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A Model of Institutional Complementarities in Ancient China

Haiwen Zhou

Abstract

In ancient China, the county system and feudalism were possible government organizational forms. Government officials might be selected through recommendations and examinations. The centralization of authority in the hands of emperors was achieved through a group of institutions such as the county system, the Imperial Examination System, and the division of authority among government officials. This paper provides a systematic interpretation of the interrelationship among this group of institutions and studies institutional complementarities in a model. It is shown that an increase in the degree of increasing returns in the military sector will increase the ruler's incentive to adopt the county system. Institutional complementarities between the adoption of the Imperial Examination System and the division of authority among officials under the county system are established. A decrease in the level of coordination costs of elite increases the ruler's incentive to choose a higher degree of the division of authority.

Keywords: Institution, China, centralization of authority, Imperial Examination System, division of authority

JEL Classification Numbers: D02, N45, H11

1. Introduction

In ancient China, the central government had institutions such that the coordination costs of regional governments and the people were very high, giving the court the ability to have them unable to resist orders effectively. This centralization of authority was achieved through various institutions, and the main ones include the county system, the Imperial Examination System, and the division of authority among government officials.¹ The county system is different from feudalism under which the country is organized into kingdoms. The major difference between counties and kingdoms is as follows. In the county system the central authority appointed the key administrators of local governments. Local officials were rotated every few years and might not be allowed to serve in their hometown area. This produced loyalty because the interests of the regional officials became more closely tied to the court as the system was meritocratic. In kingdoms, kings appointed their commandery and their constituent county officials. Often only

¹ The county system in ancient China should be called the commandery-county system (*jun xian zhi*). For simplicity, we will use the county system throughout the paper.

persons loyal to the king were appointed. This produced loyalty to the king at the court's expense (Edwards, 2009).

This paper contributes to the literature by using economics to interpret the interrelationship among the county system, the Imperial Examination System, and the division of authority among officials systematically and studying institutional complementarities in ancient China in a model. In this model, to deal with external threats and internal rebellions, the ruler chooses the percentage of population administered by counties, the ability of government officials, and the degree of the division of authority among officials. Institutional complementarity means that if a parameter change causes a response of an institution, it will cause another institution to respond in a similar direction.

Under the county system, we establish the existence of institutional complementarities between the Imperial Examination System and the division of authority among officials. Institutional complementarities in ancient China can be illustrated as follows. With the concentration of power in the central government under the county system, possibilities of government officials' usurpation of power increased. To decrease possibilities of usurpation of power, rulers increased degrees of the division of authority among officials. During this process, rulers adopted and improved the Imperial Examination System to recruit talented individuals into the government. Historically speaking, the degree of mobility among high-rank officials was high under the Imperial Examination System (He, 1962). This high degree of mobility decreased the possibility of officials' usurpation of power and increased the rulers' incentives to adopt the Imperial Examination System.

Understanding institutions in ancient China will be helpful to understand China's economic boom after 1978 (Brandt, Ma, and Rawski, 2014). In addition, while we focus on institutional complementarities in ancient China, some aspects of our study could also be relevant to some other regions, such as Europe. Rulers' consolidations of power were also present in Europe when feudalism was eliminated (Tilly, 1992). The periods that France and the United Kingdom introduced examinations into the selection of officials were also periods of the decline of feudalism (Teng, 1943). Thus, complementarities between the elimination of feudalism and the usage of examinations in the selection of officials might also be present in Europe.

In the literature, Yang (1998) and Hui (2005) have illustrated the origin of the county system in ancient China, Zhou (2012) has used a formal model to address the ruler's choice of government organizational form to handle internal rebellions and external threats, Huang (1989) has discussed the selection of government officials, Huang (1974) has studied division of fiscal authorities in the Ming dynasty, Edwards (2009) has emphasized the division of authority as a method of control over regional governments, with specific examples from the Han and Tang Dynasties as well as the Roman Empire, and Qian (2001) has discussed the gains and losses of Chinese political affairs in Chinese history. However, there is no formal model addressing institutional complementarities in ancient China. A formal model will be useful to organize our thinking on this important issue and helps us to understand the evolution of complementary institutions in ancient China.

The plan of the paper is as follows. In Section 2, we describe the evolution of the centralization of authority in the hands of emperors in ancient China to motivate the model. In Section 3, we specify the model, establish the existence of a unique equilibrium, and conduct comparative statics to explore properties of the equilibrium. In Section 4, we conclude.

2. Evolution of the centralization of authority in the hands of emperors in ancient China

In this section, we describe the evolution of the ruler's choices of government organizational form, the mechanism to select government officials, and the degree of the division of authority among officials in handling external threats and internal rebellions.²

2.1. Choice of government organizational form

In ancient China, a ruler may choose from two types of government organizational forms: feudalism under which kingdoms were dominant, and the county form. In addition, the ruler may choose the mixed form under which both counties and kingdoms played significant roles.

In a feudal system there are large tracts of unused or unopened land between the central authority and the regional fiefs. This open land may have some small numbers of people. In contrast, the county system is set up so that the land of the country is contiguously divided into counties. Each piece of land belongs to one county that is governed by a centrally appointed

² In addition to the above institutions, other mechanisms also contributed to the centralization of authority in the court, such as the usage of spy agencies in the Ming dynasty and the usage of secret report system (*mi-zhou zhi*) in the Qing dynasty.

county magistrate. There is no open land with unaccounted for people or tribes in the county system (Hui, 2005).

2.1.1. Feudalism

The Zhou dynasty (1045 BC-256 BC) practiced feudalism, as a recognition of reality. Only with the support of hundreds of vassals, the founder of the Zhou dynasty, King Wu of Zhou, was able to defeat King Zhou of Shang. To reward relatives and friends, and to avoid a second round of war with strong vassals such as Chu and Yue, states such as Qi, Lu, and Yan were established. Within a state, land was awarded to Great Officers (*da-fu*). To ensure the rule of the Zhou ruling house, states held by the royal clan occupied strategic places of the country (Yang, 1999, chap. 4; Hui, 2005).

Because rulers of states and Great Officers had their independent military forces, while the Zhou ruling house could not control the states effectively, within a state powerful Great Officers frequently revolted against the ruler. There are various examples of power struggles between rulers and Great Officers. First, conflicts in the Lu state among the rulers and three Great Officers weakened the state and led to the eventual demise of the state (*san huan luan Lu*). Second, in the Jin state, powerful Great Officers divided the state into three states Zhao, Wei, and Han (*san jia fen Jin*) and the Jin state was left with a small territory and eventually disappeared. Third, in the Qi state, the ruling Jiang family got usurped by the Tian family even though the name of the state was kept (*tian shi dai qi*) (Sima, 1988).

