

# THE ECONOMIC CONSEQUENCES OF POLITICAL HIERARCHY: EVIDENCE FROM REGIME CHANGES IN CHINA, 1000–2000 C.E.

Ying Bai and Ruixue Jia\*

**Abstract**—We study how political hierarchy shapes regional development in China, using variations driven by regime changes during the 1000–2000 C.E. period. We find that changes in the status of the provincial capital led to the rise and decline of different prefectures as measured by population and urbanization. Two other novel findings stand out: (1) the economic advantages of the provincial capitals did not persist if they lost their political status, and (2) political hierarchy shaped economic development not only through public employment but also through the development of important infrastructure, such as transportation networks. Our findings highlight the importance of politics in determining the locations of economic activities.

## I. Introduction

POLITICAL hierarchy is observed in most countries whose governance is divided into units (e.g., provinces, states, regions) with administrative centers that connect these units with the central government. Economists use cross-country or cross-regional variations to document that administrative centers (or cities) are larger than average cities (DeLong & Shleifer, 1993; Ades & Glaeser, 1995; Davis & Henderson, 2003) and that the locations of these centers are important in terms of political accountability and stability (Campante & Do, 2014; Campante et al., 2019). However, some related questions remain unanswered. For example, how does political hierarchy shape regional development? Should we consider administrative centers to be “parasitic cities” that achieve success primarily due to an increase in public employment but have no advantage in productivity?<sup>1</sup> The answers to these questions will not only inform several lines of research in the fields of political economy and urban economics but also have important policy implications, as the determination to set up administrative centers can be considered a place-based policy.

A major challenge to investigating the long-run consequences of gaining and losing political importance is the lack of a suitable empirical setting, in which there is reshuffling of

administrative centers within a relatively stable political system. In addition, such gains and losses may be endogenous. For instance, it may be that the more successful cities become administrative centers. In this paper, we argue that China during the second millennium offers an appealing setting to address these challenges. First, six major distinctive dynasties or regimes existed during the 1000–2000 C.E. period, and regime shifts during this period led to changes in national capitals, provincial boundaries, and provincial capitals (with the latter among the prefectures that comprise provinces). Second, as noted by scholars, the three-tier administrative system (province-prefecture-county) in China was formed in approximately 960 C.E. and remained stable over the following millennium.<sup>2</sup> Third, thanks to this stable administrative system, rich information from several centuries is available in historical archives. We construct a data set based on a large number of historical and modern sources that enables us to study the consequences of political changes for development within periods comprising several decades before and after the changes. Finally, guided by historical narratives, we can address the challenge of endogeneity by providing a novel algorithm to predict the locations of administrative centers.

Our empirical setting is the core regions of China (the shaded area in appendix A.1, termed “China proper” by historians) during the second millennium.<sup>3</sup> We aim to understand the effects of (re)locating provincial capitals—the most important regional administrative centers—on the spatial locations of economic activity. Accordingly, for our baseline analysis, we construct a panel data set across 261 prefectures during eleven periods (980, 1078, 1102, 1393, 1580, 1776, 1820, 1851, 1910, 1964, and 2000).<sup>4</sup>

We first discuss the underlying reasons for relocating provincial capitals. Although the choice of a provincial capital certainly involves many factors, the process is subject to general and testable political logic. Specifically, a provincial capital plays two roles: it acts as an administrative center responsible for fiscal, judicial, and welfare governance within a province and as a node through which to transfer resources and information from a province to the central government. Thus, when determining the location of a provincial capital, the central government faces a trade-off between granting provincial autonomy and maintaining central control. This

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\*Bai: Chinese University of Hong Kong; Jia: University of California, San Diego, and London School of Economics and Political Science.

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<sup>1</sup>This notion has long been discussed by social scientists, with such centers described as “Oriental cities,” following Weber (1921), or as “parasitic cities,” following Bairoch (1985).

<sup>2</sup>The persistence of this administrative and bureaucratic structure is regarded by many as one of the most important features of the Chinese political system (Ma & Rubin, 2019).

<sup>3</sup>Historical China is usually divided into proper and peripheral regions. We do not study the peripheral regions because they were not always under the control of the central government, and few historical data are available.

<sup>4</sup>The median area of a Chinese prefecture is 11,649 square kilometers, roughly comparable to that of seven median-sized counties in the United States.

trade-off can be proxied empirically by the weighted sum of the distances to the other prefectures within a province and the distance to the national capital (what we call the “hierarchical distance”). Intuitively, if provincial autonomy dominates, we would expect proximity to other prefectures within the province to be more important, whereas if central control dominates, proximity to the national center should be more important. During the millennium considered in this study, China underwent six dynastic regime changes that led to relocations of national capitals and the redivision of provincial boundaries. As a result, the two sources of variation that underlie hierarchical distance—the locations of the national center and the provincial boundaries—are altered by regime change. Utilizing these variations, we show that the simplest form of hierarchical distance (e.g., based on exogenous geometric distances) already has a powerful influence on changes in provincial capital locations across regimes. Therefore, this form of hierarchical distance may be a useful instrument for determining the status of provincial capitals.

Using a difference-in-differences (DID) strategy and an instrumental variable (IV) strategy based on the hierarchical distance, we find that administrative hierarchy has important effects on the spatial distribution of economic activity over the millennium. Specifically, changes in administrative hierarchy led to the rise and decline of different prefectures (as measured by population density and urbanization). The magnitude of this consequence is large. For instance, using our DID strategy, we find that the change in provincial capital status is associated with a 40% to 50% change in population density. We discuss the empirical challenges facing the DID and IV strategies and conduct a series of checks, such as period-by-period analysis to examine pretrends, grid-level analysis to address uneven gaps in our data, and checking concerns about the exclusion restrictions applied to our IV analysis. Overall, the results obtained using one strategy corroborate those obtained using the other.

We examine the impact of gaining and losing provincial status separately. Unsurprisingly, we find that gaining political importance led to improved development. In light of the large body of literature on the persistence of economic activities (discussed below), however, it is less clear whether losing political importance leads to significant declines of provincial capital cities. In this context, we find that such a loss of status is very important: once status was lost, a provincial capital returned to a level of development similar to that of its noncapital peers within 75 years. The observed lack of persistence prompts us to ask why these economic advantages disappeared. This question is related to the underlying mechanism by which politics determines the allocation of economic activities.

Three economic forces may drive this link between politics and development: the direct effects of public employment, the spillover effects of public employment (through private employment and agglomeration), and improvements in market access (mediated by investments in infrastructure). Using public office and transportation network panel data sets,

we find that these forces can work together. Importantly, our finding suggests that the consideration of provincial capitals as “parasitic cities” may be too narrow, as market access is also altered by political status. The market access finding has implications on the heterogeneous impact of capital status on population and spatial spillover, which are supported by data. In addition, we conduct a counterfactual analysis to illustrate the economic cost of setting up provincial capitals following the political logic. In a politically decentralized counterfactual scenario where provincial capitals were set at the provincial centroid, provincial aggregate market access could be 10.8% higher.

Our study adds to the political economy literature on how political factors affect economic geography. Compared with the above-noted studies, the setting of our study allows us to shed light on the determinants of political status in certain localities and to study both gains and losses of political importance. In this process, we uncover some new factors that underlie the link between politics and development. In particular, a strong, centralized state plays a critical role in overcoming inertia in economic activity by providing important public goods, such as transportation networks. Dell et al. (2018) provide convincing evidence of the benefits of a Chinese-style strong and centralized state through a study of regional variation in Vietnam. Although our main findings are consistent with the effectiveness of a strong, centralized state, the declines of former capital prefectures and changes in transportation networks have implications on the cost side of such a political system.

Our perspective complements the literature on the long-term spatial distribution of economic activity by documenting its changes.<sup>5</sup> A large body of political economy literature emphasizes the long-term persistence of economic activity due to different channels (see Nunn, 2009, for a review).<sup>6</sup> Another stream of literature is motivated by trade theories and emphasizes the role of locational fundamentals (Davis & Weinstein, 2002; Barjamovic et al., 2019) or the persistent impact of temporary advantages (Bleakley & Lin, 2012, among many others). In light of the theory of locational fundamentals, our findings could be interpreted to mean that politics can affect geography in our setting by, for example, altering canal routes and land routes. Our findings may differ from earlier work emphasizing the persistent impact of temporary advantages because in our context, the state plays an important role in overcoming inertia in the location of

<sup>5</sup>To clarify, we also find some persistent patterns in our key variables (e.g., population density, human capital, and transportation), implying that geography and other market factors also matter in China. Although these factors are somewhat persistent, they change systematically with political status. However, these changes are less well studied than patterns of persistence.

<sup>6</sup>As Nunn (2009) noted, these channels include geography, institutions, human capital, and culture. We must omit here the related literature produced during the decade since his review. In particular, by taking a long temporal framework, our study joins the effort to understand long-run urban development in different parts of the world (Bosker et al., 2013; Stasavage, 2014; Duben & Krause, in press). Our study design is appealing because it allows us to trace gains and losses of status.

economic activity.<sup>7</sup> Our finding thus suggests that whether the state (or other stakeholders) has the incentive and capacity to invest in important infrastructure, such as transportation networks, is an important predictor of whether we should expect persistence. This perspective can be useful when interpreting persistence versus changes in different contexts.<sup>8</sup>

Our findings also inform the place-making literature (Glaeser & Gottlieb, 2008). In recent years, an increasing number of countries have increased their quantity of sub-national administrative units, leading to more administrative centers (Grossman & Lewis, 2014). Although such policies are intended to enhance economic development, their economic consequences remain unclear.<sup>9</sup> Our finding suggests that in a context in which politics plays a critical role in resource allocation, it is unclear whether the implementation of administrative centers can boost economic development in the long run after a loss of political advantage.

Finally, our study contributes to the literature on the political economy of administrative divisions (Alesina & Spolaore, 1997; Bolton & Roland, 1997; Michalopoulos & Papaioannou, 2013; Ko et al., 2018). These studies often focus on national-level variation; in contrast, our research question involves within-nation variation. Broadly, we consider the logic of setting up administrative centers to be a spatial implementation of federalism, as discussed in earlier theoretical literature (Blanchard & Shleifer, 2001; Treisman, 2007).

## II. Background and Data

### A. Regime Changes and Capital Relocation

The Chinese political system, which is characterized by a stable three-tier (province-prefecture-county) administrative system and multiple distinctive dynasties/regimes, is particularly suitable for our research design. Regime shifts have led to changes in national capitals, provincial boundaries, and provincial capitals. In each regime, however, the central government has monopolized the powers of appointing, rotating, and removing officials on each tier. We next summarize the major administrative changes that occurred over the millennium under study.

*Regime changes.* During the millennium studied, six major regimes came into existence: the Song dynasty (960–

1279), which coexisted with the Liao (907–1125) and Jin (1115–1234) dynasties in the north; the Xixia dynasty (1038–1227) in the northwest; and the Dali dynasty (937–1253) in the southwest. This was followed by the Yuan (1271–1368), Ming (1368–1644), and Qing (1636–1912) dynasties, the Republic (1912–1949), and the People's Republic (1949–the present).

