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

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This version, June 2017

Abstract

The effect of China's civil examination system (*keju*) on human capital outcomes persists to this day. Using the variation in the density of *jinshi*—the highest qualification—across 278 Chinese prefectures in the Ming-Qing period (1368-1905) to proxy for the *keju* effect, and river distance to a prefecture's nearest locations of pine and bamboo—the main ingredients for producing ink and paper—as instrumental variable, we find that an additional *jinshi* per 10,000 people during the Ming-Qing period leads to an increase in schooling of 0.7 years in the present day. Moreover, the persistent effect of *keju* can be explained by the transmission of human capital across generations and a culture of valuing education. Finally, cultural transmission was significantly weakened by the Cultural Revolution (1966-76), as parents responded to the deadly attacks on intellectuals by discounting the value of education.

Keywords: Persistence, Human Capital, Culture, Institutions, Cultural Transmission, Civil Exam System (*keju*), China

JEL classification Nos.: N15, O43, Z10

*We thank the editor, Fabrizio Zilibotti, three anonymous referees, Ying Bai, Sascha Becker, Stephen Broadberry, Felipe Caicedo, Davide Cantoni, Matteo Cervellati, Carl-Johan Dalgaard, Steven N. Durlauf, Oded Galor, Paola Giuliano, Yu Hao, Debin Ma, Stelios Michalopolous, Joel Mokyr, Petra Mosher, Nathan Nunn, Omer Özak, Luigi Pascali, Louis Putterman, Ashraf Quamrul, Paola Sapienza, Carol Shiue, Tuan Hwee Sng, Enrico Spolaore, Nico Voigtländer, Hans-Joachim Voth, David Weil, Noam Yuchtman, and various seminar participants at Brown University, University of California-Berkeley, the Chinese University of Hong Kong (Asian Meeting of the Econometric Society), Fudan 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), and University of Warwick for helpful comments and suggestions. We are solely responsible for any remaining errors.

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Growing evidence suggests that historical institutions and culture can each generate long-lasting effects on modern economic development (Acemoglu, Johnson, and Robinson, 2001; Dell, 2010; Guiso, Sapienza, and Zingales, 2016; Michalopoulos and Papaioannou, 2013; Nunn, 2008; Nunn and Wantchekon, 2011; Voigtländer and Voth, 2012). In contrast, much less is known about how institutions can generate this kind of effect through the culture that it may have unwittingly created in the process. China's civil exam system is one such institution and was designed to recruit learned individuals to serve in the bureaucracy, and as such it historically provided social mobility and political stability.[1] We take advantage of its millennium-long history and examine its effect on human capital, which persists to this day through a process of cultural transmission long after it was abolished (circa 1905). Our study is inspired by the strong positive correlation unveiled between a region's success in the civil exam during the Ming and Qing dynasties and years of schooling today (Figure 1).[2] The question of overriding importance is whether this relationship is causal, and if so, through what *channel(s)* does such persistence occur?

[Figure 1 about here]

A primary mechanism is the persistence of human capital itself (especially within the educated elite families). Above all, parents can transmit their own human capital—genetically but also through parenting—to their offspring (e.g., Becker, 1991). With a premium placed upon literacy, bookishness, and education, for instance, the Jews have most persuasively demonstrated this process of passing skills and attitudes on to later generations (Botticini and Eckstein, 2012). Likewise, we observe a similar tendency among the Chinese, who are also known for placing a huge emphasis on their children's academic success, and as such are willing to invest heavily—in terms of time and money—in their children's education (Chao and Tseng, 2002; Rozman, 2014; Stevenson and Lee, 1990).

But the persistence of human capital may not be the only channel. Through the culture channel, historical institutions can impact upon the behavior of individuals

[1] See Ho (1962) and Bai and Jia (2016) for the importance of China's civil exam system on respectively social mobility and political stability.

[2] As Squicciarini and Voigtländer (2015) point out, schooling is a strong predictor of both economic growth and per capita income at all levels of the economy.

and, more generally, economic development (e.g., Alesina and Fuchs-Schündeln, 2007; Becker, Boeckh, Hainz, and Woessmann, 2016; Tabellini, 2010). As arguably the earliest meritocratic and most influential political institution in history, the extraordinary returns—nonpecuniary as well as pecuniary—accrued to civil exam success had likely bred a culture of valuing education, a culture that has possibly persisted to this day.

To account for the persistent effect of *keju* on human capital outcomes today we draw upon the variation in the number of *jinshi*—the highest attainable qualification under China's civil exam—across the 278 Chinese prefectures (normalized by their population) in the Ming-Qing dynasties as our key independent variable (hereafter *jinshi* density). These historical Chinese prefectures correspond to 272 municipalities in today's China. We choose *jinshi* as our primary measure because, as the highest (national level) degree that one could achieve in China's civil examination, it enabled a holder to become a mid-to-high ranking official. The baseline ordinary least squares (OLS) result shows that, for every 10,000 people, a 1% increase in *jinshi* density is associated with an increase in years of schooling in 2010 of 0.058 percentage points. This result is robust to the inclusion of a rich gamut of historical covariates including a prefecture's economic prosperity (agricultural suitability, commercial center, population density, and urbanization rate), educational infrastructure (number of Confucian academies and private book collections), strength of clan (number of genealogies) and political elites (percentage of *jinshi* who were high-level officials), and not the least geography (terrain ruggedness and distance to coast) and contemporary economic prosperity using nighttime lights in 2010 as a proxy; all with province fixed effects. Importantly, our result remains robust to the use of *juren* density—an achievement one level below the *jinshi*.

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.[3] Distance to these two raw ingredients is important because textbooks and exam aids (reference books), which contain nuanced, authoritative interpretations of

[3]Our instrument thus takes the average of the two (river) distances to a prefecture's nearest available pine and bamboo locations. We choose river and not overland distance because the raw ingredients were typically transported by boats along the river tributaries in south and southeast China, where the majority of the major printing centers were located.

the Confucian classics, were crucial to *keju* exam success, but their availability was highly uneven across space and depended on the locations of the printing centers. Given high overland transport costs, an overwhelming majority of the major printing centers were located in close proximity to the pine and bamboo sites.

