Commercial Revolution in Medieval China*

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Abstract

We use a spatial regression discontinuity design to examine the origins and consequences of a commercial revolution in Song dynasty China — the world's first. We find that counties that were politically stable and allowed a freer allocation of labour after recovering from the An-Shi Rebellion (755-763) exhibited, two centuries later: 1) distinctly higher commercial taxes, 2) a larger number of market towns, and 3) a higher population density. We show that, with its roots in robust agricultural productivity growth, this commercial revolution was underscored by "Smithian growth" — using proto-industries, shipbuilding, and river networks as proxies for specialization and markets expansion.

Keywords: Commercial Revolution, War Shock, Tax Reform, Migration, Political Stability, Smithian Growth, China

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1 Introduction

Notwithstanding the nascent emergence of commerce in North Italy around the 12th century, Europe in the Middle Ages remained a largely feudal economy; it was overwhelmingly agricultural, medieval (or manorial), and, "exchange" — where it occasionally occurred — was determined by "custom, usage, and law" rather than by "negotiation between traders", who, on the whole, were few and far between (Rosenberg and Birdzell, 1986, p. 38).[1] Markets were still far from being the order of the day. The Commercial Revolution that set Europe off on a new stage of development had to wait until the European exploration and the discovery of the New World several centuries later, without which the expansion of both overseas and domestic trade and consequently the development of capitalism might not have been feasible.[2]

In marked contrast, Song dynasty China (c. 960-1278) was already demonstrating the "growth-producing capacities of a relatively unrestricted private commercial economy" in a variety of ways (McNeill, 1982, cited in Hymes, 1997, p. 336).[3] Foremost is that the Song economy became so vibrantly commercial that after coming into existence for merely a century two-thirds of the dynastic revenue was derived from a wide array of commercial taxes levied (modestly) on trade and consumption (Bao, 2001).[4] Second, to the extent that market exchange was facilitated by the coming together of traders, market towns flourished

[1]For example, despite the fact that growing mercantile trade began to occur in the towns of European city-states from the 13th century on, commercial activities were overwhelmingly dominated by merchant families, and towns remained a crucial part of the medieval society (see Greif, 1994; Lopez, 1976; Rosenberg and Birdzell, 1986).

[2]Even then not all European countries were able to benefit from the discovery by Columbus of a new trade route. By one account, only that part of Europe "with access to the Atlantic Ocean and substantial trade with the New World, Africa, and Asia via the Atlantic" were able to benefit from it (Acemoglu, Johnson, and Robinson, 2005: 546).

[3]In addition, Elvin (1973) also claims that Song was at the peak of China's development — a claim that recently receives support from Broadberry, Guan, and Li's (2018) estimate that, with a *per capita GDP* estimated to be nearly 20% higher than Britain it was the richest country in the world before 1400.

[4]Liu (2015) thus remarks that Song was "the only fiscal state in China prior to 1880 to derive more than two-third of its tax revenues from indirect tax" (p. 94). As Wheatley (1959) observes, at one-tenth ad valorem for goods of fine quality and one-fifteenth for goods of coarse quality, the tariff of the Song was quite moderate (p. 22). More on this below.

under Song as the demand for economic exchange increased by leaps and bounds (Elvin, 1973; Golas, 2015; Hartwell, 1982; Shiba, 1970).[5] Third, as the market expands, so does specialization. Evidence indeed shows that specialization was manifested in the proliferation of "proto-industries" in the Song but not the Tang dynasty (Bao, 2001; Shiba, 1970).[6] Fourth, the expansion of markets requires a more efficient transport network to distribute goods over longer distances. In this respect Song enjoyed the remarkable improvements to a network of transport using waterways in South China — the region where markets had developed most vibrantly (Elvin, 1973). The third and the fourth features combined to constitute what Kelly (1997) calls "Smithian growth". Overall, the transformation that Song achieved was so unprecedentedly impressive that it is regarded as "unsurpassed anywhere until the Industrial Revolution" (Hartwell, 1966, p. 29).

As a Malthusian economy Song's economic achievements are perhaps best illustrated by the magnitude of its population growth over time. For over a millennium (200BC-900AD), China's population fluctuated over several dynasties but it never exceeded 60 million, as enumerated at the peak of the Tang. By 1110, the Chinese population had passed the 100 million mark for the first time (Figure 1), when the whole of Europe had only 70 million.

[Figure 1 about here]

Our primary goal is thus to provide a causal explanation of how the commercial revolution came about in Song dynasty China, by examining two important consequences that followed an exogenous military shock that occurred in the mid-Tang dynasty — one in which a powerful military commissioner, An Lushan, revolted in a famous historical incident known as the "An-Shi Rebellion" (c. 755-763). While the coup was eventually suppressed, the Tang Empire was dealt two severe blows. First, it lost all its northern territories to regional

[5] As Rosenberg and Birdzell (1986) explain, even in the feudal age European traders had to live in towns; they were "non-feudal islands in a feudal world" (p. 79). As industrial specialization develops, so does urbanization.

[6] Specialization occurred in goods regions were best suited to produce, and was linked by a highly sophisticated network of merchants, brokers, and other commercial agents (Elvin, 1973; Shiba, 1970; see also von Glahn, 2016 for a summary).

commissioners or new warlords, many of whom were Turks invited by the emperor's son to help quell the rebellion from the steppes. Second, to escape the warfare and extortionate rule of the warlords, a quarter of the population fled to the more orderly south. But a moving population rendered tax collection impossible, especially when taxes were apportioned by headcount, i.e., a poll tax, and levied in kind — specifically on grain, cloth, and corvèe labour (known as *zhu-yong-diao* in Chinese). To facilitate tax collection, the emperor changed the poll tax to a land tax in 780, levied progressively on ownership. Known by historians as the "twice-a-year" tax reform or *liangshui zhi*, this reform was implemented more successfully in areas where the central government retained effective control over the social order than in areas dominated and controlled by regional warlords. An important implication of this tax reform for growth is that it added to the momentum of migration by freeing labour from a host of taxes that farmers were obliged to pay in kind, allowing them to reallocate their labour as they saw fit.

Together, mass migration and tax reform had two important consequences. First, it supplied a "surplus" of labour to a region that was politically stable in the late Tang dynasty.[7] Second, it shifted the economy from a "bad" equilibrium of tying labour to the land under *zhu-yong-diao* (in a manner resembling that of the manorial system in tying serfs to the land of the vassals) to a "good" equilibrium of freeing up labour and allowing it to move across sectors. The results were Smithian growth or specifically specialization and the expansion of markets, in a geographic context whereby power was transferred "from the political centers of northern China to the merchants of the south" (Morris, 2010, p. 359).

To test this monumental transformation empirically, we take advantage of an exogenously created boundary that divided the Tang counties into those that were politically stable and thus more effectively governed (abbreviated as EGA, the treatment group) from those that did not (the control group), by applying a spatial regression discontinuity design (SRDD) to analyse the effects respectively of migration and tax reform on the commercial revolution

[7]Indeed, historian Nicolas Tackett (2014) argues that only the north was politically unstable in the aftermath of the An-Shi Rebellion.

experienced two centuries later in a different dynasty. On the whole, we find that the Tang EGA counties were significantly more commercialized in the Song, as shown by: (1) the larger *per capita* commercial taxes collected in 1077, (2) the greater number of market towns, and (3) the higher population density in Song. To ensure that commercialization was not already prominent in the latter half of the Tang Dynasty, we conducted a placebo test, and found that: (1) the population density in 639 and 742 (both before the An-Shi Rebellion) was negatively associated with the EGA counties, and (2) there is no significant relationship between the EGA and both the handicraft industry (as measured by a dummy variable indicating whether a prefecture had handicraft industries) and proto-industries (as measured by the number of commodities produced in a prefecture) in the Tang dynasty.

We then endeavour to identify the key channels that realized the nexus between EGA and commercialization. Given that a quarter of the population is estimated to have fled the war-afflicted north between the mid-Tang (755) and the end of the transitional "Five Dynasties" (960) (Wu, 1997), migration should undoubtedly be our primary channel. And indeed, we do find a significant relationship between EGA and a variable indicating the migrants' destinations based on historical data. We also show, as a placebo test, that the EGA counties were unlikely to be origins of migration.

The second channel is labour reallocation. While this should largely result from the tax reform, migration also played a role in that it introduced a greater supply of labour to the EGA, some of which at least did not have the wherewithal to buy land in their destinations. Thus, we expect these two independent forces to have a jointly significant effect on reallocating farm labour to a variety of nonfarm sectors. Using a historical data set that allows us to identify landowning from tenant households, we find a significantly smaller proportion of landowners in the EGA. To demonstrate the separate effects of migration and EGA on commercialization more directly, we regress commercial taxes and number of market towns against them, and find that both EGA and popular migration destinations have had a significant effect on our short-term proxies for commercial revolution.

Last, but certainly not least, we bring empirical evidence to bear on the claim that Song's Commercial Revolution, which saw a great extension of markets, trade, and specialization, robustly demonstrates the logic of Smithian growth. We begin this empirical exercise by examining Yoshinubu Shiba's (1970) hypothesis that the Song commercial revolution was primarily a consequence of having adopted a series of agricultural innovations. Empirically, we find that there were significantly more agricultural treatises written by authors in EGA counties — a measure employed as a proxy for the adoption of new agricultural knowledge and techniques. Similarly, significantly more counties in the EGA adopted the early-ripening varieties of rice and double cropping practices.

To test the proposition that the Song commercial revolution was also an outcome of increased specialization and expansion of regional markets (Elvin, 1973; Kelly, 1997; Shiba, 1970, among others), we regress the number of proto-industries arising in Song counties in the EGA, and confirm that there were significantly more of them in the EGA counties. To serve the distributional needs arising from the geographic expansion of markets, technological changes in transportation were just as important. Based on the mariner's compass (one of Song's three "great inventions"), star charts, and so forth, the Song had made massive strides in seafaring.[8] Based on the information available in Shiba (1970), we are able to identify the exact locations of the shipbuilding industry in Song to serve as another proxy for Smithian growth, and find a significantly positive relationship between the EGA counties and shipbuilding. Last, but not least, we examine the claim (e.g., Elvin, 1973; Kelly, 1997) that water transport was crucial for commercial development, by employing commercial tax, market towns, and proto-industries as proxies for commercialization. With the exception of market towns, we find that river transport is significant only for those EGA counties with proximate access to rivers (within 50km of radius). As a placebo test, the same proximity to postal roads within the EGA has no significant effect on all three measures of commer-

[8] As Findlay and O'Rourke (2007) remark: "During the Tang it was the Arabs and Persians who came all the way to China in their own ships. Under the Sung (Song), however, the Chinese built their own oceangoing vessels, great junks with several masts, watertight compartments for their hulls, stern-post rudders, moveable sails, and other nautical innovations well in advance of the rest of the world" (p. 63).

cialization, further confirming the singular importance of networks of waterways in Song's commercial revolution.

Our story of the rise of a commercial revolution in Song China has a close affinity with several bodies of economics literature. Foremost is the more general importance of warfare and exogenous shocks in breaking down a tenacious equilibrium, with long-term consequences for economic development. In the "Three Horsemen of Riches", for example, Voigtländer and Voth (2013) show how, by decimating the population in Europe the Black Death and the warfare that spread the plague had the parsimonious effect of substantially raising wages and contributing to urban economic growth. More broadly, feudalism — specifically the defending castle — was undermined by the new military technology that was based on professional armies, infantry, siege artillery and cavalry (Bean, 1973; McNeill, 1982). By contrast, Dincecco and Onorato (2018) attribute the urbanization in medieval Europe to rural to urban migration to avoid the ravages of war. Our story of how fiscal pressure generated by exogenous war shocks led to tax reforms also finds parallels with Charles Tilly's (1975) famous theory concerning how historical warfare was a major contributing factor to the formation of nation-states and economic growth in Europe (Bean, 1973; Tilly 1975, 1990; Besley and Persson 2009; Gennaioli and Voth 2014). Here we show how concerns about threats to survival can similarly be applied to Imperial China when it was on the cusp of disintegration caused by nomadic warfare.

Second, economic historians and economists alike have identified a variety of favourable economic effects of migration. Irrespective of whether it was in Europe before the Industrial Revolution, post-war Europe or the U.S., migrants had supposedly brought with them their own human capital, knowledge, or valuable cultural traits to the host countries, generating growth in the long run (e.g. Abramitzky and Boustan, 2017; Bauer et al., 2013; Becker et al., 2020; Braun and Mahmoud, 2014; Hornung, 2014, among others).[9] Similarly, in

[9]Historical examples include the Flemish and Dutch immigration in Tudor England, the Huguenot immigration during the religious upheavals of the Reformation in the 17th century, and so forth. Prompted by persecution and warfare in the source countries, these immigrants brought valuable skills and industries (for example tapestry weaving) to England.

the historical Chinese context, Bai (2021) demonstrates that historical migration has had a persistent effect on contemporary economic growth as a result of competition between migrants and natives in China's millennium-old civil service exam. Following the essence of this rich literature, we show how migration contributed to commercial development in a pre-modernized economy by providing "surplus labour" in an expanded market that could be allocated efficiently across various economic sectors.

Third, the importance of property rights or more specifically political stability (or "institutional environment" in the words of North (1981)) in fostering economic exchange and growth in the long run has been well rehearsed (e.g., North, 1990, North et al., 2009, Ogilvie and Carus, 2014). Using Song China as example, we show how political stability is of first-order importance to its commercial efflorescence.

Finally, we join the contributions of those who made creative use of historical "natural experiments" in providing causal explanations of European economic growth in the pre-industrial revolution period; examples include the birth of medieval universities (Cantoni and Yuchtman, 2014), the printing press (Dittmar, 2011), the Protestant Reformation (Becker and Woessmann, 2009), and so on.[10] Along this line of research, our paper may thus be regarded as representing the first empirical study of the origins and consequences of commercial revolution on various aspects of historical economic development outside the European context using similarly novel data and empirical methods.

The remainder of the paper proceeds as follows. Section 2 provides the historical context necessary to understand the migratory and fiscal consequences of the exogenous military shock and the alternative development path that the effectively governed area experienced. Section 3 explains the empirical strategy and introduces the variables and data sources. We present the empirical results of the spatial RDD analysis in Section 4 and analyse the underlying channels in Section 5. Section 6 reports the results as they pertain to Smithian growth. Section 7 concludes.

[10] For a summary and overview of similar contributions see Cantoni and Yuchtman (2021).

2 Background

2.1 Commercial Revolution

For more than a millennium (counting from the Han dynasty to the Tang dynasty), the imperial Chinese economy was overwhelmingly agricultural and subsistence based. But it became highly commercialized by the time the Song dynasty came of age. In other words, it was transformed from a simple subsistence economy to a highly commercialized economy unsurpassed anywhere for many centuries to come, arguably until the Industrial Revolution.[11] The highly commercialized nature of the Song economy was most evidently manifested in the formation of a nationwide market spurred by the phenomenal growth of regional specialization in the production of a wide gamut of commodities based on regional comparative advantage (or "Smithian growth", according to Kelly (1997)), and in the growth of tax revenues that were increasingly drawn from commercial transactions — specifically from roughly one third in 997 to more than two-thirds, 67.76%, in 1077 (Bao, 2001). According to Shiba (1970), the development of transport and communications and an upsurge in agricultural productivity and surplus provided the important pre-conditions for the emergence of this commercial revolution.[12] The regional ceramics from Jingdezhen in the south central Jiangxi Province, the iron and coal industrial enterprises in the northeast, lacquer from the two southeast provinces of Jiangsu and Zhejiang, and a wide diversity of tea production across the entire country, etc., were prominent examples of regional specialization that collectively defined Song's commercial economy (Hartwell, 1966; Shiba, 1970; von Glahn, 2016, among others).

Commercial development was facilitated to a significant extent by a revolution in water

[11]Both the Han and Tang dynasties were largely subsistence economies with little trade and hardly any use of money, with agricultural tax paid in kind being the primary source of fiscal revenue. Nonfarm (proto) industries were thus few and far between. But by the 11^{th} century, the Northern Song had reached a level of commercial and industrial development unsurpassed by any society until the last decades of the 18^{th} century, according to Hartwell (1982), an eminent historian of Song China.

[12]Shiba (1970) provides a detailed description of the different regions specializing in the production of different products in Song (e.g., tea, timber, textiles, lacquer, paper, and pottery), including agricultural produce.

transport that began in the Sui-Tang dynasty and became well developed in Song times, facilitating the "cheap long-distance carriage of everyday goods in large quantities" across regions for trade and marketing (Elvin, 1973, p. 135; Shiba, 1970). In particular, the network of water transport was distinctly better developed in south and central China, where "a number of hitherto separate waterway systems were now linked into an integrated whole, forming the foundation for the nationwide market", and where junks "had become very much more sophisticated" (Elvin, 1973, p. 139 and 137).[13]

But it was advances in agriculture that played a fundamental role in this transformation; in the absence of a "great leap forward" in agricultural productivity and output it is inconceivable how a nationwide market for a wide gamut of nonfarm products could have arisen (von Glahn, 2016). As Shiba (1970) observes, the significant productivity and growth in output of Chinese agriculture since the late Tang was due to (1) a decisive shift from millet to rice cultivation, and (2) the adoption of a "package" of innovative farm practices.[14] While difficult to quantify the precise individual contributions of these various innovations, the adoption of fast-ripening rice varieties and the double cropping systems that accompanied it, were probably the two major factors contributing to growth in agricultural output.[15] Compared to millet, the crop most widely cultivated by farmers in the north in Tang times,[16] rice agriculture in South China enjoyed a yield several times that of millet,[17] contributing to rapid population growth. Between Tang (at its height) and the early 12$^{\text{th}}$ century (Song),

[13]Allegedly it took a mere three days to sail from Ningbo on the southeastern coastal seaboard (of Zhejiang Province) to southern Shandong Province on the North China Plain (Elvin, 1973, p. 138).

[14]These included improvements in, and greater dependence on, hydraulic control, a more productive complex of farm tools, land reclamation by means of terracing on hillsides, etc. (McDermott and Shiba, 2015; see also von Glahn, 2016 for a summary).

[15]The Song dynasty was certainly not the first time in the history of imperial China to experience the introduction of new types of rice. As early as the sixth century no fewer than 37 varieties of rice were introduced to the Yangtze River Delta region, according to *The Essential Methods of the Common People*. However, by 1100 all these previous varieties had been replaced by the even-higher yielding early-ripening varieties (Morris, 2010, p. 334 and 377). For example, the *Champa* rice that was introduced from South Vietnam by the late 10$^{\text{th}}$ century (early Song) effectively reduced the crop cycle from 150 to 120 days.

[16]That millet was the principal crop cultivated in North China in Tang times is evident in the fact that millet constituted the main agricultural tax back then; wheat was considered "mixed cereals" at best. See Kung et al. (2022) for the importance of millet in historical China.

[17]This allowed as much as 6.2 million bushels of rice to be shipped to North China annually, including 500,000 bushels to the Khitans (c. 907-1125) in the Northeast as tribute payment.

the population in China doubled from 50 million to well over the 100 million mark (McEvedy and Jones, 1978; Maddison, 1998).[18] None of the above fundamental shifts would have occurred, however, in the absence of the massive shift of the population from north to south resulting from an exogenous military shock.

2.2 An-Shi Rebellion, Migration, and the Free Allocation of Labour

The north-south migration was sparked off by the An-Shi Rebellion, a revolt initiated by a military commissioner (*jiedushi*) named An Lushan, who, owing to the emperor's inattention, was put in charge of as many as three strategic regions — respectively in the north (Fanyang), northwest (Hedong) and northeast China (Pinglu) — to guard the border, but he staged a rebellion instead.[19] The original reason for the Tang Empire appointing military commissioners to garrison the "frontier areas" was to protect its entire northern border from the constant threat of various nomadic tribes — Khitans to the northeast, Uyghurs to the north and northwest, and Tibetans to the west — (Figure A1). Designated as "foreign towns" (*fanzhen*), these military commissioners were given unchecked military and fiscal authority — many with substantial troops — over the territories they were appointed to guard. Their attachment to a specific region gave rise to *de facto* property rights over the region, however, essentially amounting to regional warlordism. While An Lushan's self-declaration of being the emperor of a newly established rival dynasty, the Yan Dynasty, might well represent an extreme case of regionalism,[20] the Tang Empire's reliance on these semi-autonomous military commissioners for border security illustrates its vulnerability. And although An was crushed and the rebellion was suppressed after eight years by the concerted effort of

[18]Against this benchmark, the entire population of Europe was only about 70 million around the same time (Morris, 2010; Rosenberg and Birdzell, 1986).

[19]An was allegedly a favorite of Emperor Xuanzhong's concubine, Yang Guifei. Obsessed with Yang, the emperor ignored the "usual safeguards around military power" by allowing An "to accumulate control of enormous armies" (Morris, 2010, p. 355).

[20]As Figure A2 shows, the key battles took place more or less in and around the regions where he was in control.

other regional commissioners in whom the emperor's son had vested extensive powers, and by the Turks (Uighurs) from the steppes who were invited to help out, the threat of invasion posed by the nomads on the frontier had not gone away.[21] The number of warlords with *de facto* autonomous power now increased from 48 who occupied prefectures before the An-Shi Rebellion to a staggering 64 afterwards, all of whom enjoyed the privilege of not remitting taxes to the emperor on a regular basis (Guo, 2017). Indeed, evidence suggests that after the An-shi Rebellion stable tax revenues came primarily from the 49 prefectures in the eight south-eastern provinces (Chen, 1982; Twitchett, 1963). In the north, where the Tang emperor effectively lost authority over the provinces, various warlords "ruled their domains" and "fought among themselves", "with only occasional deference to the wishes of the emperors" (McNeil, 1963, p. 379).

The unstable institutional environment in the north led to a continuing process of mass migration to the Yangtze valley in the southeast and the south-central provinces — both being regions where the central government retained effective governance (Twitchett, 1979; Yang, 1957).[22] For simplicity we refer to this broader region as the "effectively governed area" or EGA. Figure A3, which plots the destination prefectures based on Wu (1997), confirms that the south-central region and the Lower Yangtze River Delta region on China's eastern coastal seaboard received the largest inflow of migrants (see also Chen and Kung, 2021). Geographically, these two sub-regions coincide largely with the EGA.

For the Tang Empire, the loss of nearly all its northern territory to the military warlords on the frontier, and the migration of a disproportionate number of people to the south dealt a severe blow to its revenue. Not only did tax revenues from the northern country shrivel, but the original poll tax that each household was made to pay in kind — grain, cloth, and corvèe labour (known as *zu-yong-diao* in Chinese) — also became uncollectable as many simply

[21]The Tang dynasty survived but owed its preservation to the Turkish intervention, and the later Tang emperors remained politically dependent on Uighur goodwill (McNeill, 1963).

[22]Political stability in this region was also reinforced by the Tang deliberately staffing the region with civilian officials, who were more loyal to the emperor in part because of the Confucian education they received, but more importantly, perhaps, because they were not in the military (Cai, 2019).

abandoned their land and went south. As a remedial measure, *Emperor Dezong* (r. 779-805) replaced *zu-yong-diao* with a tax levied progressively on land assets, effectively changing a poll tax levied in kind to a land tax that allowed farm households to pay cash in lieu of grain and cloth twice a year coinciding with the sowing seasons — hence the term "twice-a-year" tax reform or *liangshui zhi* (Qian, 1937; von Glahn, 2016). The most important implication of this change for the Song commercial revolution was that the abolition of corvèe labour and the payment of a tax in cash effectively eliminated key constraints on the allocation of household labour. Together, mass migration and tax reform substantially increased the supply of labour within the EGA — a region where — with greater political stability and better protection of property rights — this reform was most successfully implemented.[23] The vast increase in labour supply was important, as crucially it facilitated specialization and the expansion of regional markets in a context where agricultural productivity was rising and transport networks expanding.

By the late Tang dynasty, the unceasing north-south migration had already reached a point where the geographic distribution of the population was reversed — from less than 45% of the Tang's population residing in the south in 756 to 66% by 1080 (McDermott and Shiba, 2005),[24] while the overall population had nearly doubled between 740 and 1080, reaching 100 million.[25]

[23]In regions where *liangshui zhi* was effectively implemented (most notably the lower Yangtze River Delta region), the reform was deemed "an instant success"; as "it generated greater income than the central government's revenue from all sources, including the salt monopoly, in the previous year" (von Glahn, 2016, p. 213; Kegasawa, 2005; Twitchett, 1963, 1979).

[24]This was especially the case for the Yangtze River valley. Located in the southeast of the delta region (the lower reach), it supplanted the traditional heartland of the North China Plain and became the new center of gravity of the imperial Chinese economy. This remains the case to this day (Chen and Kung, 2021).

[25]The numbers are based on the two population censuses conducted in the Tang and Song dynasties, respectively. As mentioned earlier, by 1110 Song's population reached 100 million, "far surpassing the peak levels (roughly 60 million) of the Han and Tang" (von Glahn, 2016, p. 209).

2.3 A Conceptual Framework

To help make sense of the monumental transformation that occurred between the Tang and the Song dynasties we now construct a simple conceptual framework to guide our empirical analysis.[26] Figure 2 sketches the elements of this great transformation. Figure 2 begins by showing the two major consequences of an exogenous military shock, viz., the An-Shi Rebellion, which, as we have described above, were mass migration and tax reform. Together, these led to the emergence of what might be considered to be a "surplus" of labour in South China, which in turn both induced a series of innovative practices in agriculture (via population pressure) and provided a labour force that could be tapped for specialization. As agricultural productivity and output rose, and labour was freed to work in sectors of their own choice, markets expanded across regions and became integrated, enabling specialization. Aided by an efficient network of waterways, particularly in the south, these two processes — specialization and the geographic expansion of markets — produced what Kelly (1997) defines as Smithian growth (Elvin, 1973; Shiba, 1970).

[Figure 2 about here]

3 Empirical Strategy

3.1 Variables and Data Sources

3.1.1 Commercial Revolution

We employ two measures as proxies for the regional variation in the commercial revolution across the Song counties. They are commercial taxes for the year 1077 and the average number of market towns in Northern Song — both normalized by the county population.

[26] Historians refer to this transformation as the "Tang-Song Transformation", a term pioneered by the Japanese historian Naitō Konan. For details see Miyakawa Hisayaki (1955).

Commercial Taxes. According to China's first Commercial Tax Law (Shangshui Zeli) published in 960 AD, commercial taxes were of two types: a tariff levied on goods transported — *guosui*, and a consumption tax imposed on the sale of a wide array of goods and services — *zhusui*. The latter included not only major commodities of the time such as cloth, silk, liquor, tea, salt, livestock (horses, cows, mules, camels, etc.), and grain, but also *ad valorem* taxes on transactions of arable land, shops, houses, and so forth. More than 2,000 (2,060) tax stations were erected at major nodes of the official trade routes to facilitate tariff collection.[27] The fact that both tariffs and consumption tax were set at the relatively low standard rate of respectively 2% and 3% suggests that the Song administration was careful to attempt to strike a balance between milking the commercial taxes on the one hand and providing optimal incentives to the merchants on the other hand so that overall specialization and trade would not be compromised as a result of maximizing the tax revenue.

Cross-sectional data are available for commercial taxes from 1,186 Song counties for the year 1077, which is the only year for which such data are available. The data were originally collected in the Song government archival records entitled *Song Huiyao Jigao*; the ones that we use were subsequently reconstructed by a group of Qing-dynasty scholars led by *Xu Song* (1781-1848). Given that the Song's population data are only available at the prefectural level, to normalize commercial tax by a county's population it is necessary that we first derive the counties' population figures using the prefectural data available in *Yuanfeng [1078] Geographic Gazetteer* (*Yuanfeng Jiuyuzhi*) compiled by the Song scholar *Wang Cun* (1023-1101) during 1075-1080. To obtain a county's share of the prefecture's population, we multiply its share of the prefecture's land area by the prefecture's population.[28]

Figure 3A shows the geographic distribution of the *per capita* commercial tax for 1077. In terms of spatial distribution, it clearly shows that counties in the southeast region (with

[27]To facilitate long-distance trade, merchants were allowed to pay the consumption tax either at the point of origin or at the destination and obtain a certificate (*gongyin*) that spared them the inconvenience of paying the tariff along the way (Liu, 2013).

[28]Given that it is highly unlikely that counties within a single prefecture have had a homogeneous distribution of population, we aggregated our data to the prefectural level and ran the regressions again and obtained similar results (and hence not separately reported).

a few scattered ones in the southwest) were paying the bulk of these taxes — counties that coincide spatially with Tang's EGA.

[Figure 3A about here]

Market Towns. Song witnessed the flourishing of market towns set up for trade.[29] There were only a few dozen of these towns in the Tang, but the period of the Northern Song alone (c. 960-1127) saw a total of 3,422 market towns springing up, many of which arose in the countryside alongside the walled cities, which now "became thriving hubs of commercial activity in addition to their traditional administrative and military functions" (von Glahn, 2016, p. 242).[30] Moreover, the importance of the growth of market towns in Song went beyond the boundaries of trade; it also called for a new mandate that entailed the management of an increasing number of territories with dense populations (Golas, 2015; Hartwell, 1982). The growth of market towns also stimulated a gradual process of urbanization as well as commercial efflorescence. We employ the total number of market towns in a county in Northern Song as our second measure to capture the effect of both migration and Tang's tax reform on the resulting growth in specialization and trade. As with commercial taxes, we normalize this variable by the estimated county population in 1078 following the procedure just described. Figure 3B geo-references the spatial distribution of market towns at the county level. As with the commercial tax, market towns were mostly concentrated in the southeast where the majority of Tang's EGA counties were located. Data on market towns were obtained from *Fu Zongwen*'s (1989) *Songdai Caoshizhen Yanjiu* (*A Study of Song's Market Towns*).

[Figure 3B about here]

[29]Note here that the towns in Song were fundamentally different from those in Medieval Europe. In the latter, "most lines of industry and trade were the exclusive monopolies of the guilds", and the "holding of markets and fairs was permissible only under license, and their conduct was as rigidly regulated as the trade of the guilds themselves" (Rosenberg and Birdzell, 1986, p. 51). Those in the Song were in a brave new world.

[30]We choose Northern Song simply because the northern half was ceded to the Jurchen-led Jin dynasty at the end of this period (c. 1127), thus ruling out comparison of the effect of Tang's tax reform on commercial development between the effectively (primarily the southeast) and ineffectively governed areas (primarily the north).

3.1.2 Long-Run Economic Prosperity

Population Density. In a Malthusian economy, population density is a sound proxy for economic prosperity. To gauge whether the commercial revolution had long-term effects on economic prosperity, we therefore use population density that spans several dynasties as a proxy. The pertinent data are available for the following years: 639 and 742 (Tang), 980, 1078 and 1102 (Song), 1285 (Yuan), 1393 and 1580 (Ming), and 1680 and 1776 (Qing). Together, these data points enable us to construct a cross-sectional data set — approximately one per century. To ensure that the county boundaries for the various dynasties are consistent with each other, we match Song's boundary to those of various others.

Table 1 provides a summary statistics of the variables introduced above.

[Table 1 about here]

3.2 Spatial Regression Discontinuity Design (SRDD)

Our empirical strategy is to estimate the possible effects of political stability and labour reallocation combined with commercial development using a spatial regression discontinuity design (SRDD). Specifically, we compare counties located in those prefectures (*fu* as they were known then) where the leaders would still pay tax to the Tang Empire on a regular basis during the remainder of the Tang dynasty (i.e., 780-907), with those which continued to be ruled by the semi-autonomous military commissioners who refused to pay taxes to the central government (Kaisaburō, 1942, 1980). The spatial delineation between the two is shown in Figure 4, where the thick red line marks the boundary between these two types of county, while the dashed lines depict spatial radius thresholds 400, 300, 200, and 100 kilometres from the boundary of the EGA. Information about Tang's fiscal administration was obtained from Chen (1982) and Twitchett (1963). Our spatial RDD assumes the following specification:

$$Outcome_c = \alpha + \beta EGA_C + f(GeographicLocation_c) + \sum_{i=1}^{n} Seg_c^i + \varepsilon \tag{1}$$

where $Outcome_c$ represents the three outcome variables of interest as they pertain to commercial revolution across county c. Our key explanatory variable, EGA_c, is an indicator variable set to 1 if county c fell within Tang's EGA, and 0 if it did not. $f(GeographicLocation_c)$ is the RD polynomial controlling for smooth functions of the geographic location. Given that the tax boundary forms a multi-dimensional discontinuity in longitude-latitude space, we employ polynomials of a county's centroid in latitude and longitude to control for unobserved confounding variables, in a manner analogous to the spatial RD design of Becker et al. (2016), Dell (2010), Dell et al. (2017) and Dell and Querubin (2018). To ensure robustness, we also control for polynomials of the distance to the boundary following Becker et al. (2016). As in Dell and Querubin (2018), we split the boundary into 10 segments of equal-length, with Seg_c^i equal to 1 if a county is closest to segment i, and 0 otherwise.

[Figure 4 about here]

To exploit the advantages of the spatial RD design fully, we employ: 1) a full sample of all counties, 2) a subsample of counties located respectively within 400, 300, 200, and 100 kilometres of the spatial threshold from the boundary of the Tang's EGA (graphically shown in the dotted lines of Figure 4), and 3) a subsample of counties within the optimal bandwidth from the same boundary estimated according to Calonico et al. (2014, 2017, 2022). As is standard practice, we employ a local linear RD polynomial for all baseline specifications and document robustness for a wide range of bandwidths and RD polynomials.

3.3 Validity of the Spatial RD Design

Identification of the spatial RD relies on three assumptions: 1) the formation of the boundary is exogenous to commercial development in the Song dynasty; 2) except for the treated variable, all other confounding factors vary smoothly at the boundary (balance checks); and

3) the outcome variables vary discontinuously across the boundary as a result of the greater political stability and freer allocation of labour within the EGA counties.

3.3.1 Exogeneity of the EGA Boundary

We begin with assumption (1). Because the boundary that separates the two types of county is an outcome of a military conflict waged by a rebellious military commissioner, concerns arise that there might be unobserved heterogeneities associated with the counties on either side of the boundary — heterogeneities that may have affected commercial development directly in late Tang on through to Song. This concern is unwarranted, however, because the "*fanzhen*" system (of decentralized military governance) was completely abolished by *Emperor Taizu*, the Song's founding emperor. Realizing that army commanders had brought down most dynasties, and specifically that the autonomous warlords were the primary cause of the fall of the Tang, *Emperor Taizu* effectively "dissolved the militarists' power with a cup of wine" by toasting the generals for having reached retirement (Morris, 2010, p. 373; Kuhn, 2011; Qian, 2001; Tanner, 2010).[31] In particular, to prevent regional governors from cultivating and consolidating their power base in a specific locale, *Taizu* made them rotate from one outpost to another periodically. Moreover, regional officials were also stripped of the power to command the military within their jurisdictions. In a nutshell, the thoroughgoing abolition of *fanzhen* in Song ensures that the boundary drawn on the basis of the effectiveness of the tax reform two centuries ago would be unlikely to affect commercial development through unobserved dimensions.

Perhaps a stronger claim for the boundary's exogeneity can be made in relation to the continuing warfare that occurred during the Five Dynasties and Ten Kingdoms period (c. 907-979) — the dynasty that existed briefly in the transition from the Tang to the Song and which altered the Tang's boundary (Zhou, 2017). In fact, the boundary changed so much during the first 20 years of his rule (c. 960-979) that the Song emperor had to merge as

[31] Clearly, the generals were caught by great surprise, but *Taizu* was able to get away with his bloodless coup anyway.

many as 299 or 22% (out of 1,388) underpopulated counties. This resulted in a demarcation radically different from that of the Tang (Li, 2017). As shown in Figure A4, the Tang's boundary (the green shaded area) differs (for the most part) from the Song's provincial boundary (the dark grey lines), providing evidence that further ensures that our outcome variables of interest would be unlikely to be affected by the boundary drawn some 200 years ago. All of these combine to satisfy assumption (1).

3.3.2 Balance Check

To verify assumption (2) we make use of a balance check, which requires that all relevant variables other than tax reform vary smoothly at the boundary. Table 2 examines a variety of geographic, social and political characteristics associated with counties on either side of the boundary by performing the regressions specified in equation (1). For instance, columns (1) and (2) of Table 2 examine various geographic characteristics such as elevation and slope and find that the point estimate of these variables is small relative to the mean and is statistically insignificant. Columns (3) and (4) show that the treatment and control areas are similarly balanced in terms of their suitability for planting China's two main staple crops — rice and wheat. To check for robustness, we also use the caloric suitability index developed by Galor and Özak (2016) to account for the effect of various other crops cultivated before 1500, and find no significant difference in that respect between the counties on either side of the boundary (column (5)). In columns (6) and (7) we further test the differences in the average terrain ruggedness and a county's distance to the nearest river, and similarly find no significant difference between counties across the boundary.

Turning from geography to politics and using data on battles taken from *China's Military History* (*Zhongguo Junshishi*) (2003), we find that counties on either side of the boundary are insignificantly different in respect of how frequently battles were fought during the transitional period of the Five Dynasties and Ten Kingdoms (column (8)). Finally, we examine whether there is any difference in the administrative status of the counties lying across the boundary, in that the Song dynasty classified them under a three-tier ranking system based mainly on military importance. Using information in the *Yuanfeng [1078] Geographic Gazetteer* (*Yuanfeng Jiuyuzhi*), we assign a unique rank to each of the 1,197 counties and confirm that there is also no significant difference in administrative status (column (9)). Together, the results of our balance check suggest that it is highly likely that the EGA boundary affects the outcome variables of interest only through the commercial revolution.

[Table 2 about here]

We leave the test of assumption (3), i.e., that our two dependent variables that measure commercial development vary discontinuously at the boundary, to Section 4.

4 Tang's Effectively Governed Area (EGA) and Song's Commercial Revolution

4.1 Effect of Political Stability and Labour Reallocation on Song's Commercial Revolution

We begin our analysis by first showing graphically the relationship between distance to the boundary of Tang's EGA and our two dependent variables of commercial development, i.e., commercial tax and number of market towns, in Figure 5, restricting the sample counties to those within the 400-kilometer radius. Panel A plots the shortest distance between the sample counties (measured from its centroid) and the boundary with respect to the size of *per capita* commercial tax, with dashed lines marking the 95% confidence intervals. The discontinuity between the counties on either side of the boundary in terms of *per capita* commercial tax is sharp and clear, suggesting that Tang's EGA had a lasting impact on commercial development during Song. In panel B, we repeat the same exercise but for market towns, and find a similar result — the number of market towns in a county changes discontinuously at the boundary. This satisfies assumption (3).

[Figure 5 about here]

The results of our spatial RDD analysis that uses whether a Song county falls within the Tang's EGA boundary as predictor are reported in Tables 3A (*per capita* commercial tax) and 3B (the number of market towns), respectively. In Table 3A, we report the coefficients of both linear regression and those including various polynomials (ranging from quadratic to quartic) in latitude and longitude. In terms of bandwidth, we report results for all sample counties, and, in addition, also those which fall within the 400, 300, 200, and 100-kilometer radius, as well as the optimal bandwidth selector proposed by Calonico et al. (2014) and detailed in Calonico et al. (2017, 2022), in columns (1) through (6). Irrespective of the choice of the polynomial and bandwidth, the Song counties that fall within the Tang's EGA have significantly higher commercial tax per capita in most cases. Taking the 200-kilometer radius estimate as an example, counties within the EGA yield an average of 6.6% more of *per capita* commercial tax. Moreover, with larger point estimates, the various polynomial results are strikingly similar to that using a linear relationship.[32] To check the robustness of these results we use a (more conventional) one-dimensional geographic RD model, in which we include only the linear and quadratic polynomials of distance to the boundary, and interact it with the EGA dummy (bottom panel of Table 3A). The results remain statistically significant regardless of choice of bandwidth (the 100km sample excepting).

[Table 3A about here]

In Table 3B we replace *per capita* commercial tax with the number of market towns as the dependent variable. Consistent with the findings in Table 3A, the EGA shows a similarly significant effect on the number of market towns.

[Table 3B about here]

[32] An exception is the specification within the 100 kilometer-radius. But the coefficients of the within EGA boundary indicator are nevertheless positive, while the significance is probably compromised by the larger standard errors resulting from a smaller sample size (of only 240 counties).

To ensure that our results on these two outcome variables are not driven by the estimated county population, we re-estimate the regressions in Tables 3A and 3B using prefectural-level data by aggregating the county-level data of commercial tax and market towns to the higher prefectural level. The results reported in Tables A1 and A2 in the Appendix confirm that the effect of using data of a higher administrative level is similarly robust.

4.2 Robustness Check: Commercial Development in Tang

To verify the proposition that political stability in the EGA was an important precondition for the emergence of a Commercial Revolution in Song, we conduct a placebo test to verify that this transition had not already occurred in the Tang dynasty, using: 1) the population density in 639 and 742 (i.e., both before the An-Shi Rebellion), 2) a dummy variable indicating whether a county had a handicraft industry, and 3) the overall number of proto-industries as measured by the number of commodities produced in the Tang dynasty. The data on population density is obtained from *The Population History in Sui-Tang Dynasties* (*Zhongguo Renkoushi Sui-Tang Juan*), while the data on the locations of handicraft industry and various proto-industries are taken from *Tang's Regional Economy* (*Tangdai Quyu Jingji*) (Weng, 2001) and *Tang's Proto-industries* (*Tangdai Gongshangye*) (Zhang, 1995), respectively. As reported in panels A and B of Table 4, population density in both periods of early Tang is significantly negatively correlated with counties inside the EGA boundary across various bandwidth specifications (columns (1) - (5)) but insignificant in the optimal bandwidth regression (columns (6)), suggesting that counties inside the EGA were no different — if not poorer — to those outside it before the An-Shi Rebellion. And there is plainly no significant difference in terms of either handicraft or proto-industrial development as indicated by the results in panels C and D of Table 4. Together, these indicators combine to suggest that the Tang economy was far from commercialized.

[Table 4 about here]

4.3 On Long-term Economic Growth

Taking a longer-term perspective of the possible effect of political stability on growth, we examine the effect of the EGA on population density for both the Song dynasty and later. To do so we regress the population density measured at 10 times during the period 639 - 1776 against the EGA dummy using the optimal bandwidth sample of the Quartic Polynomial RD specification, in which the dependent variable is divided into chunks of a century each for this period. We then plot the coefficients from these regressions in Figure 6. As expected, the EGA boundary has no significant effect on population density before the fiscal reform of 780 (the vertical red line). But a significantly positive effect began to emerge after the first millennium (roughly before the year 1000 and 1100) for counties located within the EGA boundary. However, the coefficient becomes insignificant again at the end of the Song dynasty, and has remained insignificant ever since.

[Figure 6 about here]

To examine the effect of political stability on long-term population growth more rigorously we use a panel-data regression for estimation. We begin with a difference-in-differences specification, in which we interact the dummy variable of EGA with the two period dummies of the Song dynasty and the Yuan-Ming-Qing dynasties, respectively (abbreviated in Equation 2 as Post-Song):[33]

$$PopDensity_{ct} = \alpha + \beta EGA_c * Song_t + \rho EGA_c * PostSong_t + \gamma_c + theta_t + \varepsilon_{ct} \tag{2}$$

The results are reported in panel A of Table 5. In these regressions, we control for all county- and year- fixed effects and cluster the standard errors at the county level. The results show that the EGA counties had a significant effect on population density not just during the Song dynasty but also those beyond it, albeit with smaller coefficients (columns (3) - (5)).

[33]Population figures are available at three times for the Song and seven for the Yuan-Ming-Qing.

[Table 5 about here]

To further control for unobserved differences across the EGA boundary, we use a spatial RD specification, in which we interact the EGA dummy, the RD polynomials, the segment fixed effects with the same period dummies as in panel A. The precise specification is outlined in Equation 3, as follows:[34]

$$\begin{aligned} PopDensity_{ct} = {} & \alpha + \beta EGA_c * Song_t + \rho EGA_c * PostSong_t + f(GeographicLocation_c) \\ & + f(GeographicLocation_c) * Song_t + f(GeographicLocation_c) * PostSong_t \\ & + \sum_{i=1}^{n} Seg_c^i * Song_t + \sum_{i=1}^{n} Seg_c^i * PostSong_t + \varepsilon_{ct}. \end{aligned} \tag{3}$$

The results are reported in panel B of Table 5. Possibly because of the stricter control of the spatial RD regressions, the results show that the EGA interaction term has a significantly positive effect on population density only for the Song dynasty but not after it. The insignificance of the EGA on the post-Song era is attributable possibly to the wars and conflicts that occurred during the Mongol invasion and the conflicts during the dynastic change between the Ming and Qing dynasties, both of which annihilated a vast proportion of the population.[35] In terms of magnitude, all the RD specifications of $EGA_c * Song_t$ exhibit a robustly higher population density in the range of 21.7%-45% for the counties inside the EGA boundary during the Song dynasty.

[34] As for the specifications in Panel A, we also control for county- and year- fixed effects and cluster the standard errors at the county level.

[35] According to estimates made by the eminent historian Liang Fangzhong (1980), China's taxable population declined from 76,335,485 (corresponding to 19,526,273 households) in 1195 to 59,848,964 (corresponding to 13,430,322 households) at the beginning of the Yuan dynasty (1291). Population loss was disproportionately severe in North China; at 29 million people or 7.31 million households, 87% of its population was wiped out.

5 Channels of EGA

Based on the stylized historical facts rehearsed earlier, we propose two primary channels through which the respective effects of migration and tax reform impacted the Song Commercial Revolution. The first is political stability, for which migration is a proxy, while the second pertains to the free reallocation of labour. However, by increasing the labour supply in the EGA counties, migration also captures the effect of labour reallocation, if indirectly. By comparison, the expected effect of tax reform is more straightforward, as it should primarily capture the effect of labour reallocation. For this reason, migration might exhibit either a greater level of significance or larger magnitude than that of EGA.

5.1 Migration

The An-Shi Rebellion sparked off large-scale migration from the war-afflicted north to the peaceful and orderly south, providing a safe haven to nearly 15 million of the migrants or 25% of the existing population. To verify the channel of migration, we collected data on the major origins and destinations of migration after the An-Shi Rebellion, which are contained in two atlases in *A Migration History of China, Volume 3 on Tang and Song Dynasties* (*Zhongguo Yiminshi III Sui-Tang Juan*) compiled by Wu (1997). Specifically, these atlases contain detailed categorical information on the location and ranking of all migration origins and destinations; e.g., from none to minor, semi-major (or median) and major. Reported in panels A and B of Table 6, the results clearly show that the EGA counties were a major destination for migration and, conversely, an unlikely origin of migration, respectively. Given the ordered nature of the dependent variable, we use an ordered probit model in columns (1) through (5). The results are robust across estimates for all bandwidths. In column (6), which we estimate using the optimal bandwidth, we find that the EGA counties were 27.3% more likely to be a major destination for migrants compared to non-EGA counties, and 23.2% less likely to be origins of migration. To the extent that migration may have a spillover effect on the neighbouring counties, the coefficients are probably underestimated because of this downward bias. Our findings are thus likely to represent a lower-bound estimate of the actual effect of migration.

[Table 6 about here]

Given that the inflow of migration to South China implies an increase in the labour supply for the migration destinations, and unless all migrants were sufficiently rich to acquire land in the destination counties, many may have become landless labourers, forced to seek work on or off the farm. To verify whether an increase in labour supply in the Tang's EGA counties helped to fuel commercialization through a change in land distribution, we employ data on the distribution of households registered as either having land (*zhihu*) or not having land (*kehu*) in the total population according to the survey of 980 as a proxy. While crude, this measure allows us to construct a variable to account for the proportion of population that was landless in 980. *Ceteris partibus*, a rise in the number of landless labourers would provide an important precondition for specialization. The pertinent data are obtained from the *Universal Geography of the Taiping Era* (*Taiping Huanyuji*), compiled by *Shi Le* for the period 976-983. By regressing the proportion of landless households in the overall population on the EGA boundary across a number of bandwidths, and controlling for the cubic polynomial in longitude and latitude and segment fixed effects (Panel C of Table 6), we find that the proportion of landless population was significantly higher in the EGA counties, by 14% thereby providing an important precondition for the emergence of a commercial revolution.

5.2 Tax Reform

In addition to migration, the fiscal reform or *zhu-rong-diao* should also have the expected effect of facilitating commercial development by freeing up the farm labourers previously obligated to provide corvèe labour services and pay part of their taxes in kind such as cloth for off-farm employment. To verify that, we regress the *per capita* commercial taxes and number of market towns against EGA in Table 7, and find that the latter does have had a significant effect on both of these proxies, albeit with only a small magnitude. Similarly, to verify the direct effect of migration on commercialization, we also regress the same two dependent variables against the migration destinations designated by historians as representing their varying degrees of popularity (major, median, and minor, respectively), and find that the more popular destinations are consistently significant. The considerably higher magnitudes associated with migration (than EGA) suggest that migration probably captures the effect of both political stability (which is why people moved) and labour reallocation.

[Table 7 about here]

6 Song Commercial Revolution as Smithian Growth

Using Song China as an example, Kelly (1997) proposes that the two prominent features of economic development in the Song dynasty — specialization and the geographic expansion of markets — rigorously demonstrate the dynamics of Smithian growth. As Shiba (1970) points out, the growth in agricultural productivity and farm surpluses formed an important precondition for markets to expand and specialization to deepen, which, as we have seen, was attributed to the adoption of a package of new agricultural innovations. Equally important is Elvin's (1973) proposition that the Smithian growth in Song may not have been so effective if not for improvements made before and during Song times to the network of waterways and transport. We test the proposition regarding the importance of agricultural innovations in Section 6.1, the salient features of Smithian Growth in terms of both specialization and market expansion in Section 6.2, and not least the importance of the waterway network in Section 6.3.

6.1 Agricultural Innovations

We hypothesize that the mass migration induced by the An-Shi Rebellion had the effect of increasing population pressure in the south, thus providing the South with a strong impetus to adopt new agricultural technologies such as improved fertilizing practices, the adoption of a double-cropping system, planting early-ripening rice varieties, and so forth (see, e.g., von Glahn, 2016). To test this hypothesis empirically, we construct three measures as proxies for agricultural innovation. They include: 1) the number of agricultural treatises (*nongshu*), measured by the book titles written by authors of different counties; 2) a dummy variable indicating whether a county practiced double cropping (either both cycles of rice or one cycle of rice followed by another of wheat, see Shiba, 1970); and 3) a dummy variable indicating whether a county had adopted the new, early-ripening rice varieties. The data on the titles of agricultural treatises are obtained from *Amano*'s (1989) *Zhongguo Gunongshukao* (*A Study on Imperial Chinese Book on Agricultural Knowledge*), *Zhongguo Gu Nonglin Shuili Shumu* (*A Catalogue of Chinese Book Titles on Agricultural and irrigation Knowledge*) (Nanjing Library, 1956), and *Wang*'s (2006) *Zhongguo Nongxue Shulu* (*A Catalogue of Chinese Book Titles on Agricultural Knowledge*). We combine the three sources to create a complete catalogue of books on agricultural technology and practice published in the Song dynasty. Altogether there were 214 such titles. Data on the adoption of the double cropping systems and new seed varieties respectively are obtained from *Han*'s (1993) *Song's Agricultural Economy.*

Table 8 reports the results of regressing the number of book titles of agricultural treatises against the EGA, using the same spatial RD specifications as previously. The results clearly show that, first, significantly more agricultural treaties were written by authors within the EGA. Second, double-cropping was also practiced significantly more in the EGA. Third, early-ripening seed varieties were adopted significantly more within the EGA. Together, these findings coalesce in confirming that it was the EGA counties that experienced what von Glahn (2016) describes a "great leap forward" in agricultural productivity, forming an important pre-condition for specialization both within and beyond agriculture, with the expansion of regional markets as a corollary.

[Table 8 about here]

6.2 Salient Features of Smithian Growth

According to Kelly (1997), the Song dynasty exhibited two major features of Smithian growth — specialization and the geographic expansion of markets (see also Shiba, 1970). To measure specialization, we use the number of proto-industries, which is measured effectively by using the number of commodities produced in a county as a proxy. Emerging in the European countryside before the industrial revolution, proto-industries were essentially artisanal, home-based "manufacturing" (i.e., non-assembly-line) operations such as spinning and weaving (see, e.g., Ogilvie, 1993). In the Chinese context, where agriculture had long been the mainstay of the economy until the Song dynasty, proto-industries testified to the wide array of specialization highlighted by Song historians (e.g., Shiba, 1970). Information on proto-industries in Song China was documented in two compendia of geographic gazetteers for this dynasty; one is the aforementioned *Universal Geography of the Taiping Era* (*Taiping Huanyuji*), the other is the *Yuanfeng [1078] Geographic Gazetteer* (*Yuanfeng Jiuyuzhi*). According to these compendia, there were as many as 10 proto-industries in the Song, including: ceramics, silk, tea, iron, shipbuilding, timber, cotton, silver, coal, ink, paper and calligraphy brushes. Lacking information on the particulars of these industries such as size and complexity, we simply count the type of proto-industries in each county as a measure of its specialization, for which the maximum was four in our sample counties. The geographic distribution of proto-industries is shown in Figure 7. We report the results of the relevant estimates in panel A of Table 9. Except for the 100km bandwidth estimate (column (5)), which is insignificant, there were significantly more proto-industries in the EGA counties. In terms of magnitude, the result from column (6) indicates that the EGA counties had an average of 17% more proto-industries, suggesting that there was already a non-trivial amount of labour being reallocated from the farm to nonfarm sectors in Northern Song.

[Figure 7 and Table 9 about here]

The other salient feature of Smithian growth pertains to the geographic expansion of markets, which in the specific Chinese context was aided by an effective national waterway network (Elvin, 1973; Kelly, 1997; Shiba, 1970). According to Shiba (1970), domestic trade had stimulated the development of shipbuilding, which in turn facilitated regional trade and development. Based on the data Shiba (1970) provided in *Commerce and Society in Sung China*, a county is set to 1 if it had developed a shipbuilding industry, and 0 otherwise. We report the estimated effects of the EGA boundary on the geographic distribution of shipbuilding industry in panel B of Table 9, and confirm that counties within the EGA were significantly more likely to have developed a shipbuilding industry during the Song dynasty.

6.3 Rise of Waterway Network and the National Market

An obvious advantage with which south-eastern China enjoyed in respect of commercialization was its dense and well-connected river networks, a feature on which China's "transport revolution" depended crucially (Elvin, 1973). The importance of river transport in trade and development in Song China is well borne out by a historian's estimates (Liu, 2015). Of all the commercial taxes collected, those collected along the 12 major river tributaries accounted for half. To assess whether river networks indeed conferred a significant effect on commercial development, we construct a dummy variable to indicate whether a county falls within a 50km radius of the network of navigable rivers in the Song dynasty.[36] As a placebo test, we also construct another dummy variable, namely whether a county falls within a 50km radius of postal road, on the assumption that the effect of postal roads on regional development and market expansion was less than that of the river network. The data for postal roads are

[36]We choose a radius of 50 km because the average diameter of a county was 47 km.

obtained from The *Transportation Network in Tang-Song Dynasties* (Aoyama, 1963), while those for navigable rivers are from The Making of a Fiscal State in Song China, 960–1279 (Liu, 2015), respectively.

We regress the proxies for commercial revolution on these two dummy variables of respectively river and road transport infrastructure in columns (1)-(2), (7)-(8), and (13)-(14) of Table 10, and their interactions with the EGA boundary in columns (3)-(6), (9)-(12), and (15)-(18), respectively. Panel A is estimated using the amount of commercial tax, while panel B uses the number of market towns, both normalized by the county population, and panel C the number of proto-industries, respectively, as dependent variables. The first striking observation arising from Table 10 is that, by itself proximity to postal road has a significantly positive effect on a county's commercial development, but proximity to river networks does not. However, once we interact river networks with EGA, counties closer to the river networks (defined as 50km or less in distance to these networks) inside the EGA experienced a significantly faster growth in commercial development, relative to those further away from it (columns (3)-(4), (9)-(10), and (15)-(16)). But the same does not apply to postal roads (columns (5)-(6), (11)-(12), and (17)-(18)). These findings thus importantly substantiate Elvin's (1973) and later Kelly's (1997) theses regarding just how crucial a "transport revolution" premised on the dense and widespread river network in south-eastern China was for commercial development.

[Table 10 about here]

7 Conclusion

The Commercial Revolution that grew out of the European exploration and discovery of the New World was a significant event whose importance perhaps paled in comparison to the two monumental transformations it preceded — the development of capitalism and later the Industrial Revolution. It was a development of epic proportions nonetheless, not least because the rise of a merchant class effectively undermined the feudal order that existed in medieval Europe for nearly six centuries. The Chinese experienced a commercial efflorescence several centuries ahead of the Europeans, transforming, equally significantly, an overwhelmingly agricultural or subsistence economy which had lasted for at least a millennium, to one based on commerce and trade. Instead of debating, as historians did, why the Song failed to leverage this development to further transform its economy and society so that it would be the first to undergo an industrial revolution (e.g., see Hymes, 1997), we chose to identify the origins of this commercial revolution as well as to provide causal evidence for the consequences of this transformation of epic proportions. Moreover, by identifying migration and tax reform as the two primary channels of commercialization, we point to political stability and the free allocation of labour as important preconditions for facilitating long-term economic growth. And last, but certainly not least, we provide solid empirical evidence to bear upon the rich historical narrative that historians of Song China have meticulously documented; i.e., facilitated by remarkable improvements to a network of waterways, the Song Commercial Revolution went through an unambiguous expansion of the market, trade, and urban growth in the manner which Adam Smith had accurately predicted.

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Figure 1. Population Growth between 200 BC and 1400 AD

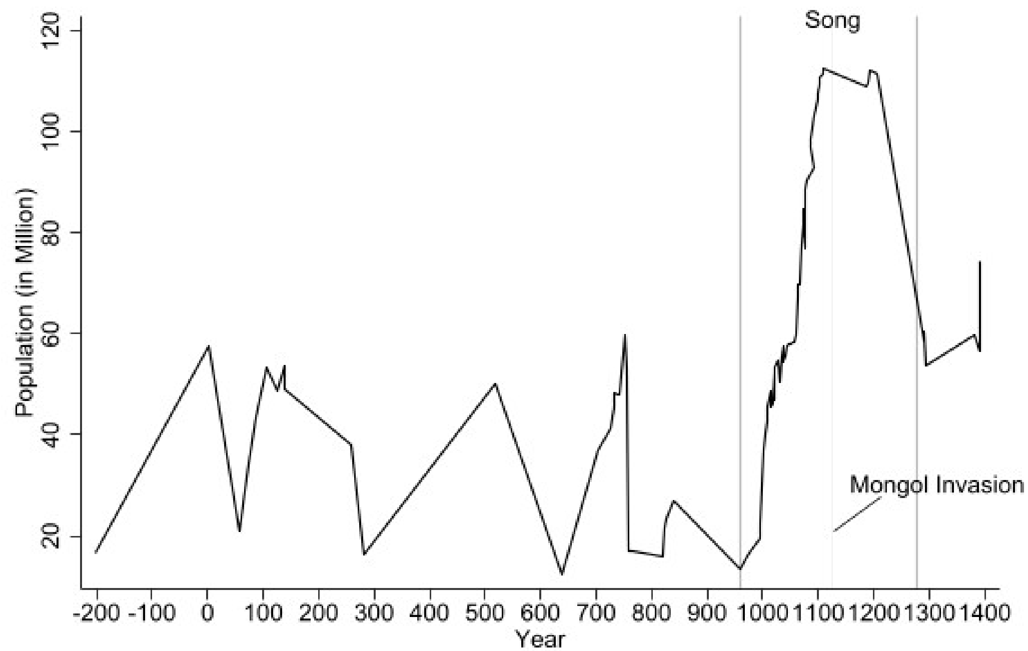


Figure 2. Conceptual Framework: Anshi Rebellion and the Rise of Commercial Revolution

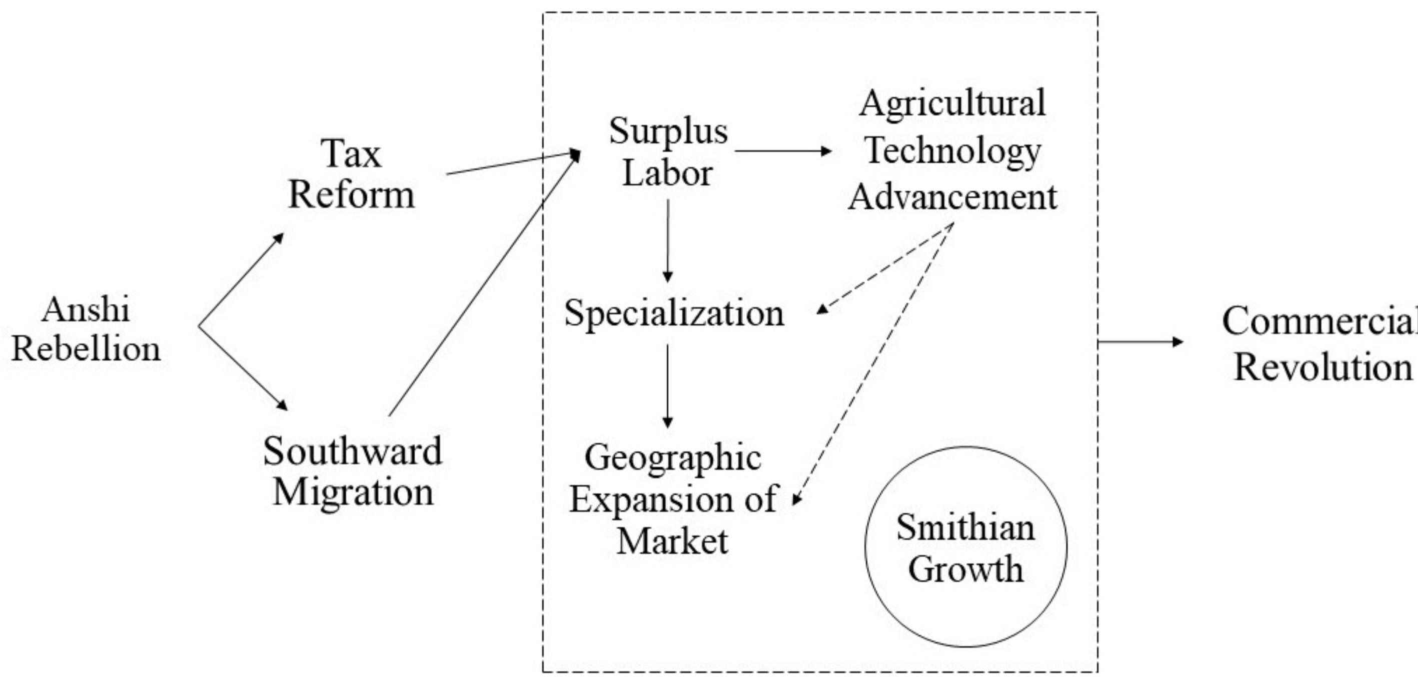
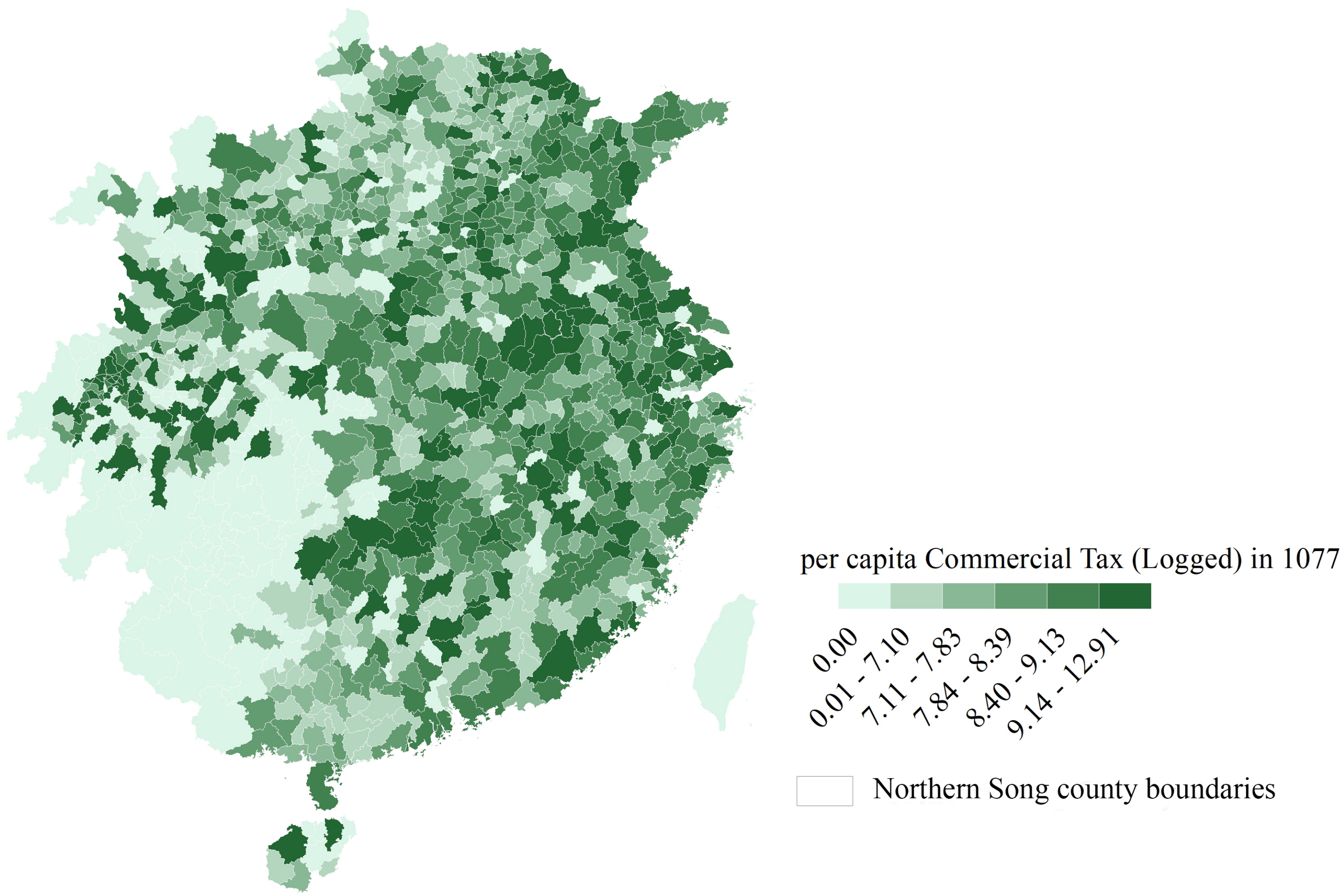
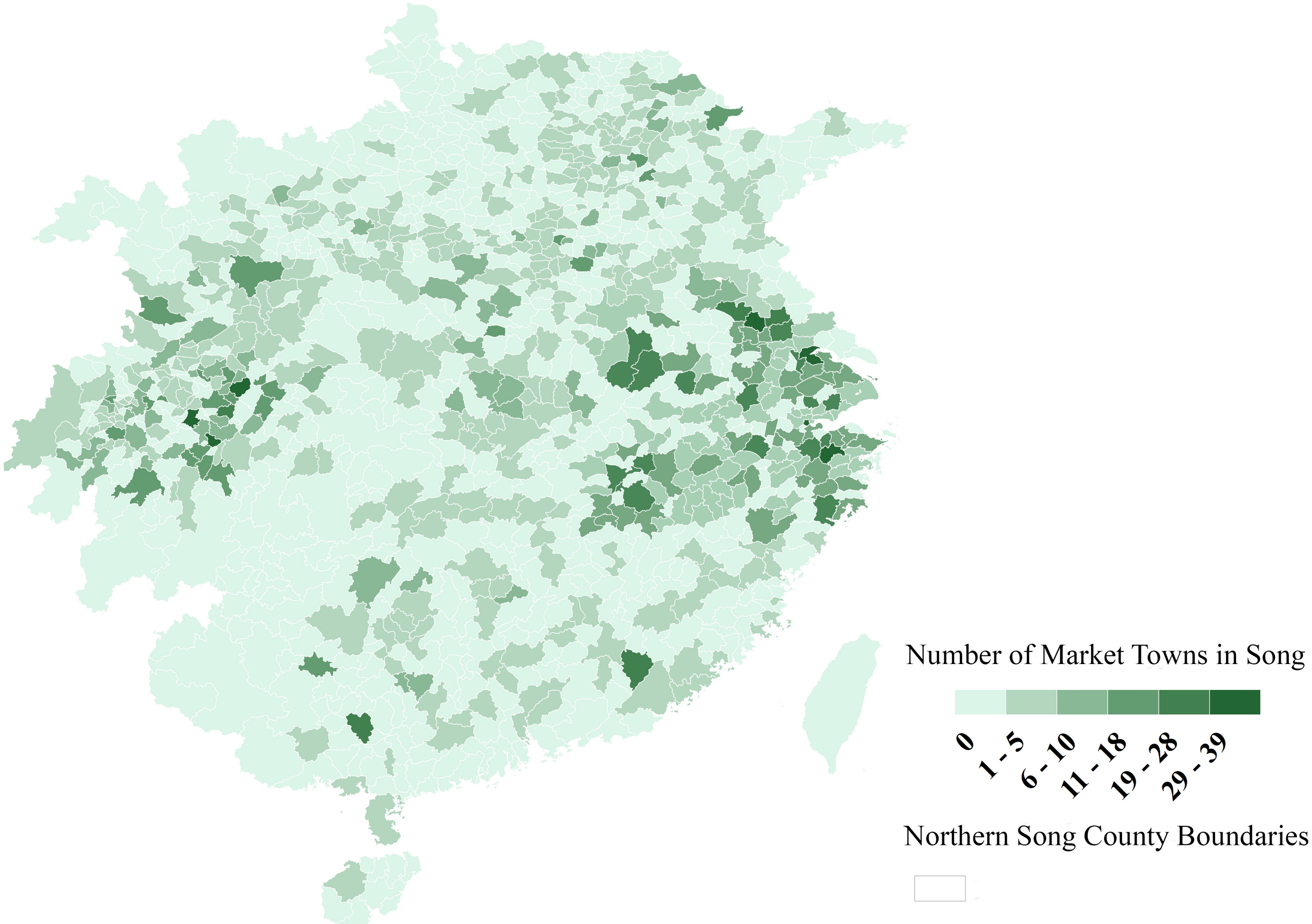


Figure 3. Geographic Distribution of Proxies of Commercial Revolution in Song



Panel A. Commercial Tax (Logged) in 1077



Panel B. Market Towns in Song Dynasty

Figure 4. The Boundary of the Effectively Governed Area in Late Tang (c. 780 and Beyond)

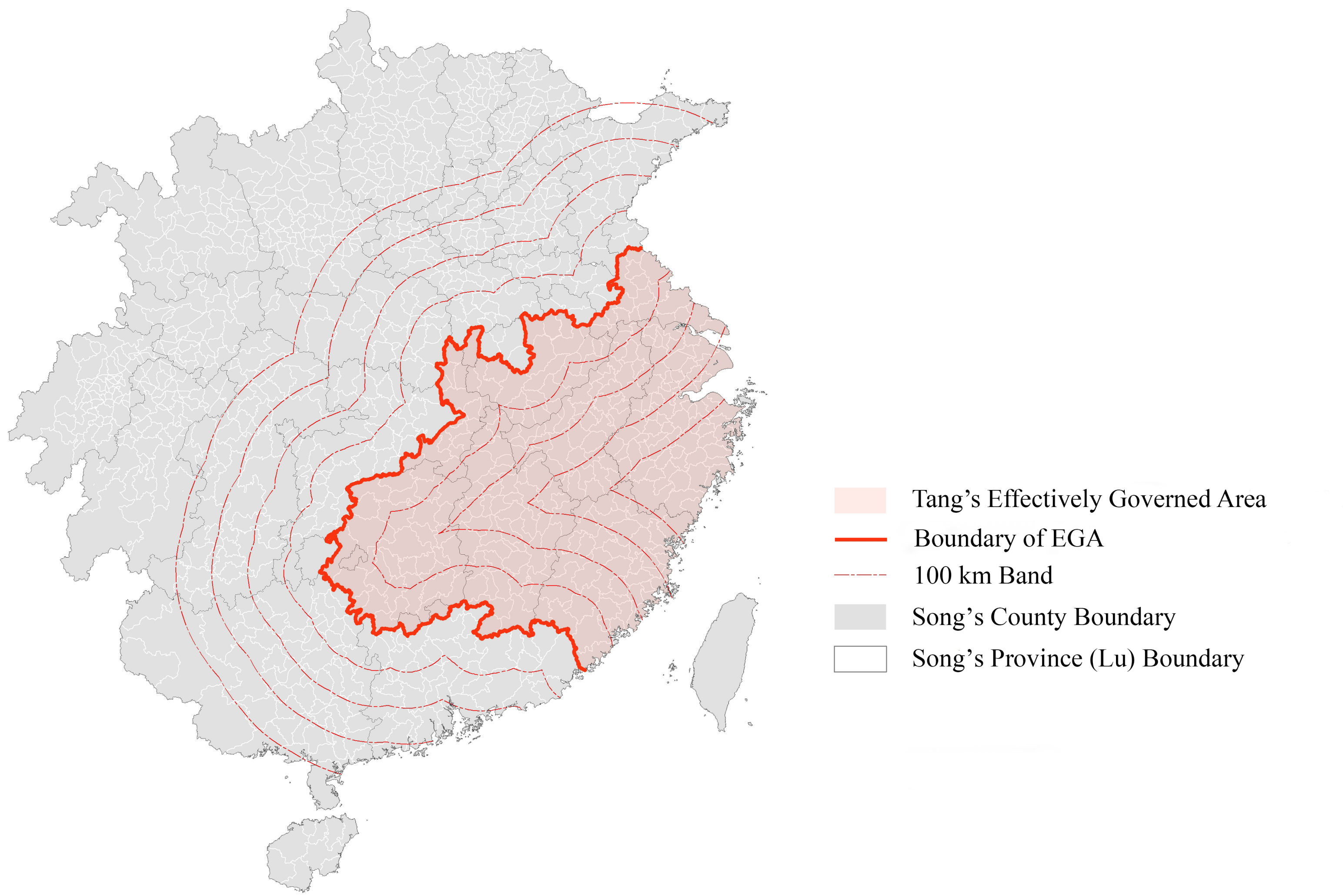


Figure 5. Fitted Values from a Local Linear Regression of the Three Commercial Measures in the Song Dynasty

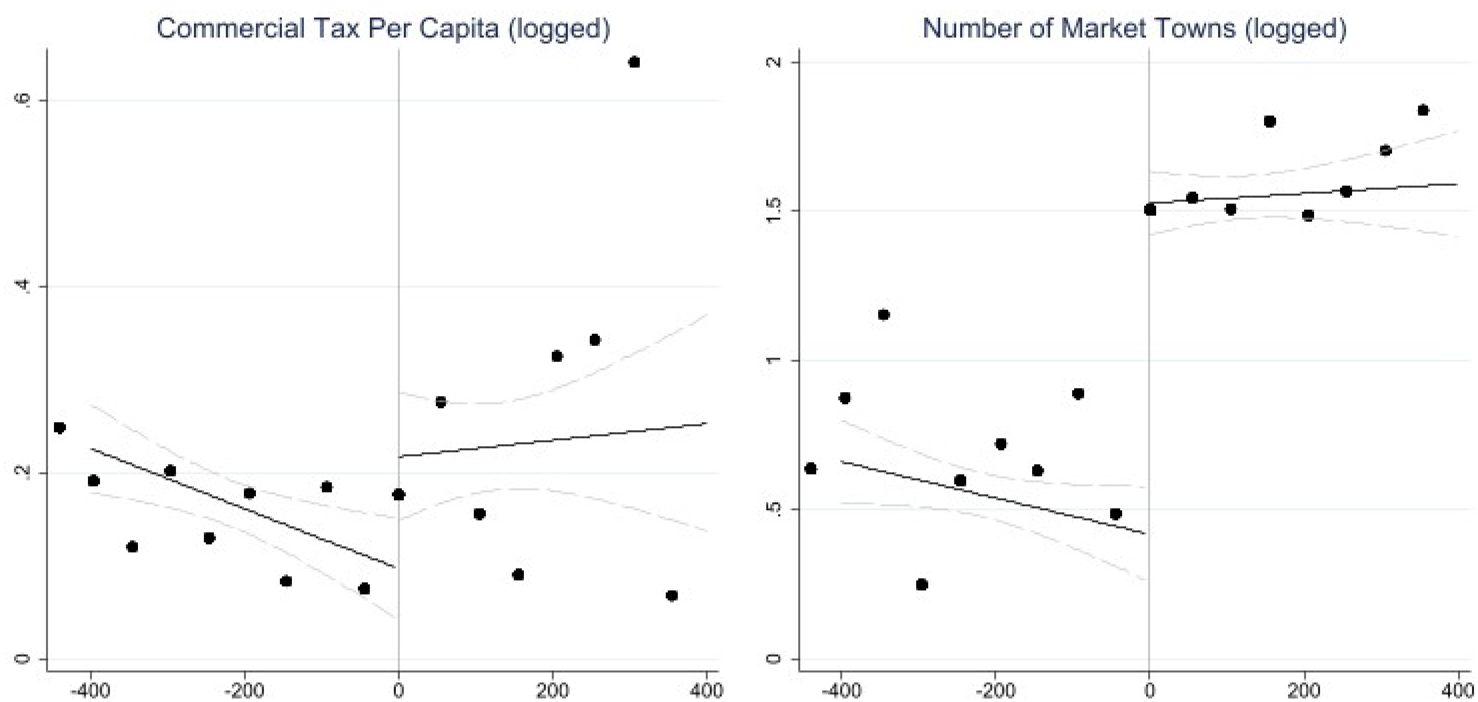


Figure 6. RD Estimates of the Effectively Governed Area on Population Density between 680 and 1776

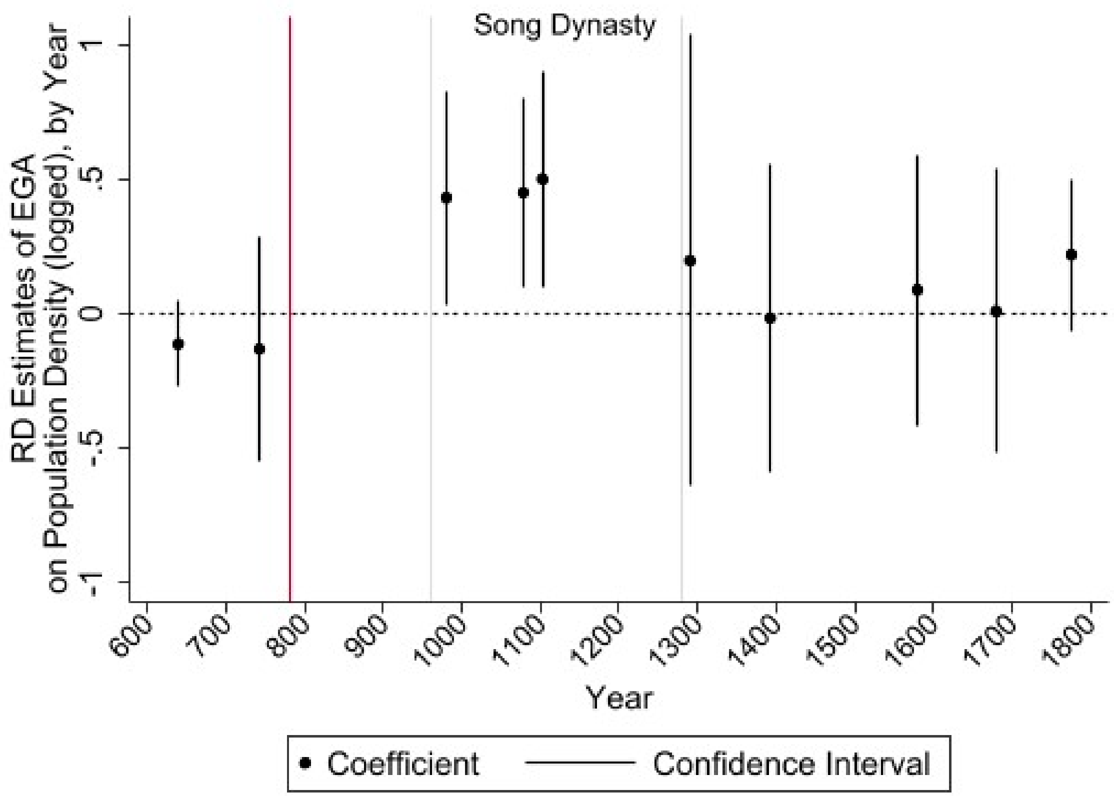


Figure 7. Geographic Distribution of Proto-industries in Song Dynasty, 1078

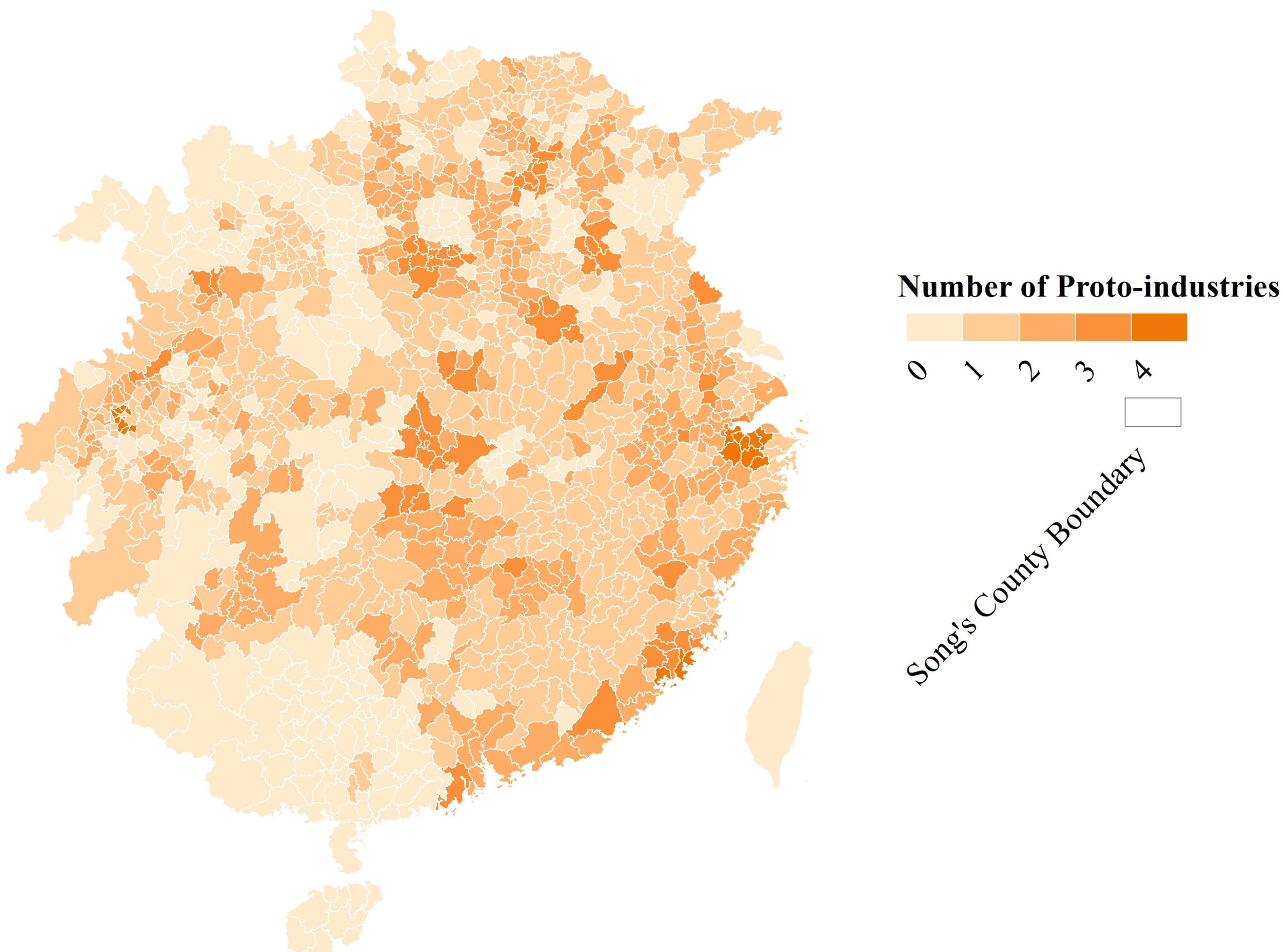


Table 1. Summary Statistics of the Variables Employed in the Analysis

Variables	# of Obs.	Mean	Std. Dev.	Min	Max
Commercial Tax per capita (Logged)	1197	0.053	0.115	0	1.179
Number of Market Towns (Logged)	1197	0.029	0.100	0	2.791
Effectively Governed Area (=1)	1197	0.302	0.459	0	1
Major Migration Inflow Destination	1197	0.688	0.745	0	3
Major Migration Outflow Origin	1197	0.493	0.761	0	3
Ratio of Landless Population (c. 980)	1185	0.418	0.280	0.494	1.507
Number of Agricultural Treatise Titles in Song	1197	0.134	0.215	0	7
Adoption of Double Cropping (=1)	1197	0.071	0.096	0	1
Adoption of Early-Ripening Rice Varieties (=1)	1197	0.097	0.112	0	1
Number of Proto-industries (logged)	1197	0.668	0.450	0	1.792
Locations of Shipbuilding Industry in Song (=1)	1197	0.041	0.175	0	1
Near River (<=50km)	1197	0.607	0.489	0	1
Near Road (<=50km)	1197	0.191	0.393	0	1
Elevation	1197	472.810	507.645	0.842	3755.941
Slope	1197	9.954	7.577	0.494	37.669
Rice Suitability	1197	1124.134	1135.700	0	5535
Wheat Suitability	1197	2739.371	1136.972	61	7431
Caloric Suitability	1197	1994.197	427.652	261.157	2960.697
Distance to River	1197	10.453	1.259	3.007	13.362
Terrain Ruggedness Index	1197	179.486	146.274	0	972.474
Number of Battlefields	1197	24.595	10.714	0	53.648
Administrative Ranking	1197	1.196	0.481	1	3

Table 2. Balance Check

	Optimal Bandwidth								
	Elevation	Slope	Rice Suitability	Wheat Suitability	Caloric Suitability	Terrain Ruggedness Index	Distance to River	Number of Battlefields	Administrative Ranking
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Effectively Governed Area	52.079	-0.370	299.752	127.097	25.995	-9.088	-0.263	2.245	0.027
	(33.710)	(0.989)	(282.927)	(154.490)	(65.311)	(12.998)	(0.164)	(1.656)	(0.055)
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	884	405	677	355	878	775	478	1061

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 3A. Effectively Governed Area and Commercial Revolution: A Spatial Regression Discontinuity Analysis

	Commercial Tax *Per Capita* (logged)					
	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
	(1)	(2)	(3)	(4)	(5)	(6)
No RD Polynomial	0.007	0.054*	0.045	0.066**	0.060*	0.130***
	(0.032)	(0.030)	(0.029)	(0.028)	(0.032)	(0.039)
Polynomials in Latitude and Longitude						
Linear Polynomial	0.189***	0.073**	0.066*	0.065**	0.032	0.130***
	(0.049)	(0.035)	(0.035)	(0.032)	(0.034)	(0.039)
Quadratic Polynomial	0.154***	0.087**	0.100**	0.109**	0.067	0.130***
	(0.046)	(0.040)	(0.044)	(0.050)	(0.059)	(0.039)
Cubic Polynomial	0.022	0.097**	0.121**	0.125**	0.095	0.130***
	(0.064)	(0.048)	(0.051)	(0.057)	(0.059)	(0.039)
Quartic Polynomial	0.005	0.110**	0.122**	0.072	0.022	0.130***
	(0.054)	(0.048)	(0.049)	(0.048)	(0.047)	(0.039)
Polynomials in Distance to Boundary						
Linear Polynomial	0.237***	0.089**	0.109**	0.119**	0.071	0.130***
	(0.048)	(0.042)	(0.045)	(0.048)	(0.059)	(0.039)
Quadratic Polynomial	0.118***	0.091**	0.116***	0.101**	0.049	0.130***
	(0.044)	(0.040)	(0.042)	(0.043)	(0.058)	(0.039)
Interacted Linear Polynomial	0.208***	0.098***	0.118***	0.095**	0.079	0.130***
	(0.047)	(0.036)	(0.040)	(0.041)	(0.063)	(0.039)
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1197	733	578	406	240	620

* $p<0.10$, ** $p<0.05$, *** $p<0.01$. Robust standard error in parentheses. Constant added but not reported.

Table 3B. Effectively Governed Area and Commercial Revolution: A Spatial Regression Discontinuity Analysis

	Number of Market Towns (logged)					
	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
	(1)	(2)	(3)	(4)	(5)	(6)
No RD Polynomial	1.035***	0.967***	1.047***	0.973***	0.919***	0.925***
	(0.059)	(0.064)	(0.067)	(0.082)	(0.112)	(0.168)
Polynomials in Latitude and Longitude						
Linear Polynomial	0.943***	0.955***	0.917***	0.846***	0.856***	0.925***
	(0.083)	(0.096)	(0.100)	(0.114)	(0.142)	(0.168)
Quadratic Polynomial	0.807***	1.067***	0.931***	0.904***	0.737***	0.925***
	(0.093)	(0.117)	(0.129)	(0.154)	(0.191)	(0.168)
Cubic Polynomial	1.027***	1.028***	0.948***	0.957***	0.763***	0.925***
	(0.109)	(0.128)	(0.136)	(0.160)	(0.209)	(0.168)
Quartic Polynomial	1.017***	1.047***	0.906***	0.957***	0.818***	0.925***
	(0.121)	(0.134)	(0.140)	(0.172)	(0.231)	(0.168)
Polynomials in Distance to Boundary						
Linear Polynomial	0.957***	1.046***	0.973***	0.963***	0.850***	0.925***
	(0.087)	(0.104)	(0.109)	(0.126)	(0.170)	(0.168)
Quadratic Polynomial	0.979***	1.054***	0.949***	0.954***	0.828***	0.925***
	(0.097)	(0.104)	(0.112)	(0.139)	(0.225)	(0.168)
Interacted Linear Polynomial	0.941***	1.063***	0.931***	0.948***	0.810***	0.925***
	(0.088)	(0.107)	(0.117)	(0.153)	(0.266)	(0.168)
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1197	733	578	406	240	620

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 4. Placebo Test of Effectively Governed Area on Tang's Commercial Development

	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
Panel A			Population Density in 639			
	(1)	(2)	(3)	(4)	(5)	(6)
Effectively Governed Area	-0.597***	-0.237***	-0.236***	-0.262***	-0.172***	-0.136
	(0.120)	(0.079)	(0.073)	(0.066)	(0.056)	(0.093)
Observations	1198	734	579	406	240	1198
Panel B			Population Density in 742			
	(7)	(8)	(9)	(10)	(11)	(12)
Effectively Governed Area	-0.022	-0.586***	-0.515***	-0.438***	-0.419***	-0.100
	(0.122)	(0.088)	(0.085)	(0.093)	(0.110)	(0.229)
Observations	1198	734	579	406	240	1198
Panel C			Handicraft Industry in Tang (=1)			
	(13)	(14)	(15)	(16)	(17)	(18)
Effectively Governed Area	-0.012	-0.032	0.012	-0.002	0.060	0.074
	(0.047)	(0.051)	(0.049)	(0.052)	(0.051)	(0.046)
Observations	1198	734	579	406	240	1198
Panel D			Number of Proto-industries in Tang (logged)			
	(19)	(20)	(21)	(22)	(23)	(24)
Effectively Governed Area	0.038	0.020	0.016	-0.026	-0.010	0.021
	(0.023)	(0.061)	(0.083)	(0.025)	(0.022)	(0.014)
Observations	1195	733	578	405	240	1195
Cubic Polynomial	Yes	Yes	Yes	Yes	Yes	Yes
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 5. Effectively Governed Area and Population Growth: Song and Beyond

	Population Density				
	All	<=400km	<=300km	<=200km	<=100km
Panel A	DID Estimation				
	(1)	(2)	(3)	(4)	(5)
Effectively Governed Area*Song	0.920***	0.847***	0.902***	0.766***	0.547***
	(0.046)	(0.053)	(0.060)	(0.063)	(0.082)
Effectively Governed Area*Post-Song	1.375***	0.817***	0.672***	0.536***	0.336***
	(0.057)	(0.056)	(0.059)	(0.071)	(0.105)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	12953	8001	6311	4438	2631
Panel B	RDD Estimation				
	(6)	(7)	(8)	(9)	(10)
Effectively Governed Area*Song	0.450***	0.434***	0.382***	0.303***	0.217***
	(0.065)	(0.053)	(0.050)	(0.052)	(0.059)
Effectively Governed Area*Post-Song	0.087	0.083	0.099	0.048	-0.044
	(0.092)	(0.083)	(0.082)	(0.087)	(0.094)
Linear Polynomials*Song/Post-Song	Yes	Yes	Yes	Yes	Yes
Segment Fixed Effects*Song/Post-Song	Yes	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	12953	8001	6311	4438	2631

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 6. Effectively Governed Area and Mass Migration after An-Shi Rebellion

	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
Panel A			Major Migration Inflow Destination			
	(1)	(2)	(3)	(4)	(5)	(6)
Effectively Governed Area	0.984***	0.968***	0.911***	0.802**	0.884**	0.273*
	(0.202)	(0.235)	(0.267)	(0.326)	(0.413)	(0.140)
Observations	1198	734	579	406	240	1198
Panel B			Major Migration Outflow Origin			
	(7)	(8)	(9)	(10)	(11)	(12)
Effectively Governed Area	-0.044	-0.199**	-0.195**	-0.289***	-0.184*	-0.232**
	(0.076)	(0.083)	(0.089)	(0.098)	(0.101)	(0.109)
Observations	1198	734	579	406	240	1198
Panel C			Ratio of Landless Population (c. 980)			
	(13)	(14)	(15)	(16)	(17)	(18)
Effectively Governed Area	0.183***	0.267***	0.255***	0.282***	0.221**	0.140**
	(0.045)	(0.053)	(0.057)	(0.067)	(0.090)	(0.063)
Observations	1185	726	572	402	239	1185
Cubic Polynomial	Yes	Yes	Yes	Yes	Yes	Yes
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 7. Effects of Effectively Governed Area and Mass Migration Destinations on Commercial Revolution

	Commercial Tax per capita (logged)		Number of Market (logged)	
	<=400km	<=200km	<=400km	<=200km
	(1)	(2)	(3)	(4)
Effectively Governed Area	0.099***	0.096*	0.919***	0.857***
	(0.038)	(0.052)	(0.134)	(0.168)
Major Migration Destination	0.120***	0.122**	0.363***	0.413**
	(0.038)	(0.049)	(0.112)	(0.172)
Median Migration Destination	0.136**	0.197**	0.299**	0.257
	(0.056)	(0.086)	(0.125)	(0.182)
Minor Migration Destination	0.276	0.111	0.715***	0.525
	(0.270)	(0.113)	(0.277)	(0.442)
Cubic Polynomial	Yes	Yes	Yes	Yes
Segment Fixed Effects	Yes	Yes	Yes	Yes
Observations	733	406	734	406

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 8. Effectively Governed Area and Agricultural Innovations

	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
Panel A	Number of Agricultural Treatise Titles in Song					
	(1)	(2)	(3)	(4)	(5)	(6)
Effectively Governed Area	0.433***	0.551***	0.683***	0.652***	0.487***	0.524***
	(0.060)	(0.050)	(0.048)	(0.062)	(0.047)	(0.049)
Observations	1197	733	578	406	240	766
Panel B	Adoption of Double Cropping (=1)					
	(7)	(8)	(9)	(10)	(11)	(12)
Effectively Governed Area	0.298*	0.277***	0.242**	0.206***	0.111***	0.139***
	(0.142)	(0.055)	(0.082)	(0.061)	(0.025)	(0.027)
Observations	1197	733	578	406	240	670
Panel C	Adoption of Early-Ripening Rice Varieties (=1)					
	(13)	(14)	(15)	(16)	(17)	(18)
Effectively Governed Area	1.158*	1.423*	1.195**	1.142*	1.059*	1.364**
	(0.484)	(0.615)	(0.433)	(0.511)	(0.477)	(0.480)
Observations	1197	733	578	406	240	645
Cubic Polynomial	Yes	Yes	Yes	Yes	Yes	Yes
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Table 9. Song's Commercial Revolution as Smithian Growth

	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
Panel A	Number of Proto-industries in Song					
	(1)	(2)	(3)	(4)	(5)	(6)
Effectively Governed Area	0.222***	0.178***	0.205***	0.132*	0.021	0.173**
	(0.055)	(0.066)	(0.069)	(0.075)	(0.081)	(0.072)
Observations	1197	733	578	406	240	580
Panel B	Locations of Shipbuilding Industry in Song (=1)					
	(7)	(8)	(9)	(10)	(11)	(12)
Effectively Governed Area	0.290***	0.138***	0.114***	0.115***	0.121**	0.267**
	(0.083)	(0.027)	(0.043)	(0.024)	(0.050)	(0.122)
Observations	1197	733	578	406	240	745
Cubic Polynomial	Yes	Yes	Yes	Yes	Yes	Yes
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1197	733	578	406	240	620

* $p<0.10$, ** $p<0.05$, *** $p<0.01$. Robust standard error in parentheses. Constant added but not reported.

Table 10. Waterway Network and Commercial Revolution

	<=400km	<=200km	<=400km	<=200km	<=400km	<=200km
Panel A	Commercial Tax per capita (logged)					
	(1)	(2)	(3)	(4)	(5)	(6)
Effectively Governed Area (EGA)	0.111**	0.142**	0.067	0.088*	0.081*	0.100*
	(0.048)	(0.057)	(0.048)	(0.052)	(0.043)	(0.054)
Near River (<=50km)	0.068**	0.048	0.003	-0.06	0.066*	0.05
	(0.034)	(0.042)	(0.030)	(0.037)	(0.034)	(0.042)
Near Roads (<=50km)	0.107***	0.131***	0.106***	0.132***	0.064**	0.075**
	(0.029)	(0.044)	(0.029)	(0.044)	(0.026)	(0.036)
EGA * Near River			0.121**	0.181***		
			(0.061)	(0.063)		
EGA * Near Roads					0.073	0.082
					(0.048)	(0.057)
Observations	733	406	733	406	733	406
Panel B	Number of Market (logged)					
	(7)	(8)	(9)	(10)	(11)	(12)
Effectively Governed Area (EGA)	0.167***	0.199***	0.167***	0.163**	0.110	0.156*
	(0.055)	(0.074)	(0.053)	(0.069)	(0.078)	(0.080)
Near River (<=50km)	0.056	0.008	-0.003	-0.078	0.056	0.01
	(0.037)	(0.028)	(0.035)	(0.052)	(0.036)	(0.029)
Near Roads (<=50km)	0.068*	0.125***	0.067*	0.126***	0.067**	0.076
	(0.035)	(0.046)	(0.035)	(0.046)	(0.033)	(0.053)
EGA * Near River			0.128*	0.144**		
			(0.070)	(0.066)		
EGA * Near Roads					0.002	0.072
					(0.050)	(0.056)
Observations	733	406	733	406	733	406
Panel C	Number of Proto-industries (logged)					
	(13)	(14)	(15)	(16)	(17)	(18)
Effectively Governed Area (EGA)	0.169**	0.163**	0.094	0.128	0.180**	0.167*
	(0.068)	(0.077)	(0.172)	(0.179)	(0.091)	(0.088)
Near River (<=50km)	-0.005	0.005	0.153**	0.264**	-0.001	0.001
	(0.044)	(0.063)	(0.068)	(0.106)	(0.043)	(0.062)
Near Roads (<=50km)	0.084**	0.106**	0.085**	0.103**	0.164***	0.202**
	(0.034)	(0.044)	(0.034)	(0.045)	(0.061)	(0.087)
EGA * Near River			0.277***	0.294***		
			(0.067)	(0.077)		
EGA * Near Roads					0.114	0.105
					(0.178)	(0.155)
Observations	734	406	734	406	734	406
Cubic Polynomial	Yes	Yes	Yes	Yes	Yes	Yes
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

* p<0.10; ** p<0.05; *** p<0.01. Robust standard error in parentheses. Constant added but not reported.

Appendix

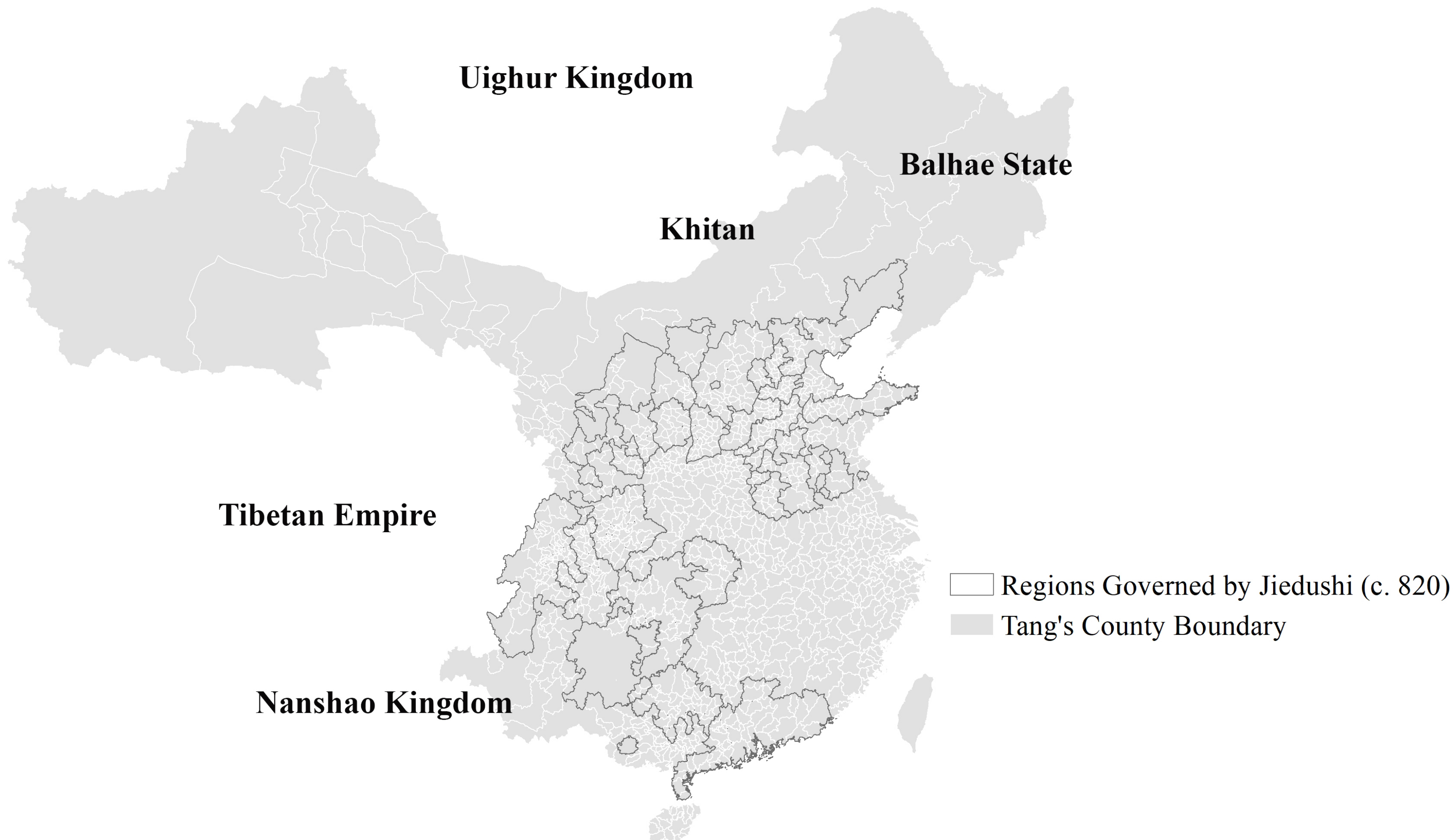


Figure A1. Territorial Boundary of Tang Dynasty

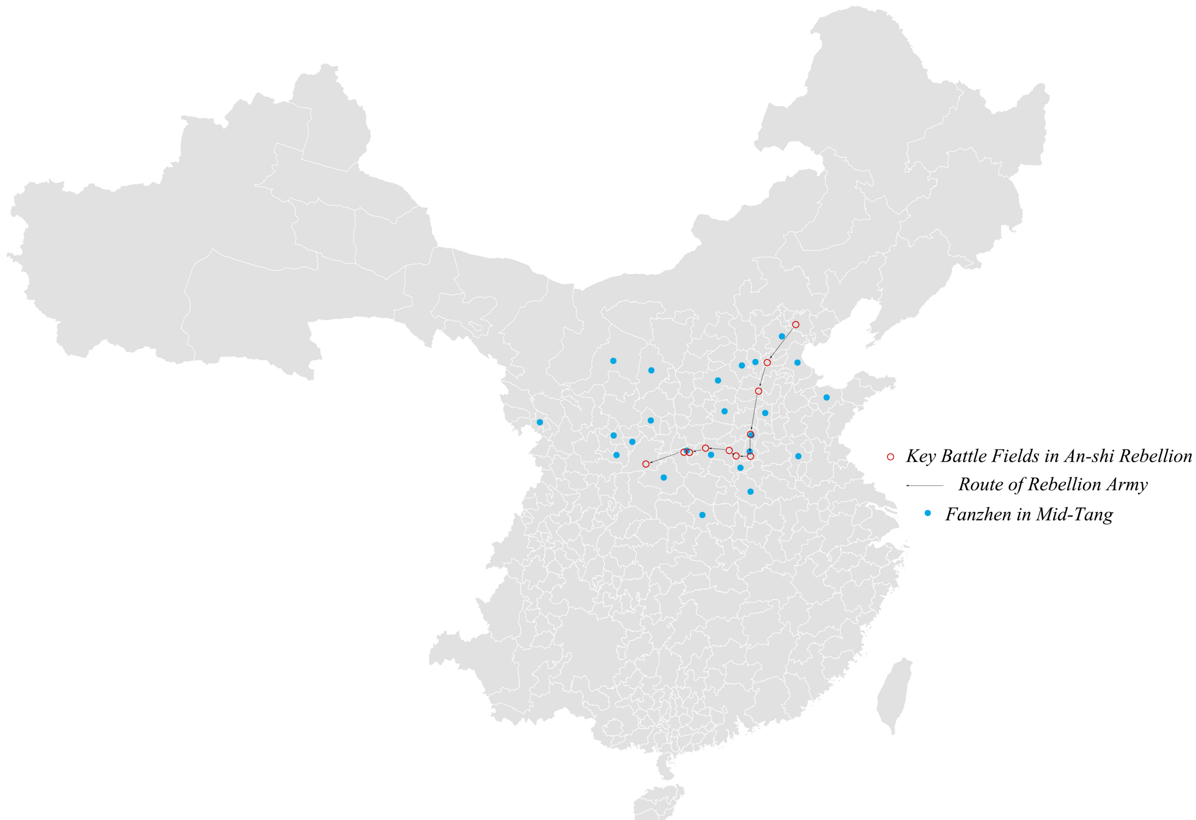


Figure A2. Geographic Distribution of "Foreign Towns" (*Fanzhen*) and Key Battle Fields in Tang's An-shi Rebellion

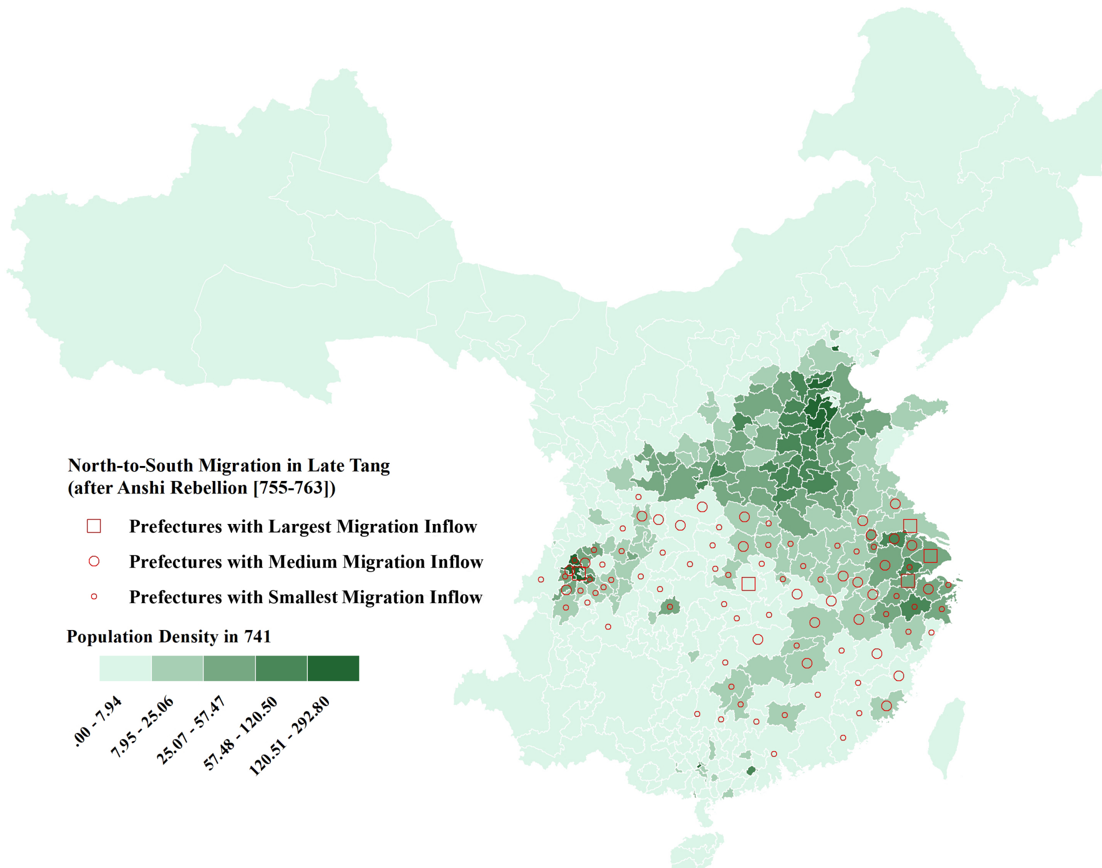


Figure A3. Migration after the An-Shi Rebellion (c. 755-763) and Population Density in 1078

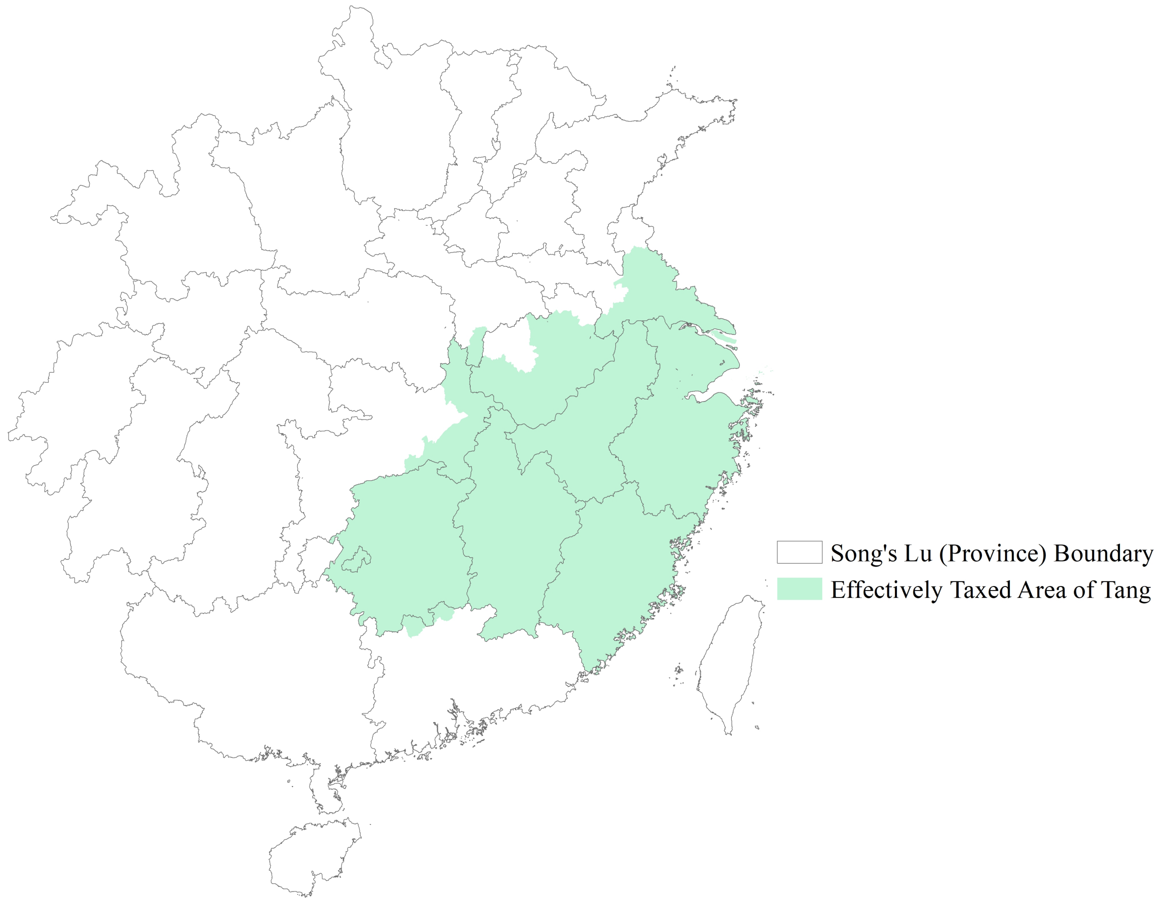


Figure A4. Tang's Effectively Governed Area and Song's Provincial Boundary

Table A1. Effectively Governed Area and Commercial Revolution: A Spatial Regression Discontinuity Analysis, Prefectural Level Data

	Commercial Tax *Per Capita* (logged)					
	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
	(1)	(2)	(3)	(4)	(5)	(6)
No RD Polynomial	-0.081	0.044	0.059	0.064	0.102*	0.209**
	(0.061)	(0.045)	(0.042)	(0.044)	(0.060)	(0.085)
Polynomials in Latitude and Longitude						
Linear Polynomial	0.247**	0.117*	0.125*	0.127*	0.085	0.209**
	(0.107)	(0.062)	(0.065)	(0.064)	(0.063)	(0.085)
Quadratic Polynomial	0.306***	0.144**	0.150**	0.220**	0.215	0.209**
	(0.098)	(0.066)	(0.076)	(0.109)	(0.162)	(0.085)
Cubic Polynomial	0.133	0.155*	0.174*	0.279**	0.229	0.209**
	(0.124)	(0.083)	(0.101)	(0.137)	(0.151)	(0.085)
Quartic Polynomial	-0.074	0.181*	0.206*	0.263**	0.167	0.209**
	(0.114)	(0.093)	(0.110)	(0.120)	(0.115)	(0.085)
Polynomials in Distance to Boundary						
Linear Polynomial	0.391***	0.142**	0.167**	0.215**	0.194	0.209**
	(0.108)	(0.063)	(0.075)	(0.089)	(0.118)	(0.085)
Quadratic Polynomial	0.076	0.148**	0.168**	0.216**	0.223*	0.209**
	(0.113)	(0.072)	(0.077)	(0.086)	(0.121)	(0.085)
Interacted Linear Polynomial	0.340***	0.143**	0.166**	0.217**	0.242*	0.209**
	(0.104)	(0.066)	(0.072)	(0.083)	(0.127)	(0.085)
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	281	165	129	95	61	281

* $p<0.10$, ** $p<0.05$, *** $p<0.01$. Robust standard error in parentheses. Constant added but not reported.

Table A2. Effectively Governed Area and Commercial Revolution: A Spatial Regression Discontinuity Analysis, Prefectural Level Data

	Number of Market Towns (logged)					
	All	<=400km	<=300km	<=200km	<=100km	Optimal Bandwidth
	(1)	(2)	(3)	(4)	(5)	(6)
No RD Polynomial	0.862***	0.801***	0.950***	0.972***	0.977***	0.486***
	(0.130)	(0.128)	(0.133)	(0.149)	(0.192)	(0.110)
Polynomials in Latitude and Longitude						
Linear Polynomial	0.834***	0.770***	0.623***	0.542**	0.602***	0.486***
	(0.173)	(0.209)	(0.206)	(0.217)	(0.220)	(0.110)
Quadratic Polynomial	0.649***	1.038***	0.783***	0.526*	-0.079	0.486***
	(0.204)	(0.220)	(0.247)	(0.265)	(0.276)	(0.110)
Cubic Polynomial	0.839***	0.705***	0.701***	0.558**	-0.051	0.486***
	(0.225)	(0.241)	(0.244)	(0.278)	(0.344)	(0.110)
Quartic Polynomial	0.723***	0.578**	0.575**	0.498*	0.191	0.486***
	(0.257)	(0.236)	(0.238)	(0.252)	(0.252)	(0.110)
Polynomials in Distance to Boundary						
Linear Polynomial	0.848***	1.123***	0.966***	0.778***	0.322	0.486***
	(0.168)	(0.206)	(0.225)	(0.257)	(0.321)	(0.110)
Quadratic Polynomial	1.083***	0.974***	0.943***	0.877***	0.761***	0.486***
	(0.234)	(0.202)	(0.214)	(0.219)	(0.273)	(0.110)
Interacted Linear Polynomial	0.657***	1.066***	1.023***	1.018***	1.151***	0.486***
	(0.193)	(0.179)	(0.189)	(0.189)	(0.246)	(0.110)
Segment Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	281	165	129	95	61	281

* p<0.10, ** p<0.05, *** p<0.01. Robust standard error in parentheses. Constant added but not reported.