State Formation and Bureaucratization: Evidence from Pre-Imperial China

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Abstract

How does one build a centralized bureaucratic state? A dominant view is that wars incentivize rulers to directly extract resources, thereby increasing state capacity. The Chinese empire, one of the earliest states to develop a centralized bureaucracy, can provide useful insights. Using hand-collected data, I present the first systematic evidence on patterns of wars, state-building and activity of political elites in pre-imperial China, and argue that they do not support the “war-makes-states” theory. Instead, I postulate that war can dampen state-building: when military threat is large, rulers need to incentivize agents to defend against invasion by giving them residual claims to the land. Then, I demonstrate increasing activity of non-nobles in state administrations, and argue that human capital is an important channel for state-building as it reduces the cost of administrative appointments. Furthermore, I postulate that increased productivity and incidence of civil unrest contributed to the increase in human capital by improving commoners’ access to and incentives for learning. I develop a model to formalize these claims, and test the model’s predictions in light of historical examples and data. I find that bureaucratic rule is more likely to transpire in regions that face less military threat, and when agents have weaker political connections.

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# Introduction

Building strong, functioning states\(^1\) has been a key objective of rulers and statesmen throughout human history. From ancient Egypt and medieval Europe, to premodern Japan and present-day Middle East, one can find many examples of success, and plenty more of failure. Yet, the question of how to build a centralized bureaucratic\(^2\) state has long remained a puzzle to both aspiring state-builders and scholars (Tilly 1992; Finer 1997; Ertman 1997).\(^3\)

The creation of a centralized bureaucratic state has profound implications for economic development. States play an important role in the provision of public goods (Besley and Persson 2011; Hoffman 2015), and can enhance the protection of property rights and encourage productive investments through limiting the use of violence (North et al. 2009; Bates et al. 2002; Olson 1993; de la Sierra 2018). The impact of state institutions on economic growth is also determined by the configuration of administrative power within the state (De Lara et al. 2008; Greif 2008). Every state administration involves the delegation of authority, and for a state to be strong, incentives of the ruling body and its agents must be aligned to a certain extent.

Through what processes, then, do centralized bureaucratic states form? Existing theories of state formation primarily draw from European history, and place a heavy emphasis on the role of warfare. The common argument is that wars incentivize rulers to build up their extractive capacity and create fiscal infrastructures (Hintze 1975; Tilly 1985, 1992; Olson 1993; Hui 2005; Zhao 2006; Besley and Persson 2009), and that wars and military competition forces state to adopt more efficient bureaucratic forms (Lewis 1990; Weber 1978).

The Chinese empire, on the other hand, had received much less attention in the literature. As one of the longest-lived authoritarian regimes, China serves both as a case of global importance in its own right, but also as a valuable case for understanding the formation and robustness of centralized bureaucracies. In the seventh century B.C., China was composed of over one hundred autonomous regional states (zhuhou guo 诸侯国) ruled by warlords and their vassals. Since then, the process of centralization and bureaucratization took off and continued for the next five centuries, accompanied by constant warfare among the regional states and frequent conquests of the weak by the powerful. This process eventually consummated in the birth of the Chinese empire in 221 B.C. that was consolidated under and “administered by a centralized bureaucratic government” (Creel 1964:155; Finer 1997:13,87,90). Remarkably, many of the institutional innovations developed then were to persist for the next two millennia, even though the first empire collapsed within fifteen

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\(^{1}\)A state, as defined by Weber (1946), is a monopoly on the legitimate use of physical force within a given territory.

\(^{2}\)Weber (1978:954) suggests that the ideal type of rational bureaucracy is characterized by qualifications-based appointment and promotion of officials, hierarchical organization and monitoring of officials based on written regulations, payment of salaries in money and officials who do not own their positions (Kiser and Cai 2003; Swedberg and Agevall 2005:19). It should be noted that no premodern administration ever reached such standard (Eich 2015:93).

\(^{3}\)Political theorists have extensively studied the selection of state agents, credibility of commitment and power-sharing among ruling elites, and how these affect the administrative forms of the government (Egorov and Sonin 2011; Acemoglu et al. 2010; Myerson 2008; Gehlbach et al. 2016; Boix and Svolik 2013). Others examine the roots of state-building through the lens of history, using as context premodern Europe (Hintze 1975; Tilly 1992; Mann 1993), Japan (Ikegami 1997; Jansen 2002) and Latin America (Centeno 2003; Arias 2013), and at times with a comparative perspective (Wong 2000; He 2013).
years of its founding.

In this paper, I hand-collect novel datasets on wars, administrative divisions, political elites, iron and bronze money over the Spring and Autumn Period (770-481 B.C.) and the Warring States Period (480-221 B.C.), leading up to the first empire. First and foremost, I argue that evidence in pre-imperial China does not support the “war-makes-states” theory. I show that, during the Spring and Autumn Period—the early stage of state-building—the major regional states of the Spring and Autumn Period achieved different degrees of state-building. Meanwhile, no positive relationship between warfare and state-building can be observed.

I also provide the first systematic evidence on patterns of state formation in pre-imperial China, and demonstrate that these patterns differ from what is stated in the literature. I use hand-collected data on political elites—most of whom were also the nobles—during the Spring and Autumn Period to show that wars were only responsible for 4% of 351 recorded elite exits, and around 92.59% of elite exits were attributable to their civil rivals. I also show that the exits of political elites were not entirely the consequence of rulers eliminating their local rivals. While rulers of regional states were responsible for only 20.7% of 251 unnatural deaths of political elites, nobles themselves were responsible for 62.15% of those deaths, suggesting that the aristocracy actively participated in many of the political struggles at the time.

Then, I document an increase in the political activity of non-nobles in the state administration over the Spring and Autumn Period, and an increase in the downward mobility of nobles in the second half of the Spring and Autumn Period. This is accompanied by an overall expansion in trade and commerce, which indicates a more widespread distribution of literacy and numeracy in the general population, and an improvement in productivity as reflected by an increase in the usage of iron tools.

Based on these findings, I propose (1) an alternative mechanism via which war affects state-building, and (2) human capital as another important channel for state-building. Firstly, war can dampen state-building because, in regions facing higher military threat, rulers may find it optimal to let the state agent claim residual rents from the region and therefore incentivize him to defend that region. Secondly, the emergence of a class of literate commoners with no political connections provided cheaper options for administrative appointment as opposed to nobles, thereby facilitating the centralization of military and fiscal powers. I make sure to discuss the connection between

\[ \text{A political actor exits politics if he dies of an unnatural cause or flees his home state and never returns. An individual is responsible for an elite's death if he directly committed the murder of that elite, or if that elite died in a civil conflict that he initiated. If multiple individuals were responsible, then I record the person with the highest political status.} \]

\[ \text{This is consistent with the claims of Hsu (1965:63-4), Lewis (1990:243) and Yang (1998:309-11), that wars in the Spring and Autumn Period lasted for at most a day or two, and likely produced limited destructive effects.} \]

\[ \text{This finding is in contrast to Kiser and Cai (2003), who postulate that warfare facilitated bureaucratization in pre-imperial China by decimating the aristocracy and killing "the main barrier to administrative reform". Zhao (2004), on the other hand, suggests that wars were more likely the consequence, rather than the cause of, bureaucratization in pre-imperial China.} \]

\[ \text{This is in contrast to the claim of Tilly (1992), that the process of state-building entailed the "elimination, neutralization and cooptation" of the ruler's local rivals for the case of Western Europe.} \]

\[ \text{This is similar to Gennaioli and Voth (2015) for the case of Western Europe.} \]
literacy and office-holding in the proper historical context. Going on step forward, I propose a potential mechanism that fostered the rise of literate commoners. I postulate that the improvement in productivity enabled a larger share of commoners to live off the land and invest time in learning; on the supply side, I postulate that commoners acquired literacy from nobles and literati who were displaced by coups and civil wars, and corroborate it using historical accounts.\footnote{According to \textcite{Lewis1999}, teaching was one way for a textually trained person to earn a living in the late Spring and Autumn Period and the Warring States Period. He also mentions the existence of tutors in wealthy families and perhaps even village school masters.}

Formally, I develop a model in which a ruler who faces external military threat appoints an administrator to manage the affairs of a land domain. He can give the administrator a patrimonial or a bureaucratic contract. The patrimonial administrator claims the domain’s taxation income and finances a private army for its defense; but a militarized administrator as such can cause damage to the ruler by initiating a coup or a civil war. Under the bureaucratic contract, the ruler claims the domain’s taxation income and finances an army for its defense; the administrator collects taxes on behalf of the ruler, and receives a wage in return. When foreign invasion happens, an administrator can choose to stay and defend, or to defect to the enemy; and for the bureaucratic administrator, staying to defend incurs an extra effort cost.

The model makes the following predictions: (1) bureaucratic rule is less likely to transpire in places that face greater external threat and have lower strategic importance, because directly controlling these places brings less value to the ruler; (2) bureaucratic rule is less likely to transpire when administrators’ political connections are strong, because these individuals have higher bargaining power.

I demonstrate that these predictions are consistent with empirical findings. Using data on bureaucratic counties and vassal fiefs in the state of Jin (one of the most powerful regional states in the Spring and Autumn Period) and consulting a set of historical maps, I show that an administrative division that was located near the state border at its time of establishment is at least 38% more likely to be a vassal fief, and an administrative division that neighbored a large state or a nomadic tribe at its time of establishment is 50% more likely to be a vassal fief. This result is robust to controlling for geographical characteristics and distance to the capital city. I also find no evidence that distance to the capital city, which proxies for the cost of monitoring and transportation, affected the type of administrative divisions. Then, using data on political elites who administered these regions, I show that the administrator of a fief is about 20% less likely to be a member of a small noble house, and around 20% less likely to have no membership to a noble house or to be a foreign exile. I also find no evidence that the family background of those administrators is correlated with local supply of talent. This is consistent with the historical fact that the selection of administrators was usually not restricted to local residents. I further discuss these predictions in the historical context of the major regional states of the Spring and Autumn Period for which data on vassal fiefs are unavailable. The states of Zheng, Song, and Wey, which were situated next to....
the military superpowers, failed to bureaucratize. The Chu, which was militarily strong and had a relatively weak noble class, was an early state-builder. The Qin, which was located on the cultural periphery, bureaucratized late despite being militarily strong.

This paper contributes to the large strand of literature that studies war and state formation. Many works now recognize that state-building is not uniform across space, and that the relationship between war and state-building is not homogeneous across states and time. For example, Gennaioli and Voth (2015) shows that war can stifle state-building when money is not crucial for military success. Similarly, I demonstrate that military and fiscal decentralization is more likely to transpire in regions facing more severe military threat.\(^\text{11}\) However, I attribute this result to the ruler’s need to provide greater incentives for his agents to protect these regions. Michalopoulos and Papaioannou (2014) and Sug (2014) demonstrate that state institutions and extractive capacity declines in regions that are distant from the capital. In contrast, I find no evidence suggesting that distance from the capital was a binding constraint for bureaucratic rule for the state of Jin.

Scholars have also explored alternative factors that can explain state-building. Gennaioli and Voth (2015) emphasizes on the effect of fiscal resources on military strength and states’ internal cohesion, Ko et al. (2018) and Koyama et al. (2018) examine the impact of the number and direction of external threats and the size of the affected state, and Centeno (1997) discusses the availability of alternative taxable resources. Adding to this list, I highlight the importance of human capital and how it affects the nature and the extent of extraction that rulers are able to implement. My findings are consistent with Ertman (1997), who theorizes that an increase in the supply of experts in post-1450 Europe enabled rulers to bureaucratize.\(^\text{12}\) I demonstrate that this channel has broader historical relevance, substantiate this theory by providing empirical evidence on state service and postulate a mechanism for the formation of human capital.

Lastly, human capital is often linked to innovation and economic growth, and much less to institutions. Cantoni and Yuchtman (2014) postulate that law graduates in medieval Germany became administrators and codified laws and regulations, which then led to the proliferation of markets and subsequently economic development. In a similar spirit, I propose that the absorption of new human capital into the state administration can produce important effects on political institutions and state capacity.

This paper is structured as follows. Section 2 outlines the relevant historical and institutional background. Section 3 describes the data, key empirical patterns, and motivates a conceptual framework. Section 4 develops a model based on this framework, and presents key results. Section 5 tests and discusses those results using historical data and examples. Section 6 concludes.

\(^\text{11}\)This also bears historical relevance to Tudor England, where the House of Percy had maintained a powerful presence in Northumberland for centuries.

\(^\text{12}\)More specifically, Ertman (1997) claims that the increase in the supply of experts is “a result of the proliferation of medieval universities, the growth and commercial and financial markets, and changes in military technology.” Using German princes as an example, he writes: “... between 1348 and 1498, 16 universities had been founded within central Europe, and between 1502 and 1648 another 18 would open, thus producing a steady stream of graduates trained in Roman and canon law suitable for positions in government service.” (p.244)
2 Historical and Institutional Background

In this section, I provide a brief outline of the history of Western Zhou, the Spring and Autumn Period and the Warring States Period, and highlight the important institutional developments.

2.1 Western Zhou: 1041-771 B.C.

The Western Zhou was located in present-day central China. The King of Zhou maintained a royal domain of his own, and established a number of regional states for purposes of peacekeeping and local administration. The rulers of the regional states—dukes (gong 公)—were kinsmen of the King and were given the rights to the administration of local affairs, collection of taxes, and maintenance of independent armies. Similarly, dukes appointed their sons and kinsmen to be high-officials (qing 職) and ministers (dafu 大夫), collectively called the qing-dafu, and assigned each individual a domain over which he enjoyed the aforementioned privileges.

Dukes and their qing-dafu were permitted to establish clans in their respective domains, and those clans formed the basis of the noble class of the time. Clans constructed cities, temples and dwellings in their domains, organized local agricultural production, and hired artisans and craftsmen to produce goods for their members’ consumption. They appointed retainers, who were usually nobles of a lower socio-political status, to manage household affairs and subjects in the domain. Since population growth would reduce land per capita, when an existing clan acquired new land, smaller branches of the clan would usually relocate to the new territory (Zhu 1990). Ties of kinship and solidarity among different branches of the same clan were reinforced through ceremonial and festive activities and the worship of common ancestors.

Male members of the nobility received proper education and military training, and were the elite warriors of the Western Zhou regime and its regional states (Huang 1998). Fighting in wars was an honorable and strictly upper-class business, though auxiliary functionaries such as infantrymen and laborers were performed by commoners and slaves. Similarly, participation in politics was generally restricted to members of the nobility, and was hereditary to the degree that the heir of a high-official or a minister was usually able to serve in the administration, but may not necessarily hold the same office as his father (Li 2008; Zhu 1990).

Dukes relied on the high-officials and ministers and their clans to rule the regional states. The qing-dafu held offices in the duke’s administration and provided services such as policy-making and counseling. They were also responsible for managing the affairs of their domains, though day-to-day operations such as the collection of taxes were carried out by retainers and clan members. In times of need, the qing-dafu supported the duke with private arms maintained by private resources for

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13 In Western Zhou, the concept of a state is very different from nowadays. A regional state comprised of a handful of cities and the land surrounding the cities, and there existed no clear borders between states (Zhao 1990). Even by the fall of the Western Zhou in 772 B.C., its “eastern domain was still not densely populated, and there were unclaimed lands scattered about... a major state could find plenty of open space among the existing states” (Hsu 1999:550). The state of Zheng (郑), for example, was able to relocate itself to a piece of unclaimed territory in the east prior to the collapse of the Western Zhou government.
purposes of peacekeeping and defense from nomadic tribes (Yang 2003).

Noble clans relied on the duke to maintain their political status and associated material wealth. Nominally, a high-official or a minister received domains and land benefices as payment for their services and as reward for making outstanding contributions to the duke (Hsu 1965; Zhao 1990). As long as member(s) of the clan held ministerial office(s) in the regional state administration, which was generally possible since offices were largely hereditary, that clan would be able to keep its domain along with its political and administrative privileges (Zhu 1990).

Overall, the duke and the nobility shared a rather symbiotic relationship. Yet there exists an inherent conflict of interest—the expansion of the political and economic powers of the nobility posed a threat to the duke’s power and authority (Li 2006). Moreover, giving out land benefices to elites meant a direct detraction from the stock of land controlled by the duke. Hence, the duke always had an incentive to constrain the power of the noble clans, even though their military and educational training were requisite for the administration of the regional state.14

### 2.2 Spring and Autumn Period: 770-481 B.C.

Following the collapse of the Western Zhou government in 771 B.C. and the relocation of the capital city, the old political order, in which the Dukes of regional states obeyed the command of the King of Zhou, also broke down. Regional states found themselves in an environment of increasing uncertainty, and the Spring and Autumn Period that ensued was characterized by frequent, albeit small-scale, warfare among those regional states.

At the beginning of the Spring and Autumn Period, political conditions and arrangements in the regional states remained largely unaltered. In the next few centuries, the rise of prominent noble clans was seen across many regional states, as statistically shown by Hsu (1965), along with signs of bureaucratization. The expansion of the political power of noble clans and the growth of their control over the states’ political and administrative affairs posed a considerable threat to the authority of dukes, and his led to political centralization across most major regional states, in the sense that power was becoming concentrated in the hands of a few. In 562 B.C., the three largest noble clans in the state of Lu (魯) divided the duke’s standing army into three divisions and each claimed command of one division; in 514 B.C., the six largest noble clans in the state of Jin (晉) exterminated the largest branches of the duke’s clan and formed a ruling coalition where the leader of each clan would take turns to rule as the head of state, and by 403 B.C., three of those six clans have exterminated the others and divided Jin into the states of Han, Zhao and Wei; in the states of Song (宋) and Zheng (鄭), political power was monopolized by a coalition of qing-dafu; and in the state of Qi (齐), the clan of Tian (田) became so powerful that its leader eventually took over the leadership of the state from Duke Kang of Qi (齐康公) in 379 B.C.