Such infrequent regime changes are difficult to predict. For example, it would have been difficult for residents of the Song dynasty capital (Kaifeng) to imagine that China would later be ruled by the Mongols, who moved the national capital to northern China (Beijing) and drew provincial boundaries to achieve political control. The administrative decisions made by the rulers at the beginning of each new regime, including the locations of the national capital, provincial boundaries, and provincial capitals, usually persisted until the end of the regime, interspersed by only occasional changes. Variations in the national and provincial capital locations are therefore driven primarily by regime changes. Because a national capital relocation and provincial boundary redivision are the preconditions for changes in the provincial capital, we describe these in order.

*National capital relocation.* The national capital changed five times across the six regimes, reflecting the unpredictability of where a new power base could arise. Specifically, modern-day Kaifeng (in central China), Beijing (in northern China), and Nanjing (in central-southern China) were the national capitals of the Song, Yuan, and Ming dynasties, respectively,<sup>10</sup> after which Beijing served as the capital of the Qing dynasty and Nanjing as that of the Republic. Finally, the capital of the current People's Republic was once again established in Beijing.

Historians argue that one important determinant of a national capital location is the origin of the power base (Chao, 2006). For instance, the Mongols (founders of the Yuan) and Manchurians (founders of the Qing) originated in the north and, hence, chose Beijing as their national capital, whereas the power bases of the Ming and Republic were in the south, leading these regimes to favor Nanjing. Although both Beijing and Nanjing were candidates for the national capital of the People's Republic, Beijing was chosen partly due to its nearness to China's political ally at that time (the Soviet Union). Although the power base is not the only determinant of a national capital location, these observations illustrate that political considerations are usually more important than economic considerations.

*Provincial boundary redivision.* Provincial boundary alterations occurred after the national capital relocation. During the studied millennium, provincial boundaries were

<sup>7</sup>In other settings, however, market players can be incentivized to play this role if the location of economic activity has a strong effect. For instance, Rauch (1993) provides examples wherein industrial developers engage in such behavior.

<sup>8</sup>For instance, Huillery (2009) and Jedwab et al. (2017) observe the strong persistence of colonial investments in Africa. From our perspective, one interpretation is that African states lack the capacity to alter these investments. Additionally, our finding that urban geography is shaped by a change in transportation networks, which is driven by a political regime shift in our setting, is closely related to the findings reported by Michaels and Rauch (2018) on Britain before and after the collapse of the Roman Empire.

<sup>9</sup>Bluhm et al. (2020) use cross-country nightlight data to evaluate the short-term impact of administrative status. However, the extent of the long-term impact remains to be determined.

<sup>10</sup>Nanjing was the national capital of the Ming dynasty until its capital was relocated to Beijing in 1421, partly because the new emperor, who had taken power through a coup, had established his power base in Beijing. The crown princess, however, remained in Nanjing, which became the norm for this regime.

affected by a major shift between two ways of defining provincial boundaries: following or subsuming the natural lines of mountains and rivers. The former is known as “suing [i.e., following] the forms of mountains and rivers”; the latter, which intentionally includes natural barriers within provinces, is known as “interlocked like dog’s teeth” (Zhou, 1998). The latter exemplifies a spatial divide-and-rule tactic to limit the power of local governments.

The Song adhered to the first principle, generally defining provincial boundaries by natural mountains and river. However, when the Mongols rose to power, their preoccupation with the possibility that a usurper would mobilize resources against the central government led them to adopt an extreme version of the interlocking principle, with natural mountains and rivers intentionally included within (larger and fewer) provinces. After the Yuan dynasty, regimes adjusted the number of provinces using both principles, leading to a general increase in the number of provinces. In appendix A.2, we use the Yangtze River as an example to illustrate how the two principles of defining provincial boundaries were implemented across regimes. As shown, the Yangtze River was used as a provincial boundary by the (pre-Mongol) Song but included within provinces by the (post-Mongol) Ming and Qing. Historians document similar changes in provincial boundaries driven by the evolution of these two principles in other regions, including the Huang River, Qin Mountain, and Taihang Mountain (Zhou, 1998).

Based on these historical narratives, Sng et al. (2018) develop a congruence index to measure how strategic provincial boundaries were drawn by comparing actual provincial boundaries with hypothetical boundaries predicted by catchment or least-cost distance. This measure reveals two groups of provinces distinguished by high and low levels of strategic boundary setting. Consistent with historians’ conjecture, those with higher levels of strategic setting are located around the major rivers and mountains mentioned above. We consider these variations in our analysis.

*Provincial capital relocation.* The relocation of national capitals and redivision of provinces naturally affected the relative importance of prefectures, which could become rather isolated due to the new delineation and national capital, despite their central status based on the old provincial boundaries. For instance, Luzhou was the capital of Hedong province during the Song dynasty because it connected the national capital, Kaifeng, with other prefectures in the province (see panel a of appendix A.3). During the Ming dynasty, however, Luzhou lost its capital status because the redrawing of the provincial boundary placed it far from other prefectures in the province, even though it was still closer to the new national capital of Nanjing (panel b of appendix A.3). When the national capital relocated to Beijing (panel c of appendix A.3), Luzhou became even further isolated and, as a result, never regained its capital status.

In contrast, Changsha was the provincial capital of Jinghu South province during the Song dynasty and was relatively close to the national capital and the other prefectures in the province (appendix A.3). This prefecture became isolated and lost its provincial status during the Yuan and Ming dynasties. In the Qing dynasty, however, it regained its capital status due to provincial redivision.

For our baseline analysis, we map historical data onto the 261 prefectures that existed in the year 2000 and construct a panel data set (see the discussion of data construction in section II). Of these 261 prefectures, 63 were provincial capitals at least once during the period studied (see their locations in figure A1): 36 lost their capital status once, 11 gained their capital status once, 8 experienced multiple changes, and 8 remained capitals throughout. We summarize these changes across regimes in figure 1.

Notably, each province has only one capital in a given regime except during the Song dynasty, when the central government limited the power of local governments by separating capitals spatially according to fiscal affairs, judicial affairs, and welfare (Mostern, 2011). As a result, the majority of provinces had two provincial capitals during this dynasty: one for fiscal affairs and one for judicial affairs and welfare. This feature is helpful because it provides a broad baseline set of possible candidates for provincial capitals. We include both in our baseline analysis and show that our findings are robust to the exclusion of the Song dynasty (and any particular regime).

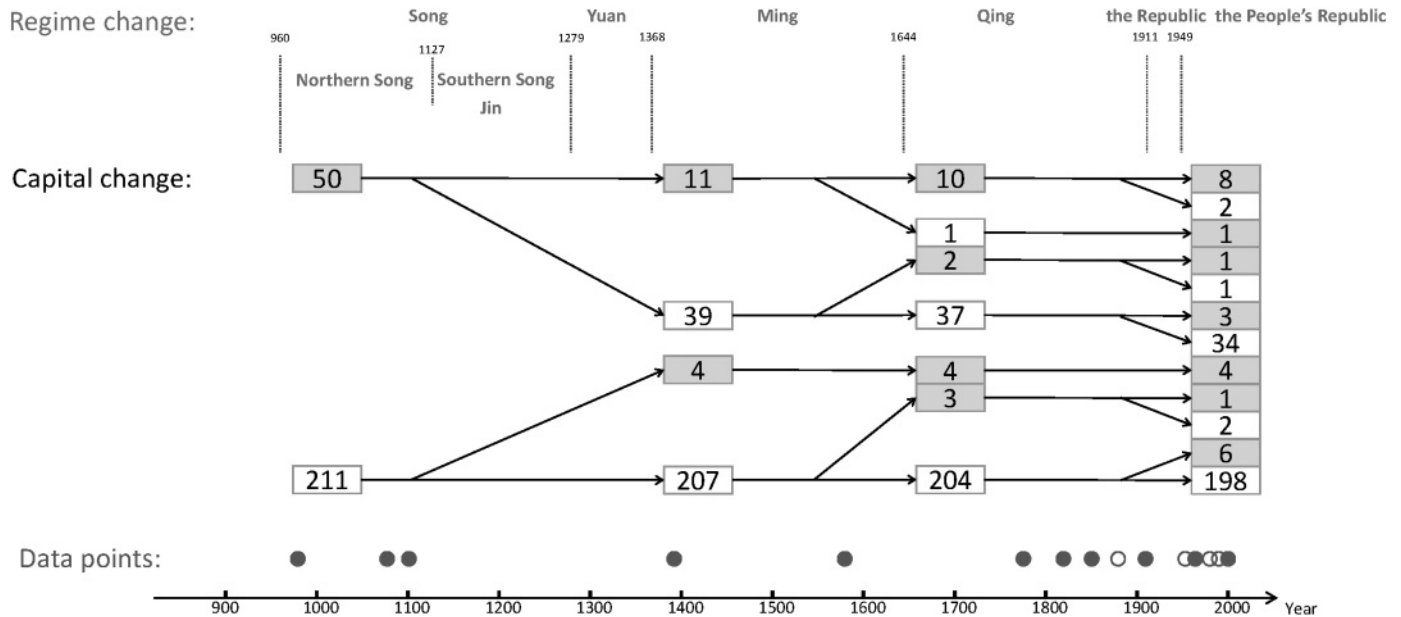
## B. Data

We construct a prefecture-level panel data set covering the 980–2000 period. We focus on four of the six major regimes. We do not study the Yuan (1279–1368) or the Republic (1912–1949) for two reasons. First, short-lived regimes are less suitable for our study because population sizes take time to adjust after a regime change. Second, prefecture-level data are less available for these two regimes.<sup>11</sup> We present the summary statistics of the key variables in table 1, and the definition and measurement of each variable in appendixes B.1 and B.2.

*Panel construction.* Although some prefecture boundaries remained fairly stable during the period under study, many others changed across regimes. To construct a panel data set, one must fix the boundaries and map the original data to these fixed boundaries. We achieve this by (a) using the boundaries of the 261 prefectures in 2000 in our baseline analysis, as our readers are more familiar with these divisions, and (b) complementing these with our grid-level analysis, in which the 261 prefectures are divided into grids with sizes

<sup>11</sup>In addition, the Song dynasty (960–1279) was divided into the Northern Song (960–1127) and the Southern Song (1127–1279). The latter controlled only the southern part of China proper and did not conduct any census. Thus, the data on the Song dynasty cover only the Northern Song.

FIGURE 1.—CHANGES IN PROVINCIAL CAPITALS ACROSS REGIMES



The gray boxes indicate the provincial capitals and the white boxes the noncapital prefectures. To make the figure more readable, we omit three changes in 1964 but include them in our empirical analyses. This figure highlights the challenge of uneven gaps in the census data, which we address in several ways in the paper. For instance, in our baseline, we exclude four census years (indicated by the open circles) to mitigate the uneven gaps.