Our instrumental variable satisfies the exclusion restrictions requirements. Foremost is that the locations of pine and bamboo are exogenous as they were all natural habitats. Second, the geographic distribution of these habitats is uncorrelated with a large number of measures of historical economic prosperity, agricultural suitability, geography, and nighttime lights in 2010. Last but not least, our instrument is unlikely to affect contemporary human capital via the channel of printing because the old printing centers went out of business soon after China opened up to the West in the mid-19^{th} century and the new technology did not use pine and bamboo as ingredients (Reed, 2004).

The two-stage least squares (2SLS) regressions produce an estimate consistent with that of the OLS but with a somewhat larger estimate (by about 41%). This time a 1% increase in the number of *jinshi* (per 10,000 people) is associated with a 0.082% 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 0.7 years when evaluated at the mean of 8.712.[4]

Next we turn to identify the channel(s) through which the persistent effects of *keju* on human capital outcomes today occur. First, to test whether the persistence works through the channel of human capital we construct measures of human capital for both one's ancestors (whether any one of them was a *jinshi* in the Ming-Qing period) and parents (years of schooling) from China's 2005 1% mini-census, and find that all four measures of human capital channels (the patrilineal and matrilineal ancestors and parents are controlled separately) are significantly correlated with years of schooling today, suggesting a strong case of human capital persistence. For instance, a 1% increase in the number of patrilineal ancestors with a *jinshi* qualification increases the descendants' years of schooling by 0.041%. Second, while the magnitude of *jinshi* density has shrunk with the inclusion of these human capital measures, the variable remains highly significant, suggesting that culture has likely also played an important

[4]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).

role in facilitating the positive effect of *keju* on years of schooling today.

To test this, we take advantage of two attitudinal questions posed in two separate surveys to proxy for the cultural norm of valuing education. The first is a nationally representative social survey (China General Social Survey, 2006) aimed at the general public, whereas the other is a survey conducted specifically among college students who came from all over China to study at one of 15 elite universities in Beijing (Beijing College Students Panel Survey, 2008-2012). These questions asked (1) whether education is the "most important determinant of social status", and (2) whether the government "should prioritize its spending on education". In both surveys we find a significantly positive effect of *jinshi* density on people's attitude toward education even after controlling for parents' years of schooling, suggesting the existence of a *keju* culture. Finally, we find that *jinshi* density is uncorrelated with the importance of success, family harmony, patience, or even trust in neighbors and strangers, suggesting that the cultural attitudes toward education are not confounded with these similar (but essentially different) attitudes.

To further verify the above finding in a more fine-grained manner, we exploit a quasi-experiment design on a group of 4,711 college students based on the 2008-2012 Beijing College Students Panel Survey mentioned earlier. By comparing only those students who attended the same college, specialized in the same major, and enrolled in the same cohort year, and controlling for the differences in their *initial* ability and family background before they entered college, we find that *jinshi* density in these students' hometowns has a significantly positive effect on both their non-cognitive skills (measured by class absenteeism and the intention to pursue postgraduate studies) and cognitive skills (measured by class ranking and scores in College English Test), confirming the persistent effect of *keju* culture.

Before concluding our study, we also examine the conditions under which *keju* culture has persisted differentially across geographic regions over time, by exploiting a number of historical incidents as exogenous shocks. For instance, we do not find any significantly weakening effect on the association between *keju* culture and today's schooling from the Taiping Rebellion—the largest peasant rebellion in China's history in terms of death toll. Likewise, the diffusion of Western culture in the "treaty ports" prefectures also has not significantly weakened *keju* culture and its persistence. Only the Cultural Revolution—a political movement aimed directly at attacking the Confucian culture and denouncing the merits of education—has had a significantly

weakening effect.

The Cultural Revolution actually provides a unique opportunity for examining whether exogenous shocks in the political environment may affect cultural transmission—specifically whether altruistic parents may adjust the investment in their children's human capital in response to these shocks (Bisin and Verdier, 2001; Doepke and Zilibotti, 2008, 2014). Using variation in the casualty of "mass killings" during the Cultural Revolution as a proxy for environmental shock, we find that *keju* culture was undermined only among the cohort that was still attending school (aged 9 to 22) during the Cultural Revolution, but not those who either had already finished college education by then, or who were born much later and hence were unaffected by the shock.

Our study contributes to a growing literature examining how historical institutions can persist in the development process (e.g., Acemoglu, Johnson, and Robinson, 2001; Guiso, Sapienza, and Zingales, 2016; Michalopoulos and Papaioannou, 2013), as well as to the literature that delves into the historical origin of cultural traits and their persistence (e.g., Alesina, Giuliano, and Nunn, 2013; Becker, Boeckh, Hainz, and Woessmann, 2016; Grosjean, 2014; Nunn and Wantchekon, 2011; Voigtländer and Voth, 2012). More distinctly, our study adds to the analysis of how historical institutions can generate a persistent effect on economic outcomes through cultural transmission channels.

The remainder of this paper proceeds as follows. The next section provides a historical background on *keju* 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 examines the specific channels through which the long-defunct *keju* has impacted on contemporary human capital outcomes. Section 6 further investigates how certain historical shocks can affect the cultural transmission process, and whether exogenous shocks in the political environment may affect cultural transmission. Section 7 offers a conclusion.

1 Historical Context

1.1 Civil Exam Success and the Gentry Class in Late Imperial China

After its consolidation and expansion in the Song dynasty (960-1276) *keju* was intended to break the monopoly power of the aristocrats in government administration by recruiting learned talents through the civil examination system. Due to military interruptions by the nomads (the Mongols in particular), however, China had to wait until the Ming dynasty (1368) for its civil exam system to become more stable and fully institutionalized. The system then lasted until 1905—a few years before the last imperial rule (the Qing dynasty, 1644-1911) came to an end.