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14 Due to the scarcity of historical records of the regional states in the Western Zhou period, it remains unclear whether conflicts between the duke and the elites ever transpired, and if so, the form in which they transpired. What we do know is that contention among the nobility over land and economic resources in the royal domain—that is, the domain directly controlled by the King of Zhou—intensified visibly during mid Western Zhou (Li 2006, 2008).
Another significant change that took place during the Spring and Autumn Period was that local administration was becoming more structured. Since Western Zhou, the basic unit of organization in rural areas had been village settlements, and their affairs were overseen by either local elders or supervisors appointed by the domain overlord, or both (Du 1990). The organization of the domain was rather horizontal, in that there existed no levels of management between the overlord and his village supervisors.\footnote{It must be emphasized, however, that in some cases it was practically impossible to create an intermediate level of administration. Noble beneuces were not in general consolidated pieces of land, but composed of village settlements scattered across the regional state (Du 1990). This was also true of some noble beneuces during the Western Zhou period (Li 2008). It was likely a consequence of continued land assignment from the duke—members of the clan who served in the duke’s administration may receive rewards for providing outstanding services—and land assignment from the clan leader to smaller branches of the clan. If village settlements were not in proximity to each other, it would obviously be difficult to create a level of administration to manage their collective affairs.}

A new unit of administration—the county (xian 县)—emerged in the Spring and Autumn Period. At the beginning, counties were predominantly converted from conquered states and regions, and counties in the states of Jin and Chu (楚) bore strong military purposes—they were situated on the state border, their armed forces were under the duke’s direct command, and their tax revenue was submitted to the duke for military use (Yang 1981; Tan 2005). By 532 B.C., there had been forty-nine counties established in the State of Jin, and at least eighteen in the state of Chu (Zhao 1990; Gu and Zhu 2001; Zhou and Li 2009). Later on, the ruling class slowly moved beyond simply converting conquered states and regions into counties, and began to transform existing state territory into counties. In 635 B.C., Duke Wen of Jin (晉文公) established eight counties on a domain that was rewarded to him by the King of Zhou, and two of the eight counties were explicitly known to be duke-controlled administrative divisions (Zhou and Li 2009). In 510 B.C., six powerful noble clans in the state of Jin joined forces to exterminate two large branches of the royal clan, transformed their landholdings into ten counties, and appointed bureaucrats to be county magistrates (Zhou 2005).

The offices of county magistrates exhibited bureaucratic features.\footnote{It should be noted that some counties in the Spring and Autumn Period still retained features of noble beneuces.} Appointments were made directly by the duke; the office was not hereditary even though some appointees were still members of the nobility, and had no military or taxation powers attached to it. In the state of Chu, it was possible for a county magistrate to be promoted to the Minister of War in the central administration if he demonstrated sufficient talent (Gu and Zhu 2001).

\section*{2.3 Warring States Period: 480-221 B.C.}

This period is characterized by large-scale warfare, extensive political reforms and consolidation among the surviving states. The seven dominant states during this era were Qin, Qi, Chu, Yan and the Han, Zhao and Wei that split from the Jin.

The county as a bureaucratic division became widely adopted and much more structured. At a lower administrative level, cantons (xiang 乡) were established to govern villages and households;
and at a higher administrative level, commanderies (jun 郡) were established to govern the counties. Another notable difference is that, in the Warring States Period, counties were created in a bottom-up manner by grouping together nearby villages; whereas in the Spring and Autumn Period, counties were created in a top-down manner by converting conquered territory (Zhou 2005). A county now had artificially delineated boundaries as opposed to natural ones, and its magistrate either had a fixed term or could be replaced at the ruler’s will. The magistrate was responsible for both civil and military affairs, though Qin counties adopted a separation of civil and military offices after the reforms of Shang Yang (商鞅) in 356 B.C. (Yang 1998).

The selection of officers across all regional states began to take individual merit into account. As a result, many of the old noble clans became replaced by a “rising new nobility awarded rank in return for meritorious service to the state in government or warfare” (von Glahn 2016:58). The ownership of benefices became non-hereditary, and owners retained only economics powers—their political powers were curbed by the state. On the other hand, the shì class of the Warring States period comprised of peoples of mixed origins—declined nobles, professional warriors, and peasants and artisans who made an effort to climb up the ranks. They were bright, knowledgeable individuals who served social and political elites, and their success was a result of personal talent rather than familial connections (Zhu 1990).

By the end of this period, the Qin had developed a rather sophisticated bureaucracy. Elaborate rules governed selection, promotion, and advancement of officials, their ranks, salaries and performance (Yates 1995). Across every regional state, officials would submit budgets and forecasts on grain storage, cultivated land, taxes, household registrations to the King at the start of the year, and their end-of-year performance would be evaluated based on these numbers (Yang 1998). They faced demotion for bad performance, and fines and punishments for misreporting and violating rules (Pines et al. 2014).

3 Data Sources, Empirical Patterns, and Theoretical Framework

In this section, I document empirical patterns on wars and the political activity of elites during the Spring and Autumn Period, the establishment of counties, and evolution of commerce and productivity over the Spring and Autumn and Warring States Periods. I then present qualitative evidence on the nature of literary instruction during the late Spring and Autumn Period and Warring States Periods. Finally, I discuss how these facts and findings motivate the conceptual framework and the model.

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17For example, Shang Yang’s reforms in the Qin created a “system of merit based on service to the state that would supersede the privileges of the old nobility” (von Glahn 2016:56).

18Zhong Lian (仲连) of Zhao, Shen Buhai (申不害) of Han and Zou Ji (邹忌) of Qi all promoted meritocratic selection and developed a set of rules to evaluate the performance of state officials. Wu Qi (吴起) of Chu implemented policies that curbed the privileges of old noble lineages.
3.1 Data Sources

Counties. Data on counties in the Spring and Autumn and Warring States Periods are digitized from Zhou and Li (2009), which is a comprehensive study of regional and local administrative divisions in China. For each regional state, it contains information on the year and location in which the state created a county, the name of the county, the reason for creating the county if applicable, and whether the county was taken over by another state and when. From 722 to 221 B.C., a total of 240 counties were created by 16 distinct states (counting the three that split from Jin as separate states).

Fiefs. Data on noble fiefs in the state of Jin in the Spring and Autumn Period are compiled from Ma (2007), a study on the historical geography of the state of Jin. For each fief, I have information on its latest date of establishment and present day location. Moreover, using the historical maps of Jin contained in Ma (2007), I determine whether a fief or a county from the Zhou and Li (2009) dataset was situated on the state border at its time of establishment, and if so, what its neighboring states and tribes were. I also determine whether it was located next to major transportation routes or in strategically defensive positions.19 There are a total of 26 Jin fiefs and 28 Jin counties for which dates of establishment exist, and for which relative location within the state can be determined.

Wars. To construct the dataset on wars and conquests, I use the Catalogue of Historical Wars.20 There are 695 recorded inter-state wars during the Spring and Autumn Period and the Warring States Period. For each war, the Catalogue contains information on its time, place and duration, the participating states, the initiator states, and the target states. It also records the outcome of each war for all participants—whether they won, lost, had an indeterminate outcome, conquered a state or became conquered by a state.

Notables. I assemble a dataset of 1306 notables who were politically active during 722-468 B.C. in the seven major states of Qi, Jin, Chu, Lu, Zheng, Song and Wei. The notables include dukes, sons and grandsons of dukes, high-officials, ministers, the shi, court scribes and priests. Information on the names of the notables, their clans and surnames are digitized from genealogies of the Spring and Autumn clans.21 All notables have made appearance(s) in the chronicle of Zuo’s Commentary,22 from which I extract information on their first and last years of activity, title and office, and if applicable, the years in which they were involved in coups or civil wars, the cause of their death, and the year of their extradition.

Zuo’s Commentary is one of the two primary textual sources used by historians to study the

19Since states usually did not have clearly delineated borders during the Spring and Autumn Period, the maps provided in Ma (2007) had estimated borders instead. I define a county or a fief to be situated on the state border if it is within 30 miles of the estimated border, which is roughly the distance that can be covered by a walking horse in one day. Distances are measured on Google Maps, using straight lines between two points.


Spring and Autumn Period (Gu and Zhu 2001:27). For each year between 722 and 468 B.C., it recounts important political, diplomatic and military events from the perspective of the state of Lu, at times with a great amount of detail. Thus, it is appropriate to think of individuals who appear in the Commentary as having an adequate level of political activity and importance. The Commentary adopts the following format: each chapter corresponds to a specific year, and a chapter begins with an entry from the Spring and Autumn Annals for that year, followed by a narrative which elaborates on this entry. Below is an excerpt from Year 17 of Duke Huan (695 B.C.), translated by Durrant et al. (2016:129-131):

**Annals** In summer, in the fourth month, on the bingwu day (16), we did battle with Qi troops at Xi.

**Zuo** In summer, we did battle with Qi troops at Xi: this was a border dispute. At that time, the men of Qi had encroached upon the Lu borders, and a border official had come to report this. Our lord said, “In the affairs of border regions, take care to maintain the integrity of the border and prepare for the unexpected. Meanwhile, complete all the preparations there, and when something happens, then fight. What is there to come calling about?”

**Bronze Money.** I compile a dataset of excavations of bronze money using Huang (2001), a study of money and coins in the major states of the Spring and Autumn and Warring States Periods. It contains a summary of archaeological records of shell money and bronze coins prior to 221 B.C. Each record has information on the location and year of excavation, the number of coins discovered and the types of coins discovered, and the character engravings on the bronze coins. Using the information on coin types, I derive an estimate of the time of mintage of the coins.

**Iron Artifacts.** I collect a dataset of iron artifacts from Western Zhou to the Warring States Period using Bai (2005:23-29, 54-111). This is a comprehensive survey of iron technology prior to and during the Han Dynasty that draws extensively from archaeological excavations. Chapter 2 (pp.23-29) contains a complete listing of iron artifacts that date back to the Western Zhou and the Spring and Autumn Period. Chapter 3 contains a complete listing of all types of iron artifacts that date back to the Warring States Period—it is impossible to compile a list of all excavated iron artifacts for this period because there are too numerous. For each artifact or type of artifact, the dataset contains information on its place(s) of excavation and the approximate time(s) of forgery. To date, a total of 91 artifacts that were forged prior to the end of the Spring and Autumn Period had been found in 8 different states.

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23The other source is the Spring and Autumn Annals, which is the official chronicle of the State of Lu and was written by Confucius. It is included in the Five Classics of Chinese literature.
3.2 States and Their Geography

Historians do not have direct evidence on the exact number of regional states established by the King of Zhou, but many believe that there may have been more than two hundred. Approximately 148 states appeared in the *Spring and Autumn Annals* and *Zuo’s Commentary*. Many of the smaller states became annexed by powerful neighbors, and around 22 survived into the Warring States Period (Yang 1998:278).

Figure 1: Major States of the Spring and Autumn Period. Source: Hsu (1999:548)

Figure 1 is a map of the major states of the Spring and Autumn Period, showing that they were located in modern-day central China and their arena of activities was the Yellow River basin and the eastern peninsula. States that are boxed in red—Qi, Jin, Wey, Lu, Zheng, Song and Chu—are the major regional states for which biographical information on political elites exist, and will be examined in greater detail. They were also the politically important and active states which maintained a continued presence throughout the Spring and Autumn Period, and constitute a majority of our understanding of this historical period. All of them survived into the Warring States Period. Qin (boxed in blue) is also important as it was militarily strong and eventually unified China. However, textual information on Qin is very limited during the Spring and Autumn Period as it was situated on the periphery of the Central Plain and was distant from the center.
stage of political activity. I will complement the discussion by referencing related archaeological works.

### 3.3 Patterns of Wars and State-Building

In this subsection, I first present data patterns on state-building. Then, I examine the relationship between wars and counties, and show that the classical theory— which predicts a positive relationship between war and state formation— is not supported by the empirical evidence from pre-imperial China. As previously discussed in Section 2, counties are bureaucratic administrative regions from which rulers directly extracted resources. In my analysis, I use the number of counties as a measure for the degree of state-building.

#### 3.3.1 Patterns of State-Building: Counties

Panel A of Table 1 contains a summary of the data on counties. The number of newly created counties has been steadily rising over time, indicating an increasing tendency towards state-building. Into the Warring States period, counties were established across a majority of the states, often as a deliberate measure to centralize control. Among the 161 counties whose dates of construction are unknown, 123 were established by Qin throughout the Warring States period. Meanwhile, the major regional states of the Spring and Autumn Period display stark differences in their degrees of bureaucratization. In Panel B of Table 1, I show the number of counties established by Jin, Chu, Zheng, Song and Qin. It is clear that Jin and Chu were the early state-builders. The Qin, which eventually unified China in 221 B.C., engaged in aggressive state-building only since the Warring States Period. In contrast, Zheng and Song each established only one county prior to their eventual conquests by Han in 385 B.C. and Qi in 286 B.C. respectively. They have visibly fallen behind in the state-building process.

Now, I briefly discuss the cases of Lu, Wey and Qi, which are among the major Spring and Autumn states that this paper focuses on. The states of Lu and Wey had no records of the xian (counties), but their cities (yi 邑) exhibited exactly the same features as counties (Zhou and Li 2009:290-91). The cities were of two types—ones that were controlled by the Duke, and ones that were controlled by powerful qing-dafu; the administrators of those cities were also selected by the Duke and by the qing-dafu respectively. Lu had 9 such cities on record before 516 B.C., while Wey had 2. Moreover, according to Zhou and Li (2009), the possibility that the state of Qi instituted counties in the Spring and Autumn Period was quite small (p.293). Into the Warring States Period,

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24For example, Prime Minister Shang Yang of the state of Qin instituted forty-one counties and re-structured county-level administrations as part of his self-strengthening reforms.

25As described in Section 2, the Jin split into the three states of Zhao, Han and Wei in 403 B.C. Thus, from the mid Warring States Period onwards, I display the number of counties instituted by each of those states in the exact order of Zhao, Han and Wei under the same column as Jin. Since the Zheng became conquered by the Han in 375 B.C., the cells for mid and late Warring States Periods are not applicable to Zheng.
the Qi was recorded to have many counties, but information on the names, locations and dates of establishment only exist for 24 of those counties (p.313).

In short, the major regional states of the Spring and Autumn Period all achieved different degrees of state formation.

### 3.3.2 Relationship between War and State-Building

The Spring and Autumn Period is characterized by repeated warfare among the regional states. The scale and intensity of wars were relatively small at the beginning, as warriors were primarily composed of members of the aristocracy.\(^{26}\) As military recruitment expanded to include all commoners towards the end of the Spring and Autumn Period, the size of armies also grew considerably. The main instruments of war were chariots, and weapons were largely made of bronze. In a typical battle, chariots would be deployed on both sides of an open plain, arranged in certain tactical formations, and combat would begin when both armies were within range. The outcome of the battle would be determined as soon as one army’s chariot formation became broken, and therefore wars were usually small and brief (Hsu 1965:63-64; Lewis 1990:243; Yang 1998:309-311).

Using the data on wars, I decompose the 501 years between 722 and 222 B.C. into sixteen 30-year periods and one 21-year period. For the regional states of Chu, Jin, Zheng, Song, Qin, Qi, Wu, Yue, Zhao, Yan, Han and Wei, I compute the total number of wars that each state was involved in for each time period, and produce a scatterplot of the number of wars against the number of new counties that they constructed.\(^{27}\)

This plot is displayed in Figure 4. In addition, in Table 3, I regress the number of newly constructed counties on the number of wars. Column 1 displays a positive correlation between the two variables, which is statistically significant. Columns 2 and 3 show that this relationship is driven by the state of Qin in the late Warring States Period, and that it disappears once those observations are excluded from the sample. Therefore, empirical evidence does not support the classical “war-makes-states” theory.\(^{28}\)

### 3.4 State Administrators

In this subsection, I examine the composition of state administrators in the Spring and Autumn Period, and provide evidence that there had been an increase over time in the political activity of commoners, especially in the latter part of the Spring and Autumn Period.

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\(^{26}\) In the 7th century B.C., the states of Qi and Chu were known to have armed forces of around twenty to thirty thousand warriors (Yang 1998:309).

\(^{27}\) These are the major regional states of the Spring and Autumn and Warring States Periods. I exclude Lu and Wey because they had cities instead of counties, and no accurate data exist on the dates of establishment of those cities. I assume that the state of Qi had zero counties during the Spring and Autumn Period according to Zhou and Li (2009:293).

\(^{28}\) In addition, in Section A.1 of the Appendix, I show that wars were not the major cause of the deaths of political elites. Instead, most of the deaths were attributable to coups and civil wars, in which nobles themselves were active participants.
The state administrators comprise of the high-officials, ministers and the *shi*. As previously mentioned in Section 2, important administrative offices in the Zhou regional states were held by the *qing-dafu*, and were to a large degree hereditarily.

I identify nobles and commoners in two ways. The first way is by examining clan names. In the Spring and Autumn Period, noble clans were known by their clan names, and a noble man would be formally addressed by the name of his clan. Clan names were distinct from clan members’ patrilineal surnames, and were often derived from the names of the places at which clan domains were located (*Du 1990*). A man of noble origins would inherit his father’s surname; in some cases, he would also inherit the name of his father’s clan, and in other cases, he may establish his own clan and adopt a different clan name. Therefore, an individual without a clan name on record is very likely to be a commoner. On the other hand, having a clan name does not necessarily mean having superior socio-economic status, as declined nobles also kept their clan names.

The second way is by examining the *shi*. In the Spring and Autumn Period, the *shi* served as warriors or performed various functional roles such as stewards and advisors to dukes and the *qing-dafu*. The pool of talent from which they were chosen “was swelled by former noblemen who had lost their status” (*Hsu 1999*:583). Over time, the *shi* class expanded to include the most capable commoners (*Gu and Zhu 2001*), and towards the end of the Spring and Autumn Period, no distinction could be made between men of noble and commoner origins in the *shi* class (*Yu 2003*). Into the Warring States Period, the *shi* provided services to social and political elites.

Figure 5 displays the share of *shi* (in black) in all administrators, and the share of administrators who did not have a clan (in blue). The share of non-noble state administrators has been increasing over the entire Spring and Autumn Period. The share of *shi* is also rising over time—and since the origin of the *shi* became increasingly mixed, this is also evidence that individuals from the lower social strata became more and more active in administrative capacities.

Restricting attention to only the high-officials and ministers (*qing-dafu*), this pattern still holds true for the second half of the Spring and Autumn Period. Figure 6 displays the share of commoner-origin ministers (in black), high-officials (in blue) and both (in green) in all *qing-dafu*. The share of commoner-origin ministers decreases over the first half of the Spring and Autumn Period, and visibly increases over the latter half. This shows that the origins of ministers were becoming increasingly mixed towards late Spring and Autumn Period.