Over time the power of the Zhou ruling house declined.³ The regional populations were growing and vassals were extending their authority beyond their original fief centered on a town, bringing the countryside into the fold, i.e. providing citizenship or land rights to peasants in the countryside in exchange for taxes and military service (Hui, 2005). In this way the regional armies were growing in size relative to that of the central authority. With more people, more cities and bigger cities, the military threat of any given location increased.

2.1.2. The county form

³ The Western Zhou dynasty ended and the Eastern Zhou dynasty started when King You of Zhou was killed by Quanrong in 771 BC (Sima, 1988).

The establishment of counties and commanderies in the Spring-Autumn and Warring States periods is illustrated in Yang (1998, chap. 6).⁴ While population had been increasing before the invention of iron, the usage of iron increased productivity and population. With a higher population, the demand for land increased and states engaged in wars of annexation. In China, the adoption of the county system during the Spring-Autumn and the Warring States periods interacted with higher degrees of increasing returns in military technologies (Yang, 1998).⁵ At that time, iron began to replace copper to be used to produce weapons. Weapons made from iron were sharper. Many new weapons such as crossbow (*nu*) were developed. Crossbows could reach enemies hundreds of meters away. This reduced the importance of chariots and increased the importance of infantry in winning wars. With the demand of a large number of infantry in mind, when a large state conquered a small one and acquired its territory, this new piece of territory could be organized into a county ruled directly by the king rather than as a fief awarded to a Great Officer ruled indirectly by the king.⁶ A ruler might also consolidate several pieces of territories already under his control to form counties. Counties had their taxation systems and enlisting systems. The establishment of counties increased the supply of soldiers and the scale of war increased (Yang, 1998).⁷

The adoption of the county system led to conflicts between the ruler of the country and the regional powerful families and nobles within the country. If the military threat increases enough, powerful families and nobles might accept the county magistrates and follow their orders. The mechanism at work in state formation is that as the military threat increases it changes the country's coordination costs of key groups within the country (Hui, 2005). In a war, a mediocre decision carried out rapidly is better than a good decision carried out slowly. This means that the military organizational efficiency of neighboring countries' armies (not just the

⁴ Yang (1981) has a discussion on the origin of the county system in Chu. Yang (2006, chap. 3) contains a study of the transformation of government organizational form from feudalism to the county system in ancient China.

⁵ Fairbank and Goldman (1998, p. 54) also state that the use of iron led to larger armies.

⁶ From its pronunciation in Chinese, county (*xian*) means "status undetermined." Its origin is as follows. During the Zhou dynasty, a piece of territory would be awarded to a vassal but who would be that vassal might have not been determined. The Zhou ruling house would send officials to manage this piece of territory temporarily. *Jun* was also established for military purposes. Initially, the status of *xian* was higher than that of *jun* in the administrative hierarchy. Later *xian* was placed under *jun*.

⁷ The increase in the scale of wars can be seen from some important battles at that time. For the Battle of Chengpu (632 BC) between Jin and Qin in the Spring-Autumn period, the state of Jin employed about 20,000 soldiers. Later in the Warring States period, the seven major states had soldiers ranging from 300,000 to one million. In the Battle of Changping (260 BC) between Qin and Zhao, about 400,000 surrounded soldiers of the state of Zhao were executed by being buried alive (Yang, 1998).

size of army) also affects the level of military threat. If a state adopts the county system there is a feedback effect where it raises the military threat faced by its neighboring states and thus their internal resisting group's coordination costs change. This mechanism and its feedback effects have been studied in Hui (2005).

Qin was the first state to establish counties throughout the state under the famous Reforms of Shang Yang in the Warring States period (Lin, 1981; Yang, 1998). In 375 BC, the ruler of Qin, Duke Xiao, ordered the registration of all households by administrators. It appears that this order to register households was not implemented, likely due to the resistance of the nobles in the regions. In 356 BC, Duke Xiao followed Shang Yang's advice and implemented the first round of reforms. Shang Yang belonged to the Legalist School, which tried to advise rulers on institutions to consolidate resources to win wars. The reforms of 356 BC only saw limited success. The nobles in the region continued to resist the administrators registering the households under their patronage. In 350 BC, Qin moved its capital city to Xianyang, a region with a lot of unopened land. The Qin court cleared the land and invited migrants from the neighboring states to move into the new plots of land. With few nobles in this relatively unopened land, resistance by nobles was limited. Forty-one counties were set up (Sima, 1988). This establishment of counties increased the power of the Qin ruler relative to that of nobles. The Reforms of Shang Yang laid the foundation for the Qin state to unify China in 221 BC. Once China was unified, there was a debate between Li Si (an important Legalist) who supported the adoption of the county system and some of his colleagues who supported feudalism. Qin Shihuang (the first emperor in China's history) sided with Li Si and the Qin dynasty (221 BC-207 BC) adopted the county system nationally (Sima, 1988).

Over China's imperial history, the layers and nomenclatures of local governments could vary under the county system. For example, there could be two layers of local governments such as commandery and county (*xian*), or three layers such as province (*sheng*), circuit (*dao*), and county.

2.1.3. The mixed form

The mixed government organizational form was adopted by rulers in the early period of the Han dynasty (206 BC-220) and the Western Jin (265-316).⁸

The Qin dynasty lasted for less than twenty years. The Qin state was established to support war. Laws and rules were strict and harsh, but on the other hand rewards from performing well in battle were high. Once the country was unified there was no more land to take over and the people had to essentially live under a police state without the previous benefits. This led to the collapse of the Qin via rebellions (Hui, 2005).

In the early period of the Han dynasty founded by Liu Bang, the kingdoms outside the Liu family were the remnants of the seven powerful states of the Warring States period. The lineages survived and staked claims as kings when the Qin fell and the Han central authority had to either attack them and carve them up into the county system, or compromise with the kings and allow them to exist as long as they paid taxes and kept the peace (Hui, 2005). In the Han dynasty, one lesson from the quick fall of Qin was the following: without kingdoms, the court would be overthrown once the central government falls. If there were kingdoms, rebels need to overthrow both the kingdoms and the central government, and this would make the job of rebels much harder. A conclusion is that some kingdoms should be established to defend the central government. Because the benefit of the county system was already established in the previous dynasty, eliminating counties altogether would not make sense. Thus, the county system was mixed with feudalism in the sense that parts of the country were organized as counties while others were organized as kingdoms (*jun guo zhi*) (Sima, 1988).