TABLE 1.—SUMMARY STATISTICS

	Sources	Obs.	Mean	SD
(a) Economic development proxies				
In Population density	1, 2, 3, 4	2,871	4.06	1.76
Urbanization ratio (%)	3, 4	1,044	15.45	15.89
(b) Time-varying provincial capital status				
Provincial capital	2, 5	2,871	0.10	0.31
(c) Hierarchical distance				
Rank in hierarchical distance	2	2,871	8.22	5.78
In Rank in hierarchical distance	2	2,871	1.81	0.84
(d) Time-invariant prefecture characteristics				
In Area	2	261	9.30	0.85
Whether a prefecture contains a plain	2	261	0.70	0.46
Whether a prefecture contains a major river	2	261	0.72	0.45
Whether it is on the coast	2	261	0.21	0.41
Slope	2	261	2.48	2.09
In Elevation	2	261	5.52	1.60
Longitude	2	261	112.08	5.88
Latitude	2	261	30.63	5.18
Wheat suitability	6	261	3.95	1.04
Rice suitability	6	261	3.04	1.08
Fox millet suitability	6	261	3.74	1.45
Maize suitability	6	261	4.49	1.05
Sweet potato suitability	6	261	3.53	0.95
(e) Other outcomes				
Public employment ln Bureaucrats in 1776	7	261	3.57	0.62
In Total employment in government/party and public institutions in 2000	8	261	9.25	0.69
Transportation networks				
Centrality in the transportation networks, $\theta = 6$ , in 1078	2, 9	261	0.90	0.29
Centrality in the transportation networks, $\theta = 6$ , in 1580	2, 9	261	0.99	0.22
Centrality in the transportation networks, $\theta = 6$ , in 1776	2, 9	261	1.01	0.27
Centrality in the transportation networks, $\theta = 6$ , in 1990	2, 9	261	0.80	0.21

Sources:

- Liang (1980).
- China Historical GIS (2007), <http://chgis.fas.harvard.edu/>.
- Ge (2000).
- Population Census 1953, 1964, 1982, 1990, 2000, accessible via the library of CUHK.
- Treatise of the Nine Regions from the Yuanfeng reign (1078-1085), <https://ctext.org/wiki.pl?if=gb&res=508139>.
- FAO GAEZ (2012), <http://fao.org/Ag/AGL/agll/gaez/index.htm>.
- Tsinghua Library Collection (2008).
- Census 2000 (microdata), accessible via the library of CUHK.
- Cheng and Hsu (1980).

that can be smaller or larger than the prefecture at baseline. We define a capital prefecture (grid) as a prefecture (grid) that contains the geocode of a provincial capital.

*Population and urbanization.* Because data on population density are the most comprehensive type of data with which to measure long-term economic development, our baseline estimations include population data from eleven years, based on all of the existing censuses: 980, 1078, 1102, 1393, 1580, 1776, 1820, 1851, 1910, 1964, and 2000. We are also able to access population data from the years 1880, 1953, 1982, and 1990. However, the gaps between periods are already uneven, which poses a challenge to the research, and including the latter group of years would make these gaps even more uneven. Therefore, we intentionally exclude the latter four years from our baseline and include them as a robustness check. Not surprisingly, the first census of each regime was usually conducted decades after the establishment of the regime.

The population data are originally available at the prefecture level based on the boundaries in each regime. We map these data to fixed prefectures in 2000 or a grid as follows. Suppose that a fixed prefecture  $i$  in 2000 comprises fractions of two prefectures (1 and 2) in 1080. We first calculate the population density in 1080 by the prefecture boundaries in 1080 and obtain  $PopDensity_{1,1080}$  and  $PopDensity_{2,1080}$ . Second, we calculate the areas of the factions included within the fixed 2000 prefecture  $i$  to yield  $Area_1$  and  $Area_2$ . Then, we calculate the population of prefecture  $i$  in 1080 as  $PopDensity_{1,1080} \times Area_1 + PopDensity_{2,1080} \times Area_2$ . Dividing the population size by the prefecture area in 2000 ( $Area_1 + Area_2$ ), we obtain the population density of prefecture  $i$  in 1080.<sup>12</sup>

We use urbanization measures as a complement to our population density measure. Compared with population data, urbanization data are less systematically available; specifically, such data are accessible for only four of our eleven years: 1580, 1820, 1964, and 2000.<sup>13</sup>

*Provincial capitals and prefecture boundaries.* We use data from CHGIS (2007) on the boundaries and provincial capitals during the period from the Ming dynasty to 2000 and digitized data on the Song dynasty based on the Treatise of the Nine Regions from the Yuanfeng Reign (1078–1085), a Song imperial geography widely used by historians who study this

dynasty (e.g., Mostern, 2011). As expected, variations in the provincial boundaries and capitals can be attributed to regime change (i.e., these were set at the beginning of each political regime). Using these data, we determine the prefecture boundaries during each regime and the exact geolocation of each provincial capital.

*Prefecture-level controls.* We capture a prefecture's characteristics by including three sets of additional variables: factors related to geography, agriculture, and regional location. The eight geographic prefecture variables include the log area, whether it contains a plain, whether it contains a major river, whether it is located on the coast, the average slope, the elevation, the longitude, and the latitude. The five agricultural variables measure suitability for wheat, rice, fox millet, maize, and sweet potato crops (FAO GAEZ, 2012). To enhance the comparability of prefectures, we compare prefectures within the well-known nine physiographic macroregions defined by Skinner (1977): the North China plain; Northwest China; the Lower, Middle, and Upper Yangtze Plains; the southeast coast; Lingnan; Yun-Gui; and Manchuria (see the map in appendix B.2). As provincial boundaries vary over time, we also control for province fixed effects in several ways.

### III. Understanding the Choice of Provincial Capitals

The selection of a provincial capital is a complex task involving many considerations. We aim to highlight important political logic that is applicable to all regimes and could be used to generate an instrument for determining provincial capital relocation. Motivated by the roles of provincial capitals, we provide a simple algorithm to characterize the selection of a provincial capital by the central government and apply this algorithm to our data set.

#### A. A Simple Algorithm

*The roles of provincial capitals.* Given China's vast territory, it would be impossible for the central government to collect taxes and information directly from every local administrative unit. Thus, a hierarchical system is necessary to maintain political control. Provincial capitals are the most important nodes through which the central government connects with lower-ranked administrative units within a province. Conceptually, a provincial capital plays two essential roles. First, it is the administrative center of the province, where fiscal and judicial affairs and welfare issues are governed. Second, it facilitates the transfer of resources and information between the central government and all of the prefectures within the province. For instance, in the Song dynasty, provincial governors (particularly those known as *fiscal intendants*) inventoried local resources and arranged for their transportation to the national center when appropriate (Mostern, 2011). Today, the fiscal budget of a province is first determined

<sup>12</sup>See appendix B.1 for a more general case, where we show that prefecture boundary changes can be considered as measurement errors in the capital status of a prefecture, which likely lead to an underestimation of the importance of capital status.

<sup>13</sup>The data from 1580 are estimated based on local gazetteers, provided by Cao Shuji, a leading scholar in Chinese population history at Shanghai Jiaotong University. The historical urbanization data from 1820 are estimated based on the population living inside and outside walled cities, obtained from CHGIS (2007), a database of place names and historical administrative units associated with Chinese dynasties, available at <https://chgis.fas.harvard.edu/>. The 1964–2000 data are collected from population censuses.

at the level of the provincial capital and then applied to lower-ranked administrative units. Although the details vary across regimes, the two roles of the provincial capitals have persisted.

*Formalization.* Next, we formalize the two roles of provincial capitals by exploiting a prefecture's proximity to the other prefectures within a province and to the national capital. The relative importance of these roles may have shifted across regimes. To address these changes, we also allow the relative importance of these roles to vary by regime.<sup>14</sup>

We use tax collection by the central government to derive the algorithm, the logic of which can be applied to other dimensions (e.g., information collection). Assume that the gross tax revenue in a province is  $T$ . In each regime  $r$ , the aim of the central government is to maximize effective tax revenues. Here, two components of cost are important. The first is the cost of moving tax resources from different prefectures ( $j$ ) in the province to the provincial capital:  $T \times a \sum_{j=1}^N \frac{A_j}{\sum_{j=1}^N A_j} D_{i,j,r}$ , where  $a$  indicates the marginal cost of distance;  $D_{i,j,r}$  indicates the distance from  $i$  to another prefecture  $j$  in the same province in regime  $r$ ; and  $\frac{A_j}{\sum_{j=1}^N A_j}$  is a weight variable. Note that when  $A_j$  is the area of prefecture  $j$ ,  $\sum_{j=1}^N A_j$  is the total area of the province and  $\sum_{j=1}^N \frac{A_j}{\sum_{j=1}^N A_j} D_{i,j,r}$  is the distance from prefecture  $i$  to the provincial centroid.<sup>15</sup> The second important component of cost is that of delivering a  $\lambda_r$  share of the tax to the national capital:  $\lambda_r T \times a D_{i,NationalCap,r}$ , where  $D_{i,NationalCap,r}$  is the distance from prefecture  $i$  to the national capital.

Thus, the central government's selection of a capital for a province containing prefecture  $i = 1, 2, \dots, N$  aims to maximize the following:

$$T - T \times a \sum_{j=1}^N \frac{A_j}{\sum_{j=1}^N A_j} D_{i,j,r} - \lambda_r T \times a D_{i,NationalCap,r}. \quad (1)$$

This is equivalent to minimizing the following specification, which we term "hierarchical distance" (denoted by  $HierDist$ ):

$$\sum_{j=1}^N A_j D_{i,j,r} + \lambda_r \sum_{j=1}^N A_j D_{i,NationalCap,r}. \quad (2)$$

The logic of this algorithm can be extended beyond tax collection. Broadly, one can consider that the first and second elements in  $HierDist$  capture the importance of provincial autonomy and central control, respectively.  $\lambda_r$  reflects the trade-off between these two considerations.

<sup>14</sup>Similarly, the importance of national capitals and provincial boundaries can vary across regimes. Such changes, however, should not affect our main findings because we are comparing prefectures within the same regime.

<sup>15</sup>To visualize this intuition, if  $A_j=1$ , each prefecture is treated as equally sized, that is, the relative sizes of the prefectures are ignored.

We attempt to keep the elements included in  $HierDist_{i,r}$  as exogenous as possible. Therefore, we focus on geographical variables. In principle, this algorithm can be enriched by considering other factors, such as using the population to measure  $A_j$  and considering transportation networks in our calculations of  $D$ . As we show later, however, both population and transportation can be affected by political hierarchy.

Assuming that  $\lambda > 0$ ,  $HierDist_{i,r}$  implies that provincial capitals should be located farther from the provincial centroid and closer to the national capital. This prediction is confirmed by the empirical patterns. To see these patterns, we zoom in on the cases of Ming (the middle period in our data) and modern China in figures 2a and 2b (see other regimes in appendix C.1), where the provincial capitals and centroids are marked with red squares and crosses, respectively. As shown in both maps, the squares (provincial capitals) tend to deviate from the crosses toward the direction of the national capital.<sup>16</sup> Thus, our simple algorithm based on arguably exogenous features shows promise as a predictor of provincial capital status. Next, we test this argument more systematically.