On the other hand, the offices of high-officials were clearly monopolized by the nobles throughout the entire Spring and Autumn Period. Into the Warring States Period, however, 48 out of 79 active prime ministers across all regional states were not known to have ties to the nobility, demonstrating that non-nobles were eligible for and capable of holding the highest office in a state (see Table 2). Together with the evidence on *shi* and ministers, it seems to be the case that the substitution

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29 This is consistent with *Hsu (1965)*, who undertook a systematic study of social stratification and mobility during the Spring and Autumn Period. He found that there had been an increase in the activity and importance of the *qing-dafu* until 602-573 B.C., followed by a gradual decline; and an increase in the concentration of *qing-dafu* in prominent clans.

30 Data source is Chapter 2 of *Hsu (1965)*.
towards non-nobles in administrative roles began from the lowest level of administration and slowly penetrated to the top of the hierarchy.

When we consider the historical conditions in the late Spring and Autumn Period, then the claim that there was increasing upward mobility for persons with little political connections over the latter half of the Spring and Autumn Period is very likely to be true. Yu (2003:15-17) examines a number of historical accounts and argues that channels for commoners to move up the social ladder (one of which was by becoming a scholar) already existed by the end of the Spring and Autumn Period, and that it was not uncommon for peasants to become a *shi*. Into the Warring States Period, as discussed in section 2, the *shi* class comprised of peoples of very different backgrounds. Some of them were hired by powerful ministers as retainers to provide counseling and lobbying services and to handle certain administrative tasks. It was possible for retainers to be recommended by their hosts to receive official appointments from the king (Yang 1998:465).

Moreover, I show that while upward mobility for non-nobles had been increasing, downward mobility of incumbent nobles was also on the rise, suggesting that incumbents were being substituted out of office-holding. Figure 7 presents evidence that the hereditariness of the offices of high-officials and ministers increased in the first half of the Spring and Autumn Period, and gradually broke down over the second half of the Spring and Autumn Period. The black line is the share of *qing-dafu* who had at least one son of equal or higher status in all *qing-dafu*; the blue line is the share of *qing-dafu* who had at least one son of equal or higher status in the subsample of *qing-dafu* who were recorded to have sons.

From this graph, it is clear that the share of *qing-dafu* who were able to pass their offices to their sons rises to reach a peak in 602-573 B.C., and then declines. The same trends hold if I calculate this share for the subset of *qing-dafu* who were recorded to have sons. This pattern is consistent with the historical reality portrayed in Section 2—the initial increase in the probability of passing offices to sons indicates an overall rise in the power of *qing-dafu*, and the subsequent decrease in this probability reflects the attrition of noble clans in the civil rivalry and power struggles, and therefore greater downward mobility for some members of the nobility.

The claim that there had been stronger downward mobility of nobles is also consistent with historical accounts. Elites who were defeated in civil strife and therefore exited politics were forced to give up their wealth and land to expropriation. For ones who were recorded to have fled to foreign regional states, only a very small fraction were able to receive official appointments there, and those who did not would then have to find some other means to make a living.

While this data does not cover the state of Qin, some archaeological findings can shed light on the social mobility of Qin in the Warring States Period. On the one hand, the disappearance of ritual bronze vessels and their ceramic counterparts from Qin mortuary indicates that the aristocracy

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31 Again, this is consistent with the finding of Hsu (1965), that there had been an increase in the activity and importance of the *qing-dafu* until 602-573 B.C., followed by a gradual decline.

32 Du (1990) also argues that the overgrowth of the ruling class population led to a decline in social status for most nobles. An anecdotal example of this would be Yan Hui, who was a student of Confucius and was active in 521-481 B.C. Even though Yan was recorded to have come from a lowly background, his ancestors had served as a high-official for the state of Lu for fourteen generations while his grand-father was a mere city steward (Zhao 1976:157-158).
was fatally hit by Shang Yang’s reforms (Shelach and Pines 2005:210-212). Regulations regarding unranked descendants of the ruling clans also helped accelerate downward mobility of the nobles (Hulsewé 1985:174). On the other hand, writings discovered from Qin tombs of the late Warring States show that newborns had a wide range of prospects from becoming a high-ranked minister, to becoming a state official, to becoming relegated to a bondservant (Wu 2000:291-311). This suggests that there existed channels of upward mobility for individuals of humble origins.

3.5 Literary Instruction

In this subsection, I discuss the nature of literary instruction in the Spring and Autumn Period, potential channels via which individuals of commoner origin could receive such instruction, and the relationship between literacy and office-holding. Where possible, I use historical anecdotes and records to complement my discussion.

Since the Western Zhou, education had been an exclusive privilege of the noble class (Chen and Zhang 2009). Private instructors who taught in public began to appear on historical records since the late Spring and Autumn Period. A famous example would be Confucius (551-479 B.C.), who began to teach publicly at the age of 23, and traveled to at least seven other regional states to spread his teachings and philosophy.33

The origin of private instruction remains obscure, but a glimpse into the classical texts may provide some insights, suggesting that civil unrest could force the literate individuals to be displaced, to experience a decline in status and to possibly seek others means to support themselves. An excerpt from the Commentary reads “when the officers of the son of Heaven are not properly arranged, we may learn from the wild tribes all round about”; a Prince of Zhou who was defeated in a civil war was recorded to have brought along court classics as he fled to the state of Chu.34 A paragraph from the Analects (Book 18, no.7) describes an instance of court musicians leaving for foreign states as the situation in their home state worsened.

Teaching was indeed one way for a textually trained person to make a living since the late Spring and Autumn Period (Lewis 1999:75). Records from the Analects, the Xunzi, the Han Feizi and the Zhuangzi all show that teachers at a high level received tuition and gifts from students, and some were even able to make a fortune. Lower level teachers could have taught at or founded village schools, which were mentioned in the Mencius.35 That literary instruction was to some degree accessible to non-nobles can be seen in excerpts from the Zhuangzi and the Han Feizi. The shi of the states of Lu and Zou were commended for being well-educated in literature, poetry and music; and by the time of Duke Ping (reign 558-532 B.C.), one-quarter of the citizens in the capital

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33 Other notable private instructors of the late Spring and Autumn Period include Deng Xi (545-501 B.C.), a minister in the state of Zheng; Guqiu Zilin, who taught Zichan, who later became the prime minister of Zheng; Shaozheng Mao (?-500 B.C.), a minister in the state of Lu; Mozi, who was born in an artisan family; Zixia and Ziyu, who were students of Confucius.

34 Years 17, 26 of Duke Zhao of Lu.

35 Teng Wen Gong Shang, Paragraph 3; Liang Hui Wang Shang, Paragraph 3.
city of Jin abandoned businesses and took up literature.\footnote{Zhuangzi, Chapter Tian Xia; Han Feizi, Chapter Wai Chu Shuo Zuo Xia.}

On the other hand, an advanced level of literacy could lead to a career in state service in the Warring States period (\textit{Lewis 1999:79}). This channel probably already existed by the late Spring and Autumn Period, if we closely examine the famous disciples of Confucius. Out of the 24 disciples for whom biographical information exists, one served as the prime minister of the states of Lu and Wey, six served as city stewards, and four served as retainers for the most powerful clan in the state of Lu; two were invited to hold administrative offices but declined, and one was studying with an eye to an official career (\textit{Lau 1979}). Confucius himself was appointed as the Minister of Crime in 500 B.C. Moreover, six of his disciples were known to be commoners or have come from poor families, showing that education had been somewhat accessible to ordinary people—they needed to have studied basic literacy before becoming disciples of Confucius.\footnote{Prime minister: Zigong. City stewards: Ziqi and Zijian for Shanfu, Zigao for Hou, Ran Boniu for Zhongdu, Ziyou for Wucheng, Zixia for Jufu. Retainers: Yuan Xian for Confucius when he was Minister of Crime; Zichi, Ran Yong, Ran You, Zilu for the Ji clan. Declined: Min Ziqian and Qidiao Kai. Poor: Zisi, Zeng Xi, Zengzi, Yan Hui, Ran Yong and Zixia. Zichi once asked Confucius about farming techniques, so he might also have come from a peasant family (Book 13 of the \textit{Analects}).}

One may wonder why literacy was preferable, or perhaps requisite, for office-holding. This can be explained by the fact that many forms of administrative documents were being widely used. In the Spring and Autumn Period, records from \textit{Zuo’s Commentary} indicate that ministers of regional states engaged in letter correspondence with each other, that states signed covenants (\textit{zai shu} 载 书) to settle war disputes, that diplomatic papers (\textit{guo shu} 国书) were used to deal with inter-state relations, and that the state began to use population registers by as early as the eighth century B.C. Into the Warring States Period, written laws and regulations, written transmission of orders between superiors and subordinates, and household and population registers were widely used in the local administration;\footnote{Documents excavated from Yunneng and Baoshan tombs contained “rules for official conduct, guidelines for keeping accounts, procedures for the inspection of officials... maintenance of official stores and records... [and instructions] for officials in the proper conduct of investigations and interrogations so as to secure accurate results and transmit them to the court.” (\textit{Lewis 1999:22})} statistical and written reports were submitted to the central administration to regulate the behavior and assess the performance of lower level officials (\textit{Yang 1998}).\footnote{“Baoshan texts record large numbers of cases transmitted from local officials to the central court for adjudication. These include instances of failure to register population, denunciations by one official of the high handed behavior of another, and remarks by higher officials on a variety of criminal cases. The documents record the plaintiffs and defendants, the officials who first examined the case, and those to whom reports were sent.” (\textit{Lewis 1999:28-29})}

### 3.6 Theoretical Framework

Thus far, I have presented evidence for (1) divergence in state-building across the major states of the Spring and Autumn Period, and (2) an increase over time in the political activity of non-nobles and in the downward mobility of nobles especially in the second half of the Spring and Autumn Period. In addition, in Appendix A.1, A.2 and A.3, I demonstrate that (3) coups and civil wars were the main mechanism via which incumbent nobles became displaced; (4) there had been a
growth in trade and commerce, which is indicative of a more widespread distribution of literacy and numeracy skills across the population; and (5) there had been an increase in the use of iron tools in production, which likely led to an increase in manufacturing and agricultural productivity.

Now, I use these findings to motivate a theoretical framework, which will be formalized in Section 4. First, I propose human capital as a determinant for state-building: the rise of a class of learned men of commoner origins facilitated state formation and bureaucratization by reducing the cost of administrative appointment. Those men were qualified for office-holding and therefore competent to serve the ruler’s needs, and they had weak political connections and therefore little external support for any private interest they may wish to pursue. This would make them desirable candidates for administrative appointment, thereby enabling the ruler to remove powers attached to office-holding and to achieve centralization.

Second, I propose a mechanism via which war can dampen state-building: in regions that face high military threat, the ruler may find it optimal to choose fiscal and military decentralization. By conceding residual rents from the region to his administrator, he can provide the administrator with stronger incentives to defend the region. In contrast, a bureaucrat receives a fixed wage, and is less committed to defending that region.

In addition, I postulate a conjecture to explain the emergence of those learned commoners. Discussion in Section 3.5 suggests that coups and civil wars possibly created a channel for non-nobles to access education by displacing the literati and other learned men and forcing them to find alternative means to make a living, one of which was by teaching. Meanwhile, increased productivity and specialization (as reflected in observations 4 and 5 and discussion on urbanization in Section A.2) would enable a greater share of the population to live off the land and participate in non-productive activities, one of which would be learning. That some commoners did engage in learning and that learning did lead to state services can be seen in historical references presented in Section 3.5.

One may wonder why coups and civil wars transpired. They were likely caused by the erosion of kinship solidarity over time and intensifying competition over resources. In the Western Zhou and the Spring and Autumn Period, dukes and qing-dafu of wealthy clans apportioned settlements and lands among various family branches, leading to fragmentation of resources (von Glahn 2016:49). Moreover, nobles of the time practiced polygamy—strictly speaking, they had one wife and a number of concubines—thereby giving rise to larger clans and families. Both would have an effect of exacerbating resource contests.40

40The Commentary contains a number of records of noble competition over land and wealth. Examples can be found in the following chapters: Year 2 of Duke Min; Years 7, 16 of Duke Cheng; Years 19, 29 of Duke Xiang; Years 3, 7, 8, 10, 13, 14 of Duke Zhao and so on. Note that this does not imply that the precise causes of all civil strife had to be about resources—the resource problem can also indirectly increase the incidence of civil strife by increasing the range of situations in which conflicts of interest between noble clans transpired, thereby increasing the range of situations in which conflicts of interest escalate to physical conflict. This can be illustrated by an example from Year 10 of Duke Xiang in Zuo’s Commentary: Zisi, the Prime Minister of Zheng, ordered the construction of irrigation ditches in farm fields; he and some fellow clan members were then murdered by nobles who suffered land losses from the construction.
4 Model

In this section, I develop a model to formalize the conceptual framework described in Section 3.6. The model links changes in human capital to changes in political institutions. In the Appendix, I include an extension of the model that incorporates production, labor market and learning.

In this model, there is one ruler, \( N_n \) nobles and \( N_c \) commoners. The ruler directly controls a royal domain of size 1, and needs to appoint an administrator to manage a domain \( D \) of size \( d \in (0, 1) \). Each unit of land produces output \( y \) and the tax rate on produced goods is \( t \).

An individual \( i \) has a vector of characteristics \((\theta_i, \kappa_i, l_i)\). \( \theta_i \in \{\theta_L, \theta_H\} \) represents administrative talent and literacy, \( \kappa_i \in \{\kappa_L, \kappa_H\} \) represents individual \( i \)'s ability to mobilize social or political forces in opposition to the ruler, and \( l_i \in \{0, 1\} \) represents his loyalty to the ruler. I make the following assumptions:

- Nobles have \( \kappa_i = \kappa_H \), because noble clans have strong social and political influence. Commoners have \( \kappa_i = \kappa_L \).
- Only individuals with \( \theta_i = \theta_H \) are qualified for administrative appointment, because literacy is important for many offices. Nobles have \( \theta_i = \theta_H \), because they receive education in their clans and can learn from clan members who hold offices. Commoners have \( \theta_i = \theta_L \) by default, and can only increase \( \theta_i \) to \( \theta_H \) if they invest time in learning.
- The ruler cannot observe loyalty \( l_i \). An administrator is loyal \( (l_i = 1) \) with exogenous probability \( q \), and disloyal \( (l_i = 0) \) with probability \( 1 - q \).

Finally, an individual’s outside option is given by \( v_i = a_v \kappa_i \theta_i \). It is increasing in \( \kappa_i \) because more rents are needed to please high-\( \kappa_i \) individuals. It is increasing in \( \theta_i \) because high-\( \theta_i \) individuals have a wider range of outside options—they can seek careers in state services, teaching or ritual services, fields of proto-science and philosophical schools.

4.1 Basic Setup

The self-interested ruler appoints an administrator to manage domain \( D \), from which he derives a benefit of \( b = ad \).\(^{42}\) Domain \( D \) produces taxable output \( \tau_D = dty \) and needs military protection from a foreign army of size \( m_F \).

\(^{41}\)In historical reality, the “ruler” can adopt a broader interpretation than just the duke. In other words, the “ruler” embodies one individual or a group of individuals who can dictate state affairs. In the state of Jin, for example, state politics were controlled by a coalition of powerful noble clan leaders for a hundred years before the three most powerful clans exterminated the others and “bureaucratized” their domains.

\(^{42}\)This benefit could derive from holding strategically significant positions such as high grounds, natural barriers or choke points, managing important natural resources such as forests, rivers or mineral ores, being able to collect information about things happening in and around the domain, or simply instituting a trusted subordinate in a place so that he can support the ruler in times of need.
After an administrator is appointed, tax receipt $\tau_D$ is collected and military investment $m_i$ is made to defend domain $D$. Then, foreign invasion happens. If defense is successful, the remaining rents $\tau_D - m_i$ are consumed; otherwise, nothing is consumed. In line with the literature on conflict (Dixit 1987; Skaperdas 1996), the probability of successful defense is modeled by the contest success function:

$$P(m_i, m_F) = \frac{m_i}{m_i + m_F}$$  \hspace{1cm} (1)

In appointing the administrator, the ruler can choose from two types of contracts: patrimonial (P) and bureaucratic (B). The key trade-off between the two contracts is as follows: a patrimonial administrator has full incentives to defend the domain, but can be disruptive as he is militarized; a bureaucrat is peaceful, but may defect to the enemy and not defend the domain. Note that the ruler’s choice of contract is constrained by the administrator’s outside option.

1. **Patrimonial contract**: the administrator claims taxes $\tau_D$ from domain $D$, and chooses $m_i$. When foreign invasion happens, the administrator always defends. If defense is successful, he will consume the remaining rents, and the ruler will get his derived benefits $b$. Then, the militarized administrator can choose to start a coup or civil conflict. If he does so, he will receive a gain of $x$ and cause a damage of $\epsilon x$ to the ruler, where $\epsilon \in (0, 1)$; a loyal administrator will suffer a cost of $c$, while a disloyal administrator suffers no cost.

2. **Bureaucratic contract**: the ruler claims taxes $\tau_D$ from domain $D$, and chooses $m_i$. When foreign invasion happens, the bureaucrat can choose to defect or to defend.
   - If he defects to the enemy, the ruler will get nothing, and the bureaucrat will get his full outside option $v_i$ with certainty.
   - If he defends, and defense is successful, the ruler will get his benefits $b$ and the remaining rents, and the bureaucrat will receive a wage $w_i$. A disloyal bureaucrat incurs an effort cost $e$ when defending, while a loyal bureaucrat incurs no cost.

The gameplay is summarized by Figure 7 above. Actions are indicated in blue. The ruler’s payoff from domain $D$ and the administrator’s payoff are included at the end of each node.

Below, I state the payoffs and utility maximization problems for the ruler and the administrator under the two contracts.

**Patrimonial Contract.** An administrator with loyalty $l_i$ will choose $m_i$ to solve:

$$\max_{m_i \leq \tau_D} P(m_i, m_F) [\tau_D - m_i + l_i(1)(x > c)(x - c) + (1 - l_i)x]$$  \hspace{1cm} (2)

Recall that the ruler does not know the loyalty of the administrator. Letting $m_{i,d}, m_{i,l}$ denote the military investments made by the loyal and the disloyal administrators respectively, the expected payoff of the ruler is:
**Bureaucratic Contract.** The ruler first chooses $m_i$ to maximize his expected payoff from domain $D$:

$$\max_{m_i \leq \tau_D} P(m_i, m_F) \left[ \tau_D - m_i + b \right]$$

(4)

Then, he chooses whichever outcome that gives him the better payoff: setting $w_i = \frac{m_i + m_F}{m_i} v_i$ and only letting the disloyal administrator defect, or setting $w_i = \frac{m_i + m_F}{m_i} (v_i + e)$ and making both types willing to defend. In the first case, both the loyal and the disloyal administrator receive an expected payoff of $v_i$. In the second case, both receive $v_i + e$.