This mixed system was not stable because kingdoms within the Liu family established to protect the central government turned out to rebel against the central government. Even the Liu kings began to lose their ties to the central government since subsequent generations had lost the personal bonds of their predecessors (Sima, 1988). In the Han dynasty, after a civil war between the central government and the several rebelling kingdoms (*qi wang zhi luan*), the central government took over the power of appointment and appointed local officials directly. This is in contrast to the situation before when the kings appointed their own officials within their own territories. Kingdoms with independent military forces were gradually eliminated. For kingdoms remaining, they had only nominal power: no independent military power, kings were entitled to

⁸ In the Ming dynasty, Emperor Zhu Yuanzhang established kingdoms ruled by his sons to safeguard the rule of his family. However, there were fundamental changes to the regional fiscal system in the sense that high degrees of division of power were introduced (Edwards, 2005; Liu, 2015).

tax revenues only, and the central government appointed kingdoms' officials directly (Sima, 1988; Edwards, 2009).

For the Western Jin dynasty, the ruler came to power after Sima Yi usurped power from the Cao family through a coup. To avoid the same fate happening to the Sima family, Sima Yan (founder of the Western Jin dynasty and Sima Yi's grandson) established dozens of kingdoms to safeguard powerful ministers from usurping power. The Western Jin did not recover from civil wars among kingdoms, and was eliminated by a nomadic group (Sima et al, 1084).

2.1.4. Remarks

The adoption of the mixed system reflected the process of institutional experimentation. The ruler faced the following dilemma. On the one hand, if a ruler establishes a kingdom, if it was not given independent military power, the kingdom would not have the capacity to defend the central government. On the other hand, if it was given independent military power, the kingdom could use this power to revolt against the central government. Historically, the solution for the avoidance of usurpation of power was not achieved through the establishment of kingdoms and the perfection of the mixed system. Rather, with the adoption of the Imperial Examination System and the division of authority among officials, usurpation decreased. Rulers in ancient China eventually gave up the idea of employing the mixed system.

Because feudalism disappeared with the Zhou dynasty and the mixed system was unstable, the county system was the dominant government organizational form in ancient China after the Qin dynasty. Roughly speaking, the degree of the adoption of the county system increased over time in China's history. For example, some remote regions governed by local minorities began to be incorporated into the county system in the Qing dynasty (1644-1911) (*gai tu gui liu*).

2.2. Selection of government officials

The mechanism to select officials was an important institution in China. Actually, for the system of Three Departments and Six Ministries discussed later, the Ministry of Personnel Administration (*li bu*) ranked the highest among the six ministries. Generally speaking, a person may become an official through various ways, such as recommendations and examinations. In addition, when the government had financial crises caused by civil wars or natural disasters,

government positions could be purchased. For example, as discussed in He (1962), in the Qing dynasty, many government positions were sold to raise money to put down the Taiping Rebellion (1851-1864).

Under feudalism (the Zhou dynasty), government positions were inherited. In the Warring States period, fierce competition among states forced rulers to recruit capable officials. For example, in the state of Qin, inherited positions were eliminated during the Reforms of Shang Yang. Individuals need military achievements to be promoted. This provided strong incentives for men to fight fiercely in wars. However, as pointed out by the great scholar Han Fei (the synthesizer of the Legalist School), this system of selecting officials through military merits had a serious shortcoming: individuals good at fighting wars might not be good at managing the country.

2.2.1. Cha ju zhi

In the Han dynasty, Liu Che (Emperor Wu of Han) used *cha ju zhi* to select officials, which means recommendation (*ju*) after assessment (*cha*). Under this system, the emperor asked officials to recommend men for government positions. Main criteria to select officials included filial piety (*xiao*) and integrity (*lian*). The functioning of *cha ju zhi* depended on local communities' evaluations of the reputations of candidates. Once a candidate was recommended, he might be required to take exams. However, the performance of a candidate in exams was not essential in determining his qualification. This is the key difference between the *cha ju zhi* and the Imperial Examination system to be discussed (Huang, 1989). Under the Imperial Examination System, candidates' performance in the exams was the essential criteria to select officials.

2.2.2. The nine-rank system

The functioning of the *cha ju zhi* relied on local officials' assessment of candidates. During the Period of Three Kingdoms (220-280), with high mobility due to wars, people might not know each other well and the *cha ju zhi* might not function well (Qian, 2001). Also, because individuals from powerful clans had significant influences on the determination of candidates' "reputations", powerful clans dominated the system when reputations of candidates were

important in evaluating candidates. To increase government control, Chen Qun of the Kingdom of Wei developed the nine-rank system (*jiu pin zhong zheng zhi*) to select officials.

Under the nine-rank system, the government created the position of *zhong zheng* to evaluate candidates. This increased the degree of professionalism in selecting officials because no specially designated official was established under *cha ju zhi*. Under this system, *zhong zheng* evaluated each candidate in terms of his family backgrounds, merits, and abilities, then classified the candidate into one of the nine ranks (Huang, 1989). The establishment of the nine-rank system was a compromise between the ruler and powerful clans: On the one hand, the emperor's appointment of the *zhong zheng* reflected the power of the emperor. On the other hand, the usage of the reputation of a candidate in his local community reflected the power of clans. With this institutional innovation in selecting officials, the Kingdom of Wei enjoyed an advantage in its competition with the Kingdoms of Shu and Wu.

While the nine-rank system initially played a useful role in selecting officials, the performance of this system deteriorated when it became monopolized by powerful clans. When *zhong zheng* mainly came from powerful clans, family backgrounds became the dominant factor in determining the rankings of candidates. Thus, individuals from influential families dominated high ranks and those from less influential families rarely got high ranks (Huang, 1989). For the emperors, powerful clans' controls of the ranking of candidates were harmful to their rules. This was witnessed by the frequent changes of political regimes in the Southern and Northern Dynasties (420-589). After being used for about 400 years, the nine-rank system came to an end in the Sui dynasty (581-618).

2.2.3. The Imperial Examination System

The evolution of the Imperial Examination System (*ke ju zhi*) was a dynamic process, and the topics examined and the formats of exams changed over time.⁹ The format became more and more standard and impartial over time. This decreased the influence of powerful officials and clans in selecting officials. Literally, *ke ju* means selection (*ju*) through categories (*ke*). The System originated in the Southern and Northern dynasties and started officially in the year 605 by Emperor Yang Guang of the Sui dynasty (Huang, 1989).

⁹ In addition to the selection of civilian officers, there were also examinations to select military officers starting from the Tang dynasty.

In the Tang dynasty (618-906), different subjects were tested. Successful candidates were assigned to low level positions. Except under Empress Wu's rule, the Tang dynasty did not implement measures to ensure the anonymities of candidates. Candidates might also submit their works during times other than the examination process. Thus, information outside the examination process such as candidates' reputations was also used in evaluating candidates. While this additional information could improve the assessment of candidates' abilities, it also led to high levels of corruptions at the end of the Tang dynasty.¹⁰

In the Song dynasty (960-1127), the role of the System came to a new height because officials from the System completely dominated the political stage. Improvements in the printing technologies lowered the costs of printing books, and the diffusion of knowledge increased the number of individuals attending examinations. The Song court competed with Jin and Liao courts.¹¹ To win the support of the intellectuals, relatively large numbers of candidates were allowed to pass exams. It became an established procedure that exams would be held every three years.¹² Exams were held at three levels: provincial, metropolitan, and the palace examination.¹³ A candidate was called a Bachelor (*xiu cai*) if succeeded in provincial examination, a Licentiate (*ju ren*) if succeeded in metropolitan examination, and a Doctor (*jin shi*) if succeeded in the palace examination (Teng, 1943; Hucker, 1958). In the Song dynasty, materials covered in the exams were in general relevant to the handling of government affairs.

In the Yuan dynasty (1271-1368) established by Mongols, many officials originated from serving as functionaries (*li*) of the government. Since the usage of the System would increase the influence of Han Chinese in the government, Kublai Khan was hesitant in adopting it (Li, 2014).¹⁴ The System was used only at the beginning and near the end of the dynasty. Compared with other dynasties adopted the System, overall individuals selected from the System did not have significant influence in the Yuan dynasty. While the Song court treated officials selected through the System well, the Yuan court treated government officials like slaves (Li, 2014).

¹⁰ During the Tang dynasty, interviews were also used in evaluating candidates for a while. Because it would be difficult to verify if conflicting arguments arose, oral examinations were eventually dropped.

¹¹ Jin and Liao also adopted the Examination System in selecting officials.

¹² Additional examinations might be held to celebrate the inauguration of an emperor, birthdays of an emperor, or birthdays of an empress dowager.

¹³ Sophisticated procedures were developed to prevent candidates from cheating, such as measures to prevent the candidates' handwritings from being recognized by evaluators.

¹⁴ While the Qing dynasty was established by Manchu, Emperor Kangxi used the System to win the support of the intellectuals of the Han majority.

Compared with the preceding Song dynasty and the following Ming and Qing dynasties, the Yuan dynasty did not last long.

The System was important in selecting officials in the Ming and Qing dynasties. To educate individuals located at remote regions with Confucianism ideas, Zhu Yuanzhang (founder of the Ming dynasty) established schools and ordered the distribution of books of Confucianism classics over the country. In the Ming dynasty, the school system was integrated into the Imperial Examination System: the main purpose of schools became helping candidates to succeed in the exams. This integration was believed to have decreased the independent thinking of scholars and increased the control of emperors. Neo-Confucianism was adopted in the Ming dynasty as the official state orthodoxy, which was very conservative. To cultivate a future official's sense of devotion to the emperor and the country, test material was restricted to the classic Confucianism ideas. Topics such as mathematics, astronomy, and medicine were dropped. Through a process of evolution of hundreds of years in which examinees and examiners interacted, eight-legged essay (*ba-gu wen*) was institutionalized as the standard format of writing papers.¹⁵ This standardized format helped the evaluation of candidates.

The Imperial Examination System was a highly robust and advanced mechanism lasted for about 1300 years. There were different opinions about the performance of the System, such as the possibility of making type I error of rejecting capable candidates and type II error of accepting incapable candidates into the government. On the one hand, supporters of the System have argued that the System tested general abilities of candidates and provided a fair mechanism to select officials from all kinds of backgrounds. Historically, the System was successful in recruiting highly capable individuals. For example, during the latter part of the Ming dynasty, men who attained high ranks without being a Doctor were exceedingly rare (Hucker, 1958, p. 14). For the 119 Han Chinese who reached the level of Grand Secretaries (*nei ge xue shi*) in the Qing dynasty, only one (Zuo Zongtang) was not a Doctor. Famous ministers in late Qing such as Zeng Guofan, Li Hongzhang, and Zhang Zhidong were all Doctors. On the other hand, critics have argued that the System was not useful in evaluating the merits of candidates. Knowledge other than Confucianism classics such as scientific knowledge was ignored. The focus on writing

¹⁵ *Gu* means antithetical parallelism (*dui ou*). An eight-legged essay contains eight *gu* and additional parts. The eight *gu* form four pairs: beginning (*qi gu*), middle part (*zhong gu*), last part (*hou gu*), and conclusion (*shu gu*). When an individual writes an eight-legged essay, he should identify himself with the views of saints such as Confucius and Mencius.

eight-legged essays constrained the creativities of individuals and harmed China's opportunities of achieving industrialization. With China's opening to the western world and suffered from the Opium Wars in the nineteenth century, many believed that the System was outdated. The System increased the opportunity cost of introducing modern schools (Chu and Liu, 1994). Eventually, the Qing dynasty terminated the System in 1905.

As the first competitive examination system in the world, the System had global influence. The System influenced the selection of government officials in some other Asian countries, such as Japan, Korea, and Vietnam. The System also influenced the adoption of the civil examination system in Europe, such as in France and in the United Kingdom (Teng, 1943; Creel, 1970).

2.2.4. Remarks

The selection of officials can be understood from a mechanism design perspective. Candidates differ in their abilities. The ability of a candidate is his private information. Compared with *cha ju zhi* and the nine-rank system, the System relied more on the costly actions of informed candidates: to succeed in the System was costly because it took years to prepare for the exams. Thus, the System could do a better job in selecting government officials than the two other ones. This observation was consistent with the fast spread of the System. Data from Huang (1989, p. 201) show that in the Tang dynasty, the percentage of prime ministers chosen by using the System under Emperor Li Shimin was 3.4% and this increased to 25% under Emperor Li Zhi (Li Shimin's son).

By eliminating the influence of powerful clans in recruiting officials, emperors consolidated power, and frequent changes of political regimes were avoided. Historically speaking, the System decreased possibilities of internal rebellions because high-rank officials were continuously being reshuffled. In the literature, it is frequently argued that the System decreased possibilities of internal rebellions because the government absorbed capable individuals from all kinds of backgrounds. This argument is obviously correct. However, this argument does not highlight the essential difference among *cha ju zhi*, the nine-rank system, and the Imperial Examination System. While all three were mechanisms to select capable officials, the System was distinct because it was not monopolized by powerful clans in the long run.

2.3. The evolution of the division of authority among officials

The division of authority means the separation of military, financial, and administrative authorities among government officials. In addition, each kind of authority can be divided among different individuals or agencies.

2.3.1. Division of authority at the central government

After the adoption of the county system, with authority concentrated in the central government, a prime minister could usurp power and was a potential threat to the ruler. The level of authority of a prime minister in the Qin dynasty and at the beginning of the Han dynasty was quite high. A prime minister at that time may be viewed as the Chief Executive Officer and an emperor may be viewed as the chairman of the Board of Directors. A prime minister could sentence other officials to death without getting the prior permission of the emperor (Sima, 1988). A consensus among students on China's history is that the authority of prime ministers relative to that of the emperor declined over time (Qian, 2001).

In the Qin dynasty, the establishment of Great Officer of Censor (*yu shi da-fu*) removed the authority of monitoring officials from prime ministers. To reduce the power of the prime ministers, Liu Che in the Han dynasty appointed relatively junior officials with limited influences as prime ministers (Sima, 1988).

The Sui dynasty started the institution of the Three Departments and Six Ministries (*san sheng liu bu zhi*) under which the authority of the prime minister was divided. For the three departments, the Secretariat (*Zhongshu Sheng*) drafts an order, the Chancellery (*Mengxia Sheng*) reviews the order, and the Department of State Affairs (*Shangshu Sheng*) implements the order.¹⁶ The Department of State Affairs was further divided into six ministries (*bu*) specializing on personnel administration, finance, rites, military, justice, and public works respectively. With the existence of multiple prime ministers and the check of power among them, the authority of any individual prime minister decreased significantly.

The Tang and Song dynasties also adopted the system of Three Departments and Six Ministries. However, during Tang and Song, the three departments might meet together to

¹⁶ The Department of State Affairs was initially a part of the inner court handling personal issues of the emperor. To reduce the influence of the prime minister, Emperor Wu of Han used it to process government documents. It gradually evolved into an important part of the outer court handling government issues. The Secretariat was established in the State of Wei in the Period of Three Kingdoms. The Sui dynasty used this agency and the Chancellery to balance the power of the Department of State Affairs.

increase the degree of coordination within the government. In the Tang dynasty, as a military commissioner (*Jie du shi*), An Lushan had authority over both military and financial affairs. An Lushan's rebellion led to the decline of the Tang dynasty. In the Song dynasty, with the lessons of the fall of the Tang dynasty in mind, division of authority was used to control military officials. Emperor Zhao Kuangyin eliminated some important military positions, and split each remaining important position into several positions so that the role of one person would not be too significant. The authority to control the military and finance were removed from prime ministers. The Chief Military Commission (*Shu-mi yuan*) had the authority of deploying armies, while the three offices (*san ya*) were actually managing the armies. There were also divisions of authority within the three offices.

In general, the division of authority among officials increased over time in terms of breadth and depth. The division of authority among officials reached the zenith in the Ming and Qing dynasties. In the Ming dynasty, Emperor Zhu Yuanzhang eliminated the position of the prime minister and he spread the responsibilities of the prime minister over the six ministers. Thus, the system of Three Departments and Six Ministries became the system of Six Ministries, and the emperor played roles of both Chairman of the Board of Directors and CEO. For the Ministry of Revenue, while it was a centralized ministry in the Song dynasty, it was splintered into thirteen bureaus, corresponding to the thirteen provinces of the empire (Huang, 1974, p. 15).

In the Qing dynasty, Emperor Yongzheng established the Grand Council (*Jun-ji Chu*) as a temporary government agency to handle important military affairs. With its military nature, many activities handled by this agency were kept secret. However, this agency became permanent and also began to handle activities unrelated to military affairs. Thus, while the process for decision making was open in previous dynasties, it was conducted secretly in the Qing dynasty (Qian, 2001). This increased the emperors' power.

2.3.2. Division of authority at the local level

The division of authority at the local level can be illustrated by institutions in the Ming dynasty. In the Ming dynasty, authority at the province level was divided among the Provincial surveillance Office (*an cha si*), the Provincial Administration Office (*bu zheng si*), and the Regional Military Commission (*du zhi hui shi si*), which formed a triad of autonomous agencies

called “the three provincial offices” (*san si*). With the division of authority among the three offices, no person had the authority of a provincial governor (Hucker, 1958).

Emperor Zhu Yuanzhang in the Ming dynasty intentionally decentralized financial authorities, and revenues might not be concentrated at the provincial level before being distributed (Huang, 1974; Edwards, 2005; Liu, 2015). The idea is as follows. Suppose a province collects revenues from locations A, B and C, while the revenue should be distributed to locations D, E and F. In the early period of the Ming dynasty, rather than having the revenues from A, B, and C first aggregated at the province level and then distributed, each of the three revenue generating units could be required to send its revenue directly to the three revenue receiving locations (Huang, 1974). This kind of regional fiscal institutional changes in the early Ming Dynasty was a major break from the previous dynasties (Edwards, 2005; Liu, 2015).

2.3.3. Remarks

By reducing military strengths of the country, a higher degree of the division of authority among officials could be costly to rulers (Zhou, 2012). Overall, the ruler faces the following tradeoff in choosing the degree of the division of authority: a higher degree of the division of authority decreases possibilities of internal rebellions, but may make handling external threats less effective.

2.4. Implications of the concentration of authority in ancient China

Chinese culture originated in the North China Plain. Geographical conditions helped China’s unification.¹⁷ With political unification, rulers established various institutions to consolidate power. Specifically, while territories of states changed frequently in the Warring States period, the unification of weight and measure helped the Qin state to consolidate occupied territories and eventually unified China. After Qin Shihuang unified China, he established common language, currency, weight, and measure for the whole country. In addition to achieving economies of scale and network externalities, those measures helped to create a common culture for Chinese. In the Han dynasty, Confucianism (actually “Legalism with a Confucian façade”) was adopted as the national philosophy for the unity of thoughts (Zhou,

¹⁷ Hicks (1969, pp. 38-39) has provided a comparison on the role of geographical conditions between China and Europe on the possibility of industrialization.

2011). Those policies and institutions made it possible for China to unify many times and avoided the fates of the Roman Empire and the Ottoman Empire.

The centralization of authority in the hands of emperors had benefits and costs. For the benefits, ancient China was frequently the largest economy in the world.¹⁸ Ming and Qing governments were able to rule a large country relatively effectively for hundreds of years.¹⁹ Those were significant achievements. For the costs, ancient China was not able to achieve industrialization. Starting from the Han dynasty, salt and iron were frequently monopolized by the government. With important and profitable industries owned by the state, limited room was left for merchants to accumulate wealth. In China, primogeniture was not practiced and property was divided among offspring. Thus, merchants could not accumulate enough wealth to challenge political power in ancient China. Since the government was challenged neither by nobles (as a result of the Imperial Examination System) nor by rich merchants, state was stronger than society, and industrialization was unlikely (Zhou, 2009).

3. The model

There is a ruler. His maximization problem is as follows. The ruler's payoff is affected by handling external threats and internal rebellions, and costs of selecting capable officials. The ruler chooses the percentage of population administered by counties p , ability of officials a , and the degree of the division of authority among officials z to maximize his expected payoff.²⁰ The ruler can neither pick the ability nor the division of authority in kingdoms, since the kings control these powers. However, in the county system, where the ruler appoints the officials, a and z can be picked by the ruler. Since p is a percentage, we have $0 \leq p \leq 1$. A higher value of a means a higher level of ability of officials, and $a > 0$. A higher value of z indicates a higher degree of the division of authority among officials, and $z > 0$. If the ruler succeeds in handling both external threats and internal rebellions, his payoff is a positive number normalized to one. Otherwise, his payoff is normalized to zero.

¹⁸ Shiue (2002) finds that the overall level of market integration in ancient China was higher than previously thought.

¹⁹ With the high degree of concentration of power in the court, one interesting thing in the Ming dynasty is that the government could still function even though an emperor did not meet with his officials for decades (Huang, 1982).

²⁰ Compared with the nine-rank system, the adoption of the Imperial Examination System can be viewed as an increase in the value of a .

First, we specify the probability that the ruler handles external threats successfully. If the size of the population is L , the ruler's military strength is $b(1-p)L + ap^s L^s / z$. The explanation of this expression is as follows: $b(1-p)L$ is the contribution of military strength from kingdoms. The level of military power produced by each individual administered by kingdoms is b . An increase in b means that the relative advantage of establishing kingdoms increases. Here $ap^s L^s / z$ is the contribution of military power from counties. The degree of increasing returns in the production of military strength is s , and $s \geq 1$. An increase in the division of authority among officials reduces the ruler's military strength. In handling external threats, the level of external threats and the ruler's military power determine the ruler's possibility of winning. The level of external threats is a positive constant Ω .²¹ When the ruler's military strength is $b(1-p)L + ap^s L^s / z$, he handles external threats successfully with probability $\frac{b(1-p)L + ap^s L^s / z}{b(1-p)L + ap^s L^s / z + \Omega}$.²²

Second, we specify the probability that the ruler handles internal threats successfully. The ruler's probability of surviving internal threats is $(1-p)\eta + p \frac{az}{az+1/c}$, a weighted average of the possibility of surviving internal threats when both kingdoms and counties are established. When kingdoms are established, the ruler survives internal threats with probability η . Here η captures the impact of factors such as the size of the territory controlled by the ruler in affecting the ruler's possibility of winning. An increase in the relative size of the territory controlled by the ruler will increase the ruler's probability of winning. When counties are established, if the level of coordination costs of the elite (such as powerful clans) is c , the ruler survives internal threats with probability $\frac{az}{az+1/c}$. With this specification, a higher level of coordination costs or a higher level of the division of authority among officials increases the ruler's possibility of surviving internal rebellions.

In this model, the adoption of the Examination System (an increase in a) reduces the possibility of internal rebellions. The reason is as follows. Historically speaking, the

²¹ The level of military threat faced by a state is not limited to the sophistication of its neighboring states' weapons. The size of the surrounding population and the organizational efficiency of neighboring states' armies also are key determinants.

²² This specification of the probability of winning is similar to that in the literature on rent-seeking.

Examination System was very competitive. For example, roughly one out of one hundred was able to pass the provincial examination. The usage of examinations in selecting officials led to high level of social mobility (He, 1962). He's research based on data from the Ming and Qing dynasties shows that no family could succeed in the System for several generations.²³ With high turnover rates among officials, no family could accumulate enough power to challenge the emperor. While *cha ju zhi* and the nine-rank system were eventually monopolized by powerful clans, the Imperial Examination System was not. The adoption of the System increased emperors' control over society.

Third, the ruler's cost of selecting capable officials is $\frac{\gamma}{2}a^2$, where γ is a positive constant. A decrease in γ reduces the cost of recruiting capable officials, which could be caused by an increase in the level of political knowledge on institutions through intuitional experimentations. Under this specification, if the ruler keeps the abilities of the officials constant yet increases the proportion of counties, the costs go up.

To sum up, the ruler's expected payoff is

$$\Pi \equiv \left[\frac{b(1-p)L + \frac{ap^s L^s}{z}}{b(1-p)L + \frac{ap^s L^s}{z} + \Omega} \right] \left[(1-p)\eta + p \frac{az}{az + \frac{1}{c}} \right] - p \frac{\gamma a^2}{2}. \quad (1)$$

The first order conditions with respect to p , a , and z are

$$\begin{aligned} \frac{\partial \Pi}{\partial p} = & \frac{\Omega(ap^{s-1}L^s/z - bL)}{[b(1-p)L + ap^s L^s/z + \Omega]^2} \left[(1-p)\eta + p \frac{az}{az + 1/c} \right] \\ & + \left[1 - \frac{\Omega}{b(1-p)L + ap^s L^s/z + \Omega} \right] \left[\frac{az}{az + 1/c} - \eta \right] - \frac{\gamma}{2} a^2 \geq 0, \end{aligned} \quad (2)$$

$$\begin{aligned} \frac{\partial \Pi}{\partial a} = & \frac{p^s L^s \Omega}{z[b(1-p)L + ap^s L^s/z + \Omega]^2} \left[(1-p)\eta + p \frac{az}{az + 1/c} \right] \\ & + \frac{[bz(1-p)L + ap^s L^s]}{[bz(1-p)L + ap^s L^s + \Omega z]} \left[\frac{pz}{c(az + 1/c)^2} \right] - p\gamma a = 0, \end{aligned} \quad (3)$$

$$\frac{\partial \Pi}{\partial z} = \left[b(1-p)L + \frac{ap^s L^s}{z} \right] \frac{p}{c(az + 1/c)^2}$$

²³ He (1962) shows that the impact of *yin* (through which the sons of government officials might become officials without passing examinations) in the Ming and Qing dynasties was not significant.

$$-\frac{\Omega p^s L^s}{z^2 [b(1-p)L + ap^s L^s / z + \Omega]} \left[(1-p)\eta + p \frac{az}{az+1/c} \right] = 0. \quad (4)$$

When the ruler chooses between kingdoms and counties, the tradeoff can be seen from (2). For the left-hand side of (2), the first term shows difference in military strengths between the two organizational forms, the second term shows difference in the probability of preventing internal rebellions, and the third term is the cost of finding capable officials under the county system. Depending on the value of parameters, there are three possible equilibrium government organizational forms. First, if the inequality in (2) is invalid, the benefit of establishing a kingdom is always larger than that of establishing a county, and the ruler adopts feudalism. Second, if the inequality in (2) holds with equality, the benefit of establishing a kingdom is equal to that of establishing a county, the ruler establishes a mixed system in which kingdoms and counties coexist. Because the mixed system relies on the equality of (2), it may be unstable. Third, if the inequality in (2) is valid and holds strictly, the benefit of establishing a kingdom is always smaller than that of establishing a county. Thus, the ruler adopts the county system.

Under feudalism, the ruler of the central government does not choose the ability of officials since positions are inherited. Because that regime is simple, we will not study it in detail. The following proposition studies factors affecting the spread of the county system under the mixed government organizational form.

Proposition 1: A decrease in Ω , η , or γ increases the ruler's incentive to increase the percentage of population managed by counties. If the size of the population managed by counties reaches a critical level, an increase in the degree of increasing returns will increase the ruler's incentive to increase the percentage of the population managed by counties.

Proof: Under the mixed system, plugging (4) into (2) yields

$$\Theta \equiv \frac{[bz(1-p)L + ap^s L^s]}{[bz(1-p)L + ap^s L^s + \Omega z]} \left[\frac{saz}{c(az+1/c)^2} - \frac{bLpz^2}{cp^s L^s (az+1/c)^2} + \frac{az}{az+1/c} - \eta \right] - \frac{\gamma}{2} a^2 = 0. \quad (5)$$

From (5), $\frac{\partial \Theta}{\partial \Omega} < 0$, $\frac{\partial \Theta}{\partial \eta} < 0$, and $\frac{\partial \Theta}{\partial \gamma} < 0$. From (5), a sufficient condition for $\frac{\partial \Theta}{\partial s} > 0$ is

$$\frac{\partial (pL)^s}{\partial s} > 0. \text{ If } pL > 1, \frac{\partial (pL)^s}{\partial s} > 0. \blacksquare$$

The interpretation of $pL > 1$ is that the size of the population administered by counties has to reach a critical level, to make the ruler to prefer counties to kingdoms. This need for a minimum level of mass for increasing returns technologies to be preferred is common in models with increasing returns.

Proposition 1 is consistent with historical evidence. Historically, higher degrees of increasing returns in military technologies led to government organizational changes in China and Europe. The adoption of the county system in China has been discussed in Section 2.1. During the Spring-Autumn period (770 BC-476 BC) and the Warring States period (475 BC-221 BC), rulers adopted the county system so that they could control resources directly to fight wars effectively. In Europe, development of new military technologies changed the conduct of war (Parker, 1996). National states won over city-states and city-empires when mass armies recruited from a state's own population became essential to successful warfare (Tilly, 1992).

A decrease in b decreases the level of military power generated by an individual managed by a kingdom. Interestingly, from (5), a decrease in b does not necessarily lead to an increase in the incentive for the ruler to increase the percentage of the population managed by counties. The reason is as follows. If b decreases, the ruler's possibility of surviving external threats decreases. This decreases the marginal benefit of adopting the county system. Because the marginal cost also decreases, it is not clear which effect dominates.

Since the county form played a dominant role in ancient China, for the rest of this section, we focus on the county system. Under the county system, with $p = 1$, equations (3) and (4) can be simplified as

$$\Phi_1 \equiv \frac{\partial \Pi}{\partial a} = \frac{L^s \Omega}{\left(\frac{aL^s}{z} + \Omega\right)^2} \frac{1}{az + \frac{1}{c}} + \frac{L^s}{c \left(\frac{aL^s}{z} + \Omega\right) \left(az + \frac{1}{c}\right)^2} - \gamma = 0. \quad (6)$$

$$\Phi_2 \equiv L^s - c\Omega z^2 = 0. \quad (7)$$

In their stimulating work, Milgrom and Roberts (1990) have studied complementarities in the adoption of modern flexible manufacturing system. They establish that complementarity among choice variables exists when the second order cross derivatives of the objective function are nonnegative. Using their terminology, the following proposition studies the existence of institutional complementarities in ancient China.

Proposition 2: Complementarities between the adoption of the Imperial Examination System and the division of authority among officials exist under the county system.

Proof: By using (7), partial differentiation of equation (6) yields

$$\frac{\partial^2 \Pi}{\partial a \partial z} = \frac{aL^s}{\left(\frac{aL^s}{z} + \Omega\right)\left(az + \frac{1}{c}\right)} \left[\frac{2\Omega}{\left(\frac{aL^s}{z} + \Omega\right)\left(az + \frac{1}{c}\right)} - \frac{2}{c\left(az + \frac{1}{c}\right)^2} \right] = 0. \blacksquare$$

In China's history, the division of authority among officials interacted with the evolution of the mechanisms to select officials. It is frequently argued that the division of authority led to redundant officials and inefficiencies. Here we show that this kind of redundancy had a benefit: the ruler's incentive to choose more capable officials was higher when the ruler felt safer.

Institutional complementarities in ancient China can be seen from the timing of the adoption of institutions. First, the Reforms of Shang Yang can be used to illustrate the complementarity between the county system and the selection of capable officials. During the Reforms, the county system spread to the whole state. With the elimination of inherited positions, individuals with high abilities were appointed to high positions. Second, the Sui dynasty adopted both the division of authority among officials through the institution of Three Departments and Six Ministries and the Imperial Examination System. Third, in the Ming dynasty, Emperor Zhu Yuanzhang promoted both the division of authority among officials and the Imperial Examination System strongly.²⁴

Equations (6) and (7) form a system of two equations defining two endogenous variables a and z as functions of exogenous parameters. Partial differentiation of equations (6) and (7) with respect to a , z , γ , c , Ω , and L yields

$$\begin{pmatrix} \frac{\partial \Phi_1}{\partial a} & 0 \\ 0 & \frac{\partial \Phi_2}{\partial z} \end{pmatrix} \begin{pmatrix} da \\ dz \end{pmatrix} = - \begin{pmatrix} \frac{\partial \Phi_1}{\partial \gamma} \\ 0 \end{pmatrix} d\gamma - \begin{pmatrix} \frac{\partial \Phi_1}{\partial c} \\ \frac{\partial \Phi_2}{\partial c} \end{pmatrix} dc - \begin{pmatrix} \frac{\partial \Phi_1}{\partial \Omega} \\ \frac{\partial \Phi_2}{\partial \Omega} \end{pmatrix} d\Omega - \begin{pmatrix} \frac{\partial \Phi_1}{\partial L} \\ \frac{\partial \Phi_2}{\partial L} \end{pmatrix} dL. \quad (8)$$

²⁴ Zhu's adoption of the mixed system instead of the pure county system turned out to be a costly mistake (civil war) and was corrected by his son Zhu Di.

Because $\frac{\partial\Phi_1}{\partial a} < 0$ and $\frac{\partial\Phi_2}{\partial z} < 0$, the determinant of the coefficient matrix of endogenous variables of (8) is positive: $\Delta \equiv \frac{\partial\Phi_1}{\partial a} \frac{\partial\Phi_2}{\partial z} > 0$. With Δ nonsingular, a unique equilibrium exists for the system (8).

In China's history, with institutional experimentations under different political regimes, knowledge about institutions increased over time. An increase in the level of knowledge on institutions can help the rulers in designing better institutions. The following proposition studies the impact of a change in the cost of recruiting more capable officials.

Proposition 3: Under the county system, $\frac{da}{d\gamma} < 0$ and $\frac{dz}{d\gamma} = 0$.

Proof: An application of Cramer's rule on the system of (8) yields

$$\frac{da}{d\gamma} = -\frac{\partial\Phi_1}{\partial\gamma} \frac{\partial\Phi_2}{\partial z} / \Delta < 0,$$

$$\frac{dz}{d\gamma} = 0. \blacksquare$$

An increase in c indicates that the level of coordination costs of the elite increases. The following proposition studies how the ruler's choice of the degree of the division of authority among officials is affected by the level of coordination costs of the elite.

Proposition 4: A decrease in the level of coordination costs of elite increases the ruler's incentive to choose a higher degree of the division of authority.

Proof: An application of Cramer's rule on the system of (8) yields

$$\frac{dz}{dc} = -\frac{\partial\Phi_1}{\partial a} \frac{\partial\Phi_2}{\partial c} / \Delta < 0. \blacksquare$$

Similar to the proof of Proposition 4, it can be shown that the impact of a decrease in the level of coordination costs of elite on the ruler's choice of officials' abilities is ambiguous. The reason is as follows: when there is a decrease in the level of coordination costs of elite, the impact on the marginal benefit of a ruler's choice of officials' abilities is ambiguous.

The following proposition studies a change in the level of external threats on the ruler's choice of the degree of the division of authority among officials.

Proposition 5: An increase in the level of external threats leads the ruler to choose a lower degree of the division of authority.

Proof: An application of Cramer's rule on the system of (8) yields

$$\frac{dz}{d\Omega} = -\frac{\partial\Phi_1}{\partial a} \frac{\partial\Phi_2}{\partial\Omega} / \Delta < 0. \blacksquare$$

The result in Proposition 5 can be used to understand the experience of the division of authority among officials in the Song dynasty. The Song dynasty faced significant external threats. Because the degree of external threats fluctuated, the attitude of the Song government over the division of authority also fluctuated, as shown in the reforms by Fan Zhongyan and Wang Anshi. First, Fan Zhongyan initiated a reform in 1043 when Song faced significant threats from the Western Xia (1038-1227). This reform included measures such as the establishment of a professional army so that generals would be familiar with soldiers, elimination of redundant officials in the government, and an increase in the power of prime ministers. Fan's reform was initially supported by Emperor Zhao Zhen. However, after a peace treaty was signed between the Song and the Western Xia governments and the degree of external threats decreased, the concern for internal rebellions increased. Some officials in the Song government suggested to Emperor Zhao Zhen that Fan's policies were dangerous to the court and Fan Zhongyan was demoted. Second, the Song court changed attitudes toward Wang Anshi multiple times, and one reason behind this change of attitude was different levels of external threats faced by the Song court over time.

The impact of an increase in the level of external threats on the ruler's choice of the ability of officials is ambiguous. We may have expected that an increase in the level of external threats will increase the ruler's incentive to find capable officials. This ambiguity is consistent with results in oligopoly models in industrial organization and international trade in which an increase in the degree of aggressiveness of a firm's opponent may not make this firm more aggressive (Bulow, Geanakoplos, and Klemperer, 1985; Brander, 1995).

While there were significant fluctuations of population, roughly speaking the size of the population in ancient China increased over time. The following proposition studies the impact of an increase in the size of the population.

Proposition 6: An increase in the size of the population increases the ruler's incentive to choose a higher degree of the division of authority.

Proof: An application of Cramer's rule on the system of (8) yields

$$\frac{dz}{dL} = -\frac{\partial\Phi_1}{\partial a} \frac{\partial\Phi_2}{\partial L} / \Delta > 0. \blacksquare$$

The intuition behind Proposition 6 is as follows. When the size of the population increases, both the marginal benefit and marginal cost of a high division of authority increase. However, the marginal benefit increases at a faster rate than that of marginal cost. As a result, the ruler chooses a higher level of division of authority among officials when the size of the population increases. Since the impact of an increase in the size of the population on the marginal benefit of the ruler's choice of officials' abilities is ambiguous, it is unclear whether the ruler will choose more capable officials when the size of the population increases.

4. Conclusion

Institutions may play important roles in determining an economy's long-run performance. China's long history provides a rich ground to study the establishment, evolution, and performance of institutions. In this paper, we have provided a systematic discussion of the interrelationship among the county system, the Imperial Examination System, and the division of authority among officials in ancient China, and have studied institutional complementarities in a formal model. The periods that France and the United Kingdom introduced examinations into the selection of officials were also periods of the decline of feudalism. Thus, complementarities between the elimination of feudalism and the usage of examinations in the selection of officials might also be present in Europe.

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