China's imperial or 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* 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.[5] Figure A1 in the Appendix 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 *shengyuan* 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 (circa 1850-1864), that Emperor Xianfeng increased the quota to those who contributed (Chang, 1955). While there were also quotas for the *juren* and

[5]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.

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 so long as he passed each level of the exam in the established sequence.[6] 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. 114-116).

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; Miyasaki, 1976). 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.[7] 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

[6]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: 684-685). 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).

[7]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).

110 million in the Ming to 400 million in the Qing (Ho, 1962; Kuhn, 1978).[8]

1.2 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.[9] 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 later imperial Chinese society and the civil exam provided just such a possibility.[10] 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 *Three Character Primer (san zi jing)*—an ancient Confucian textbook for children—after just one year of study (Rawski, 1979).

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

[9]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.

[10]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).

2 The Effect of *Keju* on Contemporary Human Capital Outcomes

2.1 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:

$$y_i = \beta keju_i + \gamma_1 X_i^c + \gamma_2 X_i^h + \alpha_p + \varepsilon_i \quad (1)$$

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.[11] α_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 (circa 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 202 civil exams that took place between 1371 and 1904 (a period of just over 500 years) across 278 Chinese historical prefectures,

[11] In China, the prefecture is the administrative unit between a province and a county.

which correspond to 272 municipalities in today's China.[12]

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.[13] To reduce skewness we also raise the number of *jinshi* density to the natural log.

Figure A2 in the Appendix shows the geographic distribution of the *jinshi*, *juren*, and *shengyuan* quota density in the 278 historical prefectures.

2.2 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 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, Storeygard, and Weil, 2012).[14]

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 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

[12]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.

[13]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.

[14]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.

States Geographic Service (USGS).[15]

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.

2.3 Historical Correlates

In addition, it is also necessary to control for another vector of historical variables, 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 three separate dimensions, namely historical economic prosperity, educational infrastructure, and the strength of clan and political elites.

Historical Economic Prosperity

Population Density and Urbanization. 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).

Commercial Center. Although China did not experience an industrial revolution as Britain and the rest of Europe did during the 18^{th} century, several regions (e.g., Shanxi, Anhui, Guangdong, and the lower Yangtze delta more generally) were already highly commercialized, which may therefore also be correlated positively with both exam success in the past and years of schooling today. To capture the effect of commercialization we employ a dummy variable indicating whether a prefecture was a major commercial center during the Ming-Qing period as recognized by historians (Cao, 2015).

Agricultural Suitability. 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

[15]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.

after 1500) based on the Caloric Suitability Indices developed by Galor and Özak (2016).[16]

Educational Infrastructure

The positive relationship between educational infrastructure and enrollment and schooling outcomes is well documented (e.g., Duflo, 2001). In historical China, prefectures having done well in *keju* exam may also have established more and better educational infrastructure—most notably academies and private book collections.

Confucian Academies (shuyuan). The first measure is the number of Confucian academies across the Chinese prefectures in the Qing dynasty.[17] Data on the academies, which exist for the period up to 1904 (one year before the civil exam was abolished), are obtained from Ji's (1996) *Zhongguo shuyuan cidian (A Compendium on the Chinese Academies).*

Private Book Collections (cangshulou). The second measure is the number of private book collections before 1904. Unlike in modern times, in imperial China the collection of books was largely a private endeavor. Data on private book collections are obtained from Fan (2013).

Social and Political Influences

Strength of Clan. In China, clans or lineages were social organizations established with the overriding goal of providing public goods and social safety nets to its members, where membership is extended to those sharing the same ancestors (e.g., Greif and Tabellini, 2011; Freedman, 1966; Watson, 1982). In the context of the civil exam, the long-drawn process means that members require continuous financial support from clans to hire tutors, acquire books, and fund academies (Elman, 2013; Ho, 1962).

While wealth is one of the factors that reinforces a society's esteem for education, inevitably it also has a direct effect on transmission. Thus, there is a need to control for differences in family wealth, but we do not have such data. Fortunately, in China wealth varied across not just families but also lineages or clans, which allows some control over the differences in the resourcefulness of this important social organization across space. To control for the differential effect of lineage support of its members

[16]Obtained from https://ozak.github.io/Caloric-Suitability-Index/.

[17]For sure prefectural and county governments also financed education. We do not include them in the analysis, however, because there was just one of each in every county or prefecture.

across the Chinese prefectures we employ the number of genealogies compiled in a prefecture during the Ming-Qing period and normalize it by the population in that prefecture (in log).[18] The number of genealogies is a good measure of the strength of a clan because, as a form of written record genealogy is "essential to the existence of a lineage" (Bol, 2008, p. 241). As such the more resourceful clans tend to revise their genealogies more frequently, as doing so helps to strengthen the sense of belonging and honor of their own lineages (Watson, 1982). The strong correlation between the geographic distribution of *jinshi* and genealogy (0.519) attests to the relevance of clans for civil exam success. To measure the strength of clan we turn to the *Comprehensive Catalogue on the Chinese Genealogy*, which contains the genealogies of up to 52,401 clans involving more than 700 surnames across 280 prefectures in China (Shanghai Library, 2009).

Strength of Political Elites. While clans may affect civil exam success via the uneven resources they provided to clan members, political elites too could bear upon a prefecture's exam outcomes by influencing the distribution of educational resources (e.g. size of the academy) to their hometowns. To measure the strength of political elites in a prefecture, we enumerate the number of high-level officials ranked at least at the provincial level during 1779-1905 and normalize it by the population in that prefecture (per 10,000 population, in logarithm). The data are obtained from Wei's (2013) *Qingji zhiguan biao* (A Directory of Officials in the Qing Period).[19]

Regional Migration

By diffusing knowledge and stimulating competition with the native residents, immigrants can affect development (Abramitzky, Boustan and Eriksson, 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]

[18] While the majority of these genealogies were compiled during the Ming-Qing period, many were able to trace their ancestors all the way back to the Qin dynasty (211 B.C.).

