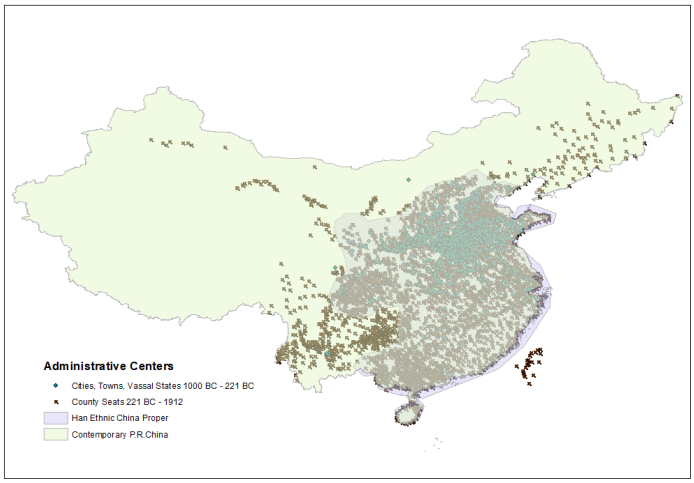

Figure 1: Data on Administrative Centers

The second measurement of state capacity is the length of road networks. Road networks have critical implications for historical states in many ways. They connect otherwise isolated regions, enhance the administration of distant localities, and promote the flow of information. They also facilitate the transportation of goods and promote economic integration. During times of crisis such as a natural

[12] For the pre-Qin period, I categorize the provincial and national capitals as prefectural seats, while other cities and towns including the capitals of vassal states (Zhu Hou) as county seats. Century fixed effects are controlled whenever possible to minimize the impact of inconsistency in the administrative systems used before and after 221BC.

disaster or foreign war, having an extensive road network facilitates resource distribution and military mobilization. Given the importance of road networks, every imperial governments put extensive efforts into their constructions and maintenance.[13] Especially from the Qin dynasty in the 2nd century BC till the end of the Tang dynasty in the 10th century, major road networks in China served primarily military and administrative purposes. Their constructions were usually initiated by the central state (such as the famous Qin-chi-Han-dao) and the state was closely involved in the maintenance and management of the roads, with custom points set up along the roads.

Strictly speaking, roads in historical China could fall under several categories, including national road networks managed by the central state, provincial roads by the local governments, and small roads constructed by local communities. The data used in this paper is based on major road networks which were largely managed by the central state, and hence, the density of which can serve as a proxy of central state capacity in a locality. The author digitized data on major road networks from the 2nd century BC to the early 20th century based on maps from Wang (2018). A time fixed effect is controlled to account for any systematic differences among data sources for different periods, and a grid cell fixed effect is controlled to account for local geographical conditions.

Admittedly, this measurement has several imperfections. Conceptually, a road might pass a series of non-relevant middle points just to connect two important cities. In addition, the data on road networks has much lower frequency (one observation for each dynasty) compared to that on administrative centers (annual frequency). Therefore, this paper will use administrative centers as the main dependent variable and road networks and others as robustness checks.

Fiscal capacity is another essential aspect of state capacity. Government tax revenue has been used by many scholars as a measure of state capacity (Karaman and Pamuk, 2011; Dincecco and Prado, 2012). Tax revenue lays the foundation for the government's operation and all other functions, while the ability to acquire tax revenue also demonstrates the state's administrative capacity. The total amount of tax payment can depend on two factors: the tax base (local economic output), which is an economic factor, and tax intensity, which is arguably a political factor. Whenever possible, I use tax per capita as a measure of tax intensity. Data on taxation in this paper comes from multiple sources. Commercial taxes during the Northern Song period (960-1279) and the Yuan dynasty (1271-1368) were digitized by the author based on maps from *The Historical Atlas of People's Republic of China* (2012), while agricultural taxes during the Ming and the Qing dynasties were digitized by the author based on data in Liang (1980) and further matched with the location of counties from the CHGIS database. All data from these sources is ultimately based on official imperial records.

In historical China, taxation policies varied greatly from dynasty to dynasty (see Appendix for more details). Some dynasties, such as the Ming and Qing, relied almost exclusively on agricultural taxes, while others, such as the Song, also utilized commercial taxes. While my data in this paper covers only one type of taxes for each dynasty, the item included tend to be the most important source of central government revenue.[14] In addition, before the widespread use of currency, many dynasties collected tax in kind. Tax revenue therefore came in a wide variety of goods, including grains like rice and wheat, fabrics like silk and cotton cloth, and many others. Whenever possible, taxes paid in kind are converted

[13] Also, roads are costly to build and even more costly to maintain over a long period of time. Hence, the variations in road networks over time can serve as a proxy for state capacity.

[14] Relatedly, official government records are also more likely to exist for the most important source of revenue. For more details on taxation policies and compositions of fiscal revenue for different dynasties, see the Appendix – Additional Explanation for Historical Data.

to gain or silver at the prevailing national price at the time.[15] Yet still, it is not possible to include all such government revenues, particularly during early periods. Hence, the tax data in this paper should not be interpreted as a measure of total government revenue. Rather, it demonstrates the spatial patterns of taxation, and it can be used to evaluate an individual region's relative contribution to national fiscal revenue.

To summarize, historical central state capacity is measured by three main variables: the density of administrative centers, length of major road networks, and tax per capita. Among these three variables, only administrative centers are of annual frequency and are most accurately measured; and hence, it is used as the main dependent variable.

4.2. Explanatory Variables

The relationship between external wars and state capacity has received much attention in the political science literature. However, using number of battles as an explanatory variable would inevitably encounter an endogeneity problem, since the location that a foreign power decides to strike is usually not random. In this paper, I employ a locality's distance to the nearest hotspot of foreign war as a proxy for the region's need for national defense. *Hotspots of foreign wars* are defined as locations with more than three battles fought in any given century between a Chinese imperial government and a foreign power. Presumably, foreign wars far away from a region should not correlate with the local economic conditions other than some macro-level common impacts, and hence serve as a valid source of exogenous shock. To address the concern that the location of foreign war hotspot cities may not be random, I also examined the subsample which includes only localities with distance to war greater than 100 km and the results remain unchanged (see Appendix A.3).

I digitized the times and locations of foreign wars based on the *Catalog of Historical Wars* produced by the Nanjing Military Academy (2003). This catalog contains information including dates, locations, and leaders for each major internal and external battle that took place in China from approximately 1000 BC to the end of the imperial period in 1911. This dataset has been used by many scholars (Jia, 2014; Dincecco and Wang, 2021).[16] In this paper, I define a foreign war as a battle fought among fragmented Han-Chinese governments or between a Chinese imperial government and a foreign state or state-like power.[17] This definition is similar to that of Dincecco and Wang (2021), except that I also include wars among fragmented states which primarily applies to the period between the 3rd century and the 6th century, a period that Dincecco and Wang (2021) does not cover. Figure 5 illustrates the spatial distribution of foreign war hotspots.

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[15] For the majority of Chinese history, agricultural taxes were paid in units of grain (shi). Towards the late-imperial period, with the increasing use of silver in the marketplace, agricultural taxes started to be paid in both units of grain and silver. In this paper, taxes paid in silver (taels) are converted into units of grain (shi) at the prevailing national price at the time. The grain price for the Tang and the Song dynasties comes from Liu (2015) (at 0.32 taels of silver per shi of rice in 740 AD and 0.7 in 1070), that for the Ming dynasty comes from Huang (1974) (at 0.6028 taels of silver per shi of rice), and that for the Qing dynasty comes from Keller and Shiue (2007) (at 1.2 taels of silver per shi of rice).

[16] This book derives its information from China's official historical books, known as the "twenty-four histories." Traditionally, each dynasty in historical China compiled a standardized history of its predecessor based on official court records. These official historical books are among the most important and reliable sources of Chinese history (Wilkinson 2000). For a detailed explanation about the dataset, see Dincecco and Wang (2021).

[17] States, as defined in this paper, must had a well-established boundary and had existed for more than 50 years. Power groups that existed for less than 50 years are counted as rebellions rather than states.

Figure 2: Foreign War Hotspots over Time

For hydraulic public goods, I use the changes of the Yellow River's course as exogenous shocks to local demands.[18] Despite conceivable randomness in terms of when and where the Yellow River changed its course, there could be concerns that newly obtained access to the Yellow River may not only change the value of public goods but also local economic conditions and agricultural productivities. To avoid the complication of omitted variables, I use a proximity variable measured as distance to the Yellow River. The advantage of using a proximity variable is that, for regions not directly along the Yellow River, there would be no immediate change in local economic conditions when the river course shifted. A change in proximity only affected the locality's need for public goods. The courses of the lower Yellow River in different periods (Figure 3) correspond with those in *The Historical Atlas of China* (Tan, 1982). They are retrieved from geographical accounts in historical writings and ancient maps, assisted with geophysical investigations on paleochannels and archaeological evidence. The courses before 350 BC are mostly conjectures based on brief historical accounts. The courses recorded after 350 BC are considered accurate.

The level of economic development in a locality is an important control. In this paper, I measure historical economic development with population density. Data on historical population was digitized by the author based on maps from *The Historical Atlas of People's Republic of China* (2012), supplemented with population data from Liang (1980) and the location of counties in CHGIS. I have detailed georeferenced population data in years 2AD, 140, 280, 549, 609, 742, 1102, 1207, 1290, 1820, 1925, and county-level population data in years 1460 and 1565. The sources for the population data is ultimately based on official household registration archives compiled by the imperial governments.

Several supplementary datasets are also used. The location of autonomous ethnic regions is based on the CHGIS database. A list of different types of autonomous ethnic regions in various dynasties is given in Appendix A.3.2. The strength of local lineages is measured by the number of genealogy books compiled in a locality. The data on genealogy books is digitized by Dincecco and Wang (2020) based on the *Comprehensive Catalogue of Chinese Genealogies* (Zhongguo Jiapu Zongmu in Chinese) (2008). The book includes information on more than 50,000 genealogy books that were compiled in China from 1005 to 2007. Each entry includes the date that the book was compiled as well as the date that the

[18] Heldring, Allen, and Bertazzini (2019) uses a similar approach utilizing the course changes of the Euphrates and the Tigris to study early state formation in Southern Iraq.

lineage was established.[19] Since most of the compiling dates were after the nineteenth century, I use the establishment dates for measuring clan activities in the main results, whereas the compiling dates are used as a robustness check in the Appendix. The strength of religious organizations is measured by number of Buddhist temples constructed in a century. The dataset on Buddhist temples is from the China Biographical Database Project (CBDB), which itself is based on records in various historical gazetteers. Information concerning fiscal policies and compositions of national fiscal revenues for various dynasties is based on the book series *The Fiscal History of China* (Zhongguo Caizheng Tongshi in Chinese) (2013-2017). The series includes ten volumes of books, each detailing the fiscal policy of one period in Chinese history. More details on fiscal policies and tax revenue data are given in Appendix A.3.1.

Table 1 below provides a summary of the main variables employed in this paper, with variable explanations and time period coverages. The location of administrative centers and foreign wars are the most accurately measured with annual frequency. Data on road networks and tax revenues are only available for certain periods and with roughly one sample of observation for each dynasty, which limits the types of robustness checks available for these variables (see discussion in Section 6). Additionally, to facilitate the interpretation of coefficients, I use *Proximity to War* and *Proximity to Yellow River* in the actual regressions, which are negative logarithm of the distances.

Table 1: List of Variables

Variable	Explanation	Time Period	Spatial Unit
Panel I: Variables of State Capacity			
NAdmin	Density of administrative centers (number per 1000 km^2). One prefectural seat is counted as six county seats.[20]	1000 BC to 1900 AD, annual data	Grid cell
NCounty	Density of county seats (number per 1000 km^2)	1000 BC to 1900 AD, annual data	Grid cell
Road	Length of major roads (km)	200 BC to 1900 AD, one sample for each dynasty	Grid cell
Taxpp	Government tax revenues, value per capita	1070 (commercial), 1300 (commercial), 1460, 1620, 1820	Prefecture
Panel II: Explanatory Variables			
Distance_War	Distance to the frontline of foreign war (km). A proxy of local demand for national defense	220 BC to 1900 AD, annual data	Grid cell
Distance_Yellow	Distance to the Yellow River (km). A proxy of local demand for hydraulic management.	1000 BC to 1900 AD, annual data	Grid cell
Panel III: Other Variables			
PopDensity	Population density (number of people in 1000 km^2). A proxy of local economic development.	2AD, 140, 280, 464, 549, 609, 742, 1102, 1207, 1290, 1420, 1565, 1820, 1925, 1990	Grid cell, County
Distance_Capital	Distance to the imperial capital of the dynasty (km).	200 BC to 1900 AD, annual data	Grid cell

[19] Most of the lineages had migrated from other locations in China, and the genealogy books traced their history to these migration events as the time of establishment.

[20] During our sample period, a prefecture on average presided over six counties.

Ntemple	Number of Buddhist temples constructed in a locality in a century.	200 BC to 1900 AD	Grid cell
Nclan	Number of lineage books compiled in a locality in a century.	200 BC to 1900 AD	Grid cell
Minority_pctg	Number of autonomous ethnic regions, as a percentage of administrative units in the locality.	200 BC to 1900 AD, annual data	Grid cell

Table 2 gives the summary statistics of the panel. The full sample spans a period of thirty centuries, from 1000 BC to 1900, while the main sample covers from 1 AD to 1900. To avoid the complexity due to changes in administrative boundaries over time, I use grid cells of 1000 square kilometers in size. All variables are aggregated or decomposed to the grid cell level.

Table 2: Summary Statistics for Major Variables

Variable	Observation	Mean	Std. Dev.
PRC: number of grid cells	11520		
China proper: number of grid cells	3454		
North China Plain: number of grid cells	432		
Panel I: Variable of State Capacity (China Proper Region)			
Log Admin	107,074	-6.998463	4.172003
Log Cnty	107,074	-5.377201	2.952705
Log Road	103,620	0.7505216	1.364103
Log Tax per capita	43,177	-5.03954	2.803443
Panel II: Explanatory Variable (China Proper Region)			
Proximity_War (i.e. – Log Distance to War)	72,534	-6.312969	1.054361
Proximity_Yellow (i.e. – Log Distance to Yellow River)	107,074	-5.727941	1.5098
Panel III: Other Variables			
Log Pop	43,075	6.145091	5.166522
Proximity_Capital (i.e. – Log Distance to Capital)	107,030	-6.511874	0.7316129
Ntemple	107,074	0.016764	0.19214
Nclan	75,988	0.209125	2.322357
Minority_pctg	107,074	0.47931	6.630202

Note: "PRC" stands for the contemporary territory of the People's Republic of China. "China proper" indicates the predominantly Han-ethnic region which is examined as the main sample in this paper, as denoted in Figure 3. "Lower Yellow River Region (Lower YR hereinafter)" refers to the region affected by lower Yellow River floods, as denoted in Figure 2. The above table provides the summary statistics for the subsample covering the China proper region, which will be used as the main data sample for the results.

5. Results

The simple theoretical framework in Appendix A.1 characterizes the state-locality dynamics in a more explicit fashion. As highlighted in the model, the higher value of public goods induces a higher level of state service as well as greater taxation in the locality. In this section, I first test the hypothesis and examine the direct impacts of war and hydraulic public goods on state capacity. Then, I demonstrate how those impacts evolved over time.

5.1. Main Results

For the main results, I employ a panel regression model.

$$State_{jt} = \beta_1 Proximity\_War_{jt} + \beta_2 Proximity\_Yellow_{jt} + \beta_3 X_{jt} + \alpha_j + \theta_t + \epsilon_{jt} \qquad (1)$$

Where *j* indexes the grid cell and *t* the century. All specifications of the model control for time-invariant local features, such as geography, and widespread time-specific shocks, such as dynasty effects, through the grid cell and century fixed effects. Three modifications of the benchmark model are examined. Firstly, to account for the path dependence of state capacity, I performed a dynamic panel model with two lags of the dependence variable. Secondly, I employed a spatial lag model in case the state capacity of a region was affected by its neighbors. Thirdly, to account for unobserved changes over time in local features, I added provincial-specific trends as a robustness check. The dynamic panel model is considered the preferred specification.

Table 3 provides the estimates, with state capacity measured by the density of administrative centers. The results demonstrate that public goods had a significant impact on state capacity. Columns (1) reports the results for the static panel model, Columns (2) perform a dynamic model to account for potential history dependence, while Column (3) focuses on the subsample covering the North China Plain which are most affected by Yellow River flooding. Column (4) to (6) include population controls, and Column (6) allows for both history dependence and provincial-specific trends. Column (7) examines a spatial lag model to allow for spatial correlation among neighboring regions. Throughout the various specifications, proximity to foreign wars consistently and significantly increased administrative capacity, while proximity to the Yellow River has somewhat positive impact. For example, in Column (4), being closer to foreign war hotspots by 1 percent increased the density of administrative centers by 0.07 percent, while being closer to the Yellow River by the same amount increased the density of administrative centers by 0.06 percent.

Table 3: Main Results – Administrative Capacity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Log Nadmin	Log Nadmin	Log Nadmin	Log Nadmin	Log Nadmin	Log Nadmin	Log Nadmin
Proximity_War	0.166***	0.0489***	0.0725**	0.0738***	0.0537	0.0599*	0.080**
	(0.0155)	(0.0114)	(0.0288)	(0.0173)	(0.0423)	(0.0328)	(0.032)
Proximity_Yellow	0.00225	0.0278*	0.0303	0.0604**	0.0542**	0.0585*	0.0033
	(0.0454)	(0.0168)	(0.0187)	(0.0235)	(0.0271)	(0.0322)	(0.0204)
log Pop				0.0556***	0.0657***	0.0497***	0.054***
				(0.00378)	(0.00907)	(0.00408)	(0.00613)
Proximity_Capital	0.0699**	0.0261*	0.121***	0.101***	0.155***	0.162***	0.072**
	(0.0337)	(0.0151)	(0.0317)	(0.0225)	(0.0435)	(0.0555)	(0.0355)
L.Y		0.735***	0.685***	0.691***	0.630***	0.679***	0.66***
		(0.00594)	(0.0125)	(0.00867)	(0.0171)	(0.00887)	(0.011)
L2.Y		-0.0184***	0.0226**	-0.0101	0.0228	-0.00152	0.04***
		(0.00521)	(0.0100)	(0.00802)	(0.0157)	(0.00812)	(0.0112)
Sample	China Proper	China Proper	North China Plain	China Proper	North China Plain	China Proper	North China Plain
Model	Panel	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic w. Prov Trend	Dynamic Spatial Lag
Observations	72,500	72,500	14,909	36,391	8,459	33,792	8,151
R-squared	0.034	0.543	0.521	0.514	0.468	0.535	
# id_ngrid	3,454	3,454	711	3,453	711	3,104	429

Notes. All specifications include country and century fixed effects. Grid-cluster-robust standard errors are given in parentheses. Column (3) uses a spatial autoregressive (SAR) model (also known as spatial lag model) with grid and century fixed effects. Columns (1) to (3) cover the period from the 3rd century BC to the early 20th century. Columns (4) to (8) cover the period from the 1st century AD to the early 20th century.

Table 4 offers the results for state capacity as measured by taxation and the length of road. Column (1) and (2) examines the impact on the length of roads. The dependent variable in Columns (3) to (5) pools agricultural tax and commercial tax together, while that of Columns (6) to (8) examines only agricultural tax. One caveat is worth mentioning here. Because road networks and taxation data are sparse with at most one observation per dynasty, a dynamic panel model is not feasible. As a result, Table 4 utilizes the static panel model, with provincial trends included as a robustness check in Columns (5) and (8). Both variables demonstrate a significant and positive influence by public goods. For example, in Column (1), a one percent decrease in distance to war leads to a 0.02 percent increase in the length of roads, while a similar decrease in distance to the Yellow River leads to a 0.045 percent increase. Column (3) shows impacts on tax per capita by foreign war and hydraulic management at similar magnitudes, with a one percent increase in the latter two variables each leading to a 0.25 percent increase in the former.[21] During time of need, tax revenue, regardless of its sources, should be good news for the state. The fact that the state was able to raise more taxes from regions that are more affected by the war and flooding suggests that the demand of the localities plays an important role in determining state fiscal capacity.

Table 4: Main Results – Road and Taxation

VARIABLES	Log Road		Log Tax per capita (Agricultural and Commercial Taxes)			Log Tax Per Capita (Agricultural Tax Only)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proximity_War	0.0262**	0.0439	0.247***	0.384***	0.107***	0.247***	0.341***	0.157***
	(0.0121)	(0.0297)	(0.0202)	(0.0846)	(0.0356)	(0.0202)	(0.0524)	(0.0312)
Proximity_Yellow	0.0452**	0.0491**	0.251***	0.220***	0.192**	NA	NA	NA
	(0.0184)	(0.0193)	(0.0728)	(0.0762)	(0.0827)			
log Pop	0.00874***	0.00577	0.0287***	0.0891***	0.0275***	-0.00017	0.00825	-0.00327
	(0.00192)	(0.00428)	(0.00367)	(0.0115)	(0.00364)	(0.00517)	(0.00809)	(0.00388)
Proximity_Capital	0.0637***	0.0806***	0.0517	0.163***	-0.0639	0.146***	0.186***	-0.0285
	(0.0156)	(0.0241)	(0.0363)	(0.0382)	(0.0632)	(0.0310)	(0.0271)	(0.0438)
Model	Panel	Panel	Panel	Panel	w. Prov Trend	Panel	Panel	w. Prov Trend
Sample	China Proper	North China Plain	China Proper	North China Plain	China Proper	China Proper	North China Plain	China Proper
Obs	36,391	8,451	8,836	1,984	8,303	5,559	1,280	5,310
R-squared	0.016	708	0.898	0.819	0.915	0.707	0.787	0.876
#id_ngrid	3,453	0.012	3,379	707	3,085	3,167	696	3,011

Notes. All specifications include grid cell and century fixed effects. Grid-cluster-robust standard errors are given in parentheses. A coefficient for proximity to the Yellow River is not available for Columns (6) to (8) because there was no change in the Yellow River course during the years when data on agricultural tax is available.

[21] This also echoes historians' observations that the burden of national defense and hydraulic management disproportionately fell on the regions nearest to the center of the action.

5.2. The Evolution of Impact over Time

To better assess how the impacts of public goods evolved over time, I relax the assumption that the coefficients are constant. In this section, I generate five period dummies, and add their interactions with the explanatory variables to the dynamic panel model as specified in Section 5.1. The regression equation becomes the following:

$$State_{jt} = \Sigma_{k=1}^{5}\beta_k Dist\_War_{jt} * Period_{kt} + \mu_1 l.State_{jt} + \mu_2 X_{jt} + \alpha_j + \theta_t + \epsilon_{jt} \qquad (1)$$

Where the five period dummies $Period_{kt}$ span non-overlapping 500-year intervals from 500 BC until the early 20th century.

The estimation results for the regression model are plotted in Figures 3 and 4. Figure 3 illustrates the impact of foreign wars, while Figure 4 plots that of the Yellow River. Foreign wars are shown to have a much bigger impact on state capacity than the Yellow River, both in terms of significance and magnitude. More interestingly, the impacts of both factors decline over time. As the states became more established and mature, the impacts of both factors diminished until they became insignificant in the late imperial period.

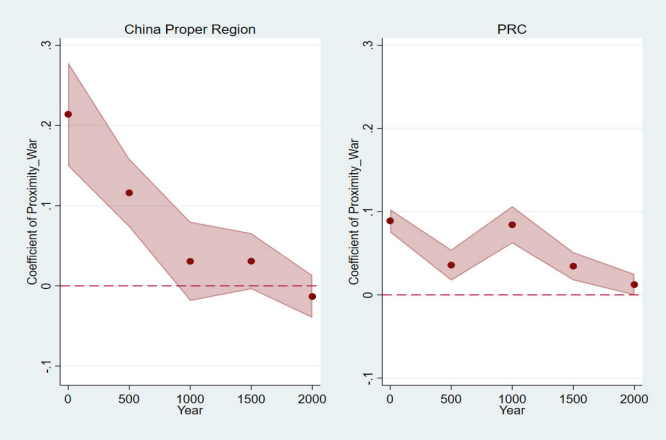

Figure 3: Coefficients of Proximity to Foreign War on Administrative Capacity

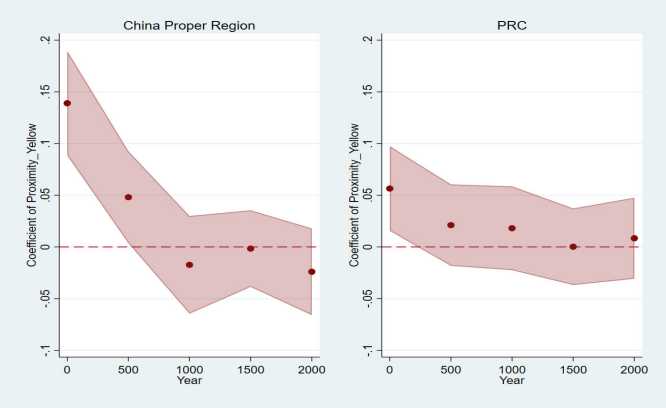

Figure 4: Coefficients of Proximity to Yellow River on Administrative Capacity

Overall, results in this section demonstrate a significant impact that public goods had on the intensification of central state capacity. The value of national defense, which is approximated by proximity to foreign war hotspots, is shown to significantly and consistently increase state capacity throughout various specifications and on all three measures. The value of hydraulic management, which is approximated by proximity to the Yellow River, has some positive impact on administrative capacity and a significant influence on taxation. The results are consistent with the predictions of the model in Section 4. Regions with higher values of public goods had higher level of central state capacity. In addition, the influence of both forms of public goods decreases over time, suggesting that these factors are more important for younger states or states in their early stages of development.

6. Discussion on Demand versus Supply-side Explanations

This section aims to examine the supply versus demand-side explanations for the results. A higher value of public goods leading to stronger state capacity does not necessarily indicate a demand-side explanation. It is possible that a central state also strategically distribute its capacity based on the value of public goods. While it may not be possible to entirely exclude this explanation, this section provides some evidence that suggests that demand-side factors are more likely to be the driving force.

6.1. Regions Away from The Frontline

First, I limit the analysis to a subsample of regions far from the foreign war frontlines, with a distance greater than 100 km. For areas so far away from the point of action, there would be much less need to build garrisons or to fulfill other military functions. The regression specification is identical to that in Section 6.1, and the estimation is given in Table 5. A positive coefficient identified in this case suggests that state expansion here is likely to be driven by demand-side factors.

Table 5: Robustness - Distance to War Greater than 100 km

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log N admin	Log N admin	Log N admin	Log N admin	Log road	Log tax per capita
prox_war	0.0555**	0.0480***	0.0565**	0.137**	0.0132	0.314***
	(0.0244)	(0.0171)	(0.0253)	(0.0596)	(0.0108)	(0.0314)
prox_yellow	0.0977***	0.0274	0.0280	0.0134	0.0563***	0.368***
	(0.0329)	(0.0231)	(0.0257)	(0.0342)	(0.0110)	(0.0374)
Controls	Y	Y	Y	Y	Y	Y
Model	Panel	Dynamic	Dynamic	Dynamic w local Trend	Dynamic	Dynamic
Sample	PRC	PRC	China Proper	China proper	China Proper	China Proper
Obs	53,428	53,428	34,205	31,632	34,205	8,642
R-squared	0.065	0.539	0.532	0.556	0.357	0.898
Num grid	11,334	11,334	3,453	3,104	3,453	3,379

6.2. Land Elevation

This section interacts the variable proximity to war with land elevation. The presumption is that localities with higher elevations are harder to attack, making them more attractive candidates to be included in the state's defense line. On the other hand, regions on a flat plain are vulnerable and would have higher demands for state protection once they move closer to the frontline. Therefore, if localities with lower elevations demonstrate a more sensitive response to war, it would be evidence for the demand-side story. Otherwise, if localities with higher elevations are more sensitive, it is likely to be driven by national interest and strategic defense planning.

The regression specification is identical to the main model in Section 6.1, except for the inclusion of an interaction term between proximity to war and land elevation. Four measurements of land elevation are tested, including two on elevation and two on slope. The result in Table 6 shows a negative coefficient on the interaction term, which would be consistent with the demand-side explanation.

Table 6: Proximity to War and Land Elevation

VARIABLES	(1) Log tax per capita	(2) Log tax per capita	(3) Log tax per capita	(4) Log tax per capita
prox_war	0.0984***	0.0894***	0.0827***	0.0823***
	(0.0242)	(0.0231)	(0.0238)	(0.0229)
prox_war * slop_median	-0.00854**			
	(0.00332)			
prox_war * slop_mean		-0.00813**		
		(0.00346)		
prox_war * elev_median			-0.000412**	
			(0.000164)	
prox_war * elev_mean				-0.000408**
				(0.000151)
Controls	Y	Y	Y	Y
Observations	8,303	8,303	8,303	8,303
R-squared	0.896	0.896	0.898	0.898
Number of grid	3,085	3,085	3,085	3,085

6.3. Local Elites - Ethnic Minorities

Lastly, I examine the interaction between foreign wars and the strength of local elites. Since local elites can serve as a partial substitute for the state in organizing defense activities, their presence might weaken the local demand for state capacity as well as the impact of foreign wars on state consolidation. Alternatively, if state expansion is primarily driven by the supply, the central state might want to develop more presence in regions with stronger elites since resource mobilization would be easier. In this section, I test the above arguments by interacting the variable proximity to war with three variables that measure the strength of different kinds of local institutions: autonomous ethnic groups, lineages, and religious organizations.

The first variable is based on the establishment of autonomous ethnic groups. Among the twelve imperial Chinese states from 221 BC to 1912, all consisted of one ruling ethnicity and ten of which were

ruled by the Han-Chinese. To mitigate the political tension between the ruling ethnicity and the local ethnic groups, the imperial governments routinely allowed for autonomous ethnic groups in areas where the non-ruling ethnic minority groups resided. Compromises were made to allow these autonomous regions to follow their own customs and be ruled by their own elites. Hence, the existence of autonomous ethnic groups could intervene with the development of state capacity by strengthening the power of the local elites and weakening efforts to create a unified national identity.

Table 5 explicitly examines this argument using the regression model. The variable *Minority_pctg* is the number of autonomous ethnic regions as a percentage of all administrative units in the locality, including both county-prefectures and non-typical administrative units. The specifications are similar to those in Section 6.1, except for the addition of an interaction term between proximity to foreign wars and *Minority_pctg*.

The results are consistent with the model predictions. Table 5 shows that having a higher percentage of autonomous ethnic regions in the locality diminishes the sensitivity of state capacity to foreign wars. For example, in Column (4), when a locality with zero minority groups moves closer to foreign war hotspots by 1 percent, its density of administrative centers increases by 0.07 percent. In comparison, in Column (3), a similar locality with minority autonomous regions experiences no change in its state capacity following a similar increase in its proximity to foreign wars.

Table 7: Ethnic Autonomy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Log Admin	Log Admin	Log Admin	Log Admin	Log Ncnty	Log Road	Log Taxpp
Proximity_War	0.0692***	0.0658***	0.0482	0.0712***	0.0430***	0.0265**	0.243***
	(0.0168)	(0.0169)	(0.142)	(0.0168)	(0.0114)	(0.0121)	(0.0202)
Proximity_War*Minority_pctg				-0.0249***	-0.0173***	-0.000143	-0.00227**
				(0.00469)	(0.00341)	(0.00147)	(0.000950)
Minority_pctg	0.0500***	NA	0.0490***	-0.126***	-0.0841***	0.00115	-0.0106
	(0.00252)		(0.00404)	(0.0322)	(0.0233)	(0.0106)	(0.00698)
Proximity_Yellow River	0.0416*	0.0439*	NA	0.0431*	0.0259	0.0454**	0.359***
	(0.0239)	(0.0236)		(0.0239)	(0.0176)	(0.0184)	(0.0948)
Log pop	0.0527***	0.0526***	0.0598**	0.0526***	0.0348***	0.00869***	0.0288***
	(0.00371)	(0.00373)	(0.0231)	(0.00371)	(0.00265)	(0.00192)	(0.00368)
Proximity to Capital	0.120***	0.116***	-1.010	0.119***	0.108***	0.0638***	0.0430
	(0.0221)	(0.0221)	(0.623)	(0.0221)	(0.0162)	(0.0156)	(0.0363)
Sample Region	China proper	Non-Minority Region	Minority Region	China proper	China proper	China proper	China proper
Observations	36,391	35,542	1,271	36,391	36,391	36,391	8,836
R-squared	0.537	0.529	0.761	0.538	0.548	3,453	0.898
Number of id_ngrid	3,453	3,361	168	3,453	3,453	0.016	3,379

Note: The above results are based on a dynamic panel model including two lags of the dependent variable. The errors are clustered at the grid cell level. The "non-minority region" in column (3) includes the grid cells that have never had an autonomous ethnic administration set up within its boundary from 221 BC to 1910, whereas the "minority region" in column (4) covers those that have had at least one autonomous ethnic administration. IV regressions are not performed here since the focus of analysis is on *Minority_pctg* and *Proximity to War*.

6.4. Local Elites - Lineages

The second variable of local institutions measures the strength of lineages. The lineages or clan, in China, refers to a location-specific kin-based organization consisting of patrilineal (and to a lesser degree matrilineal) households that trace their origin to a common (and typically male) ancestor. Notable examples that have been extensively studied by historians include the Xiao Clan in Tai-he county, Jiangxi province (Dardess, 1996), Zhuang and Liu clan in Chang-zhou prefecture, Jiangsu province (Elman, 2000), and several lineages in Fujian province (Wakefield, 1998). These clans provided important functions for the community: they sustained cooperation among members, provided local public or club goods, and played vital roles mediating between the locality and the state (Greif and Tabellini, 2017; Dincecco and Wang, 2020). It is thus possible that the clans fulfilled some of the functions of the state, and their presence moderates local demands for state capacity.

Table 6 explicitly examines this argument using the regression model. The variable *Nclan* measures the strength of lineages by counting the number of lineages founded in a locality in a century, as recorded in the genealogy books. Table 6 shows that localities with stronger presence of lineages are less sensitive to foreign wars. In Table 6 Column (3), a one standard deviation increase in the number of lineage books decreases the coefficient of proximity to war on state capacity by 8.3 percent.

Table 8: Local Lineages

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log Admin	Log Admin	Log Admin	Log Ncnty	Log Road	Log Taxpp
prox_war	0.0732***	0.0708**	0.0740***	0.0627***	0.0252**	0.243***
	(0.0173)	(0.0360)	(0.0174)	(0.0154)	(0.0121)	(0.0203)
prox_war*nclan_from			-0.00262***	-0.00198**	0.00133	0.0357
			(0.000946)	(0.000915)	(0.00123)	(0.0325)
nclan_from	0.00903***	0.00141	-0.00868*	-0.00651	0.0166**	0.273
	(0.00322)	(0.00226)	(0.00524)	(0.00573)	(0.00803)	(0.239)
prox_yellow	0.0600**	0.0673*	0.0601**	0.0445**	0.0448**	0.252***
	(0.0235)	(0.0379)	(0.0235)	(0.0209)	(0.0185)	(0.0728)
logpop	0.0554***	0.0680***	0.0554***	0.0471***	0.00858***	0.0280***
	(0.00378)	(0.00761)	(0.00378)	(0.00352)	(0.00192)	(0.00365)
prox_capital	0.100***	0.130***	0.101***	0.126***	0.0631***	0.0549
	(0.0225)	(0.0435)	(0.0225)	(0.0214)	(0.0156)	(0.0360)
Model	Dynamic	Dynamic	Dynamic	Dynamic	Panel	Panel
Sample	China proper	nclan_from>=1	China proper	China proper	China proper	China proper
Observations	36,391	11,085	36,391	36,391	36,391	8,836
R-squared	0.514	0.559	0.514	0.534	0.016	0.898
# id_ngrid	3,453	983	3,453	3,453	3,453	3,379

Note: The first five columns are based on a dynamic panel model including two lags of the dependent variable, while the last column performs a standard panel regression. The errors are clustered at the grid cell level. The sample covers the China proper region.

6.5. Local Elites - Religious Organizations

The third variable measures the strength of local religious organizations. In historical China, especially before the Song dynasty, Buddhist temples had been an important source of public goods provision, particularly in disaster relief and other charitable works. It had such substantial influence that emperors during the Tang-Song transition period, fearing the emergence of an independent powerbase united by

religion, started to take measures to confiscate the landholding by the temples and to limit their political influence (Leung, 1997). Subsequent dynasties largely followed this tradition, but religious organizations remained popular among the ordinary people and frequently played prominent roles in local governance as well as peasant riots and rebellions (Kung and Ma, 2014).

In Table 7, I use the number of Buddhist temple constructed in a century as a measure of the strength of local religious organizations. Result shows that state capacity in regions with stronger religious organizations are less sensitive to the impact of foreign wars. For example, in Column (3), a one standard deviation increase in the number of Buddhist temples decrease the sensitivity of state capacity by about 43 percent. And in the regions with very high level of religious activities, proximity to war shows no significant impact on state capacity, as shown in Column (2).

Table 9: Religion

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log Admin	Log Admin	Log Admin	Log Ncnty	Log Road	Log Taxpp
Proximity_war	0.0750***	0.0425	0.0798***	0.0682***	0.00642	0.247***
	(0.0173)	(0.0396)	(0.0174)	(0.0155)	(0.00870)	(0.0202)
Proximity_war*Ntemple			-0.177***	-0.183***	0.0277	-0.532***
			(0.0595)	(0.0499)	(0.0254)	(0.144)
Ntemple	0.253***	0.153*	-0.828**	-0.917***	0.184	-3.720***
	(0.0845)	(0.0855)	(0.327)	(0.272)	(0.154)	(0.892)
Log pop	0.0555***	0.0892***	0.0554***	0.0471***	0.00652***	0.0287***
	(0.00378)	(0.00967)	(0.00378)	(0.00352)	(0.00151)	(0.00366)
Proximity_yellow	0.0610***	0.0910**	0.0620***	0.0457**	0.0358***	0.254***
	(0.0234)	(0.0381)	(0.0234)	(0.0209)	(0.00877)	(0.0726)
Proximity_capital	0.0979***	-0.0217	0.0982***	0.124***	0.0279**	0.0489
	(0.0226)	(0.0380)	(0.0226)	(0.0214)	(0.0123)	(0.0365)
Model	Dynamic	Dynamic	Dynamic	Dynamic	Panel	Panel
Sample	China proper	Ntemple>=1	China proper	China proper	China proper	China proper
Observations	36,391	8,294	36,391	36,391	36,391	8,836
R-squared	0.515	0.591	0.515	0.534	0.342	0.898
# id_ngrid	3,453	732	3,453	3,453	3,453	3,379

Overall, the results confirm that local institutions can interfere with the demands for central state capacity. Specifically, my result contradicts the literature on representative government and instead shows a similar pattern as in Garfias and Sellars (2021) and Dincecco and Wang (2021), where the existence of local elites weakens the impact that foreign wars have on state building. The result also seems to confirm the demand-side explanation.

7. Conclusion

This paper explores the intensification and spatial distribution of central state capacity in historical China from the 2nd century BC to the early 20th century. By focusing on within-country variations, this paper zooms in on local characteristics that shifts a locality's demand for national defense and hydraulic public goods, holding the political regime and other macro-level characteristics constant. In order to obtain estimates of causal relationships between public goods and state capacity, I utilize proximity to foreign

war hotspots as a measure of local demand for national defense and proximity to the Yellow River as a measure of demand for hydraulic public goods. Random shifts of the Yellow River's course and changes in the foreign war frontlines are hence used as sources of identifying variation.

Multiple measurements of state capacity are employed, including the density of administrative centers, length of road networks, and tax revenues. Results illustrate a strong impact of public goods on the development of state capacity. Proximity to foreign wars is shown to significantly and consistently increase all measures of central state capacity throughout various specifications. The value of hydraulic public goods, on the other hand, has a mild impact on administrative capacity but significant influence over tax revenues.

I further examine the interactions of public goods with additional factors to shed light on the supply versus demand-side explanations. Interaction between public goods and land elevations shows that regions on flat plains are more sensitive to foreign wars, suggesting state expansion to be driven by demand-side factors. Local institutions are also examined. Three variables – lineages, ethnic minorities, and religious organizations – measure the strength of local elites from three different perspectives. Consistent with the demand-side explanation, the presence of local elites weakens the impact of foreign war on state capacity, and confirms a substitute relationship between the central state and local institutions.

Given the importance of foreign war in shaping state building, one might naturally wonder what China would be like if it were fragmented and decentralized in a similar fashion to Europe. In the Appendix A.6, a simulation based on the estimates is leveraged to evaluate this hypothetical question. The simulation demonstrates that a decentralized China with more evenly distributed foreign wars would have a higher level of state capacity as well as a better rebalance of tax burdens from the western to the eastern provinces. Nonetheless, there remains the question as to why some states were able to centralize and remain centralized. The answer to this question lies beyond the scope of this paper, but the findings here highlight the importance of demand-side factors in explaining the developmental trajectories of states and nations.

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Online Appendix

A.1 A Simple Theoretical Framework

Given the history and geography of China, I argue that the development of state capacity in my setting is not constrained by high cost or low benefit; instead, it is primarily determined by the bargaining dynamics between the central state and the localities. To formalize, let's consider a simple theoretical model. The economy consists of a state *S* and a locality *L*. The locality can give up part of its tax revenue in exchange for a public goods provision, which can be national defense or hydraulic management. The public goods can be provided by either the state or the local elite. Because of the scale and the public goods nature of the service, the state has a cost advantage in its provision.

In the literature, two dimensions of state capacity are frequently mentioned: revenue extraction and state services (or public goods provision). In the model, let s denote the public goods provision, τ the tax paid to the state. In a world with no state, the locality might suffer from some kind of disaster (natural disasters such as flooding or artificial disasters such as foreign wars). In the event of a disaster, the locality obtains a utility of $h - \delta$. Here, $\delta \in [0, h]$ indicates the severity of the disaster, which varies for different localities. To link the theory with the empirics, regions that are closer to foreign war frontlines or the Yellow River flooding area are considered to have larger δs.

In the state's absence, the probability of the disaster can be mitigated by the local elites. The parameter e captures the strength of local institutions, and the probability to avoid the disaster $Pr(e)$ increases in e. Specifically, without a state, the locality receives an expected utility of $u^L(d) = [1 - Pr(e)](h - \delta) + \Pr(e)\, h.$

When the state provides a public good of s, the locality has probability $Pr(s)$ to avoid the disaster. To provide a public good s, the state incurs a cost of $c(s)$, and the locality makes a tax payment of τ in exchange of the public goods. It is natural to assume that $c(s) > 0, c'(s) > 0, \Pr(s) \in [0,1]$, and $\Pr'(s) > 0$. Following the tradition of the literature, I assume increasing marginal cost for the provision of public goods, i.e. $c''(s) > 0$, and decreasing marginal impact on the probability of disaster prevention, i.e. $Pr''(s) < 0$.

I assume an impartial state: a state that values the tax revenue but not the utility of specific localities. Therefore, the disagreement utility for the state is $u^S(d) = 0$, while that for the locality is $u^L(d) = [1 - Pr(e)](h - \delta) + \Pr(e)\, h$. The bargaining utility for the state is $u^S(s, \tau) = \tau - c(s)$, while that for the locality is $u^L(s, \tau) = [1 - Pr(s)](h - \delta) + \Pr(s)\, h - \tau$.

The Nash bargaining equilibrium solves the following maximization problem:

$$Max_{s,\tau}\, F(s, \tau) = [u^S(s, \tau) - u^S(d)][u^L(s, \tau) - u^L(d)]$$
$$s.t. u^S(s, \tau) \geq u^S(d), u^L(s, \tau) \geq u^L(d)$$

$$u^S(d) = 0,$$
$$u^S(s,\tau) = \tau - c(s)$$
$$u^L(d) = [1 - Pr(e)](h - \delta) + \Pr(e)\, h$$
$$u^L(s,\tau) = [1 - Pr(s)](h - \delta) + \Pr(s)\, h - \tau$$

Denote the Nash bargaining solution as s^*, τ^*. We have the following propositions. The proofs are provided in the Appendix.

Proposition I*: the equilibrium s^*, τ^* increases in δ.*

Proposition II*: the strength of local institutions decreases the sensitivity of equilibrium state capacity in response to changes in public goods, i. e.* $\frac{\partial^2 s^*}{\partial \delta \partial e} < 0$.

Given the predictions of the theoretical framework, I lay out the following hypotheses to guide my empirical investigation.

Hypothesis H_1: *Proximity to foreign wars increases a locality's level of state capacity.*

Hypothesis H_2: *Proximity to the Yellow River increases a locality's level of state capacity.*

Hypothesis H_3: *Stronger presence of local institutions decreases the sensitivity of state capacity in response to the need of public goods.*

Admittedly, this simple theoretical framework suffers from many limitations. One such limitation is the assumption of an impartial state. A state in reality might value certain regions more than others, leading to a pre-existing preference over the spatial distribution of state capacity. By assuming an impartial state, this theoretical framework essentially zooms in on the demand-side factors and provides a useful benchmark for evaluating and comparing the relative importance of features of a locality. Another limitation is the treatment of the local institutions. In this theoretical framework, I simplified the dynamics by assuming away any decision making by the local institutions in a hope to focus on the relationships between the state and the locality. The development of local institutions, on the other hand, is an interesting research question in itself and warrants further investigation.

A.2 Additional Historical Backgrounds

A.2.1 The Public Goods Nature of National Defense

In stark contrast to the European experience, foreign wars have constituted a genuine public good in China since at least the beginning of the Han dynasty (202 BC – 220 AD).

The geography of China roughly follows a northwest – southeast dichotomy: the northern and western parts of China are primarily highlands, suitable for pastoralism and home to several famous nomadic groups including the Mongols. The flat and fertile lowlands in the east and the hilly but warm and humid regions in the south was the heartland of the Chinese agricultural economy. A line of fortifications, including the famous Great Wall, stood between the two regions (see Figure A.1). These fortifications were strategically placed, with some of them at the edge of the highlands. What it also entails is that once a foreign power passes these lines of fortifications, they will face the vast North China Plain with

fertile and populous lands ready to be plundered. The southeastern regions of China do not have suitable geography for self-defense. Protection of the entire agricultural area of China depends on the defense lines in the north and the northwest. As a result, national defense in historical China regularly involved large scale resource redistribution from the east and south toward the north and the northwest, and the state had a definitive advantage in its provision.

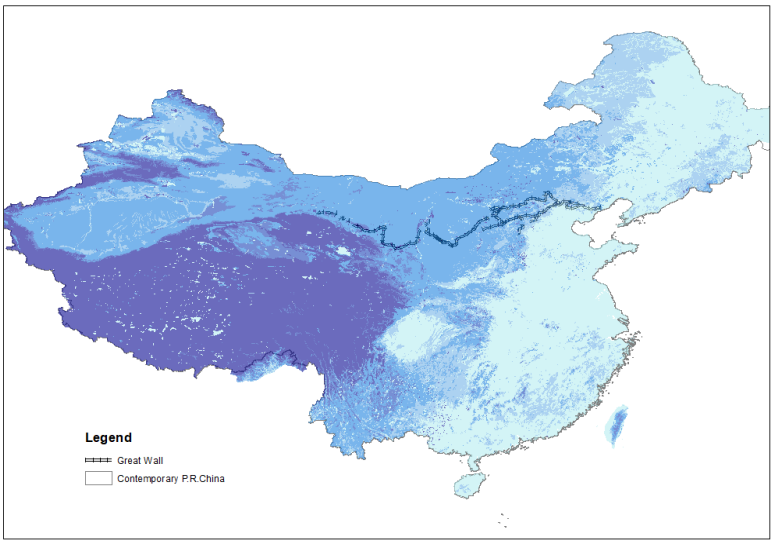

Figure A.1: Land Elevation of China

In addition to geography, the cultural landscape also emphasizes national defense as a public good. According to the author's own data, a great majority (81.4%) of external wars fought during China's imperial period (221 BC - 1912) took place between an ethnically Han-Chinese imperial government and a non-Han foreign power.[22] The Han Chinese subsistence was primarily agricultural with a bureaucratic state, while the foreign powers at war with imperial China were typically nomadic or semi-nomadic. Even dynasties established by non-Han ethnicities, such as the Yuan and the Qing, adopted a substantial part of the Chinese culture upon conquering the China proper region and modeled their governance based on the structure of Han-Chinese states. They went as far as adopting the civil service examination system, which promoted Confucianism, a Han-Chinese religion, as the formal belief system of the state. Self-proclamations as the successor of the Han state brought in immediate political payoffs for these dynasties; it also branded any effort of national defense against foreign powers as a true public goods both politically and culturally.

Moreover, every time when a change of dynasty happened, it was accompanied by prolonged civil wars, widespread devastation, and a sharp decline in national population, which had no parallel in European history (Xu, van Leeuwen, and van Zanden, 2018). For example, the invasion of the Mongols and the subsequent collapse of the Song dynasty brought in a dramatic decline in population to about half of the level at the beginning of the century. And the invasion of the Manchu and the demise of the Ming

[22] According to the author's data, between 221 BC and 1912, there were 1044 wars fought between a Chinese imperial government and a foreign ethnic polity, 178 wars fought among decentralized Chinese states (established states that had existed for over 50 years, excluding short-lived rebellions), and 60 wars fought between Chinese governments and sea pirates (Wo-Kou), which some historians refer to as mainly Japanese.

dynasty led to another sudden population decline of about 20 percent in less than two decades (Xu, van Leeuwen, and van Zanden, 2018). To the common Chinese people, losing a major foreign war usually entailed prolonged social unrest and substantial disruption to their way of life. In this context, national defense is a true common interest public good for the ordinary Chinese people.

A.2.2 The Yellow River

The Yellow River is one of the most famous rivers in the world, despite being substantially smaller than many other well-known peers. This is in part due to its status as the “cradle” of Chinese civilization, but also to the tremendous destruction and sorrow that its periodic flooding has caused over the centuries.

Figure A.2 plots the contemporary course of the Yellow River in relation to the geographic features of the region. The Yellow River originates in the western inlands of the Bayan Har Mountains. Its middle section then makes a large loop to the north through the center of the Loess Plateau, leading to substantial soil erosion in this region. The large amount of mud and sand discharged into the Yellow River at this stage makes it the most sediment-laden river in the world, as is clearly reflected in its name (Chen et. al., 2012). Eventually, the river is blocked by the Qin Mountains to the south, and it is redirected east into the flat, fertile, and densely populated North China Plain. It is at this stage when the sediments are deposited in the slower-moving lower reaches of the river, elevating the riverbeds, and creating the famous "river above ground" phenomenon which was the cause for frequent shifts of the river. As Figure A.2 clearly shows, the lower course of the Yellow River is blocked by the Taihang and the Yin Mountains in the north, and the Dabie and the Huangshan Mountains in the south. But it faces few obstacles moving around in the flat plain area between the mountains, creating a Yellow-River-affected area almost twice as large as the United Kingdom.

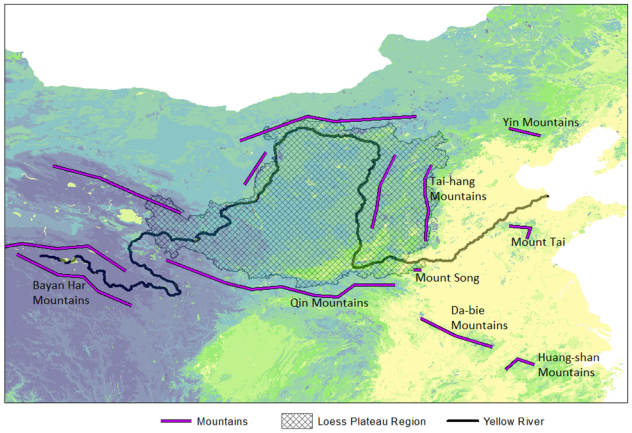

Figure A.2: The Geography of the Yellow River

Because of uneven rainfall in the upstream regions caused by East Asian monsoon and the substantial amount of silt carried in the water, the Yellow River experiences a huge fluctuation in its water level and is subject to frequent flooding. Historical documents recorded more than 1500 floods over the past 4000 years (Zou and Zhang, 2013). Moreover, the North China Plain is a fertile land suitable for agriculture. It has traditionally supported a large population and had acted as the center of the region’s economy for millennia. Each time the Yellow River flooded, it inundated a massive area of fields and settlements, displaced hundreds of thousands of people, and imposed substantial pressure on the social, political,

and environmental stability of the region (Greer, 1979; Chen et al.,2012; Zou and Zhang, 2013). Regions near the Yellow River thus saw a salient and urgent need for water management.

The unruly nature of the Yellow River also threatened the healthy operation of the economy in the North China Plain. For centuries, trade in the North China Plain region relied heavily on the Grand Canal system, transporting grain and timber from the south to the political centers in the north (Pomeranz, 1993). The Grand Canals were the centerpiece of an enormous hydraulic system, which connected several navigable waterways on the North China Plain (Figure A.3). Although the Yellow River itself was not of vital importance in terms of transportation, it connected the canals in this system, meaning that its periodic flooding naturally disrupted the transportation network of the whole region.

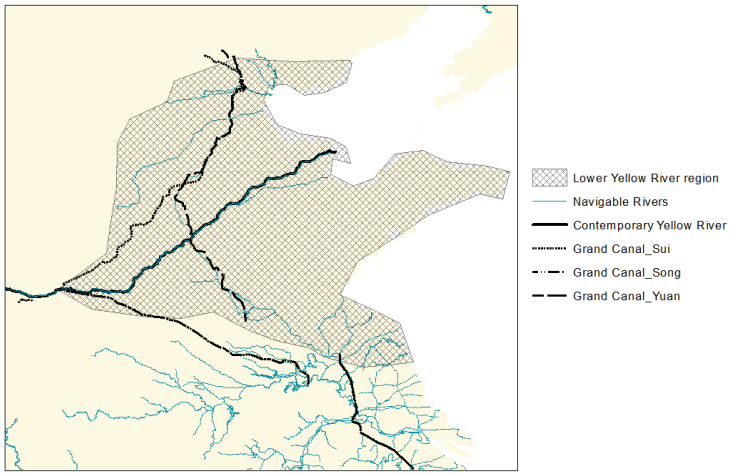

Figure A.3: Navigable Waterways and the Grand Canal System

Projecting substantial impact over a large area, the management of the Yellow River also requires coordination across many regions, the scale of which goes far beyond the capacity of any single locality. For example, Huang (1974) notes that during the Ming dynasty (1368 – 1644), there was incessant restitution of the Yellow River and the maintenance of the Grand Canal, and the work was rarely interrupted for over five years. In one maintenance project in 1578 alone, around 100,000 labors were involved, 139 breaks in the dikes were repaired, and 830,000 new willow trees were planted. No final number on the budget was recorded in the archives, but a conservative estimate set the total cost of this single project at more than 2.5 million taels of silver (Huang, 1974, p. 279).

Ever since Wittfogel (1957), many scholars have argued for the importance of the Yellow River in the formation and development of the Chinese states (Zhang, 2016). In this paper, instead of focusing on state formation, I study the impact of the Yellow River on the development and intensification of state capacity in the region. The public goods nature of water management in the Yellow River region suggests that proximity to the river may have an impact on the locality's demand for state capacity, one of the hypothesis I will formally test in this paper.

In terms of the identification strategy, there is much randomness in both the timing of Yellow River breaks and the relocation of the river course. For example, historian Zhang (2016) carefully documented the river's shift events during the 1048 – 1128 period. In 1048, following several days of heavy rainfall, the Yellow River burst out of its course and rushed into the Hebei Plain. Over the proceeding eighty

years, the central government, mid-level "hydrocrats" (shui-guan), and local residents alike strove to restore order and stability to the region, only to be repeatedly stymied by their political opponents and by the unruly nature of the river itself. In 1128, in a desperate attempt to stop the Jin invasion from the north, the Song government breached the dykes, leading to another wave of catastrophic flooding. Despite centuries of continuous efforts by the Song government to reinforce the dykes on the southern side of the river, in a pragmatic attempt to protect the valuable regions to the south, the Yellow River eventually settled into a new course to the south where it overtook the course of the Huai River, thereby profoundly impacting that region.

As shown by the above example, there were indeed cases when the Yellow River was breached for military or political purposes. However, as shown in Figure A.4, the great majority of river breaches and flooding events were due to natural causes. Out of the 174 floods recorded in *The Chronicle of Events of the Yellow River* (2001) from 1000 AD to 1980, only 3 were artificial. Because of better preservation of archives in the later years, there is a substantial increase in the number of floods after the 14th century. Apart from that, there is no discernable correlation between Yellow River floods and political and economic factors.

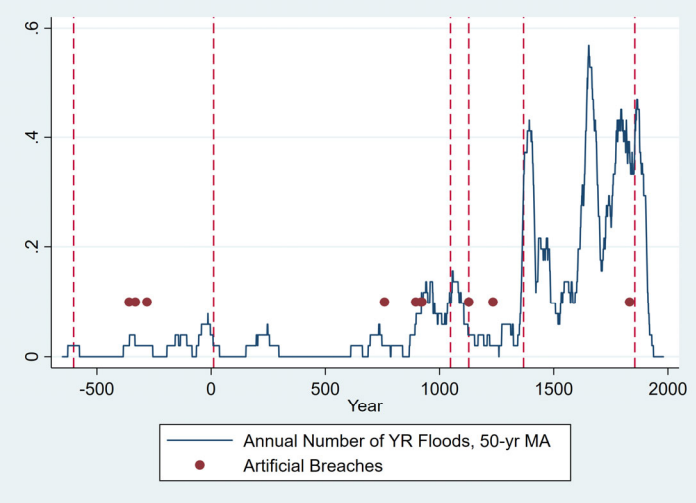

Figure A.4: Major Yellow River Floods

Notes: Data based on *The Chronicle of Events of the Yellow River* compiled by the Yellow River Conservancy Commission (2001). The dashed lines indicate the years of major Yellow River course changes.

A.3 Proof of The Theoretical Framework

The Nash bargaining equilibrium solves the following maximization problem:

$$Max_{s,\tau}\ F(s,\tau) = [u^S(s,\tau) - u^S(d)][u^L(s,\tau) - u^L(d)]$$
$$s.t.\, u^S(s,\tau) \geq u^S(d), u^L(s,\tau) \geq u^L(d)$$

$$where\ \ u^S(d) = 0,$$
$$u^S(s,\tau) = \tau - c(s)$$

$$u^L(d) = [1 - Pr(e)](h - \delta) + \Pr(e)\, h$$
$$u^L(s,\tau) = [1 - Pr(s)](h - \delta) + \Pr(s)\, h - \tau$$

Denote the Nash bargaining solution as s^*, τ^*. We have the following proposition.

***Proposition I**: the equilibrium s^*, τ^* increases in δ.*

Proof: The Nash product $F(s,\tau) = [\tau - c(s)][(\Pr(s) - \Pr(e))\,\delta - \tau]$
The equilibrium satisfies either $s^* = \tau^* = 0$ (a No-State Equilibrium) or the following first order conditions (a State Equilibrium)

$$\frac{\partial F}{\partial \tau} = 0, \frac{\partial F}{\partial s} = 0$$

$$\Rightarrow \begin{cases} 2\tau^* = \delta(\Pr(s^*) - \Pr(e)) + c(s^*) \\ \delta\, \Pr'(s^*) = c'(s^*) \end{cases}$$

$$\Rightarrow \begin{cases} \dfrac{\partial s^*}{\partial \delta}[c''(s^*) - \delta Pr''(s^*)] = Pr'(s^*) > 0 \\ \dfrac{\partial \tau^*}{\partial \delta} = \dfrac{1}{2}\left[\Pr(s^*) - \Pr(e) + \delta \Pr'(s^*)\dfrac{\partial s^*}{\partial \delta} + c'(s^*)\dfrac{\partial s^*}{\partial \delta}\right] > 0 \end{cases}$$

Because we have $(\Pr(s^*) - \Pr(e))\,\delta - \tau^* > 0$ in a State Equilibrium

$$\Rightarrow \begin{cases} \dfrac{\partial s^*}{\partial \delta} > 0 \\ \dfrac{\partial \tau^*}{\partial \delta} > 0 \end{cases}$$

Q.E.D.

***Proposition II**: the strength of local institutions decreases the sensitivity of equilibrium state capacity in response to changes in public goods, i. e.* $\frac{\partial^2 s^*}{\partial \delta \partial e} < 0$.
Proof:

$$Max_{s,\tau}\, F(s,\tau) = [u^S(s,\tau) - u^S(d)][u^L(s,\tau) - u^L(d)]$$
$$s.t.\, u^S(s,\tau) \geq u^S(d), u^L(s,\tau) \geq u^L(d)$$

$$where \;\; u^S(d) = 0,$$
$$u^S(s,\tau) = \tau - c(s)$$
$$u^L(d) = [1 - Pr(e)](h - \delta) + \Pr(e)\, h$$
$$u^L(s,\tau) = [1 - Pr(s)](h - \delta) + \Pr(s)\, h - \tau$$

Hence, $F(s,\tau) = [\tau - c(s)][(\Pr(s) - \Pr(e))\,\delta - \tau]$
The first order condition gives

$$\frac{\partial F}{\partial \tau} = 0, \frac{\partial F}{\partial s} = 0$$

$$\Rightarrow \begin{cases} 2\tau^* = \delta(\Pr(s^*) - \Pr(e)) + c(s^*) \\ \delta \Pr'(s^*) = c'(s^*) \end{cases}$$

Here, the set of feasible *s* decreases in *e*. When *e* is small, the equilibrium s^* is determined by $\delta \Pr'(s^*) = c'(s^*)$. If $e \geq s^*$, the locality always chooses the disagreement outcome.

$$\Rightarrow \begin{cases} \dfrac{\partial s^*}{\partial e} \leq 0 \\ \dfrac{\partial s^*}{\partial \delta}[c''(s^*) - \delta Pr''(s^*)] = Pr'(s^*) > 0 \\ \dfrac{\partial \tau^*}{\partial e} = \dfrac{\partial s^*}{\partial e}[\delta Pr'(s^*) + c'(s^*)] - \delta Pr'(e) < 0 \\ 2\dfrac{\partial \tau^*}{\partial \delta} = \Pr(s^*) - \Pr(e) + [\delta Pr'(s^*) + c'(s^*)]\dfrac{\partial s^*}{\partial \delta} > 0 \end{cases}$$

$$\Rightarrow \begin{cases} \dfrac{\partial s^*}{\partial e} \leq 0 \\ \dfrac{\partial s^*}{\partial \delta} > 0 \\ \dfrac{\partial \tau^*}{\partial e} < 0 \\ \dfrac{\partial \tau^*}{\partial \delta} > 0 \end{cases}$$

Q.E.D.

A.4 Additional Explanation for Historical Data

A.4.1 Taxation Policies and Fiscal Revenue Compositions

The following Table A.1 lists the percentage of central government fiscal revenue from indirect taxes for each dynasty and the sources that I used to calculate the numbers. A detailed discussion about the sources are provided after the table.

Table A.1: Compositions of Fiscal Revenue across Dynasties

Century	Dynasty	Commercial tax_pctg (%)	Indirect tax_pctg (%)	Source
6	Tang	very small	3.6	财政通史
7	Tang		18.5	财政通史
8	Tang		44.16	财政通史
9	Song	12.6	32.7	Liu (2015)
10	Song	13.4	50	Liu (2015)
11	Song	17.04	67.76	Liu (2015)
12	Song		64.82	财政通史

13	Yuan	14.8	46.6	财政通史
14	Ming	0.87	4.04	Liang (1988), 财政通史
15	Ming	3.37	10.56	Huang (1974)
16	Ming		10.27	Huang (1974), Wu (1990)
16	Qing	4.1	12.8	财政通史
17	Qing	3.7	17.02	财政通史
18	Qing	11.05	22.8	财政通史
19	Qing	34.1	59.7	财政通史

Qing Dynasty (1644-1911): The Qing government had three major sources of fiscal revenue: agricultural tax (di-ding-yin), salt tax (yan-ke), and commercial tax (guan-shui). The following table from Guo (1994, p. 56) shows the relative importance of the three sources in different periods:

Period	Agriculture (10k *liang*)	Salt (10k *liang*)	Commercial (10k *liang*)
1654	2128 (87%)	213 (9%)	100 (4%)
1725	3007 (84%)	443 (12%)	135 (4%)
1766	2991 (73%)	574 (14%)	540 (13%)

The county-level Qing dynasty tax data used in the main results refers to the agricultural tax, which made up about 70-80% of the total central government revenue. The fiscal revenue data that I use to calculate the percentage of indirect taxes in national fiscal revenue is based on the following source:

郭蕴静（1994）。清代商业史。辽宁人民出版社。
陈锋著。叶振鹏 主编（2013）。中国财政通史：清代财政史。湖南人民出版社。

Ming dynasty (1368-1644): The Ming dynasty replied predominantly on agricultural taxes, with only about 10% national income from indirect taxes such as liquor tax, commercial tax, and profit from salt monopoly. Based on data from Zhang and Zhou (2013), the following items are accounted as indirect tax: salt tax and profit from salt monopoly, tea tax and profit from tea monopoly, commercial tax (钞关税) and transportation tax (门税). The data on the indirect taxes together with the data on agricultural tax from Liang (1988) are used in calculating the composition of tax revenue for the Ming dynasty.

The fiscal revenue data during the Ming dynasty comes from the following sources:
Huang, R. (1974). *Taxation and governmental finance in sixteenth-century Ming China* (Vol. 4). Cambridge University Press.
张建民，周荣著。叶振鹏 主编（2013）。中国财政通史：明代财政史。湖南人民出版社。
Liang (1980). 梁方仲. (1980). *中国历代戶口, 田地, 田賦统计*. 上海人民出版社.
吴慧 (1990). 明清前期财政结构性变化的计量分析。*中国社会经济史研究*。

Yuan dynasty (1271-1368): A taxation system did not exist in the Mongol empire before it conquered Han-ethnic China. Upon conquering China, it adopted most of the fiscal policies and tax apparatuses of the Song dynasty in the China proper area. Among sources of tax incomes, salt tax, vinegar tax, and commercial tax are the most important.

The county-level Yuan dynasty tax data used in the main results refers to the commercial tax, which made up about 14.8% of the total central government revenue (Huang, 2013). The fiscal revenue data that I use to calculate the percentage of indirect taxes in national fiscal revenue is based on the following source:

黄纯艳著。叶振鹏 主编（2013）。中国财政通史：宋辽西夏金元财政史。湖南人民出版社。

Song dynasty (960-1279): It was during the Song dynasty that the imperial Chinese state began to transition from a population-based poll tax (or head tax) toward a wealth-based land tax. This was accompanied by a shift from a payment-in-kind system, which was based on the poll tax and corvée services, to a monetarized indirect taxation system (Liu, 2015). The Song government also started to collect a commercial tax, which accounted for about 10% of the central government's revenue in the early years (Wang, 2011). According to Liu (2015), indirect taxes made up about 32.7 percent of annual revenues in 997. This number increased to half of the total annual government revenue in 1021, and then to nearly two-thirds of the annual revenues in 1077.

The county-level Song dynasty tax data used in the main results refers to the commercial tax, which made up about 13.4% of the total central government revenue at that time (Liu, 2015). The fiscal revenue data that I use to calculate the percentage of indirect taxes in national fiscal revenue is based on the following source:

Liu, W. G. (2015). The making of a fiscal state in Song China, 960–1279. *The Economic History Review*, *68*(1), 48-78.
黄纯艳著，叶振鹏主编（2013）。中国财政通史：隋唐五代财政史。湖南人民出版社。

Tang dynasty (618 – 907): The Tang dynasty initially relied primarily on agricultural taxes and poll tax. The early Tang dynasty continued the tradition of Zu Yong Diao since the Western Wei dynasty (535 AD), where the state allocated land to all male adults and demanded taxes and corvée labor in return. However, following the An Lushan rebellion in 755, the imperial government lost control of local governance to regional military governors. Even though the imperial government managed to regain control of most regions in the ninth century, its grasps of local administration would never go back to its early level. Because of this political transition, the later Tang witnessed a deterioration and eventual collapse of its old land-based taxation system. By 780, the old taxation system was replaced by a semiannual tax paid in cash and major industries, such as salt and iron, were turned into state monopolies, signifying the beginning of a shift toward a money economy boosted by the merchant class. This shift led to a significant jump in percentages of fiscal revenue coming from indirect taxes, as shown in Table A.1. The fiscal revenue data for the Tang dynasty is based on the following source:

陈明光，孙彩红著，叶振鹏主编（2013）。中国财政通史：隋唐五代财政史。湖南人民出版社。

A.4.2 Other Variables

Post Stations:

Data on postal stations covers three dynasties: The Tang dynasty (618-907), the Ming dynasty (1368-1644), and the Qing dynasty (1645-1911). Information on Tang dynasty postal stations is based on *The Transportation Atlas of Tang Dynasty* (Yan, 1985), which has been digitized by the Academia Sinica.[23] Data on Ming dynasty postal stations is distributed by the China Historical Geographic Information System project (CHGIS), based on information compiled from the *Mingdai Yizhankao (A Study of Ming Dynasty Postal Stations)* (Yang, 2007).[24] Finally, Qing dynasty postal station information is based on the ChinaW dataset from the Skinner Data Archive (Skinner, Yue, and Henderson, 2008).

Road Networks:

Figure A.3 plots the road networks from selected period. The data is digitized based on maps provided in Wang (2018).

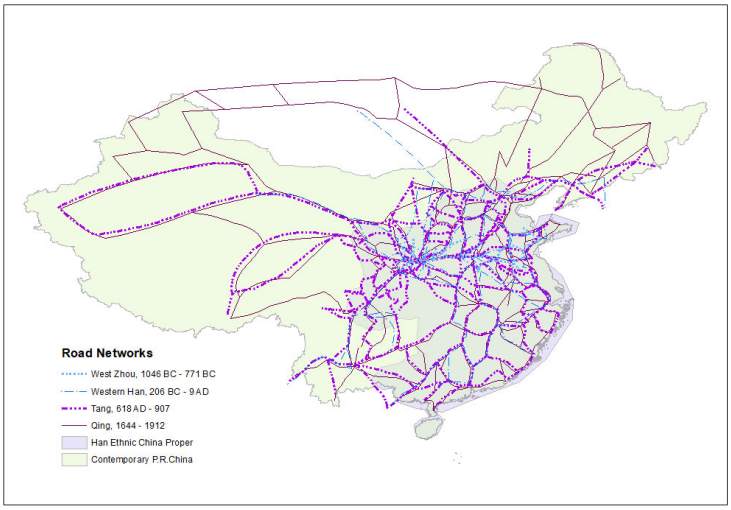

Figure A.5: Road Networks in Selected Periods

Autonomous Ethnic Regions:

Various names were used for ethnic autonomous regions in different dynasties. The following is a list of the names used in this paper to identify ethnic autonomous regions in the CHGIS database.

Table A.2: Types of Autonomous Ethnic Regions

Name of Ethnic Administrative Units	**#obs**
安抚司 An fu si	25
羁縻府州 Ji mi fu zhou	82
土府、土司、土州 Tu fu, Tu	86

[23] 中央研究院人社中心 GIS 專題中心 (2020). [online] 中華文明之時空基礎架構系統. Available at: http://gissrv4.sinica.edu.tw/gis/cctslite.aspx [Accessed Date].
[24] Website http://sites.fas.harvard.edu/~chgis/data/other/

si, Tu zhou	
宣抚司、宣慰司 Xuan fu si, Xuan wei si	17
长官司 Zhang guan si	230

Military Bases:

I measure the military capacity of imperial Chinese states using density of military garrisons. Data on military garrisons covers four periods: the Western Han dynasty (around 50 BC), the Tang dynasty (618 – 907), the Ming dynasty (1368 – 1644), and the Qing dynasty (1644 – 1911). I digitized the Han dynasty data based on information from Xiao (2012). The Tang dynasty data is recorded in *The Transportation Atlas of Tang Dynasty* (Yan, 1985). Information on the Ming dynasty garrisons was compiled from "The treatises on military affairs of the Ming dynastic history (1368-1644)" (Liew, 1998) by Michael Szonyi and John Wong.[25] Data on the Qing dynasty is based on the ChinaW dataset from the Skinner Data Archive (Skinner, Yue, and Henderson, 2008).

A.5 Robustness Checks

A.5.1 Regions Non-Adjacent on the Foreign War Frontlines

To address the concern that the results might be driven by localities in immediate proximity of foreign war hotspots and hence suffer from the same problem caused by the endogeneity of war locations, I examine a subsample which only includes localities with greater than 100km distance from any foreign war hotspots. The results remain unchanged.

Table A.3: Robustness – Distance to War ≥ 100 km

VARIABLES	(1) Log Admin	(2) Log Admin	(3) Log Admin	(4) Log Admin	(5) Log Road	(6) Log Tax Per Capita
log Dist_War	-0.0555**	-0.0480***	-0.0565**	-0.137**	-0.0132	-0.314***
	(0.0244)	(0.0171)	(0.0253)	(0.0596)	(0.0108)	(0.0314)
log Dist_Yellow	0.0977***	-0.0274	-0.0280	-0.0134	-0.0563***	-0.368***
	(0.0329)	(0.0231)	(0.0257)	(0.0342)	(0.0110)	(0.0374)
log Pop	0.146***	0.0468***	0.0542***	0.0475***	0.00676***	0.0299***
	(0.00382)	(0.00273)	(0.00340)	(0.00380)	(0.00143)	(0.00412)
L.Y		0.710***	0.698***	0.684***	0.626***	
		(0.00466)	(0.00555)	(0.00583)	(0.00495)	
L2.Y		-0.0162***	-0.0126**	0.000482	-0.0199***	
		(0.00472)	(0.00559)	(0.00587)	(0.000550)	
log Dist_Capital	-0.306***	-0.142***	-0.136***	-0.197***	-0.0397***	0.0103
	(0.0291)	(0.0204)	(0.0243)	(0.0492)	(0.0104)	(0.0325)
Model	Panel	Dynamic	Dynamic	Dynamic w. Prov. Trend	Dynamic	Dynamic

[25] The data is distributed by the CHGIS database.
https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/5RUXK8

Sample	PRC	PRC	China proper	China proper	China Proper	China Proper
Observations	53,428	53,428	34,205	31,632	34,205	8,642
R-squared	0.065	0.539	0.532	0.556	0.357	0.898
#Grid	11,334	11,334	3,453	3,104	3,453	3,379

A similar robustness check is conducted on a subsample which only includes localities with greater than 100km distance from the Yellow River. The results concerning the impact of hydraulic public goods remain unchanged.

Table A.4: Robustness – Distance to Yellow River ≥ 100 km

VARIABLES	(1) Log Admin	(2) Log Admin	(3) Log Admin	(4) Log Admin	(5) Log Road	(6) Log Tax Per Capita
log Dist_War	-0.0522***	-0.0679***	-0.00155	-0.0887**	-0.0110	-0.239***
	(0.0138)	(0.0195)	(0.0598)	(0.0385)	(0.00820)	(0.0261)
log Dist_Yellow	-0.0753	-0.136*	0.129	-0.0816	-0.129***	-0.387***
	(0.0677)	(0.0784)	(0.144)	(0.190)	(0.0330)	(0.129)
log Pop	0.0473***	0.0547***	0.0787***	0.0492***	0.00663***	0.0204***
	(0.00284)	(0.00357)	(0.0135)	(0.00398)	(0.00148)	(0.00407)
L.Y	0.715***	0.703***	0.562***	0.688***	0.639***	
	(0.00494)	(0.00596)	(0.0190)	(0.00627)	(0.00522)	
L2.Y	-0.0161***	-0.0131**	0.0302	0.000157	-0.218***	
	(0.00501)	(0.00602)	(0.0197)	(0.00632)	(0.00534)	
log Dist_Capital	-0.125***	-0.128***	-0.138*	-0.246***	-0.0257**	-0.0455
	(0.0210)	(0.0252)	(0.0768)	(0.0594)	(0.0106)	(0.0277)
Model	Dynamic	Dynamic	Dynamic	Dynamic w Prov Trend	Dynamic	Dynamic
Sample	PRC	China Proper	Lower YR	China proper	China Proper	China Proper
Observations	48,401	30,299	3,002	27,833	30,299	7,301
R-squared	0.541	0.531	0.389	0.557	0.368	0.912
#Grid	10,424	3,054	379	2,712	3,054	2,842

A.5.2 Non-Typical Administrative Centers

This section replicates the results in Table 3 in Section 6.1 by including non-typical administrative units outside the county-prefecture system as part of the dependent variable. The dependent variable in Column (1) to (4) includes both county- and prefecture-level administrative units, regardless of the nature of the units. In other words, military bases, minority regions, and fiefs at both county- and prefecture-level are all included. The dependent variable in Column (5), on the other hand, includes only country-level units. The results are largely similar to the main results.

Table A.5: Robustness – Non-Typical Administrative Centers

VARIABLES	(1) Log Nadmin (all units)	(2) Log Nadmin (all units)	(3) Log Nadmin (all units)	(4) Log Nadmin (all units)	(5) Log Ncnty (all units)
prox_war	0.132***	0.0945***	0.0485***	0.0443*	0.0519**
	(0.0118)	(0.0181)	(0.0131)	(0.0251)	(0.0224)
prox_yellow	-0.0249	-0.0466	0.0264*	0.0219	0.0134
	(0.0330)	(0.0391)	(0.0150)	(0.0213)	(0.0199)

logpop		0.121***	0.0414***	0.0372***	0.0301***
		(0.00475)	(0.00288)	(0.00312)	(0.00291)
prox_capital	0.0587**	0.216***	0.0847***	0.158***	0.158***
	(0.0257)	(0.0292)	(0.0169)	(0.0418)	(0.0395)
L.Y			0.697***	0.684***	0.694***
			(0.00863)	(0.00887)	(0.00880)
L2.Y			-0.0142*	-0.00285	0.00633
			(0.00804)	(0.00816)	(0.00817)
Constant	-4.264***	-3.716***	-0.598***	-0.115	-0.0129
	(0.258)	(0.299)	(0.154)	(0.334)	(0.310)
Model	Panel	Panel	Dynamic	Dynamic	Dynamic
Observations	72,500	36,391	36,391	33,792	33,792
R-squared	0.036	0.072	0.528	0.552	0.562
Number of id_ngrid	3,454	3,453	3,453	3,104	3,104

A.5.3 Localities Gaining New Access to the Yellow River

To address the concern that the Yellow River levee breakouts may not be random, as they could be affected by local management, I restrict the sample to the localities that gain new access to the Yellow River. The idea is that the new course that the Yellow River would move into after a break out is arguably random, given the large area that the Yellow River could potentially flood. The result confirms that localities which gained new access to the Yellow River had higher level of state capacity.

Table A.6: Robustness - Localities with New Access to the Yellow River

VARIABLES	(1) lognadmin	(2) lognadmin	(3) logroad4	(4) logtaxpp
yellowin	0.401***	0.333*	0.340***	0.416
	(0.129)	(0.179)	(0.112)	(0.315)
prox_war	0.0756***	0.0499	0.0400	0.395***
	(0.0174)	(0.0423)	(0.0297)	(0.0908)
logpop	0.0560***	0.0667***	0.00666	0.0890***
	(0.00378)	(0.00903)	(0.00427)	(0.0114)
prox_capital	0.103***	0.156***	0.0823***	0.194***
	(0.0225)	(0.0434)	(0.0241)	(0.0380)
L.Y	0.684***	0.644***		
	(0.00630)	(0.0129)		
Constant	-1.045***	-0.252	1.898***	-2.894***
	(0.176)	(0.342)	(0.260)	(0.553)
Model	Dynamic	Dynamic	Panel	Panel
Sample	China Proper	North China Plain	North China Plain	North China Plain
Observations	36,391	8,459	8,459	1,985
R-squared	0.514	0.467	0.011	0.815
Number of id_ngrid	3,453	711	711	708

A.5.4 Contemporary China Boundary

This section replicates the results in Table 3 in Section 6.1 by using the sample of all grid cells within the boundary of contemporary China. The results are similar to the main results.

Table A.7: Robustness – Contemporary China Boundary

VARIABLES	(1) Log nadmin	(2) Log nadmin	(3) Log nadmin	(4) Log nadmin
prox_war	0.0847***	0.0906***	0.0603***	0.0317
	(0.00650)	(0.0170)	(0.0124)	(0.0219)
prox_yellow	0.0328	-0.0169	0.0603**	0.0602*
	(0.0459)	(0.0544)	(0.0237)	(0.0321)
logpop		0.137***	0.0472***	0.0448***
		(0.00529)	(0.00319)	(0.00353)
prox_capital	0.0798***	0.243***	0.118***	0.162***
	(0.0249)	(0.0351)	(0.0207)	(0.0504)
L.Y			0.701***	0.689***
			(0.00823)	(0.00838)
L2.Y			-0.0146*	-0.00646
			(0.00756)	(0.00766)
Model	Panel	Panel	Dynamic	Dynamic w. Prov Trend
Observations	241,886	56,389	56,389	53,752
R-squared	0.012	0.058	0.517	0.538
# id_ngrid	11,520	11,384	11,384	10,729

A.5.5 Lineages: Founding Years vs. Book Compiling Years

This section replicates the results shown in Table 6 in Section 7.2 that examines the interaction between lineages and state capacity's response to foreign wars. What differs here is that, instead of using the years that the lineages were founded, I use the years that the genealogy books were compiled as a measure of lineage activities. The results, however, are largely the same.

Table A.8: Robustness – Lineages (Book Compiling Years instead of Founding Years)

VARIABLES	(1) lognadmin	(2) lognadmin	(3) lognadmin	(4) logncnty	(5) logroad4	(6) logtaxpp
prox_war	0.0736***	0.0745***	-0.0188	0.0633***	0.0263**	0.245***
	(0.0173)	(0.0173)	(0.0746)	(0.0154)	(0.0121)	(0.0199)
prox_war*nclan_to		-0.00324**		-0.00368***	-0.00101	0.0231
		(0.00133)		(0.00121)	(0.00113)	(0.0270)
nclan_to	0.00430**	-0.0172**	-0.00644**	-0.0203***	-0.00137	0.186
	(0.00216)	(0.00865)	(0.00257)	(0.00780)	(0.00821)	(0.198)
prox_yellow	0.0601**	0.0602**	0.107*	0.0446**	0.0449**	0.252***
	(0.0235)	(0.0235)	(0.0625)	(0.0209)	(0.0184)	(0.0732)
logpop	0.0555***	0.0554***	0.105***	0.0471***	0.00851***	0.0269***
	(0.00378)	(0.00378)	(0.0245)	(0.00352)	(0.00192)	(0.00363)
prox_capital	0.0998***	0.102***	0.00982	0.128***	0.0636***	0.0642*
	(0.0225)	(0.0226)	(0.0708)	(0.0215)	(0.0157)	(0.0359)
L.Y	0.691***	0.691***	0.596***	0.703***		
	(0.00867)	(0.00867)	(0.0379)	(0.00868)		
L2.Y	-0.0102	-0.0102	-0.0643*	-0.00114		
	(0.00802)	(0.00802)	(0.0353)	(0.00800)		
Model	Dynamic	Dynamic	Dynamic	Dynamic	Panel	Panel
Sample	China proper	China proper	nclan_from>=1	China proper	China proper	China proper
Observations	36,391	36,391	2,527	36,391	36,391	8,836
R-squared	0.514	0.514	0.418	0.534	0.016	0.899
# id_ngrid	3,453	3,453	917	3,453	3,453	3,379

A.6 Simulation: Decentralization and The Great Divergence

Many scholars have contemplated the implications of decentralization on the development of Europe as well as the lack of decentralization and the scarcity of foreign wars in China's case (Montesquieu, 1989; Mokyr, 1990; Jones, 2003; Ko, Koyama, and Sng, 2018; Dincecco and Wang, 2018). In this section, I consider a thought experiment motivated by this literature: if historical China had decentralized polities with sizes similar to those of European countries, what level of state capacity would it have had? In this section, I utilize my estimates to provide a hypothetical answer to this question.

According to data from the World Bank, European countries[26] today have an average size of 135,065 km^2. In comparison, modern China has 33 provinces (22 provinces, 5 autonomous regions, 4 municipalities, and 2 special administrative regions). Excluding Xinjiang, Inner Mongolia, and Tibet, Qinghai, Heilongjiang, Jilin, and Hainan, the remaining 26 provinces roughly correspond to the boundary of the Ming dynasty in 1453 and has an average size of 159,239 km^2. Assume that China's history remains unchanged, with the exception that the Ming dynasty was divided into these 26 decentralized polities. In my data sample, the Ming dynasty had a national boundary of 43,753 km and 14 foreign war hotspots in the 15th century. Let's assume that in a hypothetical decentralized China, the same density of foreign wars would be fought on the boundaries of the decentralized polities, yielding a total of 22 foreign war hotspots.[27] I randomly choose 22 foreign war hotspots on the provinces' boundaries, and use the distance to these hypothetical foreign war hotspots to simulate state capacity under a decentralized China (with the dynamic panel model as specified in Section 5.1).

Figure A.4 below plots the simulated locations of foreign war hotspots, as well as the differences between a hypothetical distribution of state capacity in a decentralized China and the actual 15th-century distribution. Because decentralization resulted in many more foreign wars inside the China proper region as opposed to the northern and western boundaries, the decentralized polities have much shorter distances to war on average. This closer proximity to war increases the state capacity throughout the China proper region with two notable exceptions. One is the area close to the city of Beijing and, to a lesser degree, that to the city of Nanjing. In Figure A.4, these regions are shown to have a lower simulated state capacity compared to the actual 15th-century level (as denoted in green). The other exception is southwestern China, including parts of Guangdong, Guangxi and Yunnan, in which the simulation shows a similar level of state capacity as the actual 15th-century level. This is probably due to the fact that the Ming dynasty engaged in wars with Vietnam and briefly occupied northern Vietnam during this period (1407 - 1427). It therefore set up administrative and military apparatuses in the Guangxi-Yunnan region, which my analysis here does not capture.

[26] European countries used here include all members of the European Union, plus the United Kingdom, Switzerland, Norway, Bosnia and Herzegovina, Serbia, Kosovo, North Macedonia, Albania, and Montenegro.

[27] The decentralized provinces have a total boundary of 69,632 km, without duplicate counting the shared boundaries among provinces. Assuming that there was the same density of foreign wars, the decentralized provinces should have a total of 22.3 foreign war hotspots.

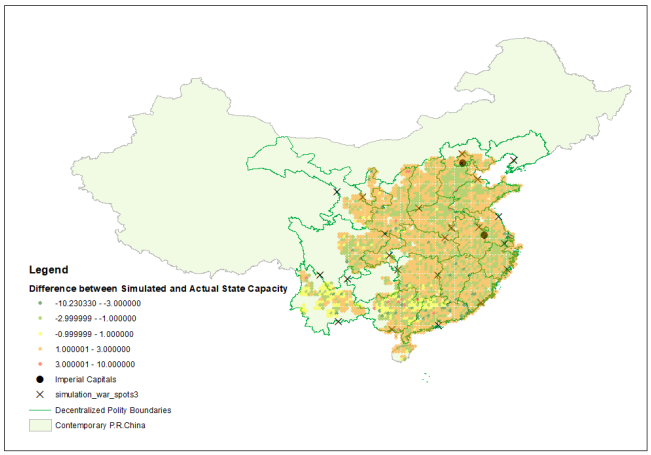

Figure A.6: Differences between a Hypothetical China under Decentralization and the Actual 15th-Century Level (Log Admin)

Under the same simulation, tax per capita of a decentralized China would be roughly the same as the actual 15th-century level, suggesting that the Ming dynasty already had a relatively high level of taxation compared to other dynasties. However, the distribution of tax revenue would be different. Figure A.5 reveals an east-west dichotomy. If foreign wars were more evenly distributed, taxation would be higher in the eastern provinces such as Hebei, Shandong, Zhejiang, and Anhui, and lower in the western provinces such as Gansu, Ningxia, Sichuan, and Guangxi. Combining Figures A.4 and A.5, one interesting fact is that the city of Beijing, the city of Nanjing, and their surrounding areas demonstrate a high level of administrative capacity and low taxation during the 15th century. This accords well with the fact that both cities had served as the imperial capital of the Ming dynasty, which might have contributed to the high level of administrative capacity and low taxation in these regions.[28]

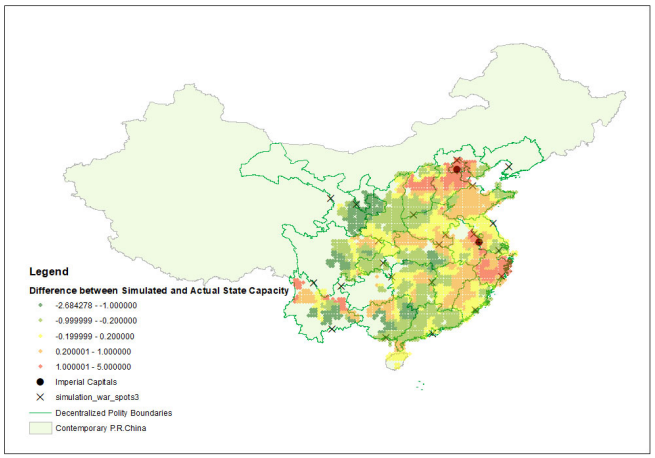

Figure A.7: Differences between a Hypothetical China under Decentralization and the Actual 15th-Century Level (Log Taxpp)

[28] The Beijing area has a wider gap between the simulation and the actual 15th-century level of state capacity. This is probably due to the fact that in 1403, the Yongle Emperor (r. 1402-1424) relocated the national capital from the city of Nanjing to the city of Beijing after his successful rebellion against the previous emperor. Subsequently, he may have lowered the taxes in this area in order to win over the support of the local people.

Admittedly, such a simulation relies on much randomness (for example, the locations of the foreign war hotspots) and many strong assumptions (for example, that the relationship between foreign wars and state capacity would hold constant). Yet, it provides some useful insights. Most notably, it demonstrates that because China achieved centralization over a large territory early on, its lack of foreign conflicts suppressed the development of state capacity throughout the China proper area, especially in the eastern regions.