# Long Live *Keju*! The Persistent Effects of China's Civil Examination System*

# Short Title: Long Live *Keju*

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October 2019

**Abstract**

China's civil examination system (*keju*), an incredibly long-lived institution, has a persistent impact on human capital outcomes today. Using the variation in the density of *jinshi*—the highest qualification—across 278 Chinese prefectures in the Ming-Qing period (c. 1368-1905) to proxy for this effect, we find that a doubling of *jinshi* per 10,000 population leads to an 8.5% increase in years of schooling in 2010. The persistent effect of *keju* can be attributed to a multitude of channels including cultural transmission, educational infrastructure, social capital, and to a lesser extent political elites.

**Keywords:** Institutions, Civil Exam (*Keju*), Persistence, Cultural Transmission, Human Capital, Social Capital, Political Elites, Inequality, China

**JEL Classification Nos:** N15, O43, Z10

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We thank the editor, Hans-Joachim Voth, and two anonymous referees for helpful comments and suggestions. We also thank Ying Bai, Sascha Becker, Stephen Broadberry, Felipe Valencia Caicedo, Davide Cantoni, Matteo Cervellati, Eric Chaney, Carl-Johan Dalgaard, Melissa Dell, Jeremiah Dittmar, Steven N. Durlauf, Oded Galor, Paola Giuliano, Wolfgang Keller, Yu Hao, Debin Ma, Stelios Michalopolous, Joel Mokyr, Petra Mosher, Nathan Nunn, Omer Ozak, Luigi Pascali, Louis Putterman, Ashraf Quamrul, Paola Sapienza, Carol Shiue, Tuan Hwee Sng, Enrico Spolaore, Nico Voigtländer, David Weil, Noam Yuchtman, Fabrizio Zilibotti, and seminar participants at Aix-Marseille Université, Brown University, University of California—Berkeley, the Chinese University of Hong Kong, University of Colorado at Boulder, Fudan University, Harvard University, Hong Kong University, Jinan University, Kyoto (XVIITH World Economic History Congress), Ludwig-Maximilians-Universität München, Peking University, Nanyang Technological University, National University of Singapore, Saint Petersburg (Second World Congress of Comparative Economics), University of Warwick, and Yale University for helpful comments and suggestions. James Kung is especially grateful to the Yan Ai Foundation for its generous financial support, and Chicheng Ma acknowledges the financial support of the National Natural Science Foundation of China (grant no. 71303135). We are solely responsible for any remaining errors.

# 1. Introduction

Growing evidence suggests that historical institutions can generate long-lasting effects on modern economic development either directly or via the cultural traits they foster (Acemoglu *et al.*, 2001; Dell, 2010; Dell *et al.*, 2018; Guiso *et al.*, 2016; Nunn, 2008; Nunn and Wantchekon, 2011; Voigtländer and Voth, 2012, among others). China's civil exam system or *keju* is one such institution. As the earliest meritocratic institution in the world (since the Song dynasty, c. 960-1276), the civil exam system was aimed at recruiting learned individuals to serve in the bureaucracy.[1] As a scholar attaining the highest qualification in the civil exam, the *jinshi* would be made a scholar-official; a position associated with considerable prestige, and received generous pecuniary rewards. Because of this, *keju* attracted millions of zealous scholars—a fervor intensified by the lack of restrictions placed upon a candidate's social background and age.[2] Over time, the civil exam institution created a distinct group of local elites with deep respect for learning and academic achievements (Russell, 1922)—a 'cultural trait' that has persisted even long after the exam's abolishment.

In this paper, we examine the persistent impact of the civil exam system—an institution of first-order importance in Chinese history—on today's human capital outcomes. Our study is inspired by the strong positive relationship between a prefecture's success in the civil exam as measured by the number of *jinshi* in the Ming and Qing dynasties and human capital outcomes as measured by the years of schooling today (Figure 1).[3] Our specific goals are twofold. First, we attempt to verify whether this relationship is *causal*. Second, and conditional upon proving the causal relationship, we endeavor to identify the various possible channels through which this effect endures to this day,

[1] Evidence to bear upon the meritocratic features of China's civil exam system can be found in the European discourse among the likes of Voltaire, Quesnay, and Christian Wolff, all of whom viewed it as a superior alternative to the traditional European aristocracy in terms of governance (Ford, 1992). For an empirical analysis of the emergence of the Song civil exam system see Chen and Kung (2019).
[2] Women, however, were not allowed to take part in the civil exam.
[3] A prefecture was an administrative unit between the province and the county in imperial China.

including a cultural norm of valuing education, schools or educational infrastructure more generally, social capital via clans and other social organizations, and political elites.

[Figure 1 about here]

Using the number of *jinshi* across the 278 Chinese prefectures (normalized by their population) as a measure of the degree of success in *keju* exam (hereafter *jinshi* density), the baseline ordinary least squares (OLS) result shows that, for every 10,000 people, a doubling of *jinshi* density is associated with an increase in years of schooling in 2010 of 6.9%, which is not small in light of the huge geographic variations in *jinshi* density across historical China. This result is robust to the inclusion of a rich gamut of covariates including a prefecture's economic prosperity both in the Ming-Qing period (population density, urbanization rate, and agricultural suitability) and today (using nighttime lights in 2010 as proxy), and not the least geography (terrain ruggedness and distance to coast); all with province fixed effects.

The variation in *jinshi* density in the Ming-Qing period across the Chinese prefectures is clearly subject to many endogenous forces, with omitted variable bias being our primary concerns. To address these issues, we construct an instrumental variable using a prefecture's shortest river distance to its nearest sites of pine and bamboo—the two key ingredients required for producing ink and paper in woodblock printing.[4] Distance to these two raw ingredients is important because textbooks and exam aids (reference books), which contain nuanced, authoritative interpretations of the Confucian classics, were crucial to *keju* exam success. We further show that our instrumental variable is orthogonal to a host of measures of historical economic prosperity, agricultural suitability, geography, and nighttime lights in 2010, and demonstrate that the locations of pine and bamboo forests, as natural habitats, are exogenous. The two-stage least squares (2SLS) regressions produce an estimate consistent with that of the OLS but with a somewhat larger estimate (by about 23%). This time a doubling of the number of *jinshi* (per 10,000 people) is associated with an 8.5%

[4] Our instrument thus takes the average of the two (river) distances to a prefecture's nearest available pine and bamboo locations.

increase in the average years of schooling today. This implies that an additional *jinshi* per 10,000 people leads to an increase in schooling of 0.74 years when evaluated at the mean of 8.712.[5]

In accounting for the persistent impact of the civil exam we first test the hypothesis that the exam had bred a culture of valuing education which was internalized by at least the educated elite families (and accordingly transmitted across generations). To do so we take advantage of a nationally representative social survey, the 2010 Chinese Family Panel Survey (CFPS), and construct variables to measure the effect of the respondents' ancestral achievements in the *jinshi* exam on their attitudes toward the importance of learning and education as a determinant of social status. After controlling for both genetic and cultural transmission of family human capital (as measured by various IQ test scores, years of education, and income), we find that ancestral *jinshi* density (measured separately along the patrilineal and matrilineal lines) has a significantly positive effect on the offspring's attitude toward the importance of education in determining social status. Moreover, these respondents also want the government to spend more on education. Those respondents who were parents expected their children to receive more education in general, and devoted more time to supervising their children's homework (by, for example, watching less TV themselves). Perhaps because of this stronger parental ethic, their children performed better in class, had lower rates of absenteeism, and spent more time studying. All of these augur well with the hypothesis regarding the transmission of a culture of valuing education within families.

Even if our instrument is valid for identifying the causal effect of historical *jinshi*, chances are it would have missed the other possible channels. The reason is that prefectures with stronger exam achievements were likely correlated with the funding of better schools or educational infrastructure more generally, better organized in their provision of local public goods, and more capable of

[5] According to the United Nations, the difference in the years of schooling between the low- and middle-income countries in 2010 was a mere 1.4 years, yet they differ in annual income by more than three times (2,109 versus 6,452 USD).

producing a class of political elites, all of which affected the incentives to acquire education. It is thus also our goal to identify these additional channels.

First, to the extent that success in the civil exam depended on the quality and quantity of schools, teachers, and books, and that prefectures with greater success in the civil exam historically would be more effective in building a good educational infrastructure, the latter is surely another likely channel of the persistent effect documented here. Indeed, we find that *jinshi* density has a positive effect not just on the number of Confucian academies in the Ming-Qing period, but also on the primary and secondary schools established at the turn of the 20$^{th}$ century, and more significantly on the universities established both before the founding of the People's Republic (in 1947) and in the more recent times (e.g., 2010).

Another obvious channel is social capital. After all, those who passed the *jinshi* exam invariably entered officialdom to join a small group of elites who would likely interact with one another in a variety of social contexts ranging from clan and lineage affairs to charitable organizations (Elman, 2000; McDermott, 1997). As has been well documented, social capital is conducive to public goods provision (Dell *et al.*, 2018; Satyanath *et al.*, 2017). Using mostly historical but also a small amount of contemporary data, we find that *jinshi* density has a significantly positive effect on the strength of clan or lineage organization as measured by the number of genealogy editions (the stronger the clan the more editions). Likewise, a higher *jinshi* density is also found to be associated with a larger number of charitable organizations in 1840, and a variety of social organizations including farmers' associations, labor unions, chambers of commerce, women's associations, educational and student bodies, religious associations, charity organizations, etc., in the survey years of both 1935 and 2008. All of these speak to the possible existence of a social capital channel.

By virtue of their entry into officialdom upon exam success the *jinshi* were also political elites. As many of them would return to their hometowns and invest in the educational infrastructure, they

perpetuated the success of their descendants. Using data on three different periods in Chinese history, we find that *jinshi* density has a significantly positive effect on the number of high-ranking officials in both the late Qing and Republican eras, suggesting the persistence also of a political capital channel. But this effect vanished when China turned to communism and the political elites were no longer confined to those coming from a literati background, thereby ending the transmission.

In the light of these multiple channels and the possibility of their widening the inequality gaps via unequal access to education, we go beyond the persistent effect of the civil exam institution on educational attainment by examining also its effect on socioeconomic inequality over the long run. Using survey evidence, we find that *jinshi* density actually has a significantly negative effect on socioeconomic inequality between children and their parents' generation in terms of years of schooling and income. Presumably because a stronger local *keju* culture has had the virtuous effect of encouraging competition in a prefecture, the same institution is rendered more 'inclusive' in that prefecture than in ones where the same cultural trait is not as strong.[6]

By examining the persistent impact of a hugely important Chinese institution on human capital outcomes today, our study contributes to, but in fact goes beyond, the literature that identifies important patterns of cultural persistence stemming from variations in historical institutions (e.g., Alesina and Fuchs-Schündeln, 2007; Dell *et al.*, 2018; Guiso *et al.*, 2016), as well as to the literature that delves into the historical origin of cultural traits and their persistence (e.g., Alesina *et al.*, 2013; Becker *et al.*, 2016; Grosjean, 2014; Nunn and Wantchekon, 2011; Voigtländer and Voth, 2012). That is, instead of focusing solely on the cultural channel (as Guiso *et al.*'s [2016] have done in an excellent manner) but in a different historical context, we went further to identify a number of additional mechanisms that might also explain the observed persistence in question.

[6] We borrow the term 'inclusive' from Acemoglu and Robinson (2012).

Our claim of a contribution notwithstanding, this study does have a major limitation. As our causal link between the civil exam institution and its attendant cultural trait of valuing education is drawn from the regional variation in civil exam success, and because both the cause and the effect are most salient at the national level, our findings—while robust—cannot be established as direct evidence to bear upon how the civil exam system affected China *as a whole*.[7]

The remainder of this paper proceeds as follows. The next section (Section 2) provides a historical background on the civil exam in the context of late imperial China. In Section 3 we examine the persistent effect of *keju* on years of schooling today, whereas in Section 4 we identify the causal effect of *keju* using an instrumental variable approach. Section 5 goes beyond the cultural transmission channel and examines a number of mechanisms through which the long-defunct *keju* has impacted on contemporary human capital outcomes, whereas Section 6 examines *keju*'s effect on socioeconomic inequality over the long run. Section 7 offers a conclusion.

## 2. Historical Context

### 2.1. Civil Exam Success in Late Imperial China

Even though *keju* was already consolidated in the Song dynasty (c. 960-1276), it was held sparingly by the Mongols in the Yuan dynasty (a mere 16 times), hence the civil exam system did not become fully institutionalized until the Ming dynasty (c. 1368-1643) when the Han resumed sovereignty. The system then lasted until 1905—a few years before the last imperial rule (the Qing dynasty, c. 1644-1911) came to an end.

China's civil exam consisted of three levels. At the entry level was the prefectural exam, success in which led to the qualification of a *shengyuan*. The next level up was the provincial exam, which only the qualified *shengyuan* (earned by passing a qualifying exam) were eligible to take. In the fortunate event that they passed they were awarded a *juren*. Finally, only those with a *juren*

[7] We thank an anonymous referee for this insight.

qualification could take the *jinshi* exam—the final stage of the civil exam. *Jinshi* holders were guaranteed a position in mid-to-high-level government administration and, as such became a *mandarin*—the envy of many.[8] Figure A1 in Appendix A summarizes the hierarchy of China's civil exam.

Regardless of its level China's civil exam was essentially regulated by a quota system. At the lowest level, the *shengyuan* quota was apportioned to the counties and prefectures on the basis of: (1) the size of the county or prefecture official school, (2) population size, (3) tax obligations, and (4) past exam achievements (Chang, 1955). Essentially the Qing dynasty inherited the s*hengyuan* quota distribution from the Ming dynasty, with the Qing Emperor Kangxi making only minor adjustments to it in 1670 after which it remained unchanged for some time. It was only after the 1850s, when, in an attempt to encourage the regional governments to help suppress the Taiping rebels (c. 1850-1864), that Emperor Xianfeng increased the quota to those who contributed (Chang, 1955). While there were also quotas for the *juren* and *jinshi*, unlike the *shengyuan* they were apportioned to the provinces, which, as with the case of the *shengyuan* had also changed little over time (Shang, 2004). As the quota system was strictly determined by the abovementioned factors and, in view of their stability over most of the Ming-Qing period, it was unlikely that a province or prefecture lobbied for more quota.

China's civil exam had three distinct characteristics. Foremost was its *openness*. *Keju* was open to all males regardless of social background. This means that a 'commoner'—someone whose ancestors had never passed even the lowest level of the exam—was eligible to sit for the civil exam

[8] For instance, Ho (1962) shows that, from the Ming dynasty onwards the *jinshi* qualification 'automatically placed a person in the *middle* stratum of the officialdom' (p. 26 and p. 120), whereas the *juren* could only be placed 'in the posts of county magistrates, directors and subdirectors of schools (at the prefectural and county levels), and other comparable offices' (p. 27). By middle stratum Ho (1962) refers to appointments ranked between fourth and sixth out of nine ranks, whereas magistrates and school directors at the county level typically commensurate with ranks seventh to ninth.

so long as he passed each level of the exam in the established sequence.[9] Ping-ti Ho, an eminent historian of China, indeed finds that in the Qing dynasty as many as 45.1% of *juren* and 37.2% of *jinshi* came from a commoner background (Ho, 1962, pp. 114-16).[10]

Second, *keju* was relatively free of corruption. For instance, to prevent examiners from recognizing a particular candidate through his handwriting, all exam scripts were hand copied first and graded by as many as eight examiners who were oblivious to the identity of the candidates (the candidates' names were concealed). Moreover, the examiners would be removed from office if they were found to have favored a particular candidate in their grading, or even faced a possible death penalty if this occurred in the final stage of the exam (Shang, 2004). The severity of the penalty is likely powerful enough to deter corruption.

Last but not least, given that one was also allowed to take the exam repeatedly (in addition to its openness), China's civil exam system was extremely competitive. Passing rates for the *shengyuan*, for example, are estimated at only 1-1.5% (Ji, 2006), whereas those for the *juren* and *jinshi* were about 6% and 17.7%, respectively.[11] Hence, in the mid-Qing the chances that someone attempting the *shengyuan* exam would eventually become a *juren* and *jinshi* were a mere 0.09% (1.5% * 6%) and 0.016% (1.5% * 6% * 17.7%), respectively—very slim indeed! Moreover, competition had intensified over time, thanks to the explosive growth in population from approximately 110 million in the Ming to 400 million in the Qing (Ho, 1962; Kuhn, 1978).[12]

[9] Thanks to its openness and positive public perceptions, at least two million men (about 2.5% of the male population aged between 15 and 49 in the mid-Qing era) registered for each prefecture-level exam, with a total quota for each exam of around 30,000 (Bai and Jia, 2016, pp.684-5). Another estimate has put the total number of literati (*dushu ren*) at around 20 million, roughly 5% of the total population in mid-Qing (Ji, 2006).

[10] The extent to which social mobility was actually achieved under the civil exam system is a subject of intense debate, with some scholars arguing that only those from 'literati or merchant families, lineages or clans with sufficient linguistic and cultural resources' were able to compete and succeed in the civil exam (Elman, 2000, p.249). Here we refrain from joining this debate but instead focus on the fact that social mobility, however small its chance may be, was indeed feasible.

[11] At each exam about 1,241 *juren* would be selected out of 20,600 *shengyuan*, and about 220 *jinshi* would be selected out of 1,250 *juren* (calculated based on our own data).

[12] The percentages of candidates who obtained the *shengyuan*, *juren* and *jinshi* qualifications in the early Qing were 5%, 0.3% and 0.053%, respectively (Ji, 2006).

### 2.2. Rewards for the *Jinshi*

Under the lasting influence of Confucianism the officials (*shi*) in imperial China were held in the highest regard, and civil exam was the only road to officialdom for commoners.[13] While made up only 2% of the population, the civil exam scholars accounted for almost a quarter (24%) of the nation's income (Chang, 1962). This explains why their salaried income was about 16 times that of a commoner. But in reality the difference was so much greater, as salaries accounted for but a tiny portion of exam scholars' actual incomes. For instance, many were found to have invested in a variety of businesses like real estate, banks, jewelry shops, and even the monopoly trade of salt. Thus, the *jinshi* was, for the majority, the ultimate qualification to achieve.

In addition to the lucrative economic rewards that came their way as a learned class, additional motivation may also come from the vanity of holding a degree and the variety of ritualistic recognitions by the community and the nation at large. For instance, the name of a *jinshi* would be recorded in the local gazetteer, carved on the monument of the local school and even the Confucian Temple in the national capital, and arches, gateways and temples would be erected in his name (Ho, 1962). For all these reasons, incentives were strong for one to climb the social ladder in late imperial Chinese society and the civil exam provided just such a possibility.[14] These extraordinary returns to the *jinshi* qualification for as long as nearly 600 years have most likely fostered a culture of valuing education among the Chinese over time. The desire to succeed in the civil exam was so strong that preparation for it began at the tender age of 6-7 years old, when children were made to recite no less than 2,000 characters from the *San Zi Jing* (Three Character Primer)—an ancient Confucian textbook for children—after just one year of study (Rawski, 1979).

[13] The social hierarchy which existed back then consisted of the *shi* (officials) at the very top, followed by the *nong* (farmers), the *gong* (artisans), and the *shang* (merchants) in that order.
[14] They were so strong that even rich merchants would allegedly send their sons to 'enter the civil examination and to rise high in the bureaucracy' (Needham, 1969, p. 202).

# 3. The Relationship between *Keju* and Contemporary Human Capital Outcomes

## 3.1. The Empirical Setup

To examine whether *keju* has had a long-term effect on contemporary human capital outcomes we begin with our baseline estimate of the following specification:

$$y_i = \beta keju_i + \gamma_1 \mathbf{X}_i^c + \gamma_2 \mathbf{X}_i^h + \alpha_p + \varepsilon_i \qquad (1)$$

where *i* indexes a prefecture; the dependent variable $y_i$ stands for the contemporary human capital measure constructed from the 2010 population census, namely average years of schooling measured at the prefecture level and raised to the natural log. We choose the prefecture as our unit of analysis simply so that we can observe the rich variations that existed within a single province. $\alpha_p$ denotes province fixed effects.

Our key explanatory variable of interest is $keju_i$, which is a measure of the degree of success in civil exams of prefecture *i* in the Ming and Qing dynasties. Specifically, we measure a prefecture's success in the *keju* exam by the total number of candidates who obtained the *jinshi* degree in that prefecture during the entire Ming-Qing period (c. 1371-1905). We choose Ming-Qing period because *keju* did not become fully stable and institutionalized until then (Ho, 1962). It is thus more likely for the cultural norm of valuing education to have received the strongest boost from Ming onwards.

While the civil exam consisted of three levels, we choose *jinshi* as our primary measure of *keju* because it was the highest attainment and hence its influence would be the most far-reaching (Chang, 1955; Ho, 1962). But we will check the robustness of our results using data on the density of *juren*—the next qualification down.

The *jinshi* data are obtained from Zhu and Xie's (1980) *Ming-Qing Jinshi Timing Beilu Suoyin* (Official Directory of Ming-Qing Civil Exam Graduates). Enumerating such information as the names and birthplaces of *jinshi*, and the places of examination (in the event it differed from the

birthplace), the Directory contains a complete list of all the 46,908 *jinshi* who sat a combined 242 civil exams that took place between 1371 and 1904 (a period of just over 500 years) across 278 Chinese historical prefectures, which correspond to 272 municipalities in today's China.[15]

As some prefectures were more sizeable than others, we normalize the number of *jinshi* by the prefecture population (in unit of 10,000) based on data compiled by Shuji Cao (2000, 2015)—the only Chinese historian to have provided population data at the prefecture level for various time points spanning both the Ming and Qing dynasties.[16] To reduce skewness we also raise the number of *jinshi* density to the natural log. To avoid losing observations with a value of zero, we add 1 to the number of *jinshi*, i.e., ln(1+*jinshi*/population). Figure A2 in Appendix B shows the geographic distribution of the *jinshi*, *juren*, and *shengyuan* quota density in the 278 historical prefectures.

### 3.2. Baseline Controls

It is necessary to control for a number of covariates that are likely to impact upon the years of schooling today. We classify them into two categories. The first is a vector of baseline control variables, denoted by $\mathbf{X}_i^c$, in equation (1).

*Nighttime Lights.* We control for contemporary economic prosperity as measured by the average satellite light density at nighttime in 2010 at the prefectural level (Henderson *et al*., 2012).[17]

*Geography.* We also control for several key features of geography, most notably distance to coast and terrain ruggedness. Distance to coast is important because prefectures located on the coast were likely early beneficiaries of Western technology, knowledge and trade, whereas terrain

[15] Our sample excludes a small number of the ethnic Manchu and Mongols (accounting for 2.8% of the *jinshi* in our full sample), as they were exempted from directly competing with the Han in the civil exam.
[16] The data points of population in Cao (2000, 2015) are 1391 (Ming), 1580 (Ming), 1776, 1820, 1851, 1880, and 1910. We normalize the number of *jinshi* in each prefecture by taking the average of these seven data points. For robustness, we also normalize the number of *jinshi* by a prefecture's land area (per 10,000 km$^2$) and use the actual number of *jinshi* as alternative measures. Both yield similar results (not reported) to the *jinshi*/population measure.
[17] The actual data are obtained from the Global DMSP-OLS Nighttime Lights provided by the Earth Observation Groups in the National Centers for Environmental Information.

ruggedness can have a profoundly lasting effect on long-term economic development either through its direct impact or through its interaction with key historical events (Nunn and Puga, 2012). Distance to the coast is measured as the distance between a prefecture's centroid to the closest point on the coast, whereas an index of terrain ruggedness is constructed by calculating the difference in elevation between adjacent cell grids using data provided by the United States Geographic Service (USGS).[18]

*Province Fixed Effects.* To control for the effect of the provincial quotas of *jinshi* (and other unobserved effects associated with the provinces) on *jinshi* density, we include provincial dummies in the regressions.

### 3.3. Historical Correlates

In addition, it is also necessary to control for another vector of historical variables, $\mathbf{X}_i^h$, which are likely correlated with *jinshi* density while also bearing upon contemporary human capital outcomes. For conceptual clarity we divide these controls into two separate dimensions, namely historical economic prosperity (population density, urbanization, and agricultural suitability) and migration.

*Historical Economic Prosperity.* Typically, a prefecture that was more prosperous was also likely to produce more *jinshi*. In the absence of reliable GDP figures, we follow Paul Bairoch (1988) by employing population density and urbanization rate as proxies for local economic prosperity. We employ the average population density between 1393 and 1910 and the average share of the urban population between 1393 and 1920 as proxies covering the entire period for which the *jinshi* variable is constructed. The data on population density and urbanization are obtained from Cao (2000, 2015).

[18] The Digital Elevation Model (DEM) is typically spaced at the 90 square-meter cell grids across the entire surface of the earth on a geographically projected map.

Given that China was still predominantly an agricultural economy in the Ming-Qing period, we estimate a prefecture's prosperity using its potential agricultural productivity (specifically yields of crops suitable for cultivation after 1500) based on the Caloric Suitability Indices developed by Galor and Ozak (2016).[19]

*Regional Migration.* By diffusing knowledge and stimulating competition with the native residents, immigrants can affect development (Abramitzky *et al.*, 2014). In the historical Chinese context, migration may affect development if prefectures with a proven track record in civil exams attracted candidates to migrate to these places. To control for this possible effect we exclude from our analysis the 1,370 *jinshi* whose birthplace was different from the place of examination—a mere 2.65% of our overall sample of 46,908.[20]

The sources and descriptive statistics of all the variables are summarized in Table 1. In addition, to deal with the potential within-province correlation of the error term, we cluster the standard errors at the province level for all specifications.

[Table 1 about here]

### 3.4. Baseline Results

The baseline results are reported in Table 2. We begin by using the number of *jinshi* normalized by a prefecture's population (*jinshi* density) as our key independent variable. To provide a benchmark we only control for province fixed effects in column (1), before we fully control for the baseline covariates in column (2). In both cases, *jinshi* has a highly significant (at the 1% level) and positive effect on years of schooling. In column (3) we control for historical economic prosperity, and find that *jinshi* density remains highly significant. In column (4), we control for historical migration by excluding the 1,370 *jinshi* migrants and find that *jinshi* density remains highly significant. The

[19] Obtained from https://ozak.github.io/Caloric-Suitability-Index/.
[20] This information is available in the *Ming-Qing Jinshi Timing Beilu Suoyin* —the same source that informs our key independent variable.

result of column (3) suggests that, for every 10,000 people, a doubling of *jinshi* density in the Ming-Qing period corresponds to an increase of 6.9% in average years of schooling today, which is translated into a marginal effect of 0.6 years when evaluated at the mean of 8.712, a non-negligible magnitude given the skewed distribution of *jinshi* density.

[Table 2 about here]

As *jinshi* was the highest attainable qualification in the civil exam, it should have a greater impact on higher levels of educational attainment today. To verify this, we divide China's population into four distinct levels of educational achievement in 2010: 'no education', 'elementary and secondary school', 'high school', and 'university and above'. Reported in columns (5)-(8) of Table 2, *jinshi* density has a significantly negative effect on the share of population with an educational attainment below high school (columns (5)-(6)), but a positive effect otherwise. The much larger coefficient of the latter suggests that the persistent effect of *keju* culture is strongest on university education.

Regressions of this nature may create concerns that the error terms among adjacent prefectures are correlated with each other, such that the observed long-term effect of *jinshi* density on years of schooling may be driven by the spatial autocorrelation in the residuals. The standard approach to deal with this type of concern is to employ the Conley (1999) standard errors adjusted for two-dimensional spatial autocorrelation (reported in brackets), in addition to clustering the standard errors at the province level (in parentheses). We find that the Conley standard errors do not change the long-term effect of the *jinshi* density on years of schooling. However, as Kelly (2019) recently points out, the Conley adjustments in most persistence studies are unable to 'increase the standard error materially' (p. 14). To test whether the observed long-term persistence effect is likely driven by spatial 'noise', we follow the two-step procedure developed by Kelly (2019). First, we conduct a Moran test for spatial autocorrelation among the regression residuals in Table 2. We then simulate a set of spatial noise variables in place of years of schooling and *jinshi* density—the two key

variables of interest—to assess the probability that the simulated noise variables account for the significance of our actual variables of interest. Reported in Table A1 in Appendix C, the results show that after controlling for provincial fixed effects, there is no spatial autocorrelation in the residuals as indicated by the insignificance of Moran's I-statistic. Consistently, probability is low that spatial noise has significant explanatory power for years of schooling and *jinshi* density—our two key variables of interest.

Geographically, the prosperous Yangtze River Delta region was where disproportionately more *jinshi* were produced, so one may be concerned that the persistence we observe was driven primarily by this region. To allay this concern, we exclude the 30 prefectures located along the Yangtze River. Reported in Table A2 in Appendix D, the effect of historical *jinshi* density in this subsample is similarly robust and consistent with the findings in Table 2.

A concern may be raised over our *jinshi* measure, whose average for the entire Ming-Qing period is invariant for more than 500 years, but over which time the importance of *jinshi* may have actually changed. To find out, we divide the total number of *jinshi* based on a 50-year interval and regress the average years of schooling on *jinshi* in each of these periods. Reporting the pertinent coefficients in Figure 2, we do find considerable variations in the effects of *jinshi* over the Ming-Qing period. On the whole, while small before the 17$^{th}$ century, the effect of *jinshi* was already significant and rising throughout the entire Ming dynasty, before it became even more salient during the early-to-mid-Qing prior to its eventual decline towards the end of the Qing dynasty when the regime faced both foreign invasions and domestic conflicts of epic proportions.

[Figure 2 about here]

### 3.5. Robustness Check of *Jinshi* as a Measure of *Keju* Culture

The above estimates may trigger several concerns, however. The first is whether *jinshi* is an appropriate measure of *keju* culture, given that there were only 46,908 over a lengthy period of 540

years, or a historical density of just 1.034 per 10,000 people. But the knowledge elite who played a pivotal role in adopting the new technologies during the Industrial Revolution was also a tiny proportion of the overall population (Mokyr, 2009; Squicciarini and Voigtländer, 2015). Regardless, to ensure that *jinshi* is a robust measure we employ the total number of *juren* degree holders as a check. Compiled from various provincial gazetteers, altogether we have identified 264,346 *juren* degree holders spanning 278 Chinese prefectures over the Ming and Qing dynasties.[21]

Likewise, we could also use *shengyuan* for the same purpose. However, unlike *jinshi* and *juren*, the number of *shengyuan* represented essentially *quotas* apportioned to prefectures and counties primarily for the purpose of maintaining social stability, and thus it remained invariant over time (Bai and Jia, 2016). The entire *shengyuan* quota for the Qing dynasty was approximately 2.5 million (Chang, 1955) and the estimated quota for the entire Ming-Qing period was roughly 4.20 million (20,800 *shengyuan* candidates*202 exams). As with *jinshi* we normalize the *juren* and *shengyuan* quota density measures by the prefecture's population.

Table 3 reports the results of employing alternative measures of *keju* success. Columns (1) and (2) report the results of using *juren* and *shengyuan* quota densities, respectively.[22] The results clearly reveal that *shengyuan* quota has no significant effect on today's schooling but *juren* does. We then put our *jinshi* density measure back along with *juren* density in column (3), and find that the latter is no longer significant. Finally, we add all three measures in column (4) to perform a 'horserace'. Again, only *jinshi* remains significant (and at the 1% level). To check robustness, we

[21] The *juren* data for four out of the 18 provinces failed to cover the entire Ming-Qing period (Guangdong, Shanxi, Gansu, and Henan). For these provinces, we used the method of linear interpolation to estimate the total number of *juren*. To ensure robustness we also ran regressions by excluding these four provinces and the results (not reported) are strikingly similar to those of the full sample.

[22] Located in the remote areas of the peripheral southwestern region, there are four contemporary prefectures for which *shengyuan* quota is equal to zero. For robustness we ran the regressions again without these four prefectures and the results remain the same (hence not reported).

regress the four levels of educational attainment on the various densities of *keju* degree holders as we did in Table 2, and obtain strikingly consistent results (columns (5)-(8)).

[Table 3 about here]

All of these results clearly suggest that, of the three measures of *keju* culture *jinshi* is the most appropriate, possibly because its cultural influences are the most far-reaching.[23] In fact, the results in Table 3 can be verified graphically in Figure A2 in Appendix B. For instance, the geographic distribution of *jinshi* is strikingly similar to that of *juren* (compare Panel A with Panel B), but that of the *shengyuan* quota is not (Panel C); as mentioned earlier the *shengyuan* quota was geographically distributed to maintain social and political stability in those regions—most notably those in the southwest—that traditionally were not a cradle of civil exam success (Ho, 1962).

## 4. Causal Identification

A prefecture's success in *keju* exam was likely associated with a complex myriad of factors. Although we have already controlled for many possible confounding ones, there may still be omitted variables—variables that are simultaneously associated with both historical *jinshi* density and years of schooling today. For instance, prefectures that had produced more *jinshi* may be associated with unobserved (natural or genetic) endowments. To deal with these concerns, we employ an instrumental variable approach.

### 4.1. Distance to the Printing Ingredients (Pine and Bamboo) as the Instrumental Variable of *Keju*

The *Four Books* and the *Five Classics* were the lynchpin of China's civil exam. For one to succeed in it one must not only memorize its contents but be able to demonstrate a solid understanding of the nuanced, authoritative interpretations of these texts. This required not just the availability of

[23] For that reason, we will employ only *jinshi* density as our measure of *keju* culture in the remaining analysis.

the relevant texts but,[24] importantly, also a large cluster of references that explained these nuances and taught the tricks of the eight-legged essay (Ho, 1962; McDermott, 2006).[25] However, the fact that only 19 printing centers were distributed across the 278 prefectures, and that these 19 centers accounted for 80% of the 13,050 texts published during that period (Zhang and Han, 2006),[26] meant that access to reference books varied enormously from one prefecture to another in view of prohibitive overland transport costs.[27]

What then determined the geographic availability of books? To address this question, we turn to the *location* of the two main ingredients required for traditional Chinese (woodblock) printing—pine and bamboo—for clues. From around the 14th century onwards the prevailing printing technology in China relied primarily on pine and bamboo for producing ink and paper (Brokaw, 2007; Tsien, 1987; Zhang and Han, 2006). To economize on transport costs, major printing centers were likely located in close proximity to the pine and bamboo habitats (Figure 3A).[28] For instance, while Tingzhou and Jianning prefectures of Fujian Province did not have their own pine and bamboo forests, the materials could be sourced from the nearby prefectures (Brokaw, 2007), as illustrated in Figure 3B. Against this stylized fact, distance to the nearest pine and bamboo sites would make a reasonable instrument in our case. Moreover, thanks to the well-connected river

[24] County and prefecture schools relied on the central government for copies of the *Four Books* and *Five Classics*, but students had to resort to the private booksellers for their own copies (McDermott, 2006).
[25] *Sishu Jicheng* (Collected Commentaries on the Four Books), for example, was 'an essential text for examination study' (Brokaw, 2007, pp. 97-8). Another popular reference was *Sishu Beizhi* (Full Purport of the Four Books).
[26] Printed books refer to the total number of book catalogues printed in a prefecture during the entire Ming-Qing period. The data are obtained from Du and Du (2001, 2009). The remaining 20% of books were published in nearby localities with the publishers hiring both technical personnel and printing machines from these centers (Zhang and Han, 2006).
[27] To illustrate, the same books in the imperial capital of Beijing fetched 1.7 times higher prices than in the lower Yangtze, and 3.3 times higher prices than in Fujian Province (McDermott, 2006). Even though books could be shipped from the south all the way up to the national capital in the north (*Huzhou Gazetteer*), effectively distributing them posed another obstacle.
[28] Out of the 19 printing centers only two—Hangzhou and Ningbo in southeastern China—had both pine and bamboo habitats in their own prefectures. Of the remaining 17 printing centers, 11 had neither pine nor bamboo; the remaining six had either pine (4) or bamboo (2), but not both. In short, all 17 of them had to rely on other nearby prefectures to supply them with either one if not both of the necessary ingredients for printing.

tributaries in the lower Yangtze delta region, the main ingredients required for making ink and paper were mostly shipped along the river (Figure 3C).[29]

[Figure 3 about here]

Thus the logic behind our instrument is as follows. To the extent that a prefecture's success in the civil exam was closely related to printing or access to books, that the major printing centers were located in close proximity to the pine and bamboo habitats, and that the ingredients required for printing were transported through the main navigable river tributaries, a prefecture's *river* distance to its nearest bamboo and pine habitats would be a feasible variable to instrument the endogenous *jinshi* density.

Information on the geographic locations of pine and bamboo forests is obtained from the *Provincial Gazetteers* (*tongzhi*) compiled during the Ming-Qing period. The publication contains a chapter on the local produce (*wuchan*) which included species of local plants and animals as well as major handicrafts. We consider a prefecture as having a pine and/or bamboo habitat only if it is sufficiently sizeable to be mentioned in the local produce chapter in the *Provincial Gazetteers*. This restricts the number of pine habitats to just 27 and bamboo to 65 among the 278 Ming-Qing prefectures.[30]

Using historical GIS data on the major inland rivers identified by Matsuura (2009) as the ones used for shipping merchandises in Qing China from Harvard CHGIS,[31] we compute a prefecture's shortest river distances to its nearest bamboo and pine forests. We then take the *average* of the two distances as our instrumental variable.

[29] For instance, Yasushi (2014) finds that, after felling the pine trees in the forests the merchants in Huizhou prefecture of Anhui Province shipped their timber to the printing centers along the river tributaries of the lower Yangtze delta. Likewise, in western Fujian Province local merchants 'cut and processed the wood and floated it down the Yin River for sale in Chaozhou, Foshanzhen, and Guangzhou' (p. 43), and 'each boat typically carried thirty 'loads' (dan) of paper (that is, about 30,000 sheets, weighing 1.82 metric tons)' (Brokaw, 2007, p. 116).
[30] While pine and bamboo habitats may also exist in prefectures other than the ones documented in the gazetteers, they were too small for supplying the printing industry.
[31] His sources include historical and government archives, travelers' notes as well as business guide books.

We examine the importance of pine and bamboo for printing and accordingly a prefecture's success in the civil exam in Table 4. We begin by regressing *jinshi* density on the number of printed books first, and find them to be highly significant (columns (1) and (2)).[32] We then examine whether river distance to the two main ingredients for printing is significantly correlated with whether a prefecture had a major printing center (columns (3) and (4)) and the number of printed books (columns (5) and (6)), and confirm their negative and significant relationships. Finally, we show that our instrument is negatively and significantly correlated with *jinshi* density (columns (7) and (8)). Taken together, these results confirm the hypothesized importance of pine and bamboo in determining the availability of books and, as a corollary, a prefecture's success in *keju* exams.

[Table 4 about here]

### 4.2. Exclusion Restrictions

A unique advantage of using the locations of bamboo and pine as instrument is that, as habitats their geographic distributions were exogenously given. Historians find little if any evidence of planting pine and bamboo intentionally for the purpose of commercial printing (Elvin, 2004).[33] While the locations of pine and bamboo forests were exogenously determined, we confirm that they are not correlated with other omitted variables—most notably economic prosperity, which may be correlated with years of schooling today. For example, our instrumental variable is found to be uncorrelated with whether a prefecture was a designated commercial center, a center specializing in the production and export of either silk or tea (China's two major export items), population density (both during and after the Ming-Qing period), and urbanization rate (both during and after the Ming-Qing period) (Panel A, Table A3 in Appendix E). It is also uncorrelated with

[32] While printing was crucial for exam success, it was unlikely to have become as popular as it did had there been no civil exam, or had the civil exam been any less important. The importance of *keju* for printing is well recognized by Chinese historians (see, for example, Cao, 2013; Zhang, 2010).

[33] Even the most successful wood merchants in Huizhou prefecture of Anhui Province preferred to lumber trees from primordial forests rather than planting their own (Li, 2000).

agricultural suitability for growing rice, wheat, tea, mulberry trees (required for sericulture), maize or sweet potato,[34] and terrain ruggedness and unfavorable weather conditions especially droughts and floods (Panel B). Last, but not least, our IV is also orthogonal to distance to a designated commercial center, a silk center, a tea center, a large city in 1920, the national capital, and a provincial capital (Panel C).

Finally, we are also confident that our IV does not have a direct effect on the contemporary development of the publishing industry and possibly economic prosperity as in the case of Europe (see, e.g., Dittmar, 2011). The adoption of the new printing technology in the late 20th century, which used rags, asphalt and wood for paper and resin and graphite for ink in the modern printing centers of Shanghai and Tianjin, led to the demise of traditional Chinese woodblock printing in the previous 19 printing centers (Reed, 2004). In fact, by regressing our instrument on *jinshi* density but dividing it into 50-year chunks (see the coefficients in Figure 4), we do find that the average distance to pine and bamboo forests is significantly and positively correlated with *jinshi* density between the early 15th and the mid-19th century (c. 1451-1840), but becomes insignificant in the post-1850 period with the advent of the new printing technology.

[Figure 4 about here]

### 4.3 Instrumented Results

With exclusion restrictions out of our way we now report the instrumented results in Table 5. Before we report the 2SLS results we first report those of the reduced form estimates. Column (1) includes only the province fixed effects, whereas column (2) includes the additional controls employed in column (3) of Table 2. Given that river distance (and the tributaries in the river basin) could also be correlated with trade and commercial activities, the effect of our instrumental variable on *keju* may come from the easy access to river transport enabled by the tributaries in the river basin rather

[34] These were the two New World crops brought to China, crops that had an alleged effect on population growth and social conflicts (Chen and Kung, 2016; Jia, 2014).

than the distance to the bamboo and pine habitats. To rule out that possibility we control for a prefecture's shortest distance to its nearest major navigable river (defined as the great-circle distance measured from a prefecture's centroid to the nearest point on the major navigable river) in the Ming-Qing period, together with the full set of control variables in column (2). In both columns, we find that the reduced form estimates are significantly negative; as hypothesized, the farther away a prefecture was from the bamboo and pine habitats the lower the years of schooling today. In columns (3) and (4) we employ the share of population with 'high school' and 'university and above' education as the dependent variable and find consistent results.

We now report the 2SLS estimates in columns (5) and (6) of Table 5. The results reveal that the first-stage IV-estimates are all significant. The F-statistic suggests that our instrumental variable is by no means a weak instrument. More importantly the second-stage IV estimates are also significant. Using the average of the two shortest river distances to pine and bamboo as instrument, we find that *jinshi* density significantly and positively explains years of schooling.[35] The instrumented *jinshi* coefficient (0.085, column (6) of Table 5) is somewhat larger than the OLS estimate (0.069, column (3) of Table 2), suggesting that the endogenous *jinshi* measure likely has the effect of biasing the estimation towards zero, and thus underestimated the long-term effect of *keju* on contemporary human capital outcomes. The instrumented result suggests that a doubling of *jinshi* density (per 10,000 people) is associated with an 8.5% increase in average years of schooling in 2010. This implies that an additional *jinshi* per 10,000 people leads to an increase in years of schooling of 0.74 when evaluated at the mean of 8.712 years.

Compared with the OLS estimates of Table 2 when the dependent variable takes on the share of population with 'high school' and 'university and above' education (columns (7) and (8)), the IV-estimates are consistently significant, with slightly larger magnitudes (by about 12% and 27%).

[35] In light of the fact that printing centers in the north may rely less on river transport, we also used great-circle distance in place of river distance as instrument to run the regressions again and obtained similar results (not reported).

[Table 5 about here]

# 5. Accounting for the Channels of *Keju* Persistence

## 5.1. Transmission of *Keju* Culture

Culture is inherently stable, and as such it is likely to transmit from one generation to the next over a long period of time (Alseina and Giuliano, 2015; Boyd and Richerson, 1985; Giuliano and Nunn, 2017; Voigtländer and Voth, 2012). Premised on this reasoning, although *keju* has long been abolished, the culture of valuing education that it fostered has likely persisted. Bertrand Russell's (1922, p.46) insightful remark in *The Problem of China* hinted precisely at that:

> 'at any rate, for good or evil, the examination system profoundly affected the civilization of China. Among its good effects were a widely-diffused respect for learning…'.

Conceptually, economists have developed a framework for analyzing how cultural traits could be transmitted vertically across generations within the family context through parental indoctrination and input (Becker, 1991; Doepke and Zilibotti, 2014; Guryan *et al*., 2008).[36] In the specific context of China, the 'widely-diffused respect for learning' is commonly understood as '*jiaxue yunyuan*' or '*shuxiang mendi*', meaning 'a long tradition of learning in the literati families'. Within East Asia where the same Confucian norm is similarly prevalent, evidence suggests that students spent significantly more time studying than either their American or European counter-parts (Rozman, 2014; Stevenson and Lee, 1990) and invested more resources in private tutoring (Chao and Tseng, 2002).

[36] In addition to transmitting their own human capital (genetically) to their offspring, typically parents also pass on their own values through parental input (e.g., Becker, 1991). For instance, with a premium placed upon literacy, bookishness, and education, the Jews have most persuasively demonstrated this process of passing skills and attitudes on to later generations (Botticini and Eckstein, 2012).

To test whether the long-term persistent effect of *keju* is due (at least in part) to the vertical transmission of culture within the educated elite families, we turn to the 2010 Chinese Family Panel Survey (CFPS), a nationally representative survey conducted by the Institute of Social Science Survey of Peking University.[37] A unique advantage of this survey is that it consists of both an adult sample, which in turn has a subsample consisting of only those who are parents, and a child sample of those aged 16 and under but over 7. In our empirical analysis we draw upon all three samples in order to more accurately capture the cultural transmission channel.

We first make use of two attitudinal questions in the overall (adult) sample to measure the strength of culture of valuing education among the 42,590 respondents. The first is a dummy variable indicating whether a respondent regards education as 'the most important determinant of social status', whereas the second is also a dummy variable indicating whether one 'prefers his/her government to prioritize spending on education' (among a long list of public expenditures).[38] To check robustness we also draw upon the parent sample; those respondents with children aged 12 and under were asked about their expectations for, and input in, their children's education. These questions include 1) 'the years of schooling their children were (ideally) expected to receive', 2) 'whether they often give up watching TV in order to accompany children', and 3) 'the total hours they spent on tutoring children's home work per week'. Additionally, the interviewer was asked to indicate on a five-point scale 'whether parents effectively communicated with (their) children'.

To gauge the familial transmission of *keju* culture, we construct two linear variables—the patrilineal and matrilineal ancestors' *jinshi* density—to proxy for the achievements (if any) of the survey respondents' ancestors in a given population who had obtained a *jinshi* qualification. To identify them, we match the surveyed individuals with their patrilineal ancestors based on the

[37] The survey covered 14,960 households in 25 provinces. Refer to the center's website (http://www.isss.edu.cn/cfps/) for further details.

[38] The list contains up to ten categories of expenditure: environmental protection, medical care, police and law enforcement, education, sport and recreation facilities, pension, social insurance, jobs creation, unemployment relief, and cultural and artistic activities.

surname and hometown (prefecture) information, under the assumption that people born in the same prefecture and sharing the same surname are likely to be related along the patrilineal line (Clark, 2014). To illustrate this idea, suppose there were 90 *jinshi* with the surname Kung in Suzhou prefecture in the Ming-Qing period. Given the population in this prefecture with the surname Kung today is 34,000, the normalized *jinshi* density for patrilineal ancestors having the surname Kung in Suzhou prefecture is thus 0.0003. Similarly, using the maiden surname and hometown information of the respondent's mother, we repeat the same procedure to construct the variable on matrilineal ancestors, i.e., the male *jinshi* from the mother's family (e.g. the maternal grandfather and uncles).

To separate cultural transmission from inherited ability, we further control for the respondents' memory and logic test scores, and their educational level and income, alongside a battery of controls for their age, gender, ethnicity and residential status (rural versus urban), in addition to all the prefectural controls.

The results are reported in Panel A of Table 6. Ancestral *jinshi* density has a significantly positive effect on the respondents' attitude towards education. Specifically, those with more *jinshi* ancestors are more likely to view education as 'the most important determinant of social status'—resonating with the so-called 'exam-to-mobility' norm that undergirded the *keju* system (column (1)). Consistently, these respondents also prefer the government to prioritize spending on education (column (2)). In the parent sample, ancestral *jinshi* density is significantly correlated with the number of years for which parents expected their children to attend school (column (3)) and the amount of time and effort that parents devoted to supervising their children's homework (columns (4)-(5)). Ancestral *jinshi* density is also consistently significantly associated with the interviewer's subjective evaluation of how often parents communicated with their children (column (6)).

[Table 6 about here]

To further verify the cultural transmission channel, we draw upon the child sample to examine the effect of ancestral *jinshi* density on children's test scores (word and math ability tests) and their

cognitive and non-cognitive performance (Panel B of Table 6). As with the specification in Panel A, we control for their inherited ability (memory and logic test scores) and family influence (parents' years of education and income). The baseline results show that children with more *jinshi* ancestors indeed performed better in both the word and math ability tests irrespective of the number of controls (columns (7) - (10)). Concerning cognitive skills, children with more *jinshi* ancestors are also more likely to pass their exams with flying colors (column (11)); and in connection with non-cognitive performance, these students also tend to be absent from class less often and to spend more time studying (columns (12) - (13)).

Perhaps a remaining concern of this analysis is that, compared with England and Wales, which altogether had 270,000 surnames in 2002 (Clark and Cummins, 2015), the Chinese have far fewer surnames—approximately 4,100 excluding the ethnic minorities based on the 1% mini census of 2005. For example, the top five surnames of Li, Wang, Zhang, Liu, and Chen together already accounted for 34.09% of the entire population. To the extent that those sharing the same surname in the same prefecture may actually come from different lineage groups (the surname Li is a good case in point), this may render the ancestral measure of family cultural transmission much less accurate. To address this concern, we restrict our sample to only the rare surnames, as the likelihood of those possessing the same surname living in the same prefecture and sharing the same ancestors would be distinctly higher. In the 1% mini census of 2005, we thus employ only 2,265 out of the 4,100 surnames, which accounted for just 20% of the Chinese population. Reported in Table A4 in Appendix F, the results of using rare surnames are strikingly consistent with those of the adult and parent samples (Panel A). In the child sample, the effect of cultural transmission on cognitive performance and that on non-cognitive performance are also consistently similar, while those on the word and math ability tests are less precisely estimated due to the larger standard errors resulting from a much smaller sample (Panel B).

### 5.2. Educational Infrastructure

In addition to culture, educational infrastructure may represent yet another channel through which *keju* produces a persistent effect on contemporary human capital outcomes.[39] In historical China, prefectures having exceled in the civil exam may also have established more comprehensive educational infrastructure—a positive relationship that can be dated back to the Song dynasty if not earlier (Chen and Kung, 2019). Our foremost task here is thus to examine whether greater success in the civil exam in the Ming-Qing period may have resulted in more Confucian academies (*shuyuan*)—the key educational infrastructure in imperial times.[40] Data on the academies are available from Ji's (1996) *Zhongguo Shuyuan Cidian* (*A Compendium on the Chinese Academies*) for the period up to 1904 (one year before the civil exam was abolished).

But with the due influence of Western ideology and values, political elites in the late 19th century enthusiastically endorsed the Western curriculum of education brought into China by the Protestant missionaries. This process intensified in the early 20th century, when the Qing authority finally decreed that all traditional academies and official schools were to be converted into modern schools using Western curricula.[41] We also examine the possible effect of *jinshi* density on this new system of education, as it formed the basis for the development of a modern educational infrastructure in the post-imperial period. To proxy for educational infrastructure, we use the number of Confucian academies in the Ming-Qing period as well as primary and middle schools enumerated in 1900 and 2010, in addition to the number of colleges established between 1895 and 1947 as measures. The data on primary and middle schools are obtained from *Diyici Jiaoyu Tongji*

[39] The positive relationship between educational infrastructure and schooling outcomes has been well documented (e.g., Duflo, 2001).
[40] While prefectural and county governments were also involved in education, we exclude them in the analysis because there was just one official school or *guanxue* in each county or prefecture.
[41] Specifically, the Confucian academies in the provincial capitals were transformed into colleges (*da xuetang*), whereas those at the lower levels—prefecture or county—were turned into middle schools (*zhong xuetang*), with the local charitable schools and community schools organized as primary schools (*xiaoxue*) (Reynolds, 1993). The process by which local elites mobilized resources in transforming the educational infrastructure is analyzed in Rawski (1979).

*Tubiao* (The First Educational Statistical Compendium) initiated by Emperor *Guangxu* in 1900, whereas those on colleges are extracted from *Dierci Zhongguo Jiaoyu Nianjian* (The Second Education Yearbook of China) compiled by the Republican government in 1947.

To further test long-term persistence via this particular channel, we also examine the effect of *jinshi* density on various levels of education ranging from primary and middle schools to universities in contemporary times (specifically 2010). The contemporary data are gathered from *Zhongguo Chengshi Tongji Nianjian* (China City Statistical Yearbook) of 2011.

The results of the impact of *keju* on educational infrastructure are reported in Table 7. First, we find that *jinshi* density has a marginally significant effect on the number of Confucian academies in the Ming-Qing period in the OLS specification (column (1)). While the IV estimate becomes less precise (due possibly to a much larger standard error; column (2)), the coefficient remains positive.

Regarding *keju*'s persistent effect, we find that *jinshi* density has a significantly positive effect on the primary and middle schools in 1900 (column (4)) but not in 2010 (column (8)). A possible reason is that primary and secondary education became compulsory after 1986, but its enrollment rates varied across China in the late 19$^{th}$ century. *Jinshi* density has a more significant effect on modern universities than on primary and middle schools in both 1947 and 2010, suggesting that *keju* culture has a stronger persistent effect on higher (university) education through this particular channel (columns (5) - (6) and (9) - (10)).

[Table 7 about here]

**5.3. Social Capital**

The extremely competitive nature of China's civil exam meant that only a small percentage actually passed and earned the highly-coveted title of *jinshi* scholar, who invariably became part of an exclusive network of the gentry class upon becoming officials. Together, these scholar-officials

had likely created a non-trivial amount of social capital via providing public goods and organizing philanthropic activities. To test the hypothesis that social capital represents a plausible channel through which human capital outcomes are affected, we generate several measures to proxy for the existence of social capital embodied in a variety of organizations across different time periods.

Perhaps the most prominent source of social capital in late imperial China was embedded in the clan or lineage organization, whose overriding goal was to provide public goods and a social safety net to its members, which consisted of those sharing the same ancestors (Freedman, 1958; Greif and Tabellini, 2017). In the specific context of the civil exam, powerful lineages in late imperial China were known to have accumulated enormous educational resources by dint of their wealth. These resources enabled their descendants to receive a better classical education (teachers, books, etc.) than others and accordingly achieve greater success in the civil exam (Elman, 2000; McDermott, 1997).

But organizations other than the clan could also be purveyors of social capital. Clubs and associations in which individuals sharing common interests, beliefs or identities form close-knit groups are typically important sources of social capital (e.g., Putman, 2000; Satyanath *et al*., 2017). China is no exception. In late imperial times, the Republican period (1935) and in the present, we invariably find an array of social organizations with which to proxy for the channel of social capital.

To proxy for the strength of clans or lineages we use the number of genealogies compiled in a prefecture in the Ming-Qing period as measure. Genealogy is an appropriate proxy because it is 'essential to the existence of a lineage' (Bol, 2008, p. 241), so much so that resourceful clans tend to revise their genealogies more frequently in order to strengthen the sense of belonging and honor (Watson, 1982). The data on genealogy are obtained from *Zhongguo Jiapu Zongmu (A Comprehensive Catalogue on the Chinese Genealogy)*, which contains the genealogies of up to 52,401 clans and involving more than 700 surnames across 280 prefectures in China (Shanghai Library, 2009).

We use two measures to proxy for social capital. For the late imperial period we enumerate the charitable organizations such as those engaged in relieving famine and running orphanages in the Qing dynasty as proxies. The data are obtained from the *Harvard ChinaMap*.[42] To construct two separate measures of social organizations—one for the Republican period (c. 1935) and the other 2008, we also enumerate a broad range of non-profit social organizations like farmers' associations, labor unions, chambers of commerce, women's associations, educational and student bodies, religious associations, charitable organizations and so forth; the sources are obtained respectively from a census survey of social organizations (Zhang and Li, 1999) and the economic census conducted in 2008.

The results are reported in Table 8. First, we find that *jinshi* density has a significantly positive effect on the number of genealogies (columns (1) and (2)), which attests to the strong relationship between civil exam success and social capital embodied in the clan organization. Likewise, *jinshi* density also has a significantly positive effect on the number of charitable organizations in the late Qing (columns (3) and (4)), as well as on the number of social organizations in 1935 and 2008 (columns (5)-(8)). Together, these results provide suggestive evidence that social capital represents another likely channel through which the civil exam has impacted upon human capital outcomes over time.

[Table 8 about here]

### 5.4. Political Elites

Upon passing the civil exam the *jinshi* was granted entry into officialdom, with some becoming high-level officials (at the level of province and above).[43] Like clans, which allegedly helped members succeed in the civil exam via the uneven resources they provided, political elites too could bear upon a prefecture's exam outcomes by influencing the distribution of educational resources

[42] An online GIS database from https://worldmap.harvard.edu/chinamap/.
[43] At the minimum a *jinshi* holder would become a county magistrate (Jiang and Kung, forthcoming).

(e.g. size of the academy) to their hometowns. To account for this channel, we construct a measure of political elites for each of the imperial, Republican and contemporary periods. To measure the strength of political elites in late Qing (c. 1779-1905), we enumerate a total of 33,620 officials ranked at the provincial level or above, and normalize it by the prefecture's population (per 10,000 population, in logarithm). The data are obtained from Wei's (1977) *Qingji Zhiguan Biao* (Official Chronicles of the Qing Government). For the Republican period (c. 1912-1948), we enumerate a total of 3,996 high-ranking officials from 25 ministries and other officials at the level of province or above, relying on data obtained from Liu's (1995) *Mingguo Zhiguan Nianbiao* (Official Chronicles of the Republican Government). Finally, for the Communist period, we use membership of the Central Committee—the party's highest level of political organization—to proxy for political elites. Given the radically different phases of communist development in China, we subdivide the sample into three periods: the revolutionary period of 1921-1948 (which saw a mere 164 Central Committee members), the socialist period of 1949-1977 (511 members), and the market transition period of 1979-2017 (1,443 members). The data before 2003 are obtained from *Zhongguo Gongchandang Lijie Zhongyang Weiyuan Dacidian* (A Dictionary of the Central Committee Members of the Chinese Communist Party, 1921-2003), compiled by *Zhonggong zhongyang dangshi yanjiushi* (Party History Research Office of the Chinese Communist Party Central Committee) in 2004, whereas those after 2003 are collected from Wikipedia.

The results on political elites are reported in Table 9. First, *jinshi* density has a significantly positive effect on the number of high-ranking officials in the late Qing period (columns (1) and (2)). Second, this effect persisted even after the imperial regime collapsed in 1911; *jinshi* density continues to have a positive effect on the number of high-ranking officials in the Republican era (columns (3)-(4)). However, *jinshi* density has no significant effect on the political elites in any of the subperiods under communism (columns (5)-(10)). For the earliest period, the political elites were primarily made up of the founding members of the Chinese Communist Party who had either

survived the deadly Long March or fought in various patriotic guerilla warfare (Kung and Chen, 2011)—a career path radically different from that of the civil exam. In the second period (c. 1949-1977), the traditional (*keju*) elite families continued to be prohibited from becoming the ruling elites—be it during the initial land reform and agricultural collectivization or the Cultural Revolution that targeted the traditional elites.[44]

[Table 9 about here]

## 6. *Keju* and Social Mobility

A positive relationship has been found between education and social mobility (Lipset and Bendix, 1959; Breen, 2010; Chetty *et al*. 2014). To the extent that the civil exam has led to more years of schooling, it is plausible that the higher human capital accumulated over time may have promoted intergenerational mobility, simply by increasing the average educational and consequently income level of various social groups.[45] However, the reverse could have been true if legacies of the civil exam have a stronger effect for some—especially the wealthier—groups than others. If that is the case, *keju* persistence would reinforce the existing inequality between these social groups, resulting in decreasing social mobility.

To test the effect of *keju* persistence on social mobility we focus our analysis on inter-generational mobility—specifically educational and income mobility across generations. Using the 1% mini census of 2005 as our sample, we compare the adult respondents' educational and income attainments with their parents' attainments. In column (1) of Table 10, we find that both *jinshi* density and family background—regardless of how it is measured, have significant effects on one's

[44] For example, children of the so-called 'Black Five' families—specifically descendants of the Nationalist government officials, landlords and capitalists—were largely deprived of education during the Cultural Revolution.

[45] The civil exam had allegedly provided social mobility in both the Song and the Ming-Qing dynasties (Kracke, 1947; Ho, 1962). The importance of perceived upward mobility provided by the civil exam system is emphasized by Bai and Jia (2016). By exploiting the variations in the quotas on entry-level exam candidates across China, these authors argue that the probability that someone would participate in a revolution in 1911 after the abolition of the *keju* exam system was significantly higher in prefectures with higher quotas per capita.

educational outcome. To examine the effect of *keju* on educational mobility across generations, we further interact *jinshi* density with parents' educational attainment in columns (2) to (3). We find that in prefectures with a stronger *keju* influence, parents' educational background has less strong an effect on an individual's educational outcome, suggesting the positive effect of *keju* persistence on social mobility in the long run. To check robustness, we replace educational mobility with income mobility in columns (4) to (6), and obtain similar results.

[Table 10 about here]

## 7. Conclusion

By observing a strong, positive relationship between prefectures with a strong historical tradition of exam success and years of schooling today, we have shown the persistent impact of a remarkably long-lived institution—China's civil exam system—on human capital outcomes or specifically educational attainment today. Moreover, we have further shown that this relationship is likely causal by using, as instrument, the average river distance to a prefecture's nearest pine and bamboo forests, which produce the main ingredients for printing.

While we have identified important patterns of cultural persistence stemming from variations in historical institutions in the Chinese context, our primary goal is to emphasize the multiplicity of channels beyond that of culture. In doing so we have provided evidence to show that educational infrastructure, social capital, and to a lesser extent political elites all facilitated the impact of China's civil exam institution on the cultural trait of valuing education. Given that multiple channels are possible, however, the success of a local exam culture may create inequalities over time through any one of these channels. For this reason, we have looked beyond the impact of *keju* on educational attainment and provided evidence suggesting that perhaps because a stronger local *keju* culture induces greater competition, it has the unwitting effect of mitigating—rather than exacerbating—educational and income inequalities across generations.

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Figure 1. *Correlation between Historical Success in China's Civil Exam (Keju) and Contemporary Human Capital Outcomes*

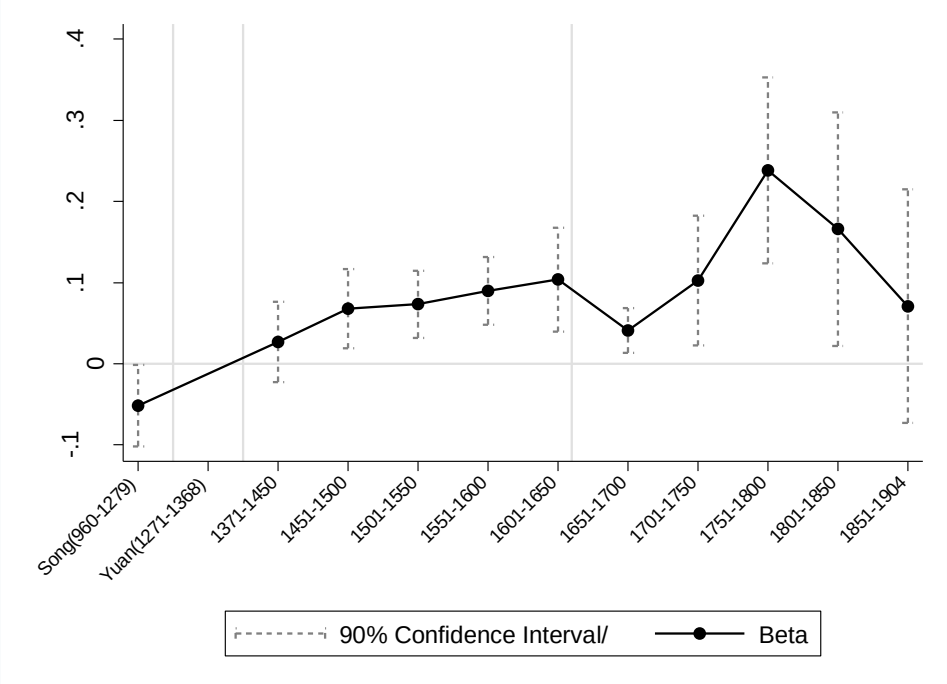


*Figure 2. Impact of Historical Success in China's Civil Exam (Keju) on Contemporary Human Capital Outcome, by Period*

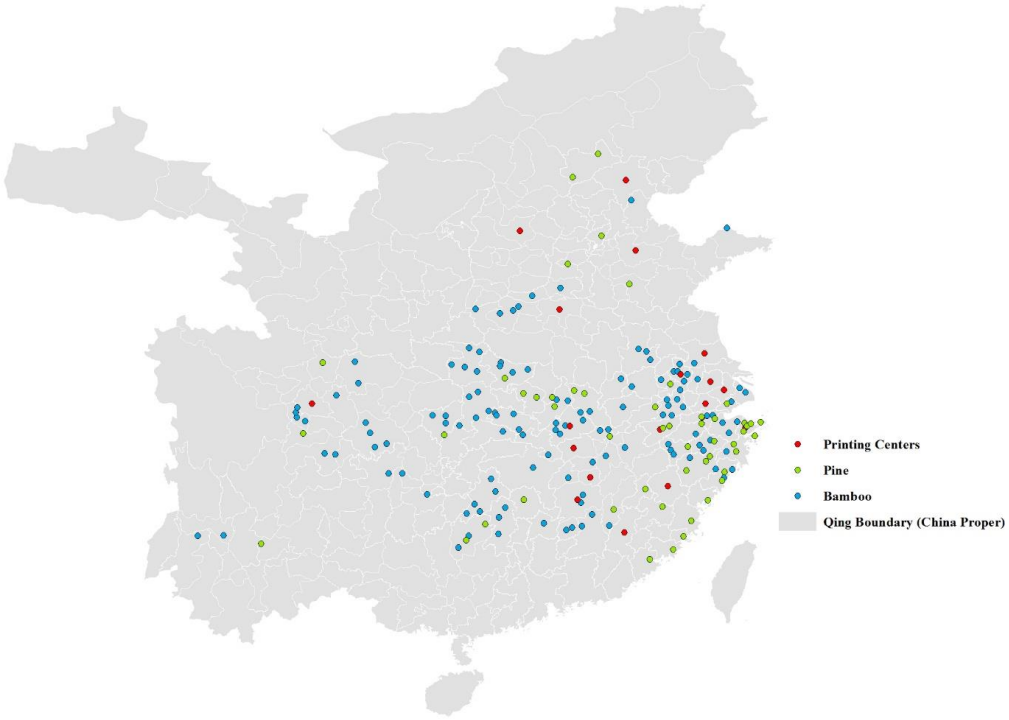


Figure 3A. *Locations of Pine and Bamboo Forests and Printing Centers*

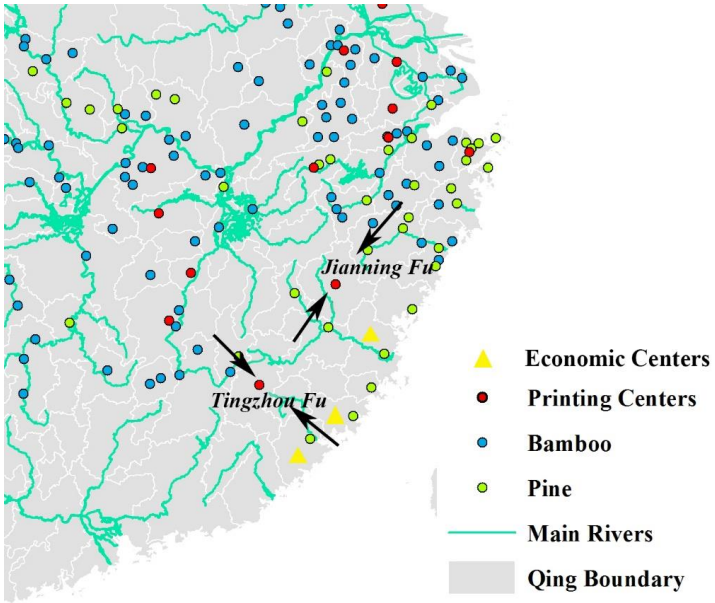


Figure 3B. *Two Examples of Printing Centers' Proximity to Pine and Bamboo Locations*

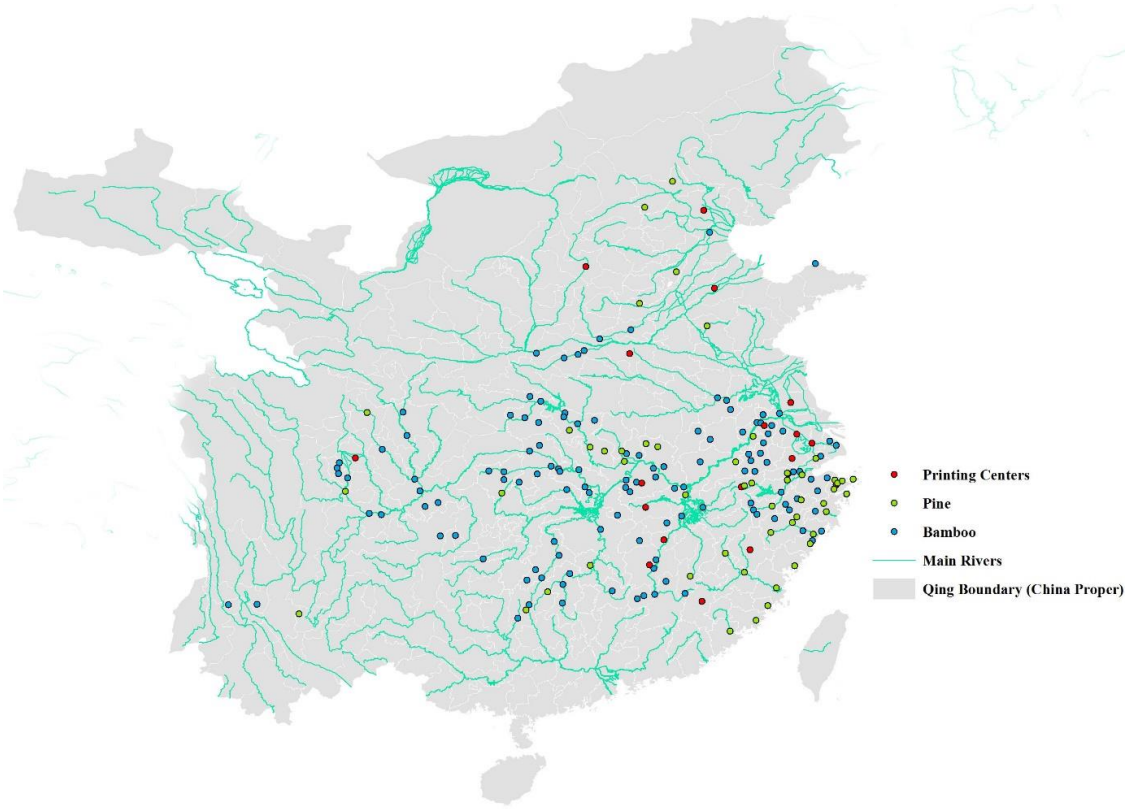


Figure 3*C. Locations of Pine and Bamboo Forests and Major Navigable Rivers*

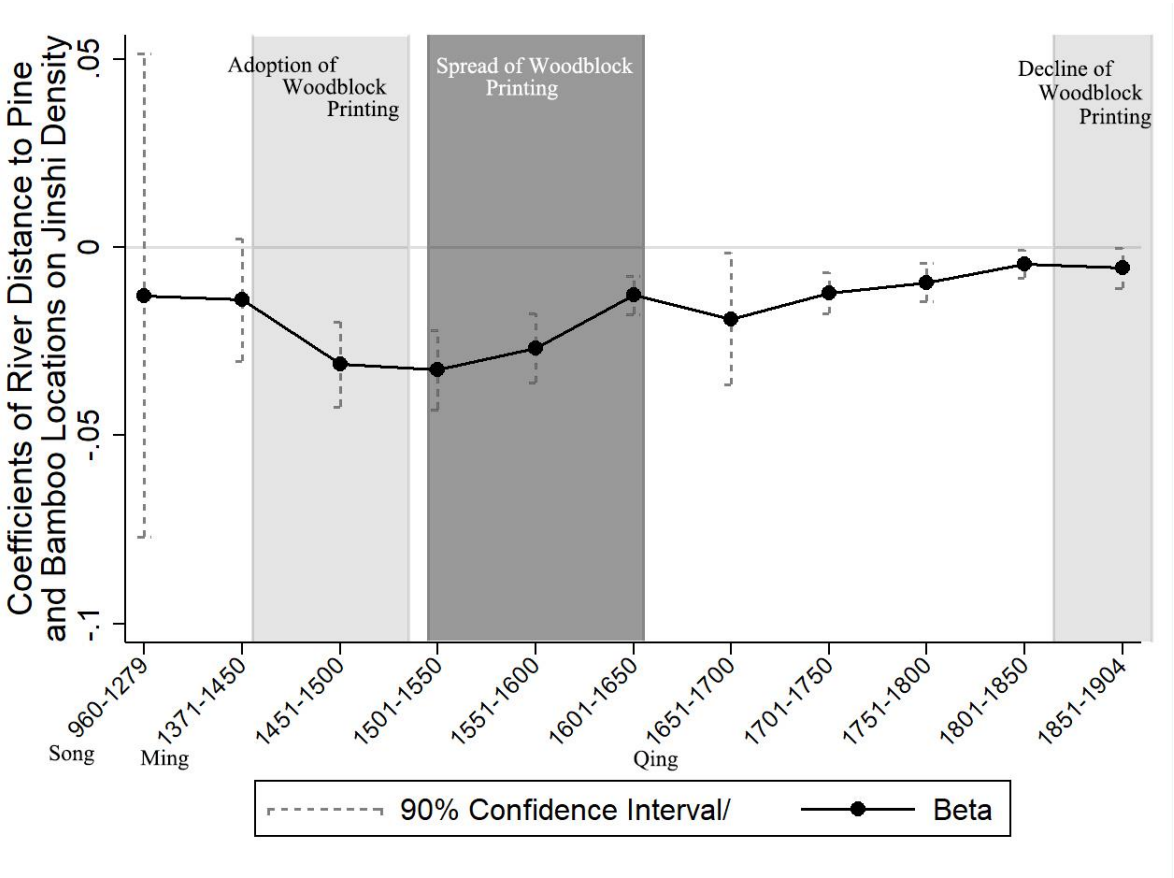


Figure 4. *Effects of River Distance to Pine and Bamboo Locations on Jinshi Density, by Period*

Table 1. *Summary Statistics*

| Variable | Obs. | Mean | S.D. | Min | Max |
|---|---|---|---|---|---|
| Average Years of Schooling (logged) | 274 | 2.16 | 0.118 | 1.726 | 2.46 |
| Share of Population with No Education (*100,logged) | 274 | 1.639 | 0.587 | -0.301 | 3.388 |
| Share of Population with Elementary and Secondary School Education (*100,logged) | 274 | 4.268 | 0.107 | 3.764 | 4.436 |
| Share of Population with High School Education (*100,logged) | 274 | 2.594 | 0.316 | 1.646 | 3.257 |
| Share of Population with University and Above (*100,logged) | 274 | 0.878 | 0.653 | -0.954 | 3.006 |
| *Jinshi* density (logged) | 274 | 0.917 | 0.701 | 0 | 3.959 |
| *Juren* density (logged) | 274 | 1.906 | 0.859 | 0 | 5.901 |
| *Shengyuan* quota density (per exam, logged) | 274 | 4.379 | 0.839 | 0 | 5.825 |
| Nighttime Lights in 2010 (logged) | 274 | 0.722 | 1.246 | -4.072 | 3.482 |
| Distance to Coast (1,000 km, logged) | 274 | 12.608 | 1.175 | 9.731 | 14.698 |
| Terrain Ruggedness | 274 | 0.207 | 0.175 | 0.005 | 0.821 |
| Agricultural suitability | 274 | 3.008 | 0.716 | 0.55 | 4.838 |
| Population Density (logged) | 274 | 2.188 | 0.992 | -1.297 | 4.153 |
| Urbanization Rates | 274 | 0.051 | 0.035 | 0 | 0.307 |
| Shortest River Distance to Pine/Bamboo (km, logged) | 274 | 9.985 | 5.606 | 0 | 21.195 |
| Shortest Distance to Major Navigable Rivers (km, logged) | 274 | 2.969 | 2.691 | 0.042 | 17.606 |
| Printed Books (logged) | 274 | 2.024 | 1.621 | 0 | 6.987 |
| Printing Center | 274 | 0.069 | 0.255 | 0 | 1 |
| Confucian Academies (Ming-Qing Dynasties, logged) | 274 | 4.230 | 1.929 | 0 | 8.725 |
| Primary and Middle Schools (1900, logged) | 274 | 4.016 | 1.532 | 0 | 7.041 |
| Universities (1947, logged) | 274 | 2.459 | 1.934 | 0 | 6.611 |
| Primary and Middle Schools (2010, logged) | 270 | 6.719 | 0.79 | 4.143 | 8.827 |
| Universities (2010, logged) | 274 | 11.24 | 1.071 | 8.462 | 15.15 |
| Clans (logged) | 274 | 0.05 | 0.728 | -5.903 | 6.078 |
| Charitable Organizations (1840, logged) | 274 | 3.606 | 0.564 | 0 | 5.341 |
| Social Organizations (1935, logged) | 274 | 3.277 | 0.707 | 0 | 4.469 |
| Social Organizations (2008, logged) | 274 | 0.345 | 0.294 | 0 | 1.187 |
| Qing Officials (logged) | 274 | 2.884 | 1.652 | -1.294 | 5.665 |
| Republican Officials (logged) | 274 | 4.081 | 0.506 | 3.195 | 6.635 |
| Central Committee Members (1921-1948, logged) | 274 | 0.252 | 0.472 | 0 | 2.565 |
| Central Committee Members (1949-1977, logged) | 274 | 0.633 | 0.734 | 0 | 4.11 |
| Central Committee Members (1979-2017, logged) | 274 | 1.087 | 0.84 | 0 | 3.219 |

Table 2. *Impact of Jinshi Density on Contemporary Human Capital Outcomes: OLS Estimates*

| | Average Years of Schoolings (logged) | | | | Share of Population with (*100, logged) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | No Education | Elementary and Secondary School | High School | University and Above |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Jinshi* Density (logged) | 0.092*** | 0.063*** | 0.069*** | 0.079*** | -0.201*** | -0.088*** | 0.118*** | 0.494*** |
| | (0.007) | (0.008) | (0.007) | (0.022) | (0.034) | (0.015) | (0.025) | (0.082) |
| | [0.008] | [0.007] | [0.007] | [0.020] | [0.032] | [0.013] | [0.021] | [0.064] |
| Nighttime Lights in 2010 (logged) | | 0.055*** | 0.063*** | 0.075*** | -0.240*** | -0.027 | 0.154*** | 0.351*** |
| | | (0.010) | (0.010) | (0.007) | (0.035) | (0.018) | (0.018) | (0.090) |
| Distance to Coast (logged) | | 0.011 | 0.010 | 0.012 | -0.016 | 0.001 | 0.024 | -0.037 |
| | | (0.013) | (0.013) | (0.012) | (0.062) | (0.011) | (0.030) | (0.072) |
| Terrain Ruggedness | | 0.062 | -0.084 | -0.019 | 0.700 | -0.261*** | -0.148 | 1.258** |
| | | (0.066) | (0.071) | (0.078) | (0.418) | (0.068) | (0.206) | (0.464) |
| Agricultural Suitability | | | -0.003 | -0.006 | 0.005 | 0.008 | -0.015 | -0.055 |
| | | | (0.014) | (0.015) | (0.089) | (0.009) | (0.030) | (0.071) |
| Population Density (logged) | | | -0.043*** | -0.036*** | 0.118* | 0.022 | -0.121*** | -0.231*** |
| | | | (0.012) | (0.012) | (0.067) | (0.017) | (0.028) | (0.069) |
| Ming-Qing Urbanization Rates | | | 0.029 | 0.253 | -1.535 | -0.320 | 0.891* | 1.232 |
| | | | (0.173) | (0.211) | (1.136) | (0.265) | (0.510) | (1.419) |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.659 | 0.744 | 0.762 | 0.699 | 0.734 | 0.592 | 0.705 | 0.598 |

Note: All results are OLS estimates. Robust standard errors adjusted for clustering at the province level are given in parentheses, whereas Conley (1999) standard errors adjusted for two-dimensional spatial autocorrelation are reported in brackets. Conley standard errors are constructed assuming a window with weights equal to 1 for observations less than 1 degree apart and 0 for observations further apart. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 3. *Impact of Keju on Contemporary Human Capital Outcomes: Alternative Measures*

| | Average Years of Schooling in 2010 (logged) | | | | Share of Population with (*100, logged) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | No Education (5) | Elementary and Secondary School (6) | High School (7) | University and Above (8) |
| *Jinshi* Density (logged) | | | 0.065*** | 0.064*** | -0.139** | -0.082*** | 0.098*** | 0.448*** |
| | | | (0.010) | (0.010) | (0.053) | (0.015) | (0.031) | (0.100) |
| *Juren* Density (logged) | 0.038*** | | 0.006 | 0.006 | -0.093 | -0.006 | 0.027 | 0.059 |
| | (0.009) | | (0.009) | (0.010) | (0.055) | (0.009) | (0.028) | (0.050) |
| *Shengyuan* Density (logged) | | 0.008 | | -0.001 | 0.018 | -0.022* | 0.022 | 0.080 |
| | | (0.009) | | (0.008) | (0.063) | (0.011) | (0.021) | (0.049) |
| Baseline Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.704 | 0.664 | 0.761 | 0.760 | 0.738 | 0.600 | 0.706 | 0.601 |

Note: All results are OLS estimates. Baseline controls include nighttime lights in 2010, distance to coast, and terrain ruggedness. Additional controls are agricultural suitability, population density, urbanization rates. Robust standard errors adjusted for clustering at the province level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 4. *River Distance to Pine and Bamboo Locations, Printing Centers and Jinshi Density*

| | *Jinshi* Density (logged) | | Printing Center | | Printed Books (logged) | | *Jinshi* Density (logged) | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Printed Books (logged) | 0.179*** | 0.149*** | | | | | | |
| | (0.031) | (0.034) | | | | | | |
| River Distance to Pine/Bamboo | | | -0.017** | -0.016** | -0.092*** | -0.080** | -0.102*** | -0.088*** |
| | | | (0.007) | (0.006) | (0.029) | (0.030) | (0.011) | (0.011) |
| Baseline Control Variables | No | Yes | No | Yes | No | Yes | No | Yes |
| Provincial Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.325 | 0.439 | 0.133 | 0.134 | 0.447 | 0.465 | 0.527 | 0.583 |

Note: All results are OLS estimates. Baseline controls include agricultural suitability, distance to coast, and terrain ruggedness. Robust standard errors adjusted for clustering at the province level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 5. *Impact of Keju on Contemporary Human Capital Outcomes: Instrumented Results*

| | Reduced-form | | | | 2SLS | | | |
|---|---|---|---|---|---|---|---|---|
| | Average Years of Schoolings (logged) | | Share of Population with (*100, logged) | | Average Years of Schoolings (logged) | | Share of Population with (*100, logged) | |
| | | | High School | University and Above | | | High School | University and Above |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Jinshi* Density (logged) | | | | | 0.083*** | 0.085*** | 0.132*** | 0.628*** |
| | | | | | (0.012) | (0.012) | (0.037) | (0.091) |
| Distance to Major Navigable Rivers (logged) | | 0.008 | 0.016 | 0.053 | | 0.006 | 0.013 | 0.039 |
| | | (0.006) | (0.017) | (0.048) | | (0.005) | (0.016) | (0.041) |
| | | | | | | | First Stage | |
| River Distance to Bamboo/Pine (logged) | -0.007*** | -0.007*** | -0.011*** | -0.053*** | -0.085*** | -0.085*** | -0.085*** | -0.085*** |
| | (0.001) | (0.001) | (0.004) | (0.010) | (0.010) | (0.010) | (0.010) | (0.010) |
| First Stage F-stat | | | | | 63.92 | 63.64 | 63.64 | 63.64 |
| First Stage Partial R-squared | | | | | 0.331 | 0.333 | 0.333 | 0.333 |
| Baseline + Additional Controls | No | Yes | Yes | No | Yes | Yes | No | Yes |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.711 | 0.714 | 0.681 | 0.519 | 0.757 | 0.758 | 0.705 | 0.587 |
| Kleibergen-Paap rk Wald F-stat | | | | | 63.919 | 63.644 | 63.644 | 63.644 |

Note: Baseline controls include nighttime lights in 2010, distance to coast, and terrain ruggedness. Additional controls are agricultural suitability, population density, urbanization rates. Robust standard errors adjusted for clustering at the province level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 6. *Testing the Cultural Transmission Channel*

| Panel A | Full Sample | | Parent Sample | | | |
|---|---|---|---|---|---|---|
| | Whether education is the most important determinant of social status (1) | Whether the government should prioritize spending on education (2) | Years of schooling parents expected their children to achieve (3) | Frequently give up watching TV (4) | Hours spent weekly on tutoring children's homework (5) | Whether parents communicate frequently with children (Interviewer Evaluated) (6) |
| Patrilineal *Jinshi* Ancestor Density (logged) | 0.285*** | 0.193*** | 0.089** | 0.025** | 0.099*** | 0.061* |
| | (0.037) | (0.035) | (0.041) | (0.012) | (0.020) | (0.036) |
| Matrilineal *Jinshi* Ancestor Density (logged) | 0.109** | 0.096** | 0.159*** | 0.071* | 0.332* | 0.089** |
| | (0.043) | (0.038) | (0.046) | (0.042) | (0.201) | (0.041) |
| Memory Test Scores (logged) | 0.078*** | 0.029** | 0.036*** | 0.018 | 0.006 | 0.030** |
| | (0.028) | (0.014) | (0.009) | (0.029) | (0.017) | (0.015) |
| Logic Test Scores (logged) | 0.019** | 0.018** | 0.001 | 0.001 | 0.003 | 0.007 |
| | (0.008) | (0.007) | (0.003) | (0.003) | (0.003) | (0.013) |
| Years of Education (logged) | 0.025*** | 0.090*** | 0.027*** | 0.025* | 0.028*** | 0.061* |
| | (0.009) | (0.021) | (0.009) | (0.014) | (0.010) | (0.036) |
| Annual Household Income (logged) | 0.109** | 0.097** | 0.159*** | 0.012*** | 0.003 | 0.024** |
| | (0.043) | (0.038) | (0.045) | (0.004) | (0.003) | (0.011) |
| Individual Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Prefecture Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 31245 | 31245 | 4541 | 4541 | 4541 | 4541 |
| Adj. R-squared | 0.359 | 0.377 | 0.512 | 0.132 | 0.131 | 0.117 |

| Panel B | Child Sample (7<Age<=16) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Word Ability Test (logged) (7) | Math Ability Test (logged) (8) | Word Ability Test (logged) (9) | Math Ability Test (logged) (10) | Class (Exam) Ranking (11) | Absenteeism Last Month (12) | Time Spent on Studying per Week (13) |
| Patrilineal *Jinshi* Ancestor Density (logged) | 0.018* | 0.063* | 0.007** | 0.021*** | 0.105** | -0.112*** | 0.061** |
| | (0.010) | (0.033) | (0.004) | (0.007) | (0.043) | (0.024) | (0.029) |
| Matrilineal *Jinshi* Ancestor Density (logged) | 0.011*** | 0.077* | 0.010** | 0.052* | 0.291*** | -0.109** | 0.025* |
| | (0.004) | (0.040) | (0.004) | (0.027) | (0.076) | (0.046) | (0.014) |
| Memory Test Score (logged) | | | 0.003 | 0.023*** | 0.092** | 0.087 | 0.018 |
| | | | (0.003) | (0.005) | (0.045) | (0.077) | (0.032) |
| Logic Test Score (logged) | | | 0.020*** | 0.001 | 0.013 | 0.056 | -0.029 |
| | | | (0.004) | (0.002) | (0.009) | (0.065) | (0.039) |
| Parents' Years of Education (logged) | | | 0.060*** | 0.021*** | 0.026** | 0.031 | 0.011** |
| | | | (0.013) | (0.005) | (0.013) | (0.020) | (0.005) |
| Annual Household Income (logged) | | | 0.079 | 0.011 | 0.069*** | -0.12 | 0.063* |
| | | | (0.095) | (0.027) | (0.011) | (0.181) | (0.033) |
| Individual Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Prefecture Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 4541 | 4541 | 4541 | 4541 | 4541 | 4541 | 4541 |
| Adj. R-squared | 0.571 | 0.223 | 0.32 | 0.14 | 0.659 | 0.571 | 0.223 |

Note: Individual control variables include age, gender, ethnicity, and residential status (rural versus urban). Robust standard errors adjusted for clustering at the prefecture level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 7. *Impact of Keju on Educational Infrastructure*

| | Confucian Academies (Ming-Qing Dynasties, logged) | | Primary and Middle Schools (1900, logged) | | Universities (1947, logged) | | Primary and Middle Schools (2010, logged) | | Universities (2010, logged) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *Jinshi* Density (logged) | 0.349* | 0.450 | 0.072 | 0.179** | 0.887*** | 0.889*** | -0.090 | 0.008 | 0.568*** | 0.772*** |
| | (0.183) | (0.404) | (0.064) | (0.091) | (0.193) | (0.278) | (0.061) | (0.089) | (0.092) | (0.152) |
| River Distance (logged) | | 0.077 | | -0.040 | | -0.067 | | -0.008 | | 0.052 |
| | | (0.098) | | (0.069) | | (0.153) | | (0.049) | | (0.045) |
| Baseline Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.509 | 0.508 | 0.846 | 0.845 | 0.288 | 0.286 | 0.386 | 0.378 | 0.616 | 0.605 |

Note: Baseline controls include nighttime lights in 2010, distance to coast, and terrain ruggedness. Additional controls are population density, urbanization rate, and agricultural suitability. Robust standard errors adjusted for clustering at the province level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 8. *Impact of Keju on Social Capital*

| | Clans (Ming-Qing Dynasties, logged) | | Charitable Organizations (1840, logged) | | Social Organizations (1935, logged) | | Social Organizations (2008, logged) | |
|---|---|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Jinshi* Density (logged) | 0.139* | 0.317** | 0.266*** | 0.376*** | 0.219*** | 0.319*** | 0.108*** | 0.110*** |
| | (0.079) | (0.152) | (0.051) | (0.103) | (0.045) | (0.089) | (0.027) | (0.037) |
| River Distance (logged) | | -0.029 | | 0.042 | | 0.020 | | 0.004 |
| | | (0.041) | | (0.039) | | (0.039) | | (0.014) |
| Baseline Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.139 | 0.125 | 0.307 | 0.298 | 0.601 | 0.594 | 0.411 | 0.409 |

Note: Social organizations include, but are not restricted to, farmers' associations, labor unions, chambers of commerce, women's associations, educational and student bodies, religious associations, and charitable organizations. Baseline controls include nighttime lights in 2010, distance to coast, and terrain ruggedness. Additional controls are population density, urbanization rate, and agricultural suitability. Robust standard errors adjusted for clustering at the province level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 9. *Impact of Keju on Political Capital*

| | High-ranking Officials in Late Qing (logged) | | High-ranking Officials in Republican Era (logged) | | Central Committee Members (1921-1948, logged) | | Central Committee Members (1949-1977, logged) | | Central Committee Members (1978-2017, logged) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *Jinshi* Density (logged) | 0.793*** | 0.675*** | 0.268*** | 0.421*** | 0.083 | 0.104 | 0.152 | 0.236 | 0.107 | 0.175 |
| | (0.121) | (0.243) | (0.045) | (0.084) | (0.070) | (0.117) | (0.099) | (0.168) | (0.103) | (0.166) |
| River Distance (logged) | | -0.068 | | 0.045 | | 0.005 | | 0.031 | | 0.251*** |
| | | (0.085) | | (0.036) | | (0.031) | | (0.053) | | (0.045) |
| Baseline Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 | 274 |
| Adj. R-squared | 0.567 | 0.565 | 0.601 | 0.579 | 0.214 | 0.211 | 0.229 | 0.224 | 0.176 | 0.252 |

Note: High-ranking officials in the late Qing period include officials who served at the provincial level and above (n= 33,620), whereas those in the Republican period include those who were either a minister or who served as a provincial or higher level official (n= 3,996). The number of Central Committee members was 164, 511, and 1,443 in the three subperiods of Communist rule. Baseline controls include nighttime lights in 2010, distance to coast, and terrain ruggedness. Additional controls are population density, urbanization rate, and agricultural suitability. Robust standard errors adjusted for clustering at the province level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table 10. *Impact of Keju on Socioeconomic Inequality*

| | Years of Education (logged) | | | Annual Income (logged) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Jinshi* Density (logged) | 0.251*** | 0.300*** | 0.351*** | 0.183*** | 0.361*** | 0.260*** |
| | (0.033) | (0.037) | (0.040) | (0.029) | (0.045) | (0.042) |
| Father's Years of Education | 0.016*** | 0.040*** | 0.016*** | 0.026*** | 0.025*** | 0.026*** |
| | (0.002) | (0.005) | (0.002) | (0.003) | (0.003) | (0.003) |
| Mother's Years of Education | 0.045*** | 0.045*** | 0.095*** | 0.040*** | 0.039*** | 0.040*** |
| | (0.004) | (0.004) | (0.011) | (0.004) | (0.004) | (0.004) |
| Parents' Income | 0.005** | 0.005** | 0.005** | 0.105*** | 0.139*** | 0.105*** |
| | (0.002) | (0.002) | (0.002) | (0.005) | (0.009) | (0.005) |
| Housing Property | 0.010*** | 0.011*** | 0.011*** | 0.025*** | 0.025*** | 0.040*** |
| | (0.001) | (0.001) | (0.001) | (0.004) | (0.004) | (0.007) |
| *Jinshi* Density × Father's Years of Education | | -0.032*** | | | | |
| | | (0.006) | | | | |
| *Jinshi* Density × Mother's Years of Education | | | -0.069*** | | | |
| | | | (0.011) | | | |
| *Jinshi* Density × Parents' Income | | | | | -0.042*** | |
| | | | | | (0.008) | |
| *Jinshi* Density × Housing Property | | | | | | -0.017* |
| | | | | | | (0.007) |
| Baseline + Additional Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Province Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Observations | 553718 | 553718 | 553718 | 172723 | 172723 | 172723 |
| Adj. R-squared | 0.247 | 0.248 | 0.250 | 0.405 | 0.406 | 0.405 |

Note: All results are based on OLS estimates from the 1% mini census of 2005. Baseline controls include nighttime lights in 2010, distance to coast, and terrain ruggedness. Additional controls are population density, urbanization rate, and agricultural suitability. Individual control variables are age, gender, ethnicity, and residential status (rural versus urban). Robust standard errors adjusted for clustering at the prefecture level are provided in parentheses. ***, **, and * indicate statistical significance at the 0.1%, 1%, and 5%, respectively.