[19] An obvious drawback of this source is that official data are missing before 1779. For robustness, we also restrict the numbers of *jinshi* and *juren* to those between 1779 and 1905, and find very similar results (not reported).

[20] This information is available in the *jinshi timing beilu*—the same source that informs our key independent variable.

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]

2.4 Determinants of Historical *Jinshi* Density

Based on the strong correlation between historical *jinshi* density and years of schooling today (Figure 1), we propose to first examine which of these historical factors better predict a high *jinshi* density before examining the baseline results of contemporary human capital accumulation. We report the results in Table 2, in which we also control for province fixed effects. Indeed, some of these controls are better than the others in predicting our explanatory variable of *jinshi* density. Economic prosperity robustly predicts not just *jinshi* but also *juren* density in the full model (columns (5) and (6)). But not all measures of economic prosperity have the same predictive power. Population density and urbanization rate, for example, are better predictors than commercial center and agricultural suitability. While strongly correlated with *juren* density, *shengyuan* quota density is insignificantly correlated with *jinshi* density (columns (5) and (6)), which may be attributed to the fact that the *jinshi* degree is one level further removed from the *shengyuan*. Likewise, the Confucian academies (but not private book collections) strongly predict the geographic distribution of *keju* success (column (4)). Both clan and political elites are strong predictors of a region's success in *jinshi* and *juren* exams (columns (5) and (6)). Finally, as soon as we include more confounding factors in the regressions terrain ruggedness loses its predictive power (columns (1) and (3)).

[Table 2 about here]

Based on the results of column (5), we show the regional variation in the residualized *jinshi* density in Panel A of Figure 2 and that in the average years of schooling today in Panel B. Together, they reveal the striking finding that regions exhibiting higher educational attainment today coincide with those that historically produced distinctly more *jinshi* (see also Figure A3 in the Appendix).

[Figure 2 about here]

2.5 Baseline Results

The baseline results are reported in Table 3. 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. As expected, average years of schooling today is strongly and positively correlated with nighttime lights in 2010.

[Table 3 about here]

In column (3) we control for the four dimensions of historical economic prosperity. With the exception of population density, which exhibits a negatively significant relationship with years of schooling today, the remaining measures are all insignificant. More importantly, *jinshi* density remains highly significant. In column (4) we further control for educational infrastructure and find that Confucian academies have a positively significant effect. Once again *jinshi* density remains highly significant. In column (5) we add the controls pertaining to social and political influences and find that only the latter has a positively significant effect. Again, in this full model *jinshi* density remains highly significant. Finally, we control for historical migration by excluding the 1,370 *jinshi* migrants and finds that *jinshi* density remains highly significant (column (6)). To allay the concern that the error term may be correlated among adjacent prefectures, we employ the Conley (1999) standard errors adjusted for two-dimensional spatial autocorrelation (reported in brackets) in addition to the standard errors clustered at the province level (in parentheses). The result of column (5) suggests that, for every 10,000 people, a 1% increase in *jinshi* density in the Ming-Qing period corresponds to an increase of 0.058 percentage points in average years of schooling today, which is translated into a marginal effect of 0.005 years when evaluated at the mean of 8.712.

2.6 Robustness Checks 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 peo-

ple. But as Squicciarini and Voigtländer (2015) show, the knowledge elite who played a pivotal role in adopting the new technologies during the French Industrial Revolution was also "a tiny proportion of the overall population" (p.1827). Regardless, to ensure that *jinshi* is a robust measure we employ the total number of *juren* degree holders as a check. But since the biographies of the *juren* have not been compiled into a single source, we made the herculean effort of enumerating them 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 4 reports the results of employing alternative measures of *keju* culture. Columns (1) and (2) report the results of using *shengyuan* quota density with and without additional controls, whereas columns (3) and (4) report those of using the *juren* measure. We then put all three measures in columns (5) and (6) to perform a "horserace". The results clearly reveal that *shengyuan* quota has no significant effect on today's schooling but *juren* does. While *juren* is indeed a sound measure, compared to *jinshi* its magnitude is only about half and its significance disappears in the "horserace", where only *jinshi* remains significant (and at the 1% level).[22] 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. In fact, the results in Table 4 can be verified graphically in Panels A to C of Figure A2 in the Appendix. 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*

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

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).

[Table 4 about here]

The second concern is that *keju* existed for about a millennium beginning from the Song dynasty, but our measure captures only half of this period. To ensure that our Ming-Qing *jinshi* measure is sufficiently representative we include the data on *jinshi* for also the Song dynasty.[23] The third concern is that by taking the average of *jinshi* for the entire Ming-Qing period the measure is invariant for more than 500 years, over which time the importance of *jinshi* may actually vary. To find out if the effect of *jinshi* did vary over this lengthy time period we thus 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.

We report the coefficients of this set of regressions in Figure 3. The coefficient of *jinshi* in the Song dynasty is not significant—a finding consistent with the historical fact that, triggered by the Mongolia invasion the mass migration in Song had dramatically changed the spatial distribution of socioeconomic advantages across regions (Shi, 2013; Ho, 1962).[24] Another important finding is that there were 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.

[23] We exclude the Sui, Tang and Yuan dynasties for the following reasons. First, exam eligibility during the Sui and Tang dynasties (581-907) was restricted to the offspring of the aristocratic families; as such it was not yet a major channel for social mobility. Moreover, throughout the 326 years in this period, only about 6,688 students had been awarded the *jinshi* title, compared to 26,837 in the Qing. Second, we exclude the Yuan dynasty (1271-1367) because *keju* in that period was interrupted under the Mongol's rule. For instance, there were only 16 *jinshi* exams in the Yuan, resulting in the award of just 1,139 *jinshi*.

[24] As a consequence of the mass migration the lower Yangtze delta region in the south had become the new economic centers, whereas the prefectures of Chang'an (the present-day Xi'an prefecture in Shaanxi Province) and Luoyang (in Henan Province) in the north had declined.