Lastly, I state the simplifying assumptions for the model and briefly discuss them.

**Assumption 1.** $x \leq c$.

This implies that the loyal administrator never initiates a coup or civil conflict. This assumption is made to simplify the comparison between patrimonial and bureaucratic contracts.
Assumption 2. \( x \leq b \leq \tau_D \).

This implies that the ruler and the administrator’s optimal military investment choices \( m_i \) are always less than \( \tau_D \). Moreover: \( x \leq b \) implies that the ruler’s net payoff from domain \( D \) is always positive; and \( b \leq \tau_D \) implies that the ruler’s derived benefits from the domain does not exceed its tax revenue. This is needed for one part of Proposition to hold.

### 4.2 Loyal vs. Disloyal Administrators

In this subsection, I analyze the ruler’s preference over loyal and disloyal administrators under perfect information for both contracts.

**Bureaucratic Contract.** The ruler pays the loyal bureaucrat \( \frac{m_i + m_F}{m_i} v_i \), and the disloyal bureaucrat \( \frac{m_i + m_F}{m_i} (v_i + \epsilon) \) to compensate for his effort cost. Thus,

**Remark 1.** Given that the loyalty of the administrator does not affect the ruler’s expected payoff from domain \( D \), he always prefers the low-cost loyal bureaucrat.

**Patrimonial Contract.** Since the administrator’s payoff function does not depend on \( v_i \), then,

**Remark 2.** The administrator will never choose to defect, as long as the payoff exceeds his outside option.

Moreover, since the loyal administrator is assumed to never initiate coups or civil conflicts, the ruler gets the following payoffs from the loyal and the disloyal administrators respectively (computational details can be found in the Appendix).

\[
\begin{align*}
(1 - \sqrt{\frac{m_F}{\tau_D + m_F}}) b & \quad (5) \\
(1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}})(b - \epsilon x) & \quad (6)
\end{align*}
\]

Compared to a loyal administrator, a disloyal administrator derives more value from the administrative position as he can obtain additional payoff from coups or civil conflicts. Therefore,

**Remark 3.** The disloyal administrator optimally invests more in military spending than the loyal administrator under the patrimonial contract.

The, the ruler’s trade-off between the two types of administrators is as follows: a loyal administrator creates no damage to the ruler, but invests less in military spending, hence lowering defense probability; a disloyal administrator creates damage, but also enhances defense probability. Therefore, the higher the damage (the larger \( x, \epsilon \) are), the more likely the ruler prefers the loyal administrator. In the Appendix, I prove the following result.
There exists $x^* < b/\epsilon$ at which the ruler’s payoff from the disloyal administrator reaches a maximum. There also exists $x' \in (x^*, b/\epsilon)$ at which

$$\left(1 - \sqrt{\frac{m_F}{\tau_D + x' + m_F}}\right) (b - \epsilon x') = \left(1 - \sqrt{\frac{m_F}{\tau_D + m_F}}\right) b. \tag{7}$$

Moreover, $x' = 0$ if $x^* < 0$, and $x'$ is decreasing in $\tau_D, \epsilon$ and increasing in $b$.

Recall that the simplifying assumptions restrict $x \leq \tau_D$ and $x \leq c$. Thus, for the ruler to prefer the loyal administrator, we must have $x' < \tau_D$, and $x \in [x', \tau_D]$. The loyal administrator is desirable over a larger range of $x$ when $\tau_D, \epsilon$ are large or $b$ is small:

- High $\epsilon$ implies that the ruler suffers higher damage from coups or civil conflicts, and the loyal administrator is more preferable.
- High $\tau_D$ means that the wedge between the loyal and disloyal administrator’s military investments is smaller and thus smaller additional gain from the disloyal administrator’s higher military investment, and the disloyal administrator is less desirable.
- Small $b$ means smaller derived benefit from the domain and therefore smaller additional gain from the disloyal administrator’s higher military investment, and the disloyal administrator is less desirable.

In the diagram above, I plot the ruler’s payoffs from the loyal and the disloyal administrators (in purple and blue, respectively) against $x$. I assume that $x' < \tau_D$, and I plot the graphs for the case $x^* > 0$. The domain over which the loyal administrator is preferred over the disloyal administrator is indicated in orange.
4.3 Bureaucratization

In this subsection, I examine the conditions under which bureaucratization is likely to happen. From here on, I assume asymmetric information.

For ease of exposition, I define the patrimonial contract to be feasible if it gives the administrator a higher gross payoff than his outside option $v_i$; and the bureaucratic contract to be feasible if it gives the ruler a higher gross payoff than what he pays the administrator in expectation, so that his expected net payoff is greater than or equal to zero. In a nutshell, bureaucratization happens when the bureaucratic contract is feasible, and when the ruler finds it more desirable than the patrimonial contract.

**Wage Choice.** Recall that under asymmetric information, the ruler either chooses the higher wage to induce both types of administrators to faithfully defend domain $D$, or the lower wage and risk letting the disloyal administrator defect. Intuitively, the ruler will find the lower wage more preferable when the administrator has a high probability $q$ of being loyal, or when the disloyal administrator has a high effort cost $e$. This simple observation can be stated more formally in the following claim.

**Claim 1.** There exists $e^*, q^*$ such that the ruler will prefer to set the lower wage $w_i = \frac{m_i + m_F}{m_i} v_i$ when $e \geq e^*$ or $q \geq q^*$, and the higher wage $w_i = \frac{m_i + m_F}{m_i} (v_i + e)$ otherwise.

**Feasibility.** The bureaucratic contract is feasible if it delivers a large net benefit to the ruler, or if its cost, $v_i + e$, is low. For ease of exposition, I let:

$$
\pi_R^B = \left(1 - \sqrt{\frac{m_F}{b + \tau_D + m_F}}\right) \left[b + \tau_D + m_F - \sqrt{m_F (b + \tau_D + m_F)}\right] \quad (8)
$$

In the Appendix, I show the following result:

**Claim 2.** Suppose $q < q^*$ or $e < e^*$, the bureaucratic contract is feasible when

$$
\pi_R^B > v_i + e. \quad (9)
$$

Otherwise, the bureaucratic contract is feasible when

$$
q\pi_R^B > v_i. \quad (10)
$$

For both cases, there exist a set of values $m_F^b, \tau_D^b, b^b, v^b$ and $e^b$ such that the bureaucratic contract is feasible when $m_F < m_F^b$, or $\tau_D > \tau_D^b$, or $b > b^b$, or $v < v^b$, or $e < e^b$.

This result is easily interpretable. A low level of foreign threat reduces the level of optimal military investment, and increases consumable rent. High tax revenue and derived benefit both contribute to a high payoff. A small outside option and effort cost means cheaper bureaucrats.
Recall that \( v_i = a_v \kappa_i \theta_i \). By construction, literate commoners who qualify for office-holding have \( \kappa_i = \kappa_L \), and therefore a lower outside option compared to literate nobles who have \( \kappa_i = \kappa_H \). In other words, the emergence of literate commoners serve to drive down the cost of bureaucratic contracts. Moreover, as will be shown in the Appendix, in the extended model which includes labor and services markets, an increase in the number of literate commoners will cause a decrease in \( a_v \), further pushing down the outside option of literate individuals and therefore the cost of bureaucratic contracts.

The following proposition examines the conditions under which bureaucratization transpires in equilibrium. Intuitively, the wedge between the ruler’s gross payoffs from the B and the P contracts needs to be large enough to offset wage costs. I find a simple lower bound on the wedge and analyze its comparative statics (see Appendix for details).

**Proposition 2.** Sufficient conditions for the ruler to prefer the bureaucratic contract over the patrimonial contract are listed below. Note that when these conditions hold, the bureaucratic contract is also feasible. Thus they are sufficient for the bureaucratic contract to transpire in equilibrium.

a) If \( x' \leq \tau_D \) and \( x \in [x', \tau_D] \), the sufficient condition is

\[
\left( 1 - \sqrt{\frac{m_F}{b + \tau_D + m_F}} \right) \left[ b + \tau_D + m_F - \sqrt{m_F(b + \tau_D + m_F)} \right] - \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right) b > v_i + e. \tag{11}
\]

This wedge \((B - P)\) is increasing in \( b \); decreasing in \( m_F \) for \( b \leq \tau_D \), which is true by Assumption 2; U-shaped in \( \tau_D \), so there exists some \( \tau_D \) at which the wedge reaches its global minimum.

b) If \( x \in [0, x'] \), the sufficient condition is

\[
\left( 1 - \sqrt{\frac{m_F}{b + \tau_D + m_F}} \right) \left[ b + \tau_D + m_F - \sqrt{m_F(b + \tau_D + m_F)} \right] - \left( 1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}} \right) \left( b - \epsilon x \right) > v_i + e. \tag{12}
\]

This wedge is increasing in \( b \) when \( x \leq b \), which is true by Assumption 2; decreasing in \( m_F \) for \( b \leq \tau_D \); U-shaped in \( \tau_D \) for small \( \epsilon x \), and increasing in \( \tau_D \) for large \( \epsilon x \).

Now, I explain the intuition behind the comparative statics results.

- **With respect to \( b \).** The key difference between the two contracts is that, under the B contract, the ruler internalizes the value of the derived benefits \( b \) into his military investment decision, whereas under the P contract, the administrator does not do so. When \( b \) increases, even though the ruler receives a direct gain from higher derived benefits under both contracts, the
B contract gives him an additional indirect gain from being able to adjust military investment to this higher value of $b$. Thus, the wedge between the B and the P contracts increases in $b$.

- **With respect to $\tau_D$.** Under both contracts, the ruler receives an indirect marginal gain from higher $\tau_D$ in the form of increased military spending and thus higher success at defending domain $D$. This indirect gain is bigger under the P contract, because the level of military investment is lower and marginal gain is bigger. Denote the difference in indirect gain by $\Delta$.

On the other hand, when $\tau_D$ increases, the ruler receives an additional direct gain in the form of tax revenue under the B contract. Thus when $\tau_D$ is small, the ruler’s gain in taxes is too small to offset $\Delta$, and the wedge decreases in $\tau_D$. When $\tau_D$ is sufficiently large, the ruler’s gain in taxes would be large enough to offset $\Delta$, and the wedge would increase in $\tau_D$.

Lastly, in case b) of Proposition 2, the damage term $\epsilon x$ serves to reduce the patrimonial administrator’s direct gain from $\tau_D$, thereby reducing $\Delta$. Thus for large $\epsilon x$, the wedge is always increasing in $\tau_D$.

- **With respect to $m_F$.** Following a similar line of logic, under both contracts, the ruler receives a marginal loss from higher $m_F$ in the form of lower defense success and therefore lower probability of obtaining derived benefits $b$. But under the B contract, this also leads to a lower probability of securing taxation income. Therefore the B contract becomes less attractive when $m_F$ is large.

**Barriers to Bureaucratization.** Finally, I briefly discuss a theoretical possibility in which the ruler is forced to choose the patrimonial contract because the bureaucratic contract is infeasible. A necessary condition for this to happen is that, the net payoff that the patrimonial contract produces for the administrator must be higher than the net payoff that the bureaucratic contract produces for the ruler, so that the patrimonial contract remains feasible when the bureaucratic contract is not. This condition only needs to hold for the loyal patrimonial administrator, in which case it will automatically hold for the disloyal administrator.

The full set of conditions are summarized in the proposition below, and the intuition for the results is very similar to Proposition 2. See Appendix for proof.

**Proposition 3.** *The necessary and sufficient conditions for forced adoption of patrimonial contract are listed below.*

a) The bureaucratic contract is infeasible, while the patrimonial contract is feasible.

$$v_i \in \left( \max\{\tau_R^B - e, q^B\}, \left(1 - \sqrt{\frac{m_F}{\tau_D + m_F}}\right)(\tau_D + m_F - \sqrt{m_F(\tau_D + m_F)}) \right)$$ (13)

b) For part a) to be true, the necessary condition is for the net payoff received by the administrator under the P contract is higher than the net payoff received by the ruler under the B contract.
If $\pi^B_R - e > \pi^B_R$, then this condition is:

$$b - 2\sqrt{m_F(\sqrt{b + \tau_D} + m_F - \sqrt{\tau_D + m_F})} < e.$$  \hfill (14)

This wedge $(B - P)$ is increasing in $b, \tau_D$ and decreasing in $m_F$.

If $\pi^B_R - e \leq \pi^B_R$, then this condition is:

$$qb - (1 - q)\tau_D - 2(1 - q)m_F - 2\sqrt{m_F(q\sqrt{b + \tau_D} + m_F - q\sqrt{\tau_D + m_F})} < 0.$$  \hfill (15)

This wedge $(B - P)$ is increasing in $b$.

5 Testing Model Predictions

In this section, I discuss results from Section 4 using historical data and examples.

5.1 Bureaucratic vs. Patrimonial Rule

Recall that Proposition 2 makes the following prediction: patrimonial contract is more likely to be implemented in regions that face higher external military threat $m_F$, and less likely to be implemented in regions with larger derived benefits $b$. I test this prediction using data on fiefs and counties in the state of Jin, which is the only state that has data on both types of administrative divisions. I then discuss it in the context of Zheng, Song and Wey, which we could discern from the historical records were consistently under severe external military threat.

A map of those fiefs and counties, of which there are a total of 54, is presented in Figure 8. Panel (a) presents the locations of fiefs and counties in the state of Jin from 772 to 500 B.C. Green units are counties, and red units are fiefs. Circles are units located on the border at the time of establishment, and dotted circles are units located in-land. Smaller green dots are counties that were converted from fiefs, and were located in-land at the time of conversion. Neighboring states are displayed in black. Panel (b) lays the map of modern England on top of the Jin, and its bottom right hand corner displays the location of the Jin relative to modern China.

I categorize the neighbors of Jin into large states, small states and nomadic tribes. I define the Qin, Chu and Qi, which were known for their superior military power, to be the large states; and all other states to be the small ones, including the Zhou. At the time, nomadic tribes posed serious

\textsuperscript{43}Border status is determined using a set of historical maps contained in Ma (2007). I define a county or a fief to be situated on the state border if it is within 30 miles of the estimated border on the map, which is roughly the distance that can be covered by a walking horse in one day. Distances are measured on Google Maps, using straight lines between two points.

\textsuperscript{44}Hsu (1999:559): “By the mid-seventh century B.C., the Zhou world was dominated by four powers: Qi, Jin, Qin, and Chu... while those states in the Central Plain, such as Zheng, Song, Lu, and Wey, were becoming ever less important in interstate politics.”
military threats to states, and their locations are determined using the historical maps contained in Ma (2007). From Panel (a) of Figure 8, we can see that the majority of Jin fiefs were located on its western side, and formed long insulation barrier against the Qin, and some nomadic tribes that are undisplayed. Its bureaucratic counties, on the other hand, tended to border the smaller foreign states. Panel (b) shows that the size of Jin is approximately the same as modern England.

I define an administrative unit to be in an important location if it is next to a major transportation route or a strategically defensive position—which means that the ruler derives large utilities from having these regions under control. I determine transportation routes and defensive locations using a list of major routes that connect the Jin to the outside world contained in Ma (2007:259-60). The Jin was initially situated on the western side of the Taihang Mountains, and began to take territory on the eastern side since 636 B.C. For this reason, I add to this list eight natural passes that were historically used to cross the Taihang Mountains.\footnote{They are the Junduxing Pass, Boyinxing Pass, Feihuxing Pass, Jingxing Pass, Fukouxing Pass, Baixing Pass, Taihangxing Pass and the Zhiguanxing Pass, and are collectively known as the “eight passes of the Taihang”.
}

First, I test the following prediction:

**Prediction 1.** Patrimonial rule is more likely to transpire when external threat is large, and less likely to transpire when derived benefits are large.

To do so, I estimate the following regression using the sample of data on patrimonial fiefs and bureaucratic counties instituted in the state of Jin between 772 to 500 B.C. I use both the linear probability model and the probit model.

\[
\mathbb{1}(Fief_i) = \alpha + \sum_{j=1}^n \beta_k F_{ik} + X_i' \gamma + \epsilon_i
\]  

(16)

where \(\mathbb{1}(Fief_i)\) is a dummy that is equal to 1 if administrative unit \(i\) is a noble fief under patrimonial rule, 0 if it is a county under bureaucratic rule. \(F_{ik}\) is a set of dummies representing the following features of administrative unit \(i\): whether it is located on the border, whether it is situated in an important location, and the types of its neighboring states and tribes. \(X_i\) controls for geographical characteristics of administrative unit \(i\), and includes the logarithm of elevation and a measure of terrain roughness computed using a metric called the relative topographic position. These statistics are obtained from and computed using ArcGIS datasets.

If prediction 1 was correct, the coefficient estimate on the dummy indicating border status and/or large neighbor should be positive and significant, and the coefficient estimate on the dummy representing important location should be negative and significant. Table 4 presents the regression results. OLS estimates are displayed in odd-numbered columns, and probit estimates are displayed in even-numbered columns.

In Panel A, Columns 1 to 4 show that an administrative unit that is located on the border is between 37% to 49% more likely to be under patrimonial rule. Columns 5 to 8 add the dummy for key locations. While the results for border units remain unchanged, results from columns 5
and 6 suggest that an administrative unit that is in a key location is around 36% less likely to be under patrimonial rule. When controls are added, the statistical significance on the dummy for important location disappears (columns 7, 8), though the qualitative direction remains the same. This is likely because this dummy variable is highly correlated with geographical characteristics.

In Panel B, I break down border administrative units by the types of neighbors they have. Regression estimates show that a unit that neighbors a large state or a nomadic tribe is between 50% to 63% more likely to be under patrimonial rule. These results are statistically significant and robust to controlling for geographical characteristics. This provides stronger evidence that patrimonial rule is more likely to transpire in regions under greater military threat, and is consistent with Prediction 1, derived from Proposition 2.

Examining the historical conditions more closely, we can discern that the states of Zheng, Song and Wey were constantly under military threat. Their examples serve to support the prediction that patrimonial rule is more likely to be implemented when external threat is large.

1. The Zheng was a powerful regional state during the reign of Duke Zhuang (744-701 B.C.), and began to decline amid a series of internal power struggles. Due to its central location, it became surrounded by the powerful states of Qi and Jin on the north, and Chu on the south (see Figure 1), since the mid Spring and Autumn Period. The Zheng was often forced to cut diplomatic ties with one powerful state, and to make alliances with another (Hsu 1999). Prior to its eventual conquest by the state of Han—one of the three states to split from the Jin—in 395 B.C., it was recorded to have created only one county.

2. The Song was in a similar situation as the Zheng. It was located in between Chu and Jin, and was therefore at the center of military contention (Ma 2008). It had a record of establishing only one county before it became conquered by the Qi.

3. The Wey was situated between Jin and Qi, and was constantly experiencing internal unrest since mid Spring and Autumn Period (Ma 2008). It was therefore a weak state compared to its neighbors. As discussed in Section 3.3.1, Even though the Wey did not establish counties (xian), its cities were essentially no different from counties. However, there only exists records of two Wey cities over the entire Spring and Autumn Period (Zhou and Li 2009:291).

The literature on bureaucracy identifies monitoring cost as an obstacle to bureaucratization (Kiser and Kane 2001; Sng 2014). Here, I test whether monitoring cost was an active constraint to the Jin rulers. I estimate the following equation using the same data sample:

\[ 1(Fief_i) = \alpha + \psi \text{DistToCapital}_i + \sum_{j=1}^{n} \beta_j F_{jk} + X_i^\prime \gamma + \epsilon_i \]  

(17)

where DistToCapital\_i represents the distance between the capital city and administrative division \_i.\footnote{Distance to the capital city is computed using geodesics in ArcGIS. The unit of measurement is hundred kilometers.} All other variable notations are the same as in Equation 16.
Regression results are shown in Table 5. Odd-numbered columns display OLS estimates, and even-numbered columns display probit estimates. Columns 1 to 4 control for border status, and columns 5 to 8 control for neighbor types. All regressions include geographical characteristics. Coefficient estimates for distance to the capital city are largely negatively and statistically insignificant. Meanwhile, results for border status and neighbor types are robust to the addition of distance to capital—the directions remain unchanged and estimates remain statistically significant. Coefficient sizes on the OLS model range from 50% to 63%, which are not much different from results in Table 4. Thus, there is no evidence that the cost of monitoring or transportation affects the ruler’s decision to institute a particular type of administrative division. This result is valid to the degree that the state of Jin was not very large. Military threat, on the other hand, proves to be an important factor of consideration.

5.2 Bureaucratic vs. Patrimonial Administrators

Proposition 2 also predicts that a smaller $v_i$, which reflects the administrator’s bargaining power, is positively associated with the implementation of bureaucratic contracts in equilibrium. I examine this prediction in the context of Jin.

Combining data from Ma (2007) and Zhou and Li (2009), I extract every known administrator for the noble fiefs and bureaucratic counties in the state of Jin. Then, using the dataset on political elites, I determine whether the administrator held membership to a clan, and if so, the type of his clan. I categorize the types of clans in the following manner: if there had been a high-official ($qing$) within the last three generations of the administrator’s patrilineal line, then his clan is a $qing$ clan;\footnote{In the Spring and Autumn Period, high-officials are the most prominent statesmen in every regional state, and they had very powerful clans.} otherwise, and if the ancestor of his clan is known, then his clan is $large$;\footnote{A clan needs to have maintained a sufficient degree of activity and influence for its members to be able to trace back to their common ancestor.} if the ancestor is not known, then his clan is $small$. If an administrator had fled to Jin from another state, then I denote him as a foreign exile. In the sample, there are a total of 75 administrators.

Recall that in the model, $v_i = a_i \theta_i$, and a smaller $a_i$ is associated with a lower $v_i$. I now test the following prediction:

**Prediction 2.** Bureaucratic rule is more likely to transpire when the administrator has weaker political connections.

To do so, I estimate the following regression using the data on administrators of Jin fiefs and counties, from 772 to 500 B.C. I use both the linear probability model and the probit model.

$$f(ClanType_i) = \alpha + \beta IsFief_i + \epsilon_i$$

where $TypeClan_i$ is a dummy for whether administrator $i$ holds membership to a particular type of clan. $IsFief_i$ is a dummy that is equal to 1 if administrator $i$ manages a patrimonial fief, and
equal to 0 if he manages a bureaucratic county.

If Prediction 2 was true, the coefficient on $IsFief_i$ should be positive for qing and large clans, and negative for small clans and no clan. Table 6 displays the baseline regression results. Odd-numbered columns show results from the linear probability model, and even-numbered columns show results from the probit model. While a patrimonial administrator is no more likely to come from a qing clan (columns 1, 2), he is indeed 36% more likely to come from a large clan (columns 3, 4), 21% less likely to come from a small clan (columns 5, 6) or to have no clans at all (columns 7, 8). These results are largely robust to controlling for the geographical characteristics of the region managed by the administrator (Panel B). Coefficient estimates for the regressions with large and small clans as dependent variables become weakly significant, and their sizes reduce to 24% and 18% respectively for the OLS model. The statistical significance of the estimates for the regression with no clan as the dependent variable remain unchanged, and the size increases to 23% for the OLS model. These findings are consistent with Prediction 2.

Then, I test whether the clan membership of administrators is associated with local supply of talent. Since one needs to have a certain degree of literacy and numeracy skills in order to participate in trade, I use local exposure to trade as a proxy for the local supply of talent.

To do so, I further combine data on the excavation of bronze coins, which is the main type of currency used in the Spring and Autumn Period. For each money excavation, I have information on the location of excavation, and the types and features of bronze money discovered (the sample of money discovery sites are illustrated in Figure 9). Consulting Huang (2001), I estimate the approximate date of mintage of bronze coins based on its size, shape and engravings. I use this date to indicate the earliest time period in which this particular location became exposed to trade. Then, for each administrator, I compute the number of locations that were situated within a 20- and a 30-kilometer radius of the region managed by that administrator, and were already exposed to trade during the administrator’s time of activity.

I estimate the following equation using both OLS and the probit models:

$$ 1(Clantype_i) = \alpha + \beta IsFief_i + \gamma Trade_i + \epsilon_i $$

where $Trade_i$ is the number of locations exposed to trade within a 20- or a 30-kilometer radius of the region managed by administrator $i$. All other variable notations are the same as in Equation 18.

Table 7 presents regression results, controlling for geographical characteristics. Panel A uses the number of trade locations within a 20-kilometer radius, and Panel B uses the number of trade locations within a 30-kilometer radius. Columns 1, 3, 5 and 6 display results from the linear probability model, and 2, 4 and 7 columns display results from the probit model. The sign and significance of the results remain largely unaltered, and all coefficient estimates on the trade variable are statistically insignificant except for one.

Therefore, there is no evidence that the selection of administrators is associated with the local supply of talent. This is indeed consistent with the historical fact that the selection of administrators was not restricted to the local body of residents. Administrators who inherited the offices of
their fathers or came from known noble families were obviously unrelated with local talent. Administrators of commoner origins usually had to make a name for themselves in the central court in order to be appointed for office by the ruler. Since vacancies are unlikely to be correlated with the places of origin for suitable candidates, this implies that the characteristics of appointees are much more likely to be associated with statewide rather than local supply of talent.49

Lastly, I test for both military threat and political connections of human capital at the same time. I combine data on administrators and geographical features of Jin fiefs and counties to estimate the following regression:

\[
F_{i} = \alpha + \sum_{k=1}^{n} \beta_{k} F_{ik} + \sum_{k=1}^{n} \phi_{k} C_{ij} + X_{i}' \gamma + \epsilon_{i}
\]

where \( C_{ijk} \) is a set of dummies representing clan membership status of administrator \( j \) of administrative region \( i \): whether he is member of a qing clan or member of a large clan. The omitted category is membership to a small clan or to no clan.

Regression results are displayed in Table 8. Columns 1 and 3 display results from the linear probability model, and columns 2 and 4 display results from the probit model. The effects of military threat and political connections are jointly statistically significant.

The examples of the Chu and the Qin also serve to support the prediction that greater bargaining power of administrators is negatively associated with the implementation of bureaucratic rule.

1. The Chu was an early state-builder, and was known to be militarily strong. Its nobles had smaller and fewer fiefs compared to other regional states, and the organizational structure of the fiefs were less advanced. This was partly because the system of enfeoffment appeared relatively late in the Chu (Tian 2017). Thus, Chu nobles were economically and politically weaker, which facilitated bureaucratization.

2. As previously discussed, the Qin possessed similar military strength as the Jin, but it had confirmed records of county establishment only in the Warring States era (Zhou and Li 2009:288). The Qin was both geographically and culturally more distant from the Zhou compared to regional states in the Central Plain—the origins of the Qin ruling lineage remain obscure, whereas the ruling lineages of other regional states were known to be descendants of the Zhou royal house or the Shang nobles, and the development of the writing script in the Qin was relatively staggered (Qiu 1988:52). While other regional states saw a rapid transformation of the script since the late Spring and Autumn Period as a result of the expansion of the usage and application of writing, such development began to take place in the Qin only in the mid Warring States Period. This phenomenon is likely to be associated with a staggered spread of literacy to non-nobles, and therefore a smaller supply of human capital, which can then explain why bureaucratization happened relatively late in the Qin.

49The Zuo’s Commentary also contains anecdotes of newly appointed officials physically moving to their new region of jurisdiction.
6 Conclusion

Do wars make states? I argue that, in addition to external warfare, human capital is an important channel for state-building. I hand-collect novel datasets on wars, counties, political elites, and iron and money excavations in pre-imperial China, and present the first systematic evidence on patterns of state-building in pre-imperial China. I show that while pressures of war remained relatively stable, regional states achieved very different levels of state formation; that the state-building process did not entirely entail the elimination and neutralization of rulers’ local rivals, but active participation by the nobility in coups and civil wars. These findings cannot be rationalized by warfare alone.

Then, I demonstrate increasing activity of commoners in administrative capacities in pre-imperial China. I argue that the emergence of new administrative talent reduces the cost of bureaucratic appointments, therefore facilitating the centralization of military and taxation powers. I also incorporate a trade-off between patrimonial and bureaucratic rule, which claims that conceding residual rents from a land to the administrator will create stronger incentives for him to defend that lend. In addition, I propose a potential mechanism for explaining the rise of this new talent. Documenting an overall increase in productivity, I postulate that this enabled commoners to engage in non-productive activities; and on the supply side, I postulate that commoners acquired education from nobles and literati who were displaced in civil strife and therefore must find alternative means to make a living.

I develop a model to formalize this theory, and I empirically test its predictions using historical data. Consistent with the model, I find that bureaucratic rule is more likely to transpire in border regions, and particularly in regions that face greater foreign military threat from large states and nomadic tribes. Secondly, I find that administrators of bureaucratic counties are more likely to have weak political connections. Thirdly, I find that the clan membership of administrators is uncorrelated with the exposure to trade of the region he manages. These results are robust to different estimating models and controlling for geographical characteristics. Furthermore, I use narrative analysis to show that these predictions are consistent with the historical conditions of the major regional states of the Spring and Autumn and Warring States Periods.

My analysis provides new insights into the driving forces and mechanisms of state formation, and the theory and results derived in this paper exhibit historical relevance beyond pre-imperial China. Across time, the link between human capital and state administration became consolidated in the Han empire, as Emperor Wu (141–87 B.C.) introduced academic examinations as a means to recruit officials. After several centuries, this eventually developed into the well-known imperial examination system instituted by Emperor Yang of Sui (604–618 A.D.), despite a series of ups and downs. Across civilizations, graduates from universities in medieval Germany played an important role in pushing for and consolidating legal and administrative innovations and in the rulers’ efforts to create bureaucratic administrations.
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Figure 4: Number of Wars and Newly Constructed Counties Per 30-Year Period, 722-222 B.C.

Notes: This figure plots the number of wars that a state was involved in, against the number of new counties that this state constructed, for each 30-year period between 722 B.C. to 243 B.C., and a 21-year period from 242 B.C to 222 B.C.
Figure 5: Share of *Shi* in All Administrators and Share of Administrators without Clans, 722-468 B.C.

Notes: This figure plots the share of *shi* in all administrators, and the share of administrators who did not belong to a clan, from 722 B.C. to 468 B.C. The black line indicates the share of *shi* in all administrators. The blue line indicates the share of all administrators who did not have a clan.
Figure 6: Share of Ministers, High-Officials and Both Types without Clans, 722-468 B.C.

Notes: This figure plots the share of ministers who did not belong to a clan, the share of high-officials who did not belong to a clan, and the share of both types who did not belong to a clan in all high-officials and ministers (qing-dafu), from 722 B.C. to 468 B.C. The black line represents the share of ministers who did not have a clan in all qing-dafu. The blue line indicates the share of high-officials who did not have a clan in all qing-dafu. The green line represents the share of both high-officials and ministers who did not have a clan in all qing-dafu.
Figure 7: Hereditariness of the Office of High-Officials and Ministers (Qing-Dafu), 722-468 B.C.

Notes: This figure plots the share of high-officials and ministers (qing-dafu) who had at least one son of equal or higher status, and the share of qing-dafu who had at least one son of equal or higher status in the subsample of qing-dafu who were recorded to have sons, from 722 B.C. to 468 B.C. The black line represents the share of qing-dafu who had at least one son of equal or higher status. The blue line indicates the share of qing-dafu who had at least one son of equal or higher status in the subsample of qing-dafu who had at least one son on record.
Figure 8: Map of Counties and Fiefs of Jin, and Comparison between Jin and Modern England.

(a) Location of Counties and Fiefs in the State of Jin, 772-500 B.C.

(b) Comparison between the State of Jin and Modern England

Note: panel (a) presents the locations of fiefs and counties in the state of Jin from 772 to 500 B.C., and panel (b) lays the map of modern England on top of the Jin. In panel (a), green units are counties, and red units are fiefs. Circles are units located on the border, and dotted circles are units located in-land. Smaller green dots are counties that were converted from fiefs, and were located in-land at the time of conversion. Black diamond is the capital city of Jin. Blue lines are rivers, taken from the World Rivers dataset. Neighboring states are displayed in black text. The bottom left hand corner of panel (b) displays the location of the Jin relative to modern China. We can see that the size of Jin is approximately the same as the size of modern England.
Figure 9: Map of Counties, Fiefs and Money Discoveries for the State of Jin.

Note: the map presents the locations of fiefs and counties in the state of Jin from 772 to 500 B.C., and archaeological sites at which bronze money were discovered. Green units are counties, and red units are fiefs. Circles are units located on the border, and dotted circles are units located in-land. Smaller green dots are counties that were converted from fiefs, and were located in-land at the time of conversion. Black diamond is the capital city of Jin. Brown triangles are money sites. Blue lines are rivers, taken from the World Rivers dataset. Neighboring states are displayed in black text.
Table 1: Number of Newly Established Counties by Historical Period, 722-222 B.C.

<table>
<thead>
<tr>
<th>Panel A: All States</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>Number of New Counties</td>
<td>Number of States that Created Counties</td>
</tr>
<tr>
<td>Early SA (772-674 B.C.)</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Mid SA (673-577 B.C.)</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>Late SA (576-481 B.C.)</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>Early WS (480-395 B.C.)</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>Mid WS (394-308 B.C.)</td>
<td>58</td>
<td>7</td>
</tr>
<tr>
<td>Late WS (307-222 B.C.)</td>
<td>89</td>
<td>10</td>
</tr>
<tr>
<td>Date Unknown</td>
<td>161</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: By Major States</th>
<th>Jin</th>
<th>Chu</th>
<th>Zheng</th>
<th>Song</th>
<th>Qin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early SA (772-674 B.C.)</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mid SA (673-577 B.C.)</td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Late SA (576-481 B.C.)</td>
<td>15</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Early WS (480-395 B.C.)</td>
<td>11</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Mid WS (394-308 B.C.)</td>
<td>5/7/14</td>
<td>3</td>
<td>-</td>
<td>0</td>
<td>23</td>
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<tr>
<td>Late WS (307-222 B.C.)</td>
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<td>-</td>
<td>1</td>
<td>39</td>
</tr>
<tr>
<td>Date Unknown</td>
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<td>19</td>
<td>0</td>
<td>0</td>
<td>123</td>
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</tbody>
</table>

Notes: Panel A displays the number of new counties created and the number of distinct states that created those counties for each time period from 722 B.C. to 222 B.C. Panel B displays the number of new counties created by the states of Jin, Chu, Zheng, Song and Qin. SA is the abbreviation of Spring and Autumn, and WS is the abbreviation of Warring States. Since Jin was split into three independent states in 403 B.C., for Mid and Late Warring States Periods, I display the counties created by the derivative states Zhao, Han and Wei in this exact order under the same column as Jin. Since the Zheng became conquered by Han in 375 B.C., the cells for mid and late Warring States are not applicable to Zheng.
Table 2: Family Background of Warring States Prime Ministers, 480-222 B.C.

<table>
<thead>
<tr>
<th>State</th>
<th>Prince or King’s Son-In-Law</th>
<th>Noble Descent</th>
<th>No Known Noble Ties</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Chu</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Yan</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Qin</td>
<td>3</td>
<td>3</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>Zhao</td>
<td>3</td>
<td>1</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Han</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Wei</td>
<td>5</td>
<td>1</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Qi</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>12</td>
<td>48</td>
<td>79</td>
</tr>
</tbody>
</table>

Notes: This table displays the family background of prime ministers in the seven states of Chu, Yan, Qin, Zhao, Han, Wei and Qi during the Warring States Period. The first column displays the number of prime ministers who were princes or were married to princesses. The second column displays the number of prime ministers who were born in noble families. The third column displays the number of prime ministers who were not known to have ties to the nobility.
Table 3: Number of Wars and Newly Constructed Counties, 722-222 B.C.

<table>
<thead>
<tr>
<th>Variables</th>
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<th>(3)</th>
<th>(4)</th>
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<tbody>
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<td>0.038</td>
<td>0.006</td>
<td>0.295***</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.036)</td>
<td>(0.037)</td>
<td>(0.101)</td>
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<tr>
<td>NumWars$^2$</td>
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<td></td>
<td>-0.009**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.004)</td>
</tr>
<tr>
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<td>116</td>
<td>104</td>
<td>116</td>
</tr>
<tr>
<td>Sample</td>
<td>All</td>
<td>w/o Late Qin</td>
<td>w/o Qin</td>
<td>w/o Late Qin</td>
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<td>State FE</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Period FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>R-sq</td>
<td>0.434</td>
<td>0.335</td>
<td>0.363</td>
<td>0.383</td>
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</table>

Notes: *** p < .01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. This table presents the regression between the number of wars that a state engaged in, and the number of counties that it established. NumWars is the number of wars, and period FE is a dummy indicating whether an observation belongs to the Warring States Period—the Spring and Autumn Period is the omitted category. Column (1) displays results for the full sample. Column (2) displays results excluding observations for the state of Qin in the late WS period. Column (3) displays results excluding observations for the state of Qin in all periods. Column (4) estimates a quadratic polynomial.
Table 4: Military Threat of Noble Fiefs and Counties in the State of Jin, 758-500 B.C.

Panel A: Border Status

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<tr>
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<td>0.974**</td>
<td>0.491***</td>
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<td>0.467***</td>
<td>1.293***</td>
<td>0.529***</td>
<td>1.613***</td>
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<td>(0.378)</td>
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<td>(0.130)</td>
<td>(0.412)</td>
<td>(0.133)</td>
<td>(0.482)</td>
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<tr>
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<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
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</table>

Panel B: Type of Neighbors

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<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
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<td></td>
<td>Whether Administrative Division is Under Patrimonial Rule</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LargeNeighbor</td>
<td>0.543***</td>
<td>1.816***</td>
<td>0.555***</td>
<td>2.430**</td>
<td>0.625***</td>
<td>2.093**</td>
<td>0.609***</td>
<td>2.708***</td>
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<tr>
<td></td>
<td>(0.154)</td>
<td>(0.659)</td>
<td>(0.153)</td>
<td>(0.702)</td>
<td>(0.167)</td>
<td>(0.831)</td>
<td>(0.159)</td>
<td>(0.845)</td>
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<td>-1.278**</td>
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<td>(0.532)</td>
<td>(0.147)</td>
<td>(0.602)</td>
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<td>0.585***</td>
<td>2.036***</td>
<td>0.589***</td>
<td>2.549***</td>
</tr>
<tr>
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<td>(0.117)</td>
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<td>(0.469)</td>
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<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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</tr>
<tr>
<td>R-squared</td>
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<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
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</table>

Notes: *** p < .01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. This table presents the results from equation 16 using as the dependent variable a dummy that is equal to 1 if the administrative division is a noble fief under patrimonial rule, 0 if the administrative division is a county under bureaucratic rule. OnBorder is a dummy indicating whether the administrative division is located on the state border. KeyLocation is a dummy indicating whether the administrative division is in an important location – a major transportation route or a strategically defensive position. LargeNeighbor is a dummy indicating whether the administrative division is located on the state border and neighbors a large state. SmallNeighbor is a dummy indicating whether the administrative division is located on the state border and neighbors a small state. TribeNeighbor is a dummy indicating whether the administrative division is located on the state border and neighbors a nomadic tribe. Controls include the logarithm of geographical elevation and terrain roughness of the administrative division, which are obtained from ArcGIS datasets. Terrain roughness is calculated using a metric called the relative topographic position.
Table 5: Distance to Capital City for Noble Fiefs and Counties in the State of Jin, 758-500 B.C.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DistToCapital</td>
<td>-0.076</td>
<td>-0.226</td>
<td>-0.106</td>
<td>-0.361</td>
<td>-0.086</td>
<td>-0.355</td>
<td>-0.111</td>
<td>-0.492*</td>
</tr>
<tr>
<td></td>
<td>(0.097)</td>
<td>(0.281)</td>
<td>(0.089)</td>
<td>(0.274)</td>
<td>(0.077)</td>
<td>(0.291)</td>
<td>(0.074)</td>
<td>(0.253)</td>
</tr>
<tr>
<td>OnBorder</td>
<td>0.500***</td>
<td>1.512***</td>
<td>0.550***</td>
<td>1.754***</td>
<td>0.558***</td>
<td>2.526***</td>
<td>0.627***</td>
<td>2.977***</td>
</tr>
<tr>
<td></td>
<td>(0.120)</td>
<td>(0.416)</td>
<td>(0.121)</td>
<td>(0.438)</td>
<td>(0.156)</td>
<td>(0.654)</td>
<td>(0.153)</td>
<td>(0.804)</td>
</tr>
<tr>
<td>LargeNeighbor</td>
<td>0.558***</td>
<td>2.526***</td>
<td>0.627***</td>
<td>2.977***</td>
<td>0.583***</td>
<td>2.343***</td>
<td>0.606***</td>
<td>2.784***</td>
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<tr>
<td></td>
<td>(0.156)</td>
<td>(0.669)</td>
<td>(0.152)</td>
<td>(0.638)</td>
<td>(0.117)</td>
<td>(0.592)</td>
<td>(0.105)</td>
<td>(0.648)</td>
</tr>
<tr>
<td>SmallNeighbor</td>
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<td>-0.275</td>
<td>0.0506</td>
<td>0.506</td>
<td>0.532</td>
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<tr>
<td></td>
<td>(0.156)</td>
<td>(0.438)</td>
<td>(0.152)</td>
<td>(0.638)</td>
<td>(0.117)</td>
<td>(0.592)</td>
<td>(0.152)</td>
<td>(0.638)</td>
</tr>
<tr>
<td>TribeNeighbor</td>
<td>0.583***</td>
<td>2.343***</td>
<td>0.606***</td>
<td>2.784***</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>KeyLocation</td>
<td>-0.258</td>
<td>-0.906*</td>
<td>-0.233</td>
<td>-1.384*</td>
<td>0.0506</td>
<td>0.506</td>
<td>0.532</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.179)</td>
<td>(0.550)</td>
<td>(0.159)</td>
<td>(0.776)</td>
<td>(0.152)</td>
<td>(0.648)</td>
<td>(0.159)</td>
<td>(0.776)</td>
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</tbody>
</table>

Observations 54 54 54 54 54 54 54 54
Controls Yes Yes Yes Yes Yes Yes Yes Yes
R-squared 0.284 0.318 0.506 0.532
Model OLS Probit OLS Probit OLS Probit OLS Probit

**Notes:** *** $p < .01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. This table presents the results from equation 16 using as the dependent variable a dummy that is equal to 1 if the administrative division is a noble fief under patrimonial rule, 0 if the administrative division is a county under bureaucratic rule. DistToCapital is the distance to the capital city, measured in hundred kilometers. OnBorder is a dummy indicating whether the administrative division is located on the state border. KeyLocation is a dummy indicating whether the administrative division is in an important location – a major transportation route or a strategically defensive position. LargeNeighbor is a dummy indicating whether the administrative division is located on the state border and neighbors a large state. SmallNeighbor is a dummy indicating whether the administrative division is located on the state border and neighbors a small state. TribeNeighbor is a dummy indicating whether the administrative division is located on the state border and neighbors a nomadic tribe. Controls include the logarithm of geographical elevation and terrain roughness of the administrative division, which are obtained from ArcGIS datasets. Terrain roughness is calculated using a metric called the relative topographic position.
Table 6: Clan Membership of Administrators of Noble Fiefs and Counties in the State of Jin, 758-500 B.C.

Panel A: No Controls

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Qing Clan</th>
<th>(2) Large Clan</th>
<th>(3) Small Clan</th>
<th>(4) No Clan</th>
<th>(5) Small/No Clan</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsFief</td>
<td>0.062</td>
<td>0.163</td>
<td>0.359***</td>
<td>-0.210**</td>
<td>-1.309***</td>
</tr>
<tr>
<td></td>
<td>(0.118)</td>
<td>(0.313)</td>
<td>(0.106)</td>
<td>(0.086)</td>
<td>(0.495)</td>
</tr>
<tr>
<td>Observations</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.004</td>
<td>0.119</td>
<td>0.118</td>
<td>0.118</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
</tr>
</tbody>
</table>

Panel B: With Controls

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Qing Clan</th>
<th>(2) Large Clan</th>
<th>(3) Small Clan</th>
<th>(4) No Clan</th>
<th>(5) Small/No Clan</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsFief</td>
<td>0.179</td>
<td>0.472</td>
<td>0.236*</td>
<td>-0.182*</td>
<td>-2.883**</td>
</tr>
<tr>
<td></td>
<td>(0.143)</td>
<td>(0.381)</td>
<td>(0.135)</td>
<td>(0.094)</td>
<td>(1.200)</td>
</tr>
<tr>
<td>Observations</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.045</td>
<td>0.108</td>
<td>0.263</td>
<td>0.213</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
</tr>
</tbody>
</table>

Notes: *** $p < .01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. This table presents the results from specification 1 using as dependent variables the types of clans to which administrators hold membership. IsFief is a dummy that is equal to 1 if the administrator is a warlord in charge of a noble fief, 0 if the administrator is a bureaucrat in charge of a county. Controls include the logarithm of geographical elevation and terrain roughness of the administrative division which the administrator manages, which are obtained from ArcGIS datasets. Terrain roughness is calculated using a metric called the relative topographic position. Columns (1) and (2) use a dummy indicating whether the administrator is member of a qing clan. Columns (3) and (4) use a dummy indicating whether the administrator is member of a large clan. Columns (5) and (6) use a dummy indicating whether the administrator is member of a small clan. Columns (7) and (8) use a dummy indicating whether the administrator is member of no clan, or is a foreigner in exile. Odd-numbered columns report estimates from OLS regressions. Even-numbered columns report estimates from probit regressions. The last column of Panel B uses a dummy that is equal to 1 if the administrator is member of a small clan, or has no clan, or is a foreigner in exile. This is because, within the subsample of data for which elevation and roughness data are available, IsFief is perfectly correlated with NoClan.
Table 7: Clan Membership of Administrators of Noble Fiefs and Counties in the State of Jin, 758-500 B.C.

Panel A: 20-Kilometer Radius

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Qing Clan</th>
<th>(2) Large Clan</th>
<th>(3) Large Clan</th>
<th>(4) Small Clan</th>
<th>(5) No Clan</th>
<th>(6) Small Clan</th>
<th>(7) Small/No Clan</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsFief</td>
<td>0.194</td>
<td>0.529</td>
<td>0.226</td>
<td>0.662*</td>
<td>-0.191**</td>
<td>-0.229**</td>
<td>-1.859***</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.385)</td>
<td>(0.138)</td>
<td>(0.390)</td>
<td>(0.094)</td>
<td>(0.088)</td>
<td>(0.502)</td>
</tr>
<tr>
<td>NumMoney</td>
<td>0.138</td>
<td>0.363</td>
<td>-0.090</td>
<td>-0.278</td>
<td>-0.072</td>
<td>0.024</td>
<td>-0.358</td>
</tr>
<tr>
<td></td>
<td>(0.116)</td>
<td>(0.294)</td>
<td>(0.105)</td>
<td>(0.304)</td>
<td>(0.049)</td>
<td>(0.067)</td>
<td>(0.464)</td>
</tr>
<tr>
<td>Observations</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.077</td>
<td>0.123</td>
<td>0.284</td>
<td>0.215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td></td>
</tr>
</tbody>
</table>

Panel B: 30-Kilometer Radius

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Qing Clan</th>
<th>(2) Large Clan</th>
<th>(3) Large Clan</th>
<th>(4) Small Clan</th>
<th>(5) No Clan</th>
<th>(6) Small Clan</th>
<th>(7) Small/No Clan</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsFief</td>
<td>0.175</td>
<td>0.482</td>
<td>0.238*</td>
<td>0.697*</td>
<td>-0.180*</td>
<td>-0.233**</td>
<td>-1.795**</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.383)</td>
<td>(0.135)</td>
<td>(0.389)</td>
<td>(0.092)</td>
<td>(0.089)</td>
<td>(0.491)</td>
</tr>
<tr>
<td>NumMoney</td>
<td>0.091</td>
<td>0.252</td>
<td>-0.069</td>
<td>-0.226</td>
<td>-0.052*</td>
<td>0.030</td>
<td>-0.183</td>
</tr>
<tr>
<td></td>
<td>(0.063)</td>
<td>(0.180)</td>
<td>(0.058)</td>
<td>(0.187)</td>
<td>(0.003)</td>
<td>(0.036)</td>
<td>(0.267)</td>
</tr>
<tr>
<td>Observations</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.075</td>
<td>0.127</td>
<td>0.287</td>
<td>0.221</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>OLS</td>
<td>Probit</td>
</tr>
</tbody>
</table>

Notes: *** p < .01, ** p < .05, * p < .1. Robust standard errors in parentheses. This table presents the results from specification 1 using dependent variables the types of clans to which administrators hold membership. NumMoney is the number of archaeological sites at which bronze money were discovered within a certain radius. Panel A uses a radius of 20 kilometers, and Panel B uses a radius of 30 kilometers. IsFief is a dummy that is equal to 1 if the administrator is a warlord in charge of a noble fief, 0 if the administrator is a bureaucrat in charge of a county. Controls include the logarithm of geographical elevation and terrain roughness of the administrative division which the administrator manages, which are obtained from ArcGIS datasets. Terrain roughness is calculated using a metric called the relative topographic position. Columns (1) and (2) use a dummy indicating whether the administrator is member of a *qing* clan. Columns (3) and (4) use a dummy indicating whether the administrator is member of a large clan. Columns (5) uses a dummy indicating whether the administrator is member of a small clan. Columns (6) uses a dummy indicating whether the administrator is member of no clan, or is a foreigner in exile. Column (7) uses a dummy that is equal to 1 if the administrator is member of a small clan, or has no clan, or is a foreigner in exile. This is to avoid the probit model omitting the variable *NumMoney*. Columns (1), (3), (5) and (6) report estimates from OLS regressions. Columns (2), (4) and (7) report estimates from probit regressions.
Table 8: Military Threat and Administrators' Clan Membership for Noble Fiefs and Counties in the State of Jin, 758-500 B.C.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OnBorder</td>
<td>0.475***</td>
<td>2.275***</td>
<td>0.575***</td>
<td>2.745***</td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.616)</td>
<td>(0.114)</td>
<td>(0.665)</td>
</tr>
<tr>
<td>BigThreat</td>
<td></td>
<td></td>
<td>0.266**</td>
<td>1.794***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.471)</td>
<td>(0.510)</td>
</tr>
<tr>
<td>QingClan</td>
<td>0.342**</td>
<td>1.968***</td>
<td>0.302**</td>
<td>1.980***</td>
</tr>
<tr>
<td></td>
<td>(0.141)</td>
<td>(0.471)</td>
<td>(0.125)</td>
<td>(0.539)</td>
</tr>
<tr>
<td>LargeClan</td>
<td>0.401***</td>
<td>2.208***</td>
<td>0.302**</td>
<td>1.980***</td>
</tr>
<tr>
<td></td>
<td>(0.149)</td>
<td>(0.502)</td>
<td>(0.144)</td>
<td>(0.539)</td>
</tr>
<tr>
<td>Observations</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.476</td>
<td></td>
<td>0.599</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>OLS</td>
<td>Probit</td>
<td>OLS</td>
<td>Probit</td>
</tr>
</tbody>
</table>

Notes: *** p < .01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. This table presents the results from equation 16 using as dependent variable a dummy that is equal to 1 if the administrative division is a noble fief under patrimonial rule, 0 if the administrative division is a county under bureaucratic rule. OnBorder is a dummy indicating whether the administrative division is located on the state border. BigThreat is a dummy indicating whether the administrative division is located on the state border and neighbors a large state or a nomadic tribe. QingClan is a dummy indicating whether the administrator for that division is member of a qing clan. LargeClan is a dummy indicating whether the administrator for that division is member of a large clan. The omitted category is administrators who are members of a small clan or have no clan. Controls include the logarithm of geographical elevation and terrain roughness of the administrative division, which are obtained from ArcGIS datasets. Terrain roughness is calculated using a metric called the relative topographic position.
Appendix A  Additional Statistical Patterns

A.1 Exits of Political Elites

In this subsection, I examine the activity of political elites. I first show that, contrary to conventional wisdom, the majority of noble administrators were neither decimated by external warfare nor eliminated and neutralized by the rulers—indeed, coups and civil wars accounted for most of their deaths and extraditions.

I define an individual to be a political elite if he is one of the following: a duke, a son of a duke, a high-official or a minister. Columns 2 and 3 in Table 9 below display the number of active elites and the number of political exits made by elites during the Spring and Autumn Period—recall that a political actor makes an exit if he dies of an unnatural cause or flees his home state and never returns. Column 4 shows the number of exits caused by coups and civil wars, which is when an elite is murdered or extradited by his civil rivals, and column 5 is the number of deaths in external war. It is clear that throughout the course of the Spring and Autumn Period, coups and civil wars had consistently accounted for a great majority of the displacements of political elites and external warfare played a negligible role.

<table>
<thead>
<tr>
<th>Year</th>
<th>Active Elites</th>
<th>Elite Exits</th>
<th>Exits Caused by Coups/Civil Wars</th>
<th>Exits Due to Death in War</th>
</tr>
</thead>
<tbody>
<tr>
<td>722-693 B.C.</td>
<td>72</td>
<td>20</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>692-663 B.C.</td>
<td>66</td>
<td>21</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>662-633 B.C.</td>
<td>110</td>
<td>33</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>632-603 B.C.</td>
<td>155</td>
<td>48</td>
<td>43</td>
<td>2</td>
</tr>
<tr>
<td>602-573 B.C.</td>
<td>194</td>
<td>42</td>
<td>37</td>
<td>2</td>
</tr>
<tr>
<td>572-543 B.C.</td>
<td>247</td>
<td>62</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>542-513 B.C.</td>
<td>264</td>
<td>64</td>
<td>61</td>
<td>2</td>
</tr>
<tr>
<td>512-468 B.C.</td>
<td>204</td>
<td>61</td>
<td>57</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>1,071</td>
<td>351</td>
<td>325</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 9: Exits of Political Elites

Now I decompose elites' deaths in civil conflicts by the political status of the individuals who were responsible. I define an individual to be responsible for an elite’s death if he directly committed the murder of that elite, or if that elite died in a civil conflict that he initiated. If multiple individuals were responsible, then I record the person with the highest political status. Columns 3 to 5 in Table 10 display the number of deaths for which individuals of different political status were responsible. High-ranked nobles are qing-dafu or sons of dukes, and low-ranked nobles are simply members of noble clans who hold no offices or titles. This table shows that dukes were not solely responsible for eliminating their local rivals. Instead, the general aristocracy were actively involved in killing each other, and therefore the displacement of office-holding elites was not simply a top-down process.
<table>
<thead>
<tr>
<th>Year</th>
<th>Elite Unnatural Deaths</th>
<th>Deaths Caused by Dukes</th>
<th>Deaths Caused by High-Ranked Nobles</th>
<th>Deaths Caused by Low-Ranked Nobles</th>
</tr>
</thead>
<tbody>
<tr>
<td>722-693 B.C.</td>
<td>19</td>
<td>4</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>692-663 B.C.</td>
<td>19</td>
<td>3</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>662-633 B.C.</td>
<td>31</td>
<td>10</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>632-603 B.C.</td>
<td>43</td>
<td>10</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>602-573 B.C.</td>
<td>32</td>
<td>8</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>572-543 B.C.</td>
<td>44</td>
<td>7</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>542-513 B.C.</td>
<td>36</td>
<td>6</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>512-468 B.C.</td>
<td>26</td>
<td>3</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>251</strong></td>
<td><strong>52</strong></td>
<td><strong>131</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

Table 10: Individuals Attributable to the Exits of Political Elites, by Political Status

A.2 Trade and Commerce

In this subsection, I show that trade and commerce had been expanding throughout the Spring and Autumn Period and the Warring States Period. I argue that this reflects a more widespread distribution of literacy and numeracy skills in the general population.

During this era, commerce had been booming and markets appeared in many cities. *Zuo’s Commentary* documented the trading of everyday goods such as timber, fish, shoes, cattle and wine in the capital city of Qi, the collection of commercial taxes and city gate tolls from merchants by the government, and the institution of officers who were in charge of overseeing market activities (Gu and Zhu 2001). The development of commerce is likely to be associated with a changing distribution of skills across the population. To participate in trade, merchants would need to acquire basic writing and accounting knowledge in order to record transactions and inventory numbers and items, and to calculate profits and losses. It is also a reflection of increasing specialization in economic production and a rise in productivity across the society.

The rise in economic activities and a growth in population are reflected in changes in city structures. Initially, a city was an area of land that was enclosed by one set of walls and housed both the ruling aristocrats and the citizens. As non-citizens began to settle and inhabit areas outside of cities, city authorities constructed a set of “outer walls”, enclosing an extra block of land, to house new residents and to accommodate for new activities such as markets, trade posts and workshops (Du 1992; Yang 1998). A surge in city-building and construction of defensive walls took place in the Spring and Autumn Period (von Glahn 2016:47). Nonetheless, the main materials used for wall-building were still rammed earth (Ma 1998).

It is common knowledge that regular, large-scale trade cannot happen without money as a medium of exchange. In Western Zhou, the main type of currency was shells—most of them were seashells obtained from trade with coastal tribes, while some were made from stone, jade and various types of metals. Mintage of bronze coins began in the Spring and Autumn Period, and was
concomitant with the expansion of trade and commerce. Dukes of major regional states actively participated in the minting of money, and as a result, many types of money differing in size, shape and character engravings were in wide circulation (Huang 2001).

For each historical period, I display in Table 11 the number of distinct present-day county-level locations that first became involved in trade in that period. I determine the earliest date of trade for a particular location by the period of mintage of the oldest coin that was discovered at that location. We can see that the circulation of money had been growing throughout the Spring and Autumn Period and the Warring States Period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Distinct Locations that First Became Involved in Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Zhou (1046-771 B.C.)</td>
<td>20</td>
</tr>
<tr>
<td>Spring and Autumn (770-481 B.C.)</td>
<td>43</td>
</tr>
<tr>
<td>Warring States (480-221 B.C.)</td>
<td>62</td>
</tr>
</tbody>
</table>

Table 11: Coin Excavations in Western Zhou, Spring and Autumn Period and Warring States Period

While this increased use of money is indicative of an expansion in trade and commerce, it also reflects, albeit indirectly, a rise in productivity. Trade emerges and grows in scale when there is a surplus of produced goods in the society, which increases with productivity. The growth in the size of cities is another piece of corroborating evidence: urban residents live off the land and are supported by the agricultural surplus to undertake non-agricultural or non-productive activities.

A.3 Iron Technology

In this subsection, I show that there had been an increase in the use of iron tools over the Spring and Autumn and Warring States Periods. I argue that this reflects increased productivity.

The substitution of stone and bronze tools by iron tools, and of bronze weapons by iron and steel weapons was a long, extended process that started in the Spring and Autumn Period, intensified during the Warring States Period and came to a completion in the Western Han (202 B.C.-A.D. 8). At the beginning, only a small number of nobles had access to wrought iron and mainly used it to make weapon blades. When cast iron was invented, it was mainly used to make production

50Wrought iron is produced by heating iron ores and charcoal together in a bloomery. Since temperature in the bloomery is usually below the melting point of iron, this method would produce softened, but not molten, iron. These softened iron blocks must undergo long, repeated hammering to have impurities removed, and will then be forged into different ironware. This method of production was costly because nearly half of the iron ore would be wasted and the removal of impurities would typically take a long time; but even so, the final iron product still contained a considerable amount of unremoved impurities and was therefore of low quality (Yang 2004).

51The invention of the blast furnace during the Spring and Autumn Period enabled the production of cast iron, while also improving productive efficiency and the quality of the end product. Cast iron is produced by melting iron in the blast furnace (this is now possible because temperature can reach above the melting point of iron) and taking various procedures to remove impurities. To date, artifacts made of cast iron have been excavated from tombs dating back to mid and late Spring and Autumn Period (Bai 2005:23-29)
implements such as hoes, shovels and carving knives, and as a result the utilization of cast iron expanded to the wider society. Since the brittleness of cast iron made it unsuitable for things that required a sharp edge (Wagner 1993), mass production of iron weapons only became possible after the development of technologies that enhanced the flexibility and durability of cast iron in early Warring States Period (Bai 2005).

Table 12: Iron Artifacts in Western Zhou, Spring and Autumn and Warring States Periods, 859-221 B.C.

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Sites</th>
<th>Number of Iron Artifacts</th>
<th>Number of States</th>
<th>Types</th>
<th>Unique Types Available by This Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Western Zhou</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>Sword, dagger-axe, spear; carving knife, adze</td>
<td>5 (2)</td>
</tr>
<tr>
<td>(859-771 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Spring and Autumn</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>Sword, dagger-axe, dagger</td>
<td>6 (2)</td>
</tr>
<tr>
<td>(770-674 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid Spring and Autumn</td>
<td>5</td>
<td>13</td>
<td>3</td>
<td>Sword; carving knife, knife, shovel, spade</td>
<td>9 (5)</td>
</tr>
<tr>
<td>(673-577 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Spring and Autumn</td>
<td>18</td>
<td>66</td>
<td>7</td>
<td>Arrows, sword, dagger; axe, carving knife, spade, shovel, adze, sickle, hoe, awl</td>
<td>14 (8)</td>
</tr>
<tr>
<td>(576-481 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Warring States</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>omitted</td>
<td>20 (11)</td>
</tr>
<tr>
<td>(481-395 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid Warring States</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>omitted</td>
<td>33 (19)</td>
</tr>
<tr>
<td>(394-308 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Warring States</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>omitted</td>
<td>85 (41)</td>
</tr>
<tr>
<td>(307-221 B.C.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The observations above can be corroborated by a dataset that I collect of excavated iron artifacts dating back to Western Zhou, the Spring and Autumn Period and the Warring States Period. I complement this source data with excavations that were made since the book was published and tabulate the data in Table 12. For Western Zhou and the Spring and Autumn Period, I show the number of iron artifacts that had been excavated (Column 3) and the number of sites and the exact regional states (Columns 2 and 4) at which they were excavated. I also show the types of those iron artifacts. Moreover, since the number of iron artifacts dating back to the Warring States Period is too numerous, 52 in Column 6 I show the number of unique types of artifacts by the earliest date at which they became available for use. The number of unique types of production tools is displayed in parentheses. We can see that the number of excavated iron artifacts increases over time, and especially towards the end of the Spring and Autumn Period. The number of unique types of iron

52 For a complete listing, see chapter 3 in Bai (2005).
artifacts and production tools also rise over time.

We should be very careful when evaluating the impact of iron technology on productivity and violence in the Spring and Autumn Period. While an improvement in iron technology did take place, the number of excavated iron artifacts was still very small compared to their bronze counterparts. Moreover, there have been several discoveries of relics of bronze foundries, but none of iron foundries, in the Spring and Autumn Period. In contrast, at least ten relics of iron workshops dating back to the Warring States Period have been discovered (Bai 2005:Appendix 1). This indicates that the scale of iron production was rather limited and a subsidiary to bronze production. On the other hand, it should be appropriate to say that iron tools were beginning to be employed in production in late Spring and Autumn Period (Bai 2005:47), while large-scale usage of iron weapons and tools took place in the Warring States Period.

Here I make a final, related remark on agricultural production: the use of bronze tools had also been growing during the latter part of the Spring and Autumn Period, and may have contributed to higher productivity. To date, archaeologists have only discovered 25 artifacts of bronze agricultural tools dating back to Shang (c. 1600-1046 B.C.) and Western Zhou, while thousands of agriculture tools made of stone and shell had been found for the same time period (Bai 1989). In contrast, 25 such artifacts were found for early and mid Spring and Autumn Period, and 80 just for the one hundred years of late Spring and Autumn Period. Molds of agricultural tools were also found at two relics of Spring-and-Autumn bronze foundries (Xu 1987). At the same time, we should not overestimate the impact of those agricultural tools since bronze was still primarily used to make weapons and ritual vessels, of which thousands of artifacts have been discovered (Chen 2002).
Appendix B  Model Solution

B.1 Equilibrium Payoffs for Contracts

Patrimonial Contract. The administrator chooses \( m_i \) to solve the problem:

\[
\max_{m_i \leq \tau_D} P(m_i, m_F) [\tau_D - m_i + r_i]
\]

where \( r_i = l_i \mathbb{1}(x > c)(x - c) + (1 - l_i)x \).

The first order condition with respect to \( m_i \) is:

\[
\frac{m_F}{(m_i + m_F)^2} (\tau_D - m_i + r_i) - \frac{m_i}{m_i + m_F} = 0.
\]

Rearranging this FOC yields the optimal military investment decisions for loyal and disloyal administrators respectively:

\[
m_{i,l}^P = \sqrt{m_F (\tau_D + \max\{0, x - c\} + m_F)} - m_F,
\]

\[
m_{i,d}^P = \sqrt{m_F (\tau_D + x + m_F)} - m_F.
\]

From the expressions above, it is clear that the disloyal administrator optimally invests more in military spending, because he has more to gain from taking the patrimonial contract.

Substituting them back into the administrator’s objective function yields the expected payoff of the loyal and disloyal administrators respectively:

\[
\pi_{i,l}^P = \tau_D + \max\{0, x - c\} - 2\left[ \sqrt{m_F (\tau_D + \max\{0, x - c\} + m_F)} - m_F \right]
\]

\[
\pi_{i,d}^P = \tau_D + x - 2\left[ \sqrt{m_F (\tau_D + x + m_F)} - m_F \right]
\]

As long as these payoffs are greater than the administrator’s outside option \( v_i \), the patrimonial administrator will never choose to defect.

And the ruler’s expected payoff from domain \( D \) is:

\[
\pi_R^P = q \left( 1 - \sqrt{\frac{m_F}{\tau_D + \max\{0, x - c\} + m_F}} \right) (b - \mathbb{1}(x > c) \epsilon x) + (1 - q) \left( 1 - \frac{m_F}{\tau_D + x + m_F} \right) (b - \epsilon x)
\]

Bureaucratic Contract. The ruler chooses \( m_i \) and \( w_i \) to solve the following problem:

\[
\max_{m_i \leq \tau_D, w_i} \left\{ qP(m_i, m_F)(\tau_D - m_i + b - w_i), P(m_i, m_F)(\tau_D - m_i + b - w_i) \right\}
\]

He can choose to set \( w_i = \frac{v_i}{P(m_i, m_F)} \), so that the disloyal administrator unambiguously defects, or he can choose to set \( w_i = \frac{v_i + \epsilon}{P(m_i, m_F)} \), so that both types of administrators will stay and defend.
Thus his optimization problem becomes:

$$\max_{m_i \leq \tau_D} \left\{ qP(m_i, m_F)(\tau_D - m_i + b) - v_i, P(m_i, m_F)(\tau_D - m_i + b) - (v_i + e) \right\}$$

Which is equivalent to:

$$\max_{m_i \leq \tau_D} \left\{ P(m_i, m_F)(\tau_D - m_i + b) \right\}$$

The first order condition respect to $m_i$ is:

$$\frac{m_F}{(m_i + m_F)^2}(\tau_D - m_i + b) - \frac{m_i}{m_i + m_F} = 0.$$ 

Rearranging this FOC yields the optimal military investment decision for the ruler:

$$m_i^B = \sqrt{m_F(\tau_D + b + m_F)} - m_F$$

Substituting this expression back to the ruler’s objective function yields his equilibrium payoff:

$$\max_{m_i \leq \tau_D} \left\{ q \left(1 - \frac{m_F}{\tau_D + b + m_F}\right)(\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - v_i, \right.$$ 

$$\left. \left(1 - \frac{m_F}{\tau_D + b + m_F}\right)(\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - (v_i + e) \right\}$$

And the administrator receives either $v_i$ or $v_i + e$ in expectation.

### B.2 Proof to Proposition 1

Given the assumption that $x < c$, the ruler’s payoffs from the loyal and disloyal types under the patrimonial contract are, respectively:

$$\pi_{R,l}^P = \left(1 - \sqrt{\frac{m_F}{\tau_D + m_F}}\right)b$$

$$\pi_{R,d}^P = \left(1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}}\right)(b - \epsilon x)$$

$\pi_{R,l}^P$ is constant in $x$. Focusing on $\pi_{R,d}^P$, and taking the partial derivative of $\pi_{R,d}^P$ with respect to $x$ yields:

$$\frac{\partial \pi_{R,d}^P}{\partial x} = \frac{1}{2} \frac{\sqrt{m_F}}{\tau_D + x + m_F} \left( b - \epsilon x \right) - \left(1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}}\right) \epsilon$$

$$= \sqrt{\frac{m_F}{\tau_D + x + m_F}} \left(\frac{1}{2} \frac{b - \epsilon x}{\tau_D + x + m_F} + \epsilon \right) - \epsilon$$

This derivative is positive when $x = -\tau_D$, and negative when $x = b/\epsilon$. Moreover, it is mono-
tonically decreasing in $x$ for $x \leq b/\epsilon$. In other words, $\pi_{R,d}$ is concave in $x$ over $x \leq b/\epsilon$:

$$\frac{\partial^2 \pi_{R,d}^p}{\partial x^2} = -\frac{1}{2} \frac{m_F}{(\tau_D + x + m_F)^2} \left( \frac{b - \epsilon x}{2 \tau_D + x + m_F} + \epsilon \right) - \frac{1}{2} \sqrt{\frac{m_F}{\tau_D + x + m_F} \left( \frac{\tau_D + x + m_F}{2} + b - \epsilon x \right)} < 0$$

Thus, there must exist some value $x^* \leq b/\epsilon$ such that $\frac{\partial \pi_{R,d}^p}{\partial x} (x^*) = 0$ and $\pi_{R,d}$ reaches a local maximum.

Note that $\pi_{R,d}^p = \pi_{R,d}^l$ when $x = 0$, and $\pi_{R,d}^p = 0$ when $x = -\tau_D, b/\epsilon$. Also, at $x = 0$, we have

$$\frac{\partial \pi_{R,d}}{\partial x} = \sqrt{\frac{m_F}{\tau_D + m_F}} \left( \frac{1}{2} \frac{b}{\tau_D + m_F} + \epsilon \right) - \epsilon$$

This can either be positive or negative, depending on the values of $\tau_D, m_F, b$ and $\epsilon$. In the former case, we will have $x^* > 0$. In the latter case, we will have $x^* < 0$. Moreover, since $\pi_{R,d}^p$ is concave in $x$, in the first case, there must exist some $x' \in (x^*, b/\epsilon)$ such that $\pi_{R,d}^p(x') = \pi_{R,d}^p$; in the second case, this $x'$ is simply equal to 0.

**Comparative Statics:** now, I let

$$F(x) = \left( 1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}} \right) (b - \epsilon x) - \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right) b$$

Then the cut-off point $x'$ is characterized by:

$$F(x') = \left( 1 - \sqrt{\frac{m_F}{\tau_D + x' + m_F}} \right) (b - \epsilon x') - \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right) b = 0$$

We know that $\frac{\partial F}{\partial x} = \frac{\partial \pi_{R,d}^p}{\partial x}$. Note that $\frac{\partial \pi_{R,d}^p}{\partial x} < 0$ since $x'$ is defined to lie in $(x^*, b/\epsilon)$. Moreover, I compute the following partial derivatives:

$$\frac{\partial F}{\partial \epsilon} = - \left( 1 - \sqrt{\frac{m_F}{\tau_D + x' + m_F}} \right) x' \leq 0$$

$$\frac{\partial F}{\partial b} = \sqrt{\frac{m_F}{\tau_D + x' + m_F}} - \sqrt{\frac{m_F}{\tau_D + x' + m_F}} \geq 0$$

$$\frac{\partial F}{\partial \tau_D} = \frac{1}{2} \left( \frac{1}{2 \tau_D + x' + m_F} \right)^{3/2} (b - \epsilon x') - \frac{1}{2} \frac{\sqrt{m_F}}{\tau_D + m_F} b \leq 0$$

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Invoking the implicit function theorem, we arrive at the following results:

\[
\begin{align*}
\frac{\partial x'}{\partial \epsilon} &= -\frac{\partial F / \partial \epsilon}{\partial F / \partial x'} \leq 0, \\
\frac{\partial x'}{\partial \tau_D} &= -\frac{\partial F / \partial \tau_D}{\partial F / \partial x'} \leq 0, \\
\frac{\partial x'}{\partial b} &= -\frac{\partial F / \partial b}{\partial F / \partial x'} \geq 0.
\end{align*}
\]

**B.3 Proof to Claims 1, 2**

Recall that the ruler chooses the larger of the following two payoffs, associated with setting the lower and the higher wage, respectively:

\[
q \left(1 - \frac{m_F}{\tau_D + b + m_F}\right) (\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - v_i, \\
\left(1 - \frac{m_F}{\tau_D + b + m_F}\right) (\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - (v_i + e)
\]

The ruler sets the lower wage when:

\[
e > (1 - q) \left(1 - \frac{m_F}{\tau_D + b + m_F}\right) (\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)})
\]

The LHS is strictly increasing in \(e\), and the RHS is strictly decreasing in \(q\). Thus there exists cut-offs \(e^*, q^*\) such that the ruler will set the lower wage when \(e \geq e^*\) or \(q \geq q^*\).

**Comparative Statics:** I let

\[
\pi_B^R = \left(1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}}\right) (\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)})
\]

Then the bureaucratic contract is feasible for the disloyal administrator if (when it is feasible for the disloyal type, it is definitely feasible for the loyal type):

\[
\pi_B^R \geq v_i + e
\]

Computing partial derivatives yields:

\[
\frac{\partial \pi_B^R}{\partial m_F} = 2 - \frac{2m_F + \tau_D + b}{\sqrt{m_F(\tau_D + b + m_F)}} = 2 - \left(\frac{\sqrt{m_F}}{m_F + \tau_D + b} + \frac{\sqrt{m_F + b}}{m_F}\right) \\
= 2 - \left(\sqrt{z} + \frac{1}{\sqrt{z}}\right)
\]

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Here, $z \in (0, 1)$. Over this domain, the function $\sqrt{z} + 1/\sqrt{z}$ is strictly greater than 2. Therefore:

$$\frac{\partial \pi^B_R}{\partial m_F} = 2 - \left( \sqrt{\frac{m_F}{m_F + \tau_D + b}} + \sqrt{\frac{m_F + \tau_D + b}{m_F}} \right) < 0$$

Moreover,

$$\frac{\partial \pi^B_R}{\partial \tau_D} = 1 - \frac{m_F}{\tau_D + b + m_F} > 0$$

$$\frac{\partial \pi^B_R}{\partial b} = 1 - \frac{m_F}{\tau_D + b + m_F} > 0$$

This shows that $\pi^B_R$ is increasing in $\tau_D, b$ and decreasing in $m_F$. Thus, there exists cut-offs $\tau^b_D, b^b, m^b_F$ such that the bureaucratic contract is feasible, so $\pi^B_R \geq v_i + e$, when $\tau_D > \tau^b_D$, or $b > b^b$, or $m_F < m^b_F$. Furthermore, since $v_i + e$ are increasing in both arguments, there exists $v^b, e^b$ such that the bureaucratic contract is feasible, so $\pi^B_R \geq v_i + e$, when $v_i < v^b$, or $e < e^b$.

### B.4 Proof to Proposition 2

The ruler prefers the bureaucratic contract over the patrimonial contract if:

$$\max\{\pi^B_R - (v_i + e), q\pi^P_R - v_i\} - (q\pi^P_R, (1 - q)\pi^P_R, d) \geq \pi^B_R - (v_i + e) - \max\{\pi^P_R, \pi^P_{R, d}\} \geq 0$$

Suppose first that $x \in (x', \tau_D)$, so the ruler prefers the loyal patrimonial administrator over the disloyal one, and the ruler prefers the bureaucratic contract if:

$$\left(1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}}\right) (\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - \left(1 - \sqrt{\frac{m_F}{\tau_D + m_F}}\right) b \geq v_i + e$$

Note that when Inequality 21 is true, the bureaucratic contract is definitely feasible. Thus, Inequality 21 is a sufficient condition for the bureaucratic contract to be implemented in equilibrium.

**Comparative Statics:** I let

$$DIFF_1 = \left(1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}}\right) (\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - \left(1 - \sqrt{\frac{m_F}{\tau_D + m_F}}\right) b$$

Computing partial derivatives yields:

$$\frac{\partial DIFF_1}{\partial b} = \sqrt{\frac{m_F}{\tau_D + m_F}} - \sqrt{\frac{m_F}{\tau_D + b + m_F}} > 0$$
Also,
\[ \frac{\partial \text{DIFF}_1}{\partial \tau_D} = 1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}} - \frac{b\sqrt{m_F}}{(\tau_D + m_F)^{3/2}} \]

This expression is strictly increasing in \( \tau_D \), so \( \text{DIFF}_1 \) is convex in \( \tau_D \). Moreover, at \( \tau_D = 0 \),
\[ \frac{\partial \text{DIFF}_1}{\partial \tau_D} = 1 - \sqrt{\frac{1}{b + m_F}} - \frac{b}{m_F} < 0 \]

And as \( \tau_D \to \infty \), \( \frac{\partial \text{DIFF}_1}{\partial \tau_D} \to 1 \). Thus, \( \text{DIFF}_1 \) is U-shaped in \( \tau_D \), and there exists some value of \( \tau_D \) at which \( \text{DIFF}_1 \) reaches a global minimum.

Lastly,
\[ \frac{\partial \text{DIFF}_1}{\partial m_F} = 2 - \left( \sqrt{\frac{m_F}{\tau_D + b + m_F}} + \sqrt{\frac{\tau_D + b + m_F}{m_F}} \right) + \frac{b}{2m_F + \tau_D} \frac{1}{\sqrt{m_F(m_F + \tau_D)}} \] (22)

I show that this is negative for \( b \leq \tau_D \):
\[ 2 - \left( \sqrt{\frac{m_F}{\tau_D + b + m_F}} + \sqrt{\frac{\tau_D + b + m_F}{m_F}} \right) + \frac{b}{2m_F + \tau_D} \frac{1}{\sqrt{m_F(m_F + \tau_D)}} < 0 \]

Rearranging the above expression yields:
\[ 2 + \frac{b}{2m_F + \tau_D} \frac{\tau_D}{\sqrt{m_F(m_F + \tau_D)}} < \sqrt{\frac{m_F}{\tau_D + b + m_F}} + \sqrt{\frac{\tau_D + b + m_F}{m_F}} \]

Squaring both sides and collecting like terms:
\[ \left(1 - \frac{\tau_D}{m_F}\right) + b \left( \frac{2\tau_D}{m_F + \tau_D} \frac{1}{\sqrt{m_F(m_F + \tau_D)}} - \frac{1}{m_F} \right) + \frac{b^2}{4} \left( \frac{\tau_D}{m_F + \tau_D} \right)^2 \frac{1}{m_F(m_F + \tau_D)} < \frac{m_F}{m_F + \tau_D + b} \]

Multiplying both sides by \( m_F + \tau_D + b \) and collecting like terms yields a cubic polynomial in \( b \). Further multiplying both sides of the polynomial by \( m_F \) yields:
\[ Ab^3 + Bb^2 +Cb + D < 0 \]

Letting \( z = \frac{\tau_D}{m_F + \tau_D} \in (0, 1) \), the coefficients are:
\[ A = \frac{1}{4\tau_D} z^3 < \frac{1}{4\tau_D} \]
\[ B = 2z\sqrt{1-z} - 1 + \frac{1}{4}z^2 \leq 0 \]
\[ C = 2\tau_D(\sqrt{1-z} - 1) \leq 0 \]
\[ D = -\tau_D^2 \]

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Thus:

$$Ab^3 + Bb^2 + Cb + D < \frac{b^3}{4\tau_D} - \tau_D^2$$

The RHS is negative when

$$b^3 < 4\tau_D^3 \Rightarrow b < 4^{1/3}\tau_D$$

Therefore,

$$b < \tau_D \Rightarrow \frac{\partial D I F F_1}{\partial m_F} < 0$$

Now suppose that $x \leq x'$, so the ruler prefers the disloyal administrator over the loyal one, and the ruler prefers the bureaucratic contract if

$$\left(1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}}\right)(\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - \left(1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}}\right)(b - \epsilon x) \geq v_i + \epsilon$$

(23)

Note that when Inequality 23 is true, the bureaucratic contract is definitely feasible. Thus, Inequality 23 is a sufficient condition for the bureaucratic contract to be implemented in equilibrium.

**Comparative Statics:** I let

$$D I F F_2 = \left(1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}}\right)(\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - \left(1 - \sqrt{\frac{m_F}{\tau_D + x + m_F}}\right)(b - \epsilon x)$$

Computing partial derivatives yields:

$$\frac{\partial D I F F_2}{\partial b} = \sqrt{\frac{m_F}{\tau_D + x + m_F}} - \sqrt{\frac{m_F}{\tau_D + b + m_F}}$$

This is positive when $x \leq b$, and negative when $x > b$. Also,

$$\frac{\partial D I F F_2}{\partial \tau_D} = 1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}} - \frac{b - \epsilon x}{\tau_D + m_F \sqrt{\tau_D + m_F}}$$

This expression is strictly increasing in $\tau_D$, so $D I F F_2$ is convex in $\tau_D$. Moreover, at $\tau_D = 0$,

$$\frac{\partial D I F F_2}{\partial \tau_D} = 1 - \sqrt{\frac{m_F}{b + m_F}} - \frac{b - \epsilon x}{m_F} = 1 - \sqrt{\frac{1}{m_F} + \frac{1}{b}} - \frac{b}{m_F} + \frac{\epsilon x}{m_F}$$

This is positive for relatively large $\epsilon x$, negative for relatively small $\epsilon x$.

Moreover, as $\tau_D \to \infty$, $\frac{\partial D I F F_2}{\partial \tau_D} \to 1$. Thus, if $\epsilon x$ is small, $D I F F_2$ is U-shaped in $\tau_D$, and there exists some value of $\tau_D$ at which $D I F F_2$ reaches a global minimum; and if $\epsilon x$ is large, $D I F F_2$ is strictly increasing in $\tau_D$. 

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Lastly,

$$\frac{\partial DIFF_2}{\partial m_F} = 2 - \left( \sqrt{\frac{m_F}{\tau_D + b + m_F}} + \sqrt{\frac{\tau_D + b + m_F}{m_F}} \right) + \frac{b - \epsilon x}{2} \frac{\tau_D}{m_F + \tau_D} \frac{1}{\sqrt{m_F(m_F + \tau_D)}} \quad (24)$$

This expression is smaller than Inequality 22. Therefore, it is negative for \( b \leq \tau_D \).

**B.5 Proof to Proposition 3**

Forced adoption of patrimonial contract occurs when the bureaucratic contract is infeasible, and the patrimonial contract is feasible for both types of administrators, which requires

$$v_i \in \left( \max\{\pi^B_R - \epsilon, q\pi^B_R\}, \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right)(\tau_D + m_F - \sqrt{m_F(\tau_D + m_F)}) \right]$$

A necessary condition for this to happen is for the RHS to be larger than the LHS. Suppose first that \( \pi^B_R - \epsilon \geq q\pi^B_R \), then this condition translates to

$$\left( 1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}} \right)(\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right)(\tau_D + m_F - \sqrt{m_F(\tau_D + m_F)}) < \epsilon$$

Which simplifies to

$$b + 2\sqrt{m_F(\sqrt{\tau_D + m_F} - \sqrt{\tau_D + b + m_F})} < \epsilon$$

Letting DIFF_3 denote the LHS of the expression above, I compute the following derivatives:

$$\frac{\partial DIFF_3}{\partial b} = 1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}} > 0$$

$$\frac{\partial DIFF_3}{\partial \tau_D} = \sqrt{\frac{m_F}{\tau_D + m_F}} - \sqrt{\frac{m_F}{\tau_D + b + m_F}} > 0$$

$$\frac{\partial DIFF_3}{\partial m_F} = -\left( \sqrt{\frac{\tau_D + b + m_F}{m_F}} - \sqrt{\frac{m_F}{\tau_D + b + m_F}} \right) + \left( \sqrt{\frac{\tau_D + m_F}{m_F}} - \sqrt{\frac{m_F}{\tau_D + m_F}} \right) < 0$$

Now suppose that \( \pi^B_R - \epsilon < q\pi^B_R \), then this condition translates to

$$q\left( 1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}} \right)(\tau_D + b + m_F - \sqrt{m_F(\tau_D + b + m_F)}) - \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right)(\tau_D + m_F - \sqrt{m_F(\tau_D + m_F)}) < 0$$

Which simplifies to

$$qb - (1 - q)\tau_D - 2(1 - q)m_F + 2\sqrt{m_F(\sqrt{\tau_D + m_F} - q\sqrt{\tau_D + b + m_F})} < \epsilon$$
Letting $DIFF_4$ denote the LHS of the expression above, I compute the following derivatives:

\[
\begin{align*}
\frac{\partial DIFF_4}{\partial b} &= q \left( 1 - \sqrt{\frac{m_F}{\tau_D + b + m_F}} \right) > 0 \\
\frac{\partial DIFF_4}{\partial \tau_D} &= \sqrt{\frac{m_F}{\tau_D + m_F}} - \left( q \sqrt{\frac{m_F}{\tau_D + b + m_F}} + (1 - q) \right) > 0
\end{align*}
\]

### B.6 Kinship-Based Rule

I briefly examine conditions under which it is desirable to appoint kins to be administrators.

Societies governed through kinship ties are a common phenomenon throughout history. The key reason for choosing kinsmen is that they are more likely to be loyal and obedient. Thus, in the following analysis, I assume that kinship status guarantees loyalty $l_i = 1$. I also restrict the ruler’s choice to be between kinsmen and non-kin nobles.

As Remark 1 in Subsection 4.2 shows, the ruler will always appoint a kinsman under the bureaucratic contract, as loyalty is strictly preferred. Similarly, under the patrimonial contract, the ruler will only appoint a kinsman when he strictly prefers a loyal administrator, the conditions of which are outlined in Proposition 1.

When is kinship-based rule associated with military and fiscal decentralization? This happens when the ruler prefers the patrimonial contract with the loyal administrator over the bureaucratic contract, and when the patrimonial contract is feasible.

**Proposition 4.** Sufficient conditions for kinship-based rule to adopt a patrimonial contract are listed below.

a) The ruler prefers the patrimonial contract. Thus we need $x > x'$, and

\[
\left( 1 - \sqrt{\frac{m_F}{b + \tau_D + m_F}} \right) \left[ b + \tau_D + m_F - \sqrt{m_F(b + \tau_D + m_F)} \right] - \left( 1 - \sqrt{\frac{m_F}{\tau_D + m_F}} \right) b < v_i.
\]

b) The patrimonial contract is feasible. There exist $m_F^b, \tau_D^p$ such that the patrimonial contract is feasible when $m_F < m_F^b$, or equivalently, when $\tau_D > \tau_D^p$, where

\[
m_F^b = \frac{(\tau_D - v_i)^2}{4v_i}, \quad \tau_D^p = v_i + 2\sqrt{m_Fv_i}.
\]

The comparative statics for Equation 25 and the intuition behind them are exactly the same as in Proposition 2. The statement in part b) of the above proposition is easily interpretable—high $m_F$ means large military burden and therefore smaller payoff to the administrator, and high $\tau_D$ means high income and therefore bigger payoff to the administrator.
B.7 Simple Model of Labor Market

There are two types of labor markets: market for production, and market for services. The supply of labor comes from two types of individuals: commoners and displaced nobles.

Nobles. I assume that a fraction $\rho$ of nobles who are displaced in coups and civil conflicts will seek employment in the market for services. Other nobles belong to the landowning class, and consume rents.

Commoners. Commoners have two choices: seek employment in the market for production, or invest a fraction $1 - \delta$ of their time in learning and then seek employment in the market for services. As stated in the main model, I assume that the latter requires some degree of literacy, and therefore learning is a prerequisite. The quality of teaching to which each commoner has access is different. I assume that a fraction $\lambda$ of commoners have access to high quality teaching, and the remaining fraction $1 - \lambda$ only have access to low quality teaching. Only commoners who receive high quality teaching are qualified to be employed in the market for services.

Market for Services. This is the labor market for service professionals such as administrators, private instructors and tutors, ritual specialists, scribes and so on. A total of $N_D$ entities hire service professionals, and each entity has production function:

$$F(L) = \theta L^\psi$$

where $L$ is labor input and $\theta \in \{\theta_L, \theta_H\}$ is literacy. Letting $w$ denote wages, total labor demand can be derived as:

$$L_D = \left(\frac{\theta \psi}{w}\right)^{1/(1-\psi)} N_D.$$

On the supply side, letting $L_c$ denote the number of literate commoners who seek employment in the services market, total supply of literate individuals is:

$$N_S = L_c + \rho N_n$$

And equilibrium wage can be solved as:

$$w^* = \psi \theta_H \left(\frac{N_D}{N_S}\right)^{1-\psi}$$

The equilibrium wage is increasing in literacy $\theta$ and decreasing in the number of candidates who are available for employment. This is the outside option of a literate commoner or a displaced noble, which was previously modeled as $v_c = a \kappa L \theta_H = a \theta_H$ if we designate $\kappa_L = 1$. In other words, $a$ is proportional to $N_D/N_S$.

Market for Goods. On the demand side, I assume that the consumption level of a non-noble person is $\gamma$. Then non-noble consumption is given by $\gamma(N_c + \rho N_n)$, and noble consumption is $ty$,
where \( y \) is the total supply of goods. Equating demand and supply yields the equilibrium level of output:

\[
y = \frac{\gamma (N_c + \rho N_n)}{1 - t}
\]

On the supply side, a commoner’s productivity level is given by \( \eta \), and the prevailing price level is \( p \). Since a fraction \( 1 - \lambda \) of commoners do not have access to high quality teaching, they will always supply labor in the goods market. The remaining fraction \( \lambda \) will choose between seeking employment in the goods and services markets. The former gives them a payoff of \( \delta w \), since literate commoners must spend a fraction \( 1 - \delta \) of their time in acquiring literacy. The latter gives them a payoff of \( p \eta \).

The supply of production is given by:

\[
y^s = \begin{cases} 
\eta (1 - \lambda) N_c, & \text{if } p \in \left[0, \frac{\delta w}{\eta}\right) \\
\eta N_c, & \text{if } p \geq \frac{\delta w}{\eta}
\end{cases}
\]

Letting \( z = \frac{\eta}{1 + \rho \frac{N_n}{N_c}} \), the number of commoners in service market is:

\[
L_C = \begin{cases}
\eta \lambda N_c, & \text{if } \frac{\gamma}{1 - \lambda} \leq (1 - \lambda) z \\
\eta N_c \left(1 - \frac{\gamma}{(1 - \lambda) z}\right), & \text{if } \frac{\gamma}{1 - \lambda} \in ((1 - \lambda) z, z)
\end{cases}
\]

Then, a simultaneous increase in \( \eta \) and \( \rho \) has the following effects. In the goods market, the bound \( z \) will rise if the increase in \( \eta \) is sufficiently large, and in this case

- If \( \frac{\gamma}{1 - \lambda} \leq (1 - \lambda) z \): the upper bound rises, and \( L_C = \eta \lambda N_c \) increases
- If \( \frac{\gamma}{1 - \lambda} > (1 - \lambda) z \): the lower bound rises; regardless of whether the bound still holds, \( L_C = \eta N_c \left(1 - \frac{\gamma}{(1 - \lambda) z}\right) \) definitely increases.

In the services market, the supply of literate individuals rises as the supply of displaced nobles \( \rho N_n \) and commoners \( L_C \) both increase. And the equilibrium wage \( w \), which is also the outside option of a literate commoner/non-noble, falls. This makes the bureaucratic contract more likely to be feasible.