### B. Test the Role of Hierarchical Distance

Here, we test the association between  $HierDist_{i,r}$  and the provincial capital status of a prefecture  $i$  in regime  $r$ . To measure  $HierDist_{i,r}$  systematically, we need to assign values to  $\lambda_r$ . We choose the value of  $\lambda_r$  that delivers the highest predictive power in each regime. We find that  $\lambda_r$  varies from around 0.3 in the Song and Ming dynasties to around 0.2 in the Qing dynasty and modern China. This choice is not crucial to our analysis, and our findings are robust to alternative ways of specifying  $\lambda_r$ . In appendix C.2, we demonstrate a similar pattern obtained when assuming  $\lambda = 0.2$  for all regimes.<sup>17</sup>

We plot the probability of a prefecture's being a provincial capital by its rank in the province with respect to its hierarchical distance. As shown in figure 3a, among the top-ranked prefectures (which vary across periods), the probability of being a provincial capital is approximately 0.40, whereas among the second-ranked prefectures, it is approximately 0.24. This probability decreases as the ranking level decreases: beyond the fifth-ranked level, the probability decreases to below 0.1 and approaches 0 by the tenth-ranked level. This nonlinear pattern also suggests a linear relation between the log rank ( $\ln RankHierDist$ ) and the probability of being selected as a

<sup>16</sup>Because the administrative hierarchy was set at the beginning of the regime, the Ming considered the location of Nanjing to be more important than that of Beijing (which became the national capital after a coup). In the Song data set, we treat Xixia and Dali as different regimes and calculate the hierarchical distance of each prefecture in these regions to the respective national capitals (Yinchuan and Dali, respectively).

<sup>17</sup>Note that when compared with a fixed  $\lambda$ , allowing  $\lambda_r$  to change by regime does not introduce additional concerns about endogeneity, as  $\lambda_r$  remains consistent for all prefectures within a single regime whose impact is absorbed by year fixed effects in our analysis. Thus, we focus on  $\lambda_r$  instead of a fixed  $\lambda$ , as the former better captures variation in the trade-offs across regimes in our baseline. We report the results using a fixed  $\lambda$  for robustness.

FIGURE 2.—ILLUSTRATING THE IDEA UNDERLYING HIERARCHICAL DISTANCE



This figure illustrates the logic underlying the hierarchical distance (weighted sum of distances to the national capital and the other prefectures within a province) using the case in 1580 and 2000: provincial capitals tend to be located away from the provincial centroid toward the national capital. We present the maps for other regimes in appendix C.1.

capital below the tenth ranking level, which is confirmed by the pattern in panel b.

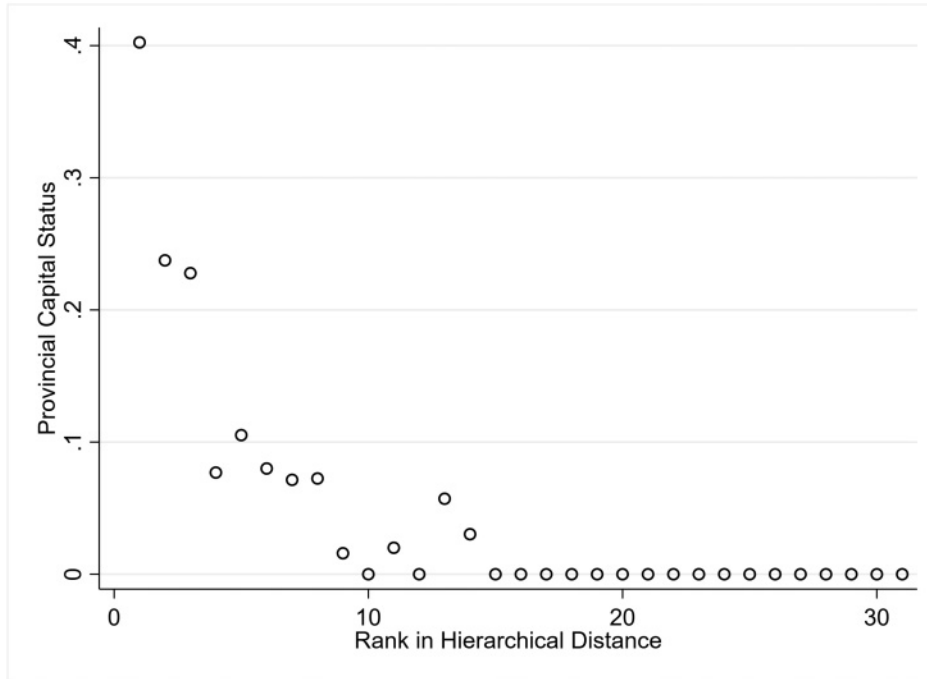
Motivated by figure 3, we evaluate how hierarchical distance influences the provincial capital location systematically using both cross-sectional and panel specifications. For

each regime  $r$ , our cross-sectional analysis is conducted as follows:

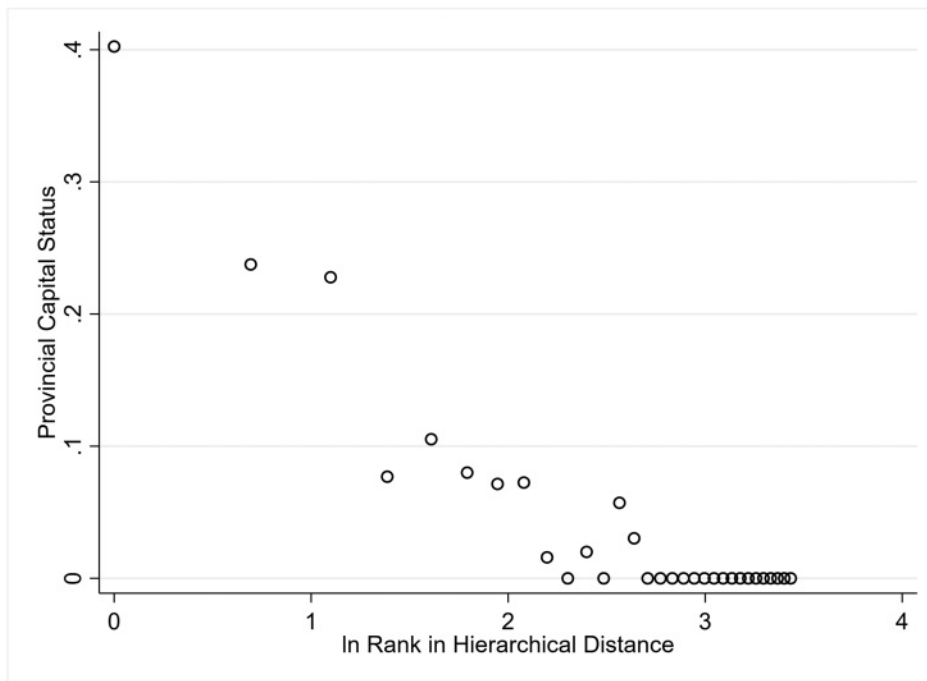
$$\begin{aligned}
 ProvCap_{i,r} = & \beta \ln RankHierDist_{i,r} \\
 & + \theta \mathbf{X}_i + \pi_m + \epsilon_{i,r},
 \end{aligned}
 \tag{3}$$

FIGURE 3.—RANK IN HIERARCHICAL DISTANCE AND THE PROBABILITY OF BEING A PROVINCIAL CAPITAL

(a) Rank in Hierarchical Distance vs. Prob. of Being Capital



(b) ln Rank in Hierarchical Distance vs. Prob. of Being Capital



The figure shows a strong, negative correlation between a prefecture's rank in hierarchical distance (weighted sum of distances to the national capital and the other prefectures within a province) within a province and its probability of being a provincial capital.

where  $ProvCap_{i,r}$  indicates whether prefecture  $i$  is a provincial capital in regime  $r$ .  $\mathbf{X}_i$  includes the geography- and agriculture-related variables mentioned above, and  $\pi_m$  indicates the Skinner macroregions.

Our panel analysis pools all regimes, enabling us to control for prefecture characteristics that do not vary or vary slowly over time (e.g., geography) and factors that affect all prefectures similarly (e.g., dynasty cycles) by including prefecture

fixed effects ( $\alpha_i$ ) and regime fixed effects ( $\gamma_r$ ). The specification is

$$\begin{aligned} ProvCap_{i,r} = & \beta \ln RankHierDist_{i,r} + \alpha_i + \gamma_r \\ & + \theta \mathbf{X}_i \times \gamma_r + \pi_m \times \gamma_r + \epsilon_{i,r}. \end{aligned} \quad (4)$$

We allow the effects of  $\mathbf{X}_i$  to vary across time by controlling for  $\mathbf{X}_i \times \gamma_r$ , and the effects of  $\pi_m$  effects to vary by regime (indicated by  $\pi_m \times \gamma_r$ ). All standard errors are clustered at the prefecture level.

In each regime, we find that  $\ln RankHierDist_{i,r}$  is a strong predictor of provincial capital status (as shown in appendix C.3). The explanatory power of  $\ln RankHierDist_{i,r}$  alone is similar to that of a large set of controls, as demonstrated by the  $R$ -squared value. We focus on panel specification, wherein we link the change in  $HierDist_{i,r}$  with the change in capital status. Again, the change in log rank in  $HierDist_{i,r}$  is a strong predictor of a change in provincial capital status. If a prefecture's rank in hierarchical distance doubles, the probability of being selected as a provincial capital decreases by 8 percentage points (around 80% of the mean probability).

In our calculation of  $HierDist_{i,r}$ , we assume the given provincial boundaries. Although administrative histories have documented the dates of provincial capital designation (e.g., Zhang, 1739, for the Ming dynasty) and showed that provinces were defined before a prefecture was designed as a provincial capital, we remain uncertain whether provincial boundary changes affect our findings. Relying on insights from Sng et al. (2018), we divide the provinces into two groups. The nonstrategic group includes provinces whose boundaries were congruent with the hypothetical boundaries predicted by geography, and the strategic group refers to those that exhibit clear incongruence. The logic of hierarchical distance applies to both groups, suggesting that the discussed trade-off is not affected by strategic concerns about provincial boundary setting (see appendix C.3).

#### IV. The Economic Consequences: Descriptive Evidence

How does political hierarchy affect economic development? To answer this question, we present two sets of descriptive patterns to motivate our empirical estimations.

##### A. A Case of Two Periods: 980 and 2000

Before analyzing our eleven-period panel data, we present descriptive patterns based on the data from 980 and 2000. This two-period structure allows us to depict the main pattern by categorizing the prefectures into four groups:

1. Capitals in both periods, denoted by “yes-yes”
2. Capitals in 980 but not in 2000, denoted by “yes-no”
3. Capitals in 2000 but not in 980, denoted by “no-yes”
4. Not capitals in either period, denoted by “no-no”

In figure 4a, the  $x$ -axis indicates the standardized log population density in 980, and the  $y$ -axis indicates the standardized log nightlight density in 2000. The figure suggests that a prefecture's economic status changes with its political status. Specifically, the crosses indicate the average economic status of different groups. As shown, an average no-no prefecture group is close to the mean in both periods, and an average yes-yes prefecture is above the mean in both periods. In contrast, an average no-yes prefecture is 0.3 standard deviations below the mean in 980 but 1 standard deviation above the mean in 2000, indicating a correlation between a gain in capital status and better economic development. An average yes-no prefecture is 0.5 standard deviations above the mean and comparable to a yes-yes prefecture in 980 (when both were provincial capitals), but decreases to near the mean, similar to a no-no prefecture, in 2000 after a loss of capital status.

##### B. Pooling All Changes Together: 980–2000

As in the above analysis, we can divide the prefectures into four groups every two regimes. This allows us to visualize the four groups period-by-period. To compare prefectures with similar characteristics, we first regress the log population density on all of the prefecture-level controls mentioned above and obtain the residuals. Then we plot the average residuals for the four groups period-by-period (relative to the time of status change) in figure 4b.

Consistent with the pattern in figure 4a, the no-no prefecture group is close to the mean (in the macro region) in all periods, whereas the yes-yes prefecture group is 40% above the mean in all periods. The gaining group (no-yes) is similar to its no-no peer group before the status change but increases to 48% higher than the no-no peer group after gaining capital status. In contrast, the losing group (the “yes-no”) is around 38% higher than its no-no peer group before the status change, whereas the two groups are comparable after losing capital status.

#### V. The Economic Consequences: Estimation Results

##### A. Empirical Strategies

We use two empirical strategies to identify the economic consequences of political hierarchy: a DID and an IV strategy. Below, we present these two strategies and discuss their empirical assumptions.

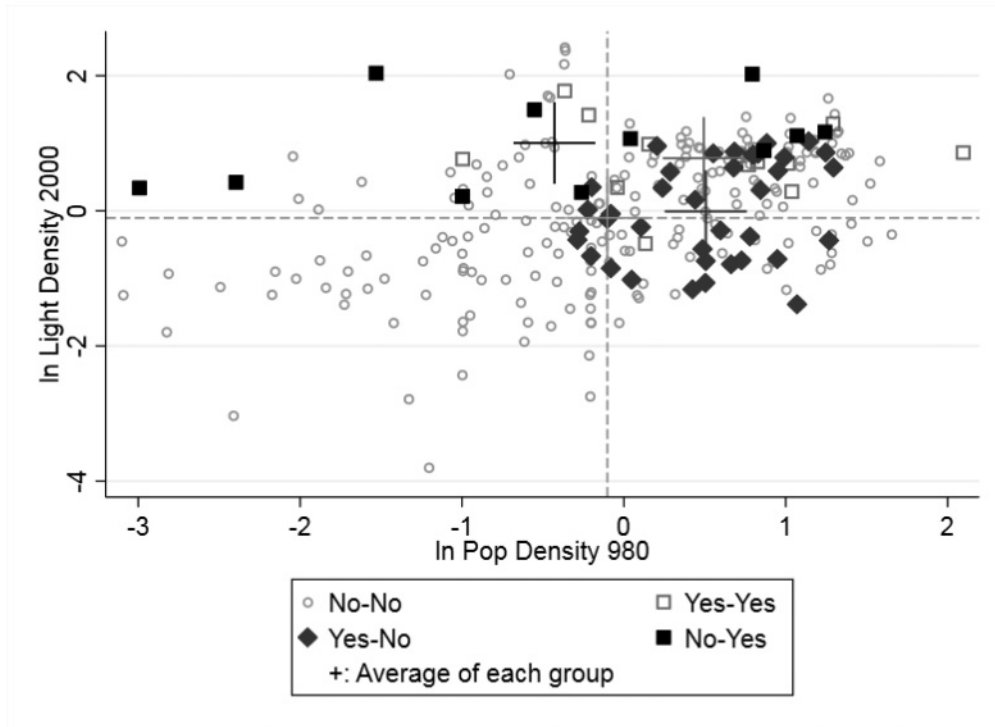
*The DID strategy.* The DID strategy is

$$y_{i,t} = \beta Capital_{i,t} + \alpha_i + \gamma_t + \theta \mathbf{X}_i \times \gamma_t + \theta' \pi_m \times \gamma_t + \epsilon_{i,t}, \quad (5)$$

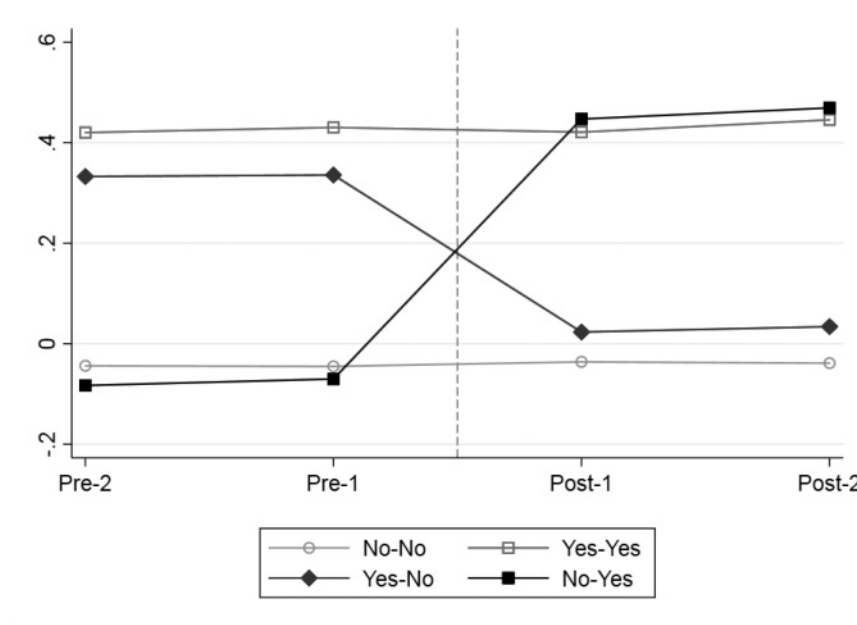
where  $Capital_{i,t}$  indicates whether a prefecture  $i$  is a provincial capital in year  $t$ .  $y_{i,t}$  is the outcome variable—log population density or urbanization rate. The other variables are the same as those in equation (3), except that we can include

FIGURE 4.—DESCRIPTIVE PATTERNS

(a) 980 vs. 2000



(b) Pooling all changes together 980-2000



Panel a shows that gaining and losing capital status is associated with a systematic change in a prefecture's economic performance. The crosses indicate the averages for each group. The "no-no" group averages are indicated by the big dashed cross. (b) The four groups are defined based on the capital status every two regimes. To increase comparability, for each period, we first regress log population density on prefecture characteristics (geography variables, agricultural variables, and macroregion dummies) and obtain residuals. We plot the average residuals by group and by period.

multiple years of observations within a regime  $r$ . Therefore, we use  $t$  to indicate the year of observation.

An important assumption of this strategy is that provincial-capital prefectures are comparable to noncapital prefectures

before the change in capital status. We validate this assumption in several ways. Under some specifications, we further control for  $EverCapital_i \times \gamma_t$  to allow the group of prefectures that have ever been a provincial capital (the ever-capital

TABLE 2.—ECONOMIC CONSEQUENCES: THE IMPACT OF CAPITAL STATUS ON POPULATION DENSITY

Method	DID				Reduced form			IV	
	All	All	All	All	All	Ever-capital	Never-capital	All	All
Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
								Second-stage	
Prov. capital	0.622*** (0.132)	0.456*** (0.104)	0.488*** (0.105)	0.470*** (0.104)				0.796*** (0.229)	0.794*** (0.165)
								First-stage	
H-distance					-0.071*** (0.021)	-0.131*** (0.038)	-0.017 (0.027)	-0.089*** (0.008)	-0.101*** (0.011)
Pref. FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE × Geography		Y	Y	Y	Y	Y	Y	Y	Y
Year FE × Agriculture			Y	Y	Y	Y	Y	Y	Y
Year FE × Region FE				Y	Y	Y	Y	Y	Y
Year FE × Prov <sub>i,r</sub> FE									Y
Observations	2,871	2,871	2,871	2,871	2,871	693	2,178	2,871	2,871
R-squared	0.757	0.850	0.865	0.882	0.878	0.924	0.881	0.880	0.957
# prefectures	261	261	261	261	261	63	198	261	261
Weak instrument test ( <i>F</i> -statistic)								131.9	87.6
Lower-bound estimate (Oster, 2017)				0.327					

This table shows that provincial capital status is associated with a higher population density. Columns 5 to 9 use *lnRank* in hierarchical distance to predict provincial capital status. Column 7 shows that hierarchical distance does not affect the development of never-capital prefectures, suggesting that the political channel is critical for hierarchical distance to matter.

We add controls step by step: (i) geography variables include log area, whether a prefecture contains a plain, a major river, whether it is on the coast, as well as its slope, elevation, longitude, and latitude; (ii) agriculture variables refer to the suitability of rice, wheat, millet, sweet potatoes and maize; and (iii) regions refer to the nine physiographic macroregions defined by Skinner (1977) (mapped in figure B2). *Prov<sub>i,r</sub>* indicates province fixed effects in all the regimes.

Standard errors presented in the parentheses are clustered at the prefecture level. \*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%.

group) to have nonparametric trends different from those of the never-capital group.

*IV strategy.* A second strategy is to use the hierarchical distance derived above as an instrument to predict provincial capital status. The first-stage and second-stage specifications are as follows:

$$Capital_{i,t} = \delta \ln RankHierDist_{i,t} + \alpha_i + \gamma_t + \theta \mathbf{X}_i \times \gamma_t + \theta' \pi_m \times \gamma_t + \epsilon_{i,t}, \tag{6}$$

and

$$y_{i,t} = \beta' \widehat{Capital}_{i,t} + \alpha_i + \gamma_t + \theta \mathbf{X}_i \times \gamma_t + \theta' \pi_m \times \gamma_t + \epsilon_{i,t}, \tag{7}$$

where  $X_i$  includes all of the controls in our DID analysis.

Although *lnRankHierDist<sub>i,t</sub>* is a strong predictor of provincial status (as shown in section III), it must satisfy two additional conditions to be a valid instrument: the change in *lnRankHierDist<sub>i,t</sub>* for a prefecture must be orthogonal to its own characteristics, and *lnRankHierDist<sub>i,t</sub>* must satisfy the exclusion restriction; that is, it must affect regional development due to the political status change rather than to omitted channels. We examine these assumptions in our analysis.

*B. Results of Regional Development Analysis*

*Baseline results.* We use the log population density during the 1980–2000 period as the primary measure of regional development. Because the prefecture boundaries are fixed in

this analysis, the coefficient also can be interpreted as the impact on population size. We further complement the analysis with urbanization data, which are available only for the latter half of the millennium studied.

Our DID estimates based on the eleven-period data indicate that provincial capital status is associated with a 40% to 50% higher population density. Column 1 of table 2 presents the result obtained with only the prefecture and the year fixed effects, for which we obtain an estimate of 0.62. Once we control for eight geographic variables and their interactions with  $\gamma_t$ , we obtain an estimate of around 0.46 (column 2). After adding the five-type crop suitability, regional dummies, and their interactions with  $\gamma_t$  to columns 3 and 4, the estimates are around 0.47.<sup>18</sup>

To put this magnitude in perspective, it is instructive to measure the variation in population density within a province. On average, the population density of the most densely populated prefecture is 158% higher than that of a median prefecture, whereas that of the least densely populated prefecture is only 60% of that of a median prefecture. Therefore, the change in density caused by a change in status can be considered as a shift from a median prefecture (normally the sixth- or seventh-ranked prefecture) to the third-ranked prefecture or from the third-ranked prefecture to the top-ranked prefecture.

Our DID analysis is challenged by the possibility that capital status might change due to omitted variables that affect development. Based on changes in the coefficient and *R*-squared

<sup>18</sup>For all of the results, we report standard errors clustered at the prefecture level. Our findings are robust to Conley spatial standard errors (see appendix D.1).

TABLE 3.—THE IMPACT OF CAPITAL STATUS ON URBANIZATION

Method	Urbanization rate (%)			lnUrban pop			lnRural pop		
	DID	IV		DID	IV		DID	IV	
	(1)	First Stage (2)	Second Stage (3)	(4)	First Stage (5)	Second Stage (6)	(7)	First Stage (8)	Second Stage (9)
Prov. capital	11.347*** (2.549)		18.519** (9.036)	0.618*** (0.141)		1.983** (0.820)	0.195* (0.103)		0.380 (0.512)
H-distance		0.055*** (0.010)			0.055*** (0.010)			0.055*** (0.010)	
Prov. FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE × Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044
R-squared	0.838	0.110	0.835	0.903	0.110	0.893	0.866	0.110	0.865
# prefectures	261	261	261	261	261	261	261	261	261
Weak instrument test		28.5			28.5			28.5	

This table shows that provincial capital status is associated with a higher urbanization rate.

We add controls step by step: (i) geography variables include log area, whether a prefecture contains a plain, a major river, whether it is on the coast, as well as its slope, elevation, longitude, and latitude; (ii) agriculture variables refer to the suitability of rice, wheat, millet, sweet potatoes and maize; and (iii) regions refer to the nine physiographic macroregions defined by Skinner (1977) (mapped in figure B2).  $Prov_{i,r}$  indicates province fixed effects in all the regimes.

Standard errors presented in the parentheses are clustered at the prefecture level. \*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%.

values across specifications in table 2, we can assess the importance of omitted variable bias using the method provided by Oster (2017). We present the bounding estimate in the last row of table 2. As shown, omitted variable bias cannot easily explain the results in table 2; after considering the possible biases, we determine a lower bound of  $\beta$  to be 0.327.<sup>19</sup>

Our IV strategy also confirms the importance of provincial capital status. Column 5 shows the reduced-form estimate: here, an increase in the hierarchical distance rank is strongly negatively correlated with population density. When the sample is separated into ever-capital prefectures and never-capital prefectures in columns 6 and 7, we find that hierarchical distance has a notable effect on population density in the ever-capital prefectures but little effect on the never-capital prefectures, suggesting that political status is a crucial channel through which hierarchical distance exerts its effects.

Column 8 reports the IV and first-stage estimates with an  $F$ -statistic of 131.9, implying that a weak instrument is not a crucial concern. Compared with the DID estimates, our IV estimate (0.79) is slightly higher, partly because it is local to prefectures whose political status is affected by hierarchical distance. Using a fixed  $\lambda$  for all regimes, the IV estimate is 0.70 (presented in appendix D.3).

To address the problem of provincial boundary changes, we further include  $Prov_{i,r} \times \gamma_t$ , where we control for province fixed effects in all regimes and their interactions with year fixed effects. We observe a similar IV estimate in column 9. In appendix D.4, we present both the DID and IV results obtained by further controlling for  $Prov_{i,r} \times \gamma_t$  or  $(\cap Prov_{i,r}) \times \gamma_t$ . As shown, none of these specifications invalidates the importance of provincial capital status. Following the discussion of provincial boundary settings in section III, we also separate the provinces into two groups by the level of strategy used in boundary setting (measured by Sng

et al., 2018). As shown in appendix D.5, our IV estimates and first-stage results hold within both groups, further suggesting that the role of hierarchical distance holds even if strategy is applied to provincial boundary setting.

As an additional measure of development, we use urbanization data, which are available only for the latter half of the millennium studied (1580, 1820, 1964, and 2000). Thus, the findings from this analysis can serve to determine whether our results hold after excluding data from the first half of the millennium. As shown in table 3, the DID and IV estimates show that provincial capital status increases a prefecture's urbanization rate by 11 to 18 percentage points, a large increase compared with the change in the mean urbanization rate (15 percentage points). We also find that the provincial capital status has an effect on urban populations approximately five times that on rural populations. This finding further confirms that political status affects economic development in terms of not only population size but also economic activity.

*Gaining versus losing political status.* We separate capital status loss from capital status gain by using change-on-change specifications (i.e., how a change in capital status affects a change in population density). Columns 1 to 4 in table 4 initially confirm that change-on-change specifications deliver estimates similar to our baseline. The inclusion of lagged population density in the previous two periods does not invalidate our main finding. Furthermore, we obtain a negative coefficient on lagged log population density in the previous two periods, which suggests a convergence pattern.

As reported in columns 5 and 6, gaining capital status is associated with an approximately 47% increase in population density, whereas losing capital status is associated with a 39% decrease in population density. These estimates decrease marginally if we further include the lagged log population density in the previous two periods (columns 7 and 8). By design, the DID estimates should be interpreted as

<sup>19</sup>See the step-by-step calculation in appendix D.2.

TABLE 4.—GAINING VERSUS LOSING STATUS

	$\Delta \ln \text{Pop Density}$				$\Delta \ln \text{Pop Density}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta$ prov. cap	0.431*** (0.106)	0.415*** (0.110)	0.334*** (0.086)	0.305*** (0.080)				
Gaining capital status					0.513** (0.221)	0.465** (0.230)	0.425** (0.165)	0.385*** (0.148)
Losing capital status					-0.390*** (0.117)	-0.389*** (0.124)	-0.287*** (0.105)	-0.263** (0.102)
Lag. ln pop. density			-0.428*** (0.015)	-0.425*** (0.017)			-0.428*** (0.015)	-0.425*** (0.017)
Lag 2 ln pop. density				-0.096*** (0.020)				-0.096*** (0.020)
Pref. FE		Y	Y	Y		Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE $\times$ Controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,610	2,610	2,610	2,610	2,610	2,610	2,610	2,610
R-squared	0.715	0.715	0.789	0.800	0.715	0.715	0.789	0.800
# prefectures	261	261	261	261	261	261	261	261

This table reports the impacts of gaining status and losing status, both of which matter.

Controls include (i) geography variables: log area, whether a prefecture contains a plain, a major river, whether it is on the coast, as well as its slope, elevation, longitude, and latitude; (ii) agriculture variables: the suitability of rice, wheat, millet, sweet potatoes and maize; and (iii) the nine physiographic macroregions defined by Skinner (1977) (mapped in figure B2).

Standard errors presented in the parentheses are clustered at the prefecture level. \*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%.

changes rather than levels. As indicated in the descriptive pattern in figure 4b, however, the losing group had a population density approximately 40% higher than that of its noncapital peers. Therefore, the impact of losing capital status is roughly equivalent to a transition to average prefecture status.

The impact of losing capital status is notable for two reasons. First, it suggests that the variables of concern omitted when determining capital status may not be essential; otherwise, we would observe that losing capital status has little effect. Second, it implies a lack of persistence: former provincial capitals lost a large part of their economic advantages after losing capital status. This finding suggests that the agglomeration effect of economic activity was not large enough to sustain a prefecture's economic advantages even a few decades after losing political economic status. As we discuss below, this finding is related to the ability of politics to shape both public employment and market access.

*A proxy for migration.* Ideally, we would quantify the importance of migration as a determinant of population change, as this information could shed light on the importance of the displacement effect. Unfortunately, no sufficient migration flow data exist across our study period. Therefore, to gauge the importance of migration, we further collect information on surname distribution in years corresponding to four regimes (1078, 1580, 1776, and 2000).<sup>20</sup> Specifically, we divide the population into those with existing surnames and those with new surnames. As reported in appendix D.6, among this sample of prefectures with available surname information, provincial capital status increases the population by 47.3%, similar to our baseline estimates. We further find

that individuals with new surnames are responsible for an 11.2% increase in the overall population, while those with existing surnames are responsible for a 36.1% increase. Although this method is certainly subject to measurement error, the results suggest that both migration and demographic growth contribute to population change.

### C. Additional Checks

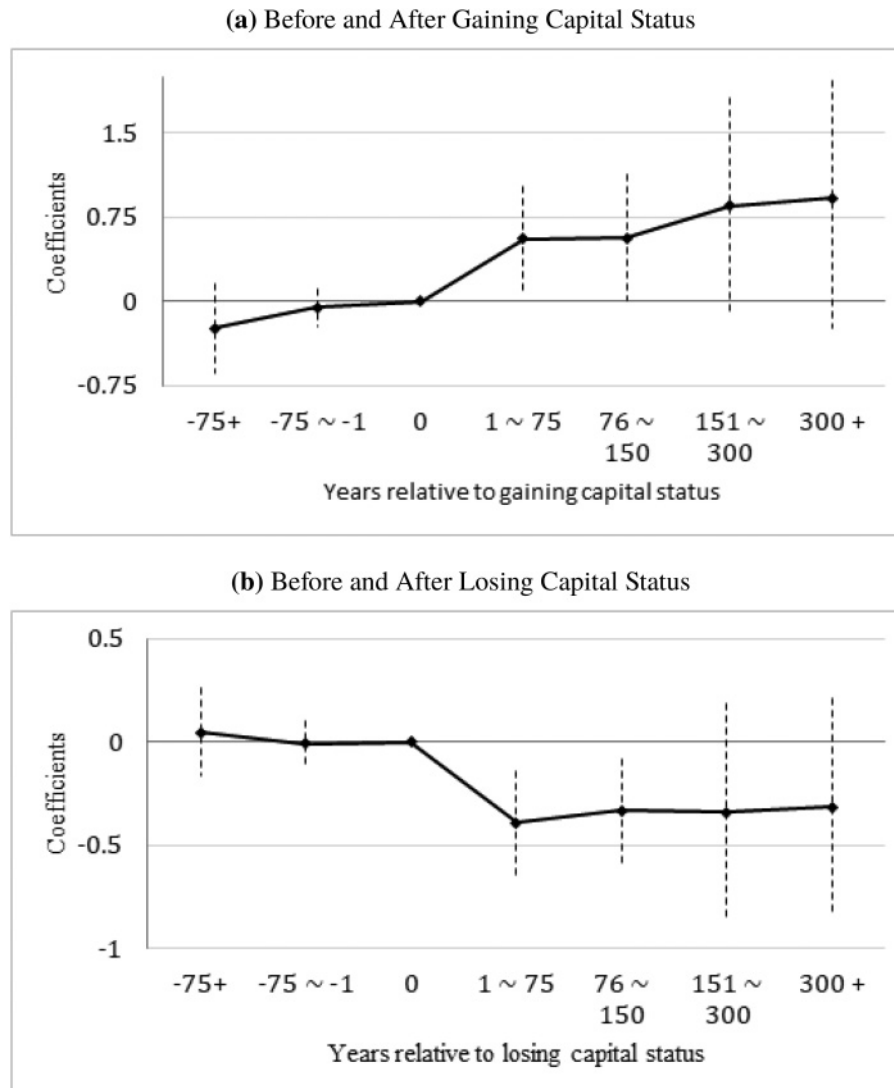
*Checks of our DID analysis.* We conduct two additional checks to address concerns about omitted variables. First, we exploit data on the 63 ever-capital prefectures; in this group, no omitted variable prevented any one prefecture from becoming a capital. We find similar results when we focus on this subsample or further control for  $EverCapital_i \times \gamma_i$  in our analysis (see appendix D.7).

Second, we conduct a period-by-period analysis in which we define periods relative to the period before a change in capital status occurs (denoted by period 0). This specification allows us to check whether provincial capitals were already on a different developmental trajectory prior to a change in political status. Due to the frequency of data availability, we divide the data into 75-year increments (approximately one-quarter of a regime's length). As reported in appendix D.8, we find no significantly different trends in population density between the capital group and other prefectures prior to status changes. Figure 5 further depicts the findings; here, the lines connect the estimates, and the dotted lines indicate the 95% confidence intervals. As shown, increases and decreases in population density occur only after gaining and losing capital status, respectively. Even though we cannot predict the exact number of years required for these effects to occur, the data indicate that they occur within 75 years after a status change.

We further conduct several measurement checks of our DID analysis. We show that our results are robust to using

<sup>20</sup>The surname information for 1080 is obtained from Harvard's China Biographical Database; that for 1580 and 1776, from data sets on presented scholars (Zhu & Xie, 1980); and that for 2000, from the population census of that year.

FIGURE 5.—THE IMPACT OF CAPITAL STATUS ON POPULATION DENSITY: PERIOD BY PERIOD



This figure visualizes the results in appendix D.8. It shows that there are no systematic differences before and after a prefecture gains or loses capital status. The reference group is the period before capital status changes. Due to the low frequency of data, we cannot pin down the exact years it takes for the change to happen, but the patterns tell us that the rise and decline happen within 75 years after status change. A period of 75 years is roughly one-fourth of a regime's length.

different periods of data (appendix D.9) or using grid-level data in the analyses (appendix D.10).

*Checks of our IV analysis.* For our IV analysis, we assume that the change in a prefecture's hierarchical distance is orthogonal to its own characteristics because this change stems from a regime change. This assumption can be confirmed by two sets of empirical results discussed in appendix D.11, where we show that  $\Delta \ln Rank HierDist_{i,t}$  is not significantly correlated with previous log population density levels ( $\ln PopDensity_{i,t-1}$  and  $\ln PopDensity_{i,t-2}$ ) or previous changes in log population density ( $\Delta \ln PopDensity_{i,t-1}$  and  $\Delta \ln PopDensity_{i,t-2}$ ).

We are concerned about the exclusion restriction. The finding that hierarchical distance is not significantly correlated with population density in the never-capital prefectures (col-

umn 7 of table 2) suggests that if hierarchical distance affects population density, regardless of capital status, we should expect to observe this relationship within the never-capital prefectures. We present three additional sets of analyses to further investigate the validity of the instrument. First, we employ  $\ln Rank$  in  $\sum_{j=1}^N A_j D_{i,j,t} \times \ln Rank$  in  $\sum_{j=1}^N A_j D_{i,NatCap,t}$  as an instrument while controlling for the independent effects of the two components. When we use the interaction of these two components as the instrument, we do not find that either alone has an additional direct effect (appendix D.12). Second, the two-component structure of hierarchical distance also allows us to create multiple placebo hierarchical distance ranks by exploiting changes in national capital status. For instance, we calculate one such placebo to Kaifeng when this location was not a capital and similar placebos for Nanjing and Beijing before they became national capitals. Including these

TABLE 5.—PROVINCIAL CAPITAL STATUS AND PUBLIC OFFICES

	(1) lnPop 1776	(2) lnBureaucrats 1776	(3) lnPop 2000	(4) lnPublic Employ. 2000	(5) lnRank in Public Offices	(6) IV
Prov. capital	0.465*** (0.087)	0.477*** (0.075)	0.680*** (0.082)	1.149*** (0.088)	-1.090*** (0.319)	-2.094*** (0.713)
Controls	Y	Y	Y	Y	Y	Y
Year FE × Controls					Y	Y
Pref. FE					Y	Y
Year FE					Y	Y
Observations	261	261	261	261	522	522
R-squared	0.757	0.623	0.710	0.582	0.414	0.365
# prefectures	261	261	261	261	261	261
First-stage F-statistic						25.8

This table shows that public offices are affected by capital status. Columns 1 to 4 present cross-sectional results; Columns 5 and 6 employ the panel structure by using lnRank in public employment as the dependent variable; the negative coefficients indicate climbing up the ladder of public employment.

Controls include (i) geography variables: log area, whether a prefecture contains a plain, a major river, whether it is on the coast, as well as its slope, elevation, longitude, and latitude; (ii) agriculture variables: the suitability of rice, wheat, millet, sweet potatoes and maize; and (iii) the nine physiographic macroregions defined by Skinner (1977) (mapped in figure B2).

Standard errors presented in the parentheses are clustered at the prefecture level. \*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%.

placebo hierarchical distance ranks does not alter our IV estimate or affect population density, implying that our findings are specific to the political status of these cities (appendix D.13). Finally, we replace  $D_{i,NationalCap,t}$  in equation (2) with  $D_{i,Market,t}$ , which measures a prefecture's distance to major market centers. Once again, this change cannot explain the role of hierarchical distance (appendix D.14). Taken together, these results indicate that political status is a crucial channel through which the hierarchical distance rank can affect economic development.

## VI. Interpretations

We document the great impact of political hierarchy on spatial development, as measured by population density and urbanization. Next, we ask what explains this link between politics and development. As noted in section I, three economic forces theoretically may contribute to this link: the direct effects of public employment, the spillover effects of public employment through private employment and agglomeration, and improvements in market access (mediated by investments in infrastructure). Here, we discuss these interpretations and use the evidence to address a question that has long attracted the interest of social scientists: Can one consider these provincial capitals' "parasitic cities" that gain success mainly via public employment but have little advantage in productivity?

### A. Public Employment and Its Spillovers

Public offices naturally moved to new provincial capitals. The historical and sociological discourse often emphasizes that merchants and artisans move to political centers to serve bureaucrats (Heng, 1999). Here, we measure public employment in two years, 1776 and 2000. To obtain historical information on bureaucrats, we digitized a 120-volume set of government records known as the Complete Directory of Qing Officials (Tsinghua Library Collection, 2008) and use the information from 1776. A limitation of these records is that

they include only individuals who hold offices and, hence, exclude a large number of employees who did not hold formal government positions. To obtain data from 2000, we use information from the population census, which refers to employment in all administrative and social organizations and in public institutions (e.g., physicians and teachers at public hospitals and schools). In contrast, the historical censuses do not include information on occupations. In our analysis, we first look at the cross-sectional correlations in both periods. Then we use the rank of a prefecture as an outcome of our panel analysis (such that a higher value of rank indicates a smaller size of public employment) based on both the DID and IV methods.

Public offices move with provincial capitals. In columns 1 to 4 of table 5, we present our cross-sectional findings on log population and public employment in 1776 and 2000. In columns 5 and 6, we show that a change in provincial capital status is associated with a change in the public employment rank. The coefficients indicate that the importance of provincial capital status is comparable to an increase in public employment from an average rank to a rank in the top 35–15 levels.

*Spillover effects.* Public employment can have spillover effects via private employment and agglomeration. Although we cannot directly estimate these spillover effects, it is instructive to conduct back-of-the-envelope analyses to understand how large an effect is needed to explain our main findings on population changes. For instance, using the census data and estimates by other scholars, we estimate that public employment in 2000 accounts for around 10% of the total labor force or 6% to 7% of the total population.<sup>21</sup> In column 4,

<sup>21</sup>See the PIIE estimate: <https://www.piiie.com/blogs/china-economic-watch/shrinking-leviathan-state-employment-china-looms-smaller-expected>. We also check the public employment shares in capital prefectures and noncapital prefectures, which were 10.3% and 5.7%, respectively, in 2000. Even if we were to use this difference to conduct a back-of-the-envelope analysis, we would still need a large multiplier for this channel alone to explain our main finding on population changes.

the coefficients of provincial capitals on log public employment and log population are 1.15 and 0.68, implying that public employment alone can explain 0.115 ( $1.15 \times 10\%$ ) of 0.68. We thus need to apply a large multiplier (e.g., approximately 6) to the spillover effects of public employment to explain our findings on regional development. Existing estimates of the spillover effect of public employment on total private employment are less than 1.<sup>22</sup> This exercise suggests that although spillover effects are certainly present, they cannot easily explain all of our findings.

### B. Market Access

The construction of new infrastructures that connect capitals is another common feature that shapes the market access of a prefecture. Historically, the construction of the Grand Canal exemplifies the role of the state in providing infrastructure that facilitates economic development. In 1992, when the central government decided to construct the national expressway network, the official objective was “to connect all provincial capitals and all cities with a population of at least 500,000” (Faber, 2014).

Transportation networks have experienced great changes across regimes for two reasons. First, it is costly to maintain routes. Many land routes disappear due to a lack of maintenance; for example, several parts of the Grand Canal were in severe disrepair for a long period (Brook, 1998). Second, when a regime replaces its predecessor, the ruler decides which parts of the transportation networks will be reconstructed, depending on the prefecture’s relative importance in the political hierarchy. Even if some of the old routes are kept, a prefecture’s centrality in the network is altered by the reconnected or newly built routes. Accordingly, the regime changes in China provide us with a rare opportunity to systematically investigate changes in transportation networks. As we show next, transportation networks are endogenous to political hierarchy, and this property underlies their changes over time.

The Grand Canal comprises historical transportation networks, which connected various waterways, and a state courier system, which was supported by many post offices. Both systems were designed by the central government. A transportation network has a primarily political aim: to maintain an adequate flow of the information, revenues, and personnel on which the state relies (Brook, 1998). Historically, commoners have also been allowed to use these routes (Zang, 1997). Thus, by facilitating the movement of goods and people, these networks have contributed to economic development. Modern transportation is much more complicated than

its historical counterpart. We focus on railroad networks because they comprise a state-owned monopoly.

To trace how transportation networks evolve over time, we digitize roads and waterway maps corresponding to three historical periods (represented by specific years)—the Song (1078), Ming (1587), and Qing (1820) dynasties—and a railroad map from the People’s Republic (1990).<sup>23</sup> See appendix E.1 for the maps by regime.

To account for the relative importance of different links in the transportation network, we apply a centrality measure used in the literature; this is defined for each prefecture  $i$  as

$$\begin{aligned} \text{Centrality}_i &= \sum_{j \neq i} \frac{1}{d_{i,j}} \\ &= \sum_{j \neq i} \frac{1}{d_{i,N_i} + d_{j,N_j} + (1/\theta)d_{N_i,N_j}}, \end{aligned} \quad (8)$$

where  $d_{i,j}$  indicates the shortest distance between  $i$  and  $j$  in a transportation network. The distances can also be weighted by population to obtain a measure similar to market access (for further discussion, see Donaldson & Hornbeck, 2016). Here, we focus on the unweighted measure to highlight a region’s position in a transportation network.

In practice,  $d_{i,j}$  comprises three parts:  $d_{i,N_i}$  and  $d_{j,N_j}$  indicate the straight-line distances from prefecture  $i$  and prefecture  $j$  to the network, respectively (points  $N_i$  and  $N_j$ , respectively);  $d_{N_i,N_j}$  indicates the minimum distance between point  $N_i$  and point  $N_j$  within the network. Following the literature, we allow an adjustment factor of 1.5 between the shortest straight-line distance and the kilometers traveled and assume that the transportation cost is four times higher without the network, that is,  $\theta$  takes a value of 6. As in the literature, our results are not sensitive to the choice of  $\theta$ .

A prefecture’s centrality in a transportation network is somewhat persistent. However, we aim to test whether changes in capital status lead to changes in spatial centrality. Similar to our analysis of public employment, we first examine the relationship between capital status and centrality in each regime. Then we use the rank of centrality as a dependent variable to build a panel data set with which to study the impact of a change in capital status. Again, a higher rank value indicates lower centrality.

As shown in columns 1 to 4 of table 6, in each regime, provincial capital status is strongly associated with higher centrality. Columns 5 and 6 report the DID and IV estimates. Again, a change in provincial capital status is strongly correlated with a change in spatial centrality rank. These coefficients suggest that the importance of provincial capital status is comparable to moving from an average prefecture rank to a rank within the top 60–40 in terms of centrality.

<sup>22</sup>Utilizing the relocation of the German federal government from Berlin to Bonn in the wake of the World War II, for example, Becker et al. (2018) find that Bonn experienced a substantial increase in public employment but only modest increases in private sector employment. Using English data at the local authority level for 2003–2007, Faggio and Overman (2014) find that public sector employment has no identifiable effect on total private sector employment.

<sup>23</sup>The historical maps are collected in the *Historical Atlas of China* (Cheng & Hsu, 1980), which covers the major routes in different periods. The railroad map in 1990 is obtained from CHGIS (2007).

TABLE 6.—PROVINCIAL CAPITAL STATUS AND SPATIAL CENTRALITY

	(1)	(2)	(3)	(4)	(5)	(6)
	Centrality				lnrank in centrality	
	1078	1580	1776	1990	IV	
Prov. capital	0.401*** (0.076)	0.575*** (0.099)	0.486*** (0.098)	0.513*** (0.150)	-0.149** (0.066)	-0.669** (0.322)
Controls	Y	Y	Y	Y	Y	Y
Year FE × Controls					Y	Y
Pref. FE					Y	Y
Year FE					Y	Y
Observations	261	261	261	261	1,044	1,044
R-squared	0.778	0.685	0.764	0.624	0.401	0.354
# prefectures	261	261	261	261	261	261
First-stage <i>F</i> -statistic						35.0

This table shows that provincial capital status affects the spatial centrality of a prefecture. Columns 1 to 4 present cross-sectional results across four regimes; Columns 5 and 6 employ the panel structure by using lnRank in centrality as the dependent variable; the negative coefficients indicate climbing up the ladder of centrality.

Controls include (i) geography variables: log area, whether a prefecture contains a plain, a major river, whether it is on the coast, as well as its slope, elevation, longitude, and latitude; (ii) agriculture variables: the suitability of rice, wheat, millet, sweet potatoes and maize; and (iii) the nine physiographic macroregions defined by Skinner (1977) (mapped in figure B2).

Standard errors presented in the parentheses are clustered at the prefecture level. \*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%.

One may wonder whether the selection of a capital depends on its level of access to a recently improved transportation network. Historically, capital status changes occurred in the early periods of dynasties (almost immediately after the foundation), whereas transportation networks were reconstructed after the government had accumulated more resources. Empirically, we examine the pretrends in transportation centrality and observe no significant differences before a capital status change. Following the literature on market access, we calculate market access while considering topography and similarly find no pretrends in terms of market access. These results are discussed in appendix E.2.

*Heterogeneous effects and spatial spillovers.* Our findings regarding changes in transportation networks have implications in terms of heterogeneous effects and spatial spillovers. First, a change in economic development in response to a change in provincial capital status may vary by the position of the prefecture in the transportation network. Therefore, we examine the impact of provincial capital status on population by the lagged centrality of a prefecture. We find that provincial status has a larger impact on prefectures with a lower (lagged) centrality (i.e., a higher value of the rank). In other words, politics appears to be more crucial for prefectures with lower positions in the transportation network (panel A of table 7).

Second, the neighboring prefectures of the provincial capitals benefit by gaining better market access, especially if they connect provincial capitals to national capitals.<sup>24</sup> To check this spatial spillover, we divide the neighboring prefectures into two groups: (a) those that connect the provincial capital to the national capital and (b) others. We find that both groups benefit and that the impact on the former group is twice that on the latter group (panel B of table 7). This result suggests that our main finding on changes in population in re-

sponse to changes in capital status cannot be fully explained by a displacement effect, which would tend to predict that neighboring prefectures would lose population to the capital prefecture.

In summary, we find that political hierarchy shapes economic development not only via public employment but also via important infrastructure, such as transportation networks.

### C. A Counterfactual Scenario of Political Decentralization

Because market access is shaped by transportation networks, our findings have implications for provincial market access. In particular, what would happen if a provincial capital were set up without following the political logic documented in section III? Recall that the choice of provincial capital location reflects the logic of a centralized state that considers both provincial autonomy and central control. Our political economy counterfactual of interest is a decentralized scenario affected by only provincial autonomy. Therefore, we conduct a simple analysis by comparing provincial market access in the current political system with that in a scenario in which provincial capitals are set in the provincial centroids. In this exercise, we assume that all prefectures in a province can still reach the other provinces and the only change is the position of the provincial capital.

We define the national market access of prefecture  $i$  in province  $p$  at time  $t$  as  $MA_{pi,t} = \sum_{j \neq pi} \frac{M_{j,t}}{d_{pi,j,t}}$ , where the market size ( $M_j, t$ ) is measured by its population. For the provincial level measure ( $MA_{p,t}$ ), we use the average market access of all prefectures in a province  $p$ , namely,  $\sum_i MA_{pi,t}/N$ , in which  $N$  is the total number of prefectures in the province. We then examine how the deviation of the provincial capital from the provincial centroid affects provincial market access. We find that if the provincial capital is located 100 kilometers from the provincial centroid, the provincial aggregate market access declines by 8.6% (appendix E.3). In our data, the average deviation is 125 kilometers, suggesting that on average, provincial aggregate market access could be 10.8% higher.

<sup>24</sup>This exercise is similar to the research of Morten and Oliveira (2018), who study how an exogenous shock to highways due to relocating the national capital to Brasilia reduced trade and migration costs.

TABLE 7.—HETEROGENEITY AND SPATIAL SPILLOVER

	(1)	(2)	(3)
A. Heterogeneity by centrality	lnPop. den	ΔlnPop. den	ΔlnPop. den
Prov. capital	0.627*** (0.141)		
Prov. capital × lnRank in centrality (lagged)	0.108** (0.046)		
ΔProv. capital		0.548*** (0.147)	
ΔProv. capital × lnRank in centrality (lagged)		0.239** (0.097)	
Gaining capital status			0.726** (0.324)
Losing capital status			-0.491*** (0.170)
Gaining capital status × lnRank in centrality (lagged)			0.226* (0.116)
Losing capital status × lnRank in centrality (lagged)			-0.262* (0.146)
lnRank in centrality (lagged)	-0.064** (0.029)	0.089* (0.050)	0.091* (0.051)
All controls	Y	Y	Y
Observations	1,012	1,012	1,012
B. Spatial spillover	lnPop. den	lnPop. den	ΔlnPop. den
Prov. capital	0.473*** (0.106)	0.469*** (0.105)	
Neighbor	0.166* (0.086)		
Neighbor × Connecting natl. capital		0.265** (0.123)	
Neighbor × Others		0.144* (0.087)	
Gaining capital status			0.560** (0.221)
Losing capital status			-0.391*** (0.115)
Gaining neighbor status (connecting natl. capital)			0.362** (0.150)
Losing neighbor status (connecting natl. capital)			-0.281** (0.117)
Gaining neighbor status (others)			0.177* (0.101)
Losing neighbor status (others)			-0.120 (0.094)
All controls	Y	Y	Y
Observations	2,871	2,871	2,610

A higher value of rank indicates centrality. All controls in the previous tables are included. Standard errors are clustered at the prefecture level. \*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%.

## VII. Conclusion

Administrative hierarchy is a complex issue, and it is difficult to find a suitable empirical setting to investigate its underlying logic and evaluate its consequences. In this study, we take advantage of China's unique historical and political setting to show how political hierarchy shaped national spatial development over a millennium. The mapping of political hierarchy to economic hierarchy remains obvious today: in 25 of 27 provinces, the provincial capital is the largest city in the province.

Broadly, our study reveals the importance of politics as a determinant of economic geography. Underlying our findings is a strong, centralized state that provides important public goods, such as transportation, that facilitate changes in the locations of economic activity. However, a strong centralized

state also can be costly. We do not observe that economic advantages persist several decades after a prefecture loses its political status. In addition, a more decentralized approach to selecting administrative centers may increase regional market access. These findings highlight the cost side of a centralized political system.

Economists have made considerable progress in understanding the persistence of economic activities, and scholars have observed many changes in this area over the long run. Our findings suggest that introducing the role of the state to this body of work may increase understanding of both persistence and changes. Admittedly, China is a special case, as the state has had both the capacity and the incentive to redefine administrative landscapes across regimes, leading to changes in the spatial distribution of economic activities. When

applying what we have learned in this setting to other contexts, it would be worthwhile to consider both the capacity and the incentives of the state.

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