[Figure 3 about here]

3 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.

3.1 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 the relevant texts but,[25] importantly, also a large cluster of references that explained these nuances and taught the tricks of the eight-legged essay (Ho, 1962; McDermott, 2006).[26] While scattered, evidence suggests that even a backwater region in the western Fujian Province, Tingzhou prefecture, had improved markedly on its civil exam performance after establishing a publishing and bookselling center; the increasing availability of texts had allegedly led to more academies devoted to training students for the exam (Brokaw, 2007, p. 51).

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),[27] meant that access to reference books

[25] 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).

[26] *Sishu jicheng* (Collected Commentaries on the Four Books), for example, was "an essential text for examination study" (Brokaw, 2007, pp. 97-98). Another popular reference was *Sishu beizhi* (Full Purport of the Four Books).

[27] Printed texts refer to the total number of book catalogues printed in a prefecture during the

varied enormously from one prefecture to another in view of prohibitive overland transport costs.[28] Hence, the locations of the printing centers importantly determined the extent of the book trade and as a corollary the availability of books.

What then determined the geographic distribution of these printing centers? 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 14^{th} 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 4A).[29] 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 4B. The same applied to major printing centers in the prefectures of Suzhou and Jiangning (today's Nanjing) in the lower Yangtze delta region. While they also do not have their own pine and bamboo forests, for a long time they could rely on prefectures in Anhui Province to their west for bamboo and prefectures in Zhejiang Province to their south for pine.[30] Against this stylized fact, distance to the nearest pine and bamboo sites would make a reasonable instrument in our case. In addition, the main ingredients required for making ink and paper were mostly shipped along the river, thanks to the well-connected river tributaries in the lower Yangtze delta region in particular (Figure 4C).[31] For instance, Yasushi (2014) finds that, after felling the pine trees in the forests

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).

[28]This may explain why 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.

[29]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.

[30]For example, Taizhou and Cuzhou prefectures in Zhejiang Province were the suppliers of pine for Nanjing and Suzhou, whereas Ningguo and Hezhou prefectures of Anhui Province supplied the bamboo.

[31]This is consistent with Elvin's (1973) observation that China had long (from the Tang dynasty [circa 618-907] onwards) "distinguished [itself] by the cheapness and, on the whole, the good

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).

[Figure 4 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 viable 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 if it is mentioned in the local produce chapter in the *Provincial Gazetteers*. Of the 278 Ming-Qing prefectures, pine grew in 27 of them whereas bamboo in 65.

Using historical GIS data on the major inland rivers identified by Matsurra (2006) as the ones used for shipping merchandises in Qing China from Harvard CHGIS,[32] 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.

We examine the importance of pine and bamboo for printing and accordingly a prefecture's success in the civil exam in Table 5. We begin by regressing *jinshi* density on the number of printed texts first, and find them to be highly significant (columns (1) and (2)); having more printed texts is indeed positively and significantly correlated with a higher *jinshi* density. We then examine whether river distance to the two main ingredients for printing is significantly correlated with whether a prefecture had a

organization of its water transport system" (p. 144).

[32]His sources include historical and government archives, travelers' notes as well as business guide books.

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 positively 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 5 about here]

3.2 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. Planting pine and bamboo intentionally for the purpose of commercial printing was not practical simply due to the crops' long growing seasons. This was especially the case for pine, which took 10-30 years to grow to maturity. While the fastest-growing bamboo species required an average of just 5-7 years before it could be harvested for use (*Yongzheng Zhejiang Gazetteer*), the ones in southwestern China required a much longer growing period of 15-20 years (Eyferth, 2009). In any case, historians find little if any evidence of large-scale commercial planting of these two crops (Elvin, 2004); 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).

While the locations of pine and bamboo were exogenously determined, they may still be correlated with other omitted variables—most notably economic prosperity, which may be correlated with years of schooling today.[33] One specific measure of historical economic prosperity is whether a prefecture was a designated commercial center. Out of the 85 prefectures in which there was either a pine or bamboo habitat (a few had both pine and bamboo), only five overlapped with the commercial centers in the Ming and six with those in the Qing. But to confirm this in a more robust fashion we regress commercial centers in the two dynasties on the average river distance to bamboo and pine, and find that they are not significantly correlated (column (1), Table 6).

[33]Dittmar (2011), for example, finds that cities where printing presses were established in 1400s Europe grew 60% faster than otherwise similar cities.

In addition, in China areas specialized in exports were also likely more prosperous (Li, 2000). In imperial China silk and tea were the two major export items, thus we also regress whether a prefecture specialized in the production and export of these two items on our instrument, and find that the two are also not significantly correlated (columns (2) and (3)).

To further ensure that our instrument is not correlated with conventional measures of economic prosperity—most notably population density and urbanization rate (both during and after the Ming-Qing period), we include them in our robustness checks. All four of them are insignificantly correlated with our instrument (columns (4) through (7)). Finally, we include also a contemporary measure of economic prosperity—nighttime lights in 2010—in our exclusion restrictions test. Once again, we do not find any significant correlation between the two (column (8)).

[Table 6 about here]

The foregoing proxies of economic prosperity share an "urban" theme. In a predominantly agrarian economy such as imperial China, however, prosperity could also be measured in terms of agricultural surpluses. A possible concern is whether prefectures favorably endowed with pine or bamboo may also be equally well suited for cultivating certain crops that could likewise give rise to economic prosperity. We report the results of a number of crops ranging from rice and wheat—the traditional staple crops for the Chinese (columns (9) and (10)), the economic crops of tea and silk or specifically mulberry trees (columns (11) and (12)), and the New World crops of maize and sweet potato (columns (13) and (14)),[34] and find that our instrument is uncorrelated with the agricultural suitability of any of these crops. Last but not least, we examine whether our instrument is correlated with terrain ruggedness, but again fail to find any significant relationship between them (column (15)).

In addition to regressing whether a prefecture was a commercial center, a silk or tea center on our instrument, we also regress a prefecture's distance to each of these centers on our instrument, but once again we find no significant correlations (columns (16) through (18)). Moreover, we further regress distance to a large city in 1920 (a dummy variable indicating whether a city had in excess of one million inhabitants) on our instrument, but again we find no significant relationship (column (19)). We do

[34]We include the latter for their alleged effects on population growth and social conflicts (Chen and Kung, 2016; Jia, 2014).

the same for distance to political centers defined in terms of the national or provincial capital, but similarly fail to find any significant relationships (columns (20) and (21)).

Summing up, the concern that our instrument—a prefecture's shortest river distance to its nearest pine and bamboo habitats—may be correlated with historical economic prosperity, agricultural suitability, and geography, is unsupported.

Still another concern is that the geographic distribution of pine and bamboo may have a direct effect on the contemporary development of the publishing industry and possibly economic prosperity (as in the case of Europe). The introduction of the modern Western printing technology—specifically lithography and relief printing machines invented by Johannes Gutenberg (1400-1468)—toward the end of the 19^{th} century (circa 1870s) eventually replaced traditional Chinese block printing (Reed, 2004). The adoption of the new printing technology, which now uses rags, asphalt and wood for paper and resin and graphite for ink, had led to the demise of traditional Chinese woodblock printing. With Shanghai and Tianjin emerging distinctly as the new centers of modern printing technology,[35] the previous 19 printing centers eventually went out of business (Reed, 2004). Brokaw (2007, p. 91) thus notes the decline of the printing industry in western Fujian: "Toward the end of the century, ..., a very new kind of technological competition threatened the two-century-long stability of the Sibao woodblock printing industry. Lithographic and letterpress machines could quickly and easily turn out much larger quantities of any text, often at a higher level of quality, than the woodblock method."[36] Against this historical backdrop we thus expect the effect of woodblock printing on *jinshi* density to be positively significant from around the beginning of the 15^{th} century onwards (i.e., shortly after the adoption of this technology) up until around the mid-19^{th} century (upon its replacement by a new one). To find out if that was indeed the case, we regress *jinshi* density on our instrument by dividing the entire Ming-Qing period into 50-year chunks. We report the coefficients of these regressions in Figure 5 and find that the average distance to pine and bamboo—our instrument—is significantly and positively correlated with *jinshi* density during precisely the expected period (circa 1451-1840). Although with

[35]Shanghai alone boasted more than 188 modern printing companies in the early 20^{th} century. Besides Shanghai, the Protestant missionaries had also helped develop the modern printing industry in other treaty ports (Reed, 2004).

[36]But woodblock printing was not the only technology to experience a decline, papermaking also failed to compete with the inexpensive and high-quality foreign substitute. As a case in point, 80-90 percent of the once-famous paper mills in Shicheng county of Jiangxi Province went out of business (Tsien, 1987).

the advent of the new printing technology the post-1850 period is insignificant, which is not unexpected, after several centuries a norm of valuing education had become so firmly established that for the entire Ming-Qing period our instrument has had a significant effect on today's schooling.[37]

[Figure 5 about here]

3.3 Instrumented Results

With exclusion restrictions out of our way we now report the instrumented results in Table 7. 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 (5) of Table 3. 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 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 (3). In all three 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.

We now report the 2SLS estimates in columns (4) through (6) of Table 7. 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.[38] The instrumented *jinshi* coefficient (0.082, column (6) of Table 7) is somewhat larger than the OLS estimate (0.058, column (5) of Table 3), suggesting that while the endogenous *jinshi*

[37] We thank Nico Voigtländer for this observation.

[38] 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).

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 bias is not large. The instrumented result suggests that a 1% increase in *jinshi* density (per 10,000 people) is associated with a 0.082% 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 0.7 when evaluated at the mean of 8.712 years.

[Table 7 about here]

4 Accounting for the Channels of *Keju* Persistence

In this section, we explore the two possible channels through which *keju* may affect human capital outcomes today. The first pertains to the persistence of human capital across generations. Human capital advantages can transmit over time through several possible mechanisms. Genetic inheritance is certainly a primary mechanism (Becker, 1991). However, perhaps a more important mechanism is parental indoctrination (Doepke and Zilibotti, 2014) and input (Guryan, Hurst, and Kearny, 2008). The time and resources that parents effectively allocate to nurture their children's development, and the values and skills they instill in them, may together confer "uncodified advantages" often required for economic success in the educational and labor markets (Becker, 1991, p. 179).[39] For example, Doepke and Zilibotti (2008) argue that the transmission of the cultural traits of patience and work ethic within the preindustrial middle class (artisans, craftsmen, and merchants) was crucial in preparing their offspring to become capitalists after the Industrial Revolution. Last, but not least, one must also include direct income/wealth effect in the transmission process.

In addition to the persistence of human capital, a society's culture represents the other possible channel through which the effect of *keju* may have endured the passage of time. Through peer imitation, the key role *keju* played in facilitating social mobility for nearly a millennium means that it has likely bred and fostered a societal norm of valuing education. Indeed, the fact that the abolition of civil exam system in 1905 had unwittingly led to the 1911 Revolution which toppled the last dynastic regime

[39]The idea that traits can be transmitted vertically in fact originates from the literature on population geneticists (see, e.g., Cavalli-Sforza and Feldman, 1981). Bisin and Verdier (2001), Doepke and Zilibotti (2008), and Dohmen, Falk, Huffman, and Sunde (2012) represent examples of economists examining the issue of transmission.

exemplifies the importance of perceived upward mobility provided by the system (Bai and Jia, 2016).[40]

Culture is likely to remain stable and 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). Although *keju* has long been abolished, the culture of valuing education fostered by *keju* may very well have persisted. In *The Problem of China* (1922), Bertrand Russell remarked 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..." (p. 46). There is indeed evidence to suggest that behavior consistent with this norm has manifested in the modern world in countries profoundly affected by this Confucian norm.[41]

4.1 Human Capital Persistence

To verify whether the long-term persistent effect of *keju* is due to the transmission of human capital within the educated elite families, we conduct a micro-level analysis using data from China's 2005 1% mini-census. We construct two measures as proxies for such transmission: patrilineal and matrilineal ancestors' achievements in the *keju* exam (both are linear variables measuring the number of ancestors in a given population who had obtained a *jinshi* qualification). To identify the ancestors of surveyed respondents, we match the surveyed individuals with their patrilineal ancestors based on the 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 respondent's mother's surname and hometown information, we repeat the same procedure to construct the

[40]By exploiting the variations in the quotas on entry-level exam candidates across China, Bai and Jia (2016) find 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.

[41]For instance, students from East Asia spent significantly more time studying than either their European or American counterparts (Rozman, 2014; Stevenson and Lee, 1990) and invested more resources in private tutoring (Chao and Tseng, 2002).

variable on matrilineal ancestors, i.e., the male *jinshi* from the mother's family (e.g. the maternal grandfather and uncles).

The results are reported in Table 8. Our dependent variable is years of schooling at the individual level. We control for an individual's age, gender, ethnicity and residential status (rural versus urban) along with all the prefectural controls (as in column (5) of Table 3). In column (1), we include only *jinshi* density and the various controls. Similar to the result in the baseline estimate, historical *jinshi* density in a given prefecture is significantly and positively correlated with one's years of schooling today. We then add the two measures of patrilineal and matrilineal ancestors' *jinshi* density in column (2); both are positive and significant (at 0.1% level), lending firm credence to the human capital channel. In terms of magnitude, a 1% increase in patrilineal ancestor with a *jinshi* qualification is associated with an increase in the decendants' years of schooling of 0.041 percentage points (equivalent to 0.3 years). Unlike studies of cultural transmission in Western societies, which typically find a stronger effect from the mother's side (see, e.g., Dohmen, Falk, Huffman, and Sunde, 2012), in China the effect is similar for matrilineal ancestors (3.3% or 0.25 years).[42]

[Table 8 about here]

We then control for parents' human capital as represented by their years of schooling (column (3)) and for their wealth as represented by their income and value of housing property in 2005 (in log terms) (column (4)), given that a more direct channel of the wealth effect is the transmission of wealth itself. The results show that both *jinshi* ancestors and parents' schooling are highly significant at the 0.1% level. And while parents' human capital and wealth similarly bear upon years of schooling today, both the significance and magnitude of *jinshi* ancestors remain unaffected; this helps relieve the concern that the persistence of human capital may be confounded by the persistence of family wealth.[43]

In China, lineages or clans are "extended" families in the sense that they were established with the overriding goal of providing public goods and social safety nets to its members, where membership was conferred on those sharing the same ancestors (e.g., Greif and Tabellini, 2011). As such they had arguably played a uniquely important role in preserving the elite family's advantage in human capital by means

[42] A test of statistical difference between the two coefficients reveals no significant difference.

[43] Data limitations however preclude us from controlling more parsimoniously for the effect of historical wealth on human capital persistence.

of the resources they allocated for hiring tutors, building a book collection, and funding academies to support their members (Elman, 2013). To examine whether the transmission of human capital is aided by clan we construct a dummy variable to indicate whether the surveyed individuals belong to a clan by making use of the data on genealogy. About 13.41% of the families surveyed in the mini-census hailed from clans with one or more genealogies. Adding this variable and its interaction with patrilineal and matrilineal *jinshi* ancestors in columns (5) and (6), we find that the effect of *jinshi* ancestor on years of schooling today is nearly doubled for individuals with written genealogical records ($0.048 + 0.041 = 0.089$).[44] Above all, *jinshi* density remains highly significant (at the 0.1% level) even after controlling for various human capital measures. This suggests that human capital cannot account for the entirety of the observed persistence.

Last but not least, we examine the relationship between a society's culture and human capital persistence in relation to cultural transmission, by interacting the two in columns (7) and (8). One interpretation of the negatively significant coefficient is that the two are likely "substitutes" according to the cultural transmission model of Bisin and Verdier (2001). That is, in prefectures with a strong *keju* culture, it takes less persuasion and accordingly effort to convince children to study hard.[45] Alternatively, one may think of this result as suggesting that social mobility is higher in societies with a stronger *keju* culture, as it reduces the transmission of human capital advantages within the elite families.

4.2 The Culture Channel

To examine whether culture represents the other channel through which the effect of *keju* persists, we make use of two attitudinal questions to measure the culture of valuing education. 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

[44]Note however that this effect is limited to only the patrilineal side, suggesting that clan has no additional effect on matrilineal transmission.

[45]That is not unconditional, however. According to Bisin and Verdier's (2001) model, only families that belong to the cultural majority are able to spend less resources in socializing their children into valuing education, since being the majority "their children will adopt or imitate with high probability the cultural trait most predominant in society at large" (p. 300).

to prioritize spending on education" (among a long list of public expenditures).[46]

As these two questions are identical and made available in two different surveys, it also allows us to verify the answers' validity from two different groups of respondents. The first of these surveys is the 2006 China General Social Survey (CGSS), a nationally representative survey of 10,391 residents conducted in 107 sample municipalities across 31 Chinese provinces. Of these respondents, 6,974 had fully answered the two questions of interest. The second survey is the Beijing College Students Panel Survey (BCSPS), which covers 4,711 college students from 15 universities in Beijing who came from all over China.[47] Both surveys were conducted by the National Survey Research Center of the Renmin University of China.[48] Among these students, 4,440 had responded to the same two questions. To verify the effect of *keju* on culture we regress these two contemporary attitudinal variables on *jinshi* density and report their 2SLS results in columns (1) through (4) of Panel A in Table 9 (columns (1) and (2) are based on the CGSS survey whereas columns (3) and (4) on the BCSPS, in which all specifications are instrumented using river distance to bamboo and pine locations). To isolate the effect of human capital persistence we control for parents' years of schooling, family income, age, gender, the university-major fixed effects and the students' test scores for the university entrance exam along with the same control variables at the regional level. Unfortunately, we cannot construct the same *jinshi* density of ancestors as we do in Table 8 of Section 5.1, as the respondents' surname is kept in strict confidence by the CGSS and the BCSPS survey.

[Table 9 about here]

The results consistently show that *jinshi* density has a significantly positive effect on the cultural norm of valuing education even up to this day. Specifically, respondents from prefectures having produced more *jinshi* historically 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 (columns (1) and (3)). It is thus not surprising that these respondents also prefer their government

[46]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.

[47]We may thus consider this sample as representing the upper-tailed distribution of college students in China in terms of cognitive abilities.

[48]Further information of both surveys can be found on the center's website: http://nsrc.ruc.edu.cn/.

to prioritize spending on education (columns (2) and (4)).

To further verify external validity, we also make use of a third survey which asked similar questions but worded in a slightly different way. In the 2010 Chinese Family Panel Survey (CFPS), another nationally representative survey this time conducted by the Institute of Social Science Survey of Peking University,[49] respondents with children under the age of 12 were asked precisely about "the years of schooling their children were (ideally) expected to receive". Moreover, the interviewer of the survey was asked to indicate on a five-point scale "the extent to which parents have provided their children a good learning environment", based on his/her evaluation of the interviewee.

Columns (5) and (6) in Panel A of Table 9 report the 2SLS estimates based on the eligible answers of the CFPS with the inclusion of the same control variables. Highly consistent with both the CGSS and BCSPS results, *jinshi* density is significantly correlated with the number of years parents expected their children to attend school (column (5)). Likewise, the higher the historical *jinshi* density the more favorable is the interviewers' evaluation of the learning environment (column (6)). Reported in Appendix Table A1, the OLS regressions yield consistently similar estimates.

Other than the culture of valuing education, *jinshi* density may also be correlated with other cultural traits such as the importance of success, of harmonious relations among family members, of patience, of working hard, and perhaps even of trust.[50] To find out, we resort to the CFPS survey. Reported in Panel B of Table 9, *jinshi* density has no effect on the importance of success, family harmony, patience or trust (columns (7) to (12)). The only slight exception is work ethic, which should not be surprising, given that educational success is in most cases a combination of intelligence, incentives and work ethic.

4.3 A Quasi-experiment on Beijing College Students: Further Evidence on the Culture Channel

According to the Beckerian approach to cultural transmission, parents are essentially transmitting preferences or non-cognitive skills (Doepke and Zilibotti, 2014). To the extent that a *keju* culture does exist and has persistently transmitted over

[49]This survey covered 42,590 respondents from some 14,960 households in 25 provinces. Refer to the pertinent center's website (http://www.isss.edu.cn/cfps/) for further information of this survey.

[50]Patience is a subjective measure evaluated by the interviewers.

time, it should thus impact upon the formation of non-cognitive skills such as perseverance, self-control, and other similar attributes. To verify this, we conduct a quasi-experiment using the same sample of 4,711 Beijing college students from the BCSPS as subjects. The rationale behind this experiment is that, while these students all studied in Beijing during the same time (2008-2012) at one of 15 elite universities, the fact that they came from all over China with varying strengths of *keju* culture provides us with the unique opportunity to exploit the effect of this variation on the formation of non-cognitive skills. As we are measuring *jinshi* density in a student's hometown prefecture, we name this the hometown *jinshi* density instead.

To ensure a valid comparison, we compare only those students who attended the same college, specialized in the same major, and enrolled in the same cohort year, using the fixed effects of their interaction term (i.e., college*major*cohort). Additionally, we also control for the differences in their initial ability before they entered college by using their test scores in the national college entrance exam as proxy.

We report the IV-estimates of hometown *jinshi* density on college students' non-cognitive ability in columns (1) and (2) of Table 10 (the OLS estimates are reported in Table A2 in the Appendix). Following the literature on skills formation (e.g., Jackson, 2014), we employ two measures to proxy for non-cognitive abilities—students' absenteeism and their intention to pursue graduate studies. The results show that *jinshi* density in a student's hometown has a significantly positive effect on these non-cognitive measures. Not only does hometown *jinshi* density significantly reduce absenteeism from class, it also invigorates one's incentive to pursue graduate studies. The strong relationship found between cognitive and non-cognitive skills (Heckman, Stixrud and Urzua, 2006) suggests that we should check the robustness of our findings by examining also the effect of hometown *jinshi* density on cognitive skills, this time using class ranking based on grade point averages (GPA) and scores in the standard College English Test (CET) as pertinent measures.[51]

[Table 10 about here]

[51]In China, classes are organized around majors; students declaring the same major would thus be grouped together in the same class, and as such they are usually required to take the same compulsory courses together as required by the major curriculum. In this context, the GPA scores of students taking the same major are thus highly comparable. The latter is a test college students in China must pass before they can graduate.

Reported in columns (3) and (4), the results show that *jinshi* density in a student's hometown has a significantly positive effect also on cognitive performance in terms of his/her class ranking (GPA) and English test scores. Examining the actual outcome in terms of graduate school admission in column (5) confirms the significantly positive effect of hometown *jinshi* density. In terms of magnitude, for example, a 1% increase in hometown *jinshi* density leads to a 6.9% increase in the likelihood that the student would pursue graduate studies, and a 4.4% increase in his/her probability of actually being admitted.

5 Conditions of Cultural Transmission

Studies on long-term persistence must account for the circumstances under which cultural norms and beliefs persist, and when they become malleable (Giuliano and Nunn, 2017; Voigtländer and Voth, 2012). Indeed, while the culture embedded in the *keju* system has on the whole persisted to this day, its persistence is also uneven across regions. For instance, persistence is noticeably stronger in the lower Yangtze region but much weaker in south central and southwestern China. This uneven pattern inspires us to examine factors that may plausibly account for the uneven transmission of *keju* culture across China over time.

5.1 Historical Shocks and *Keju* Persistence

Upon reviewing the literature on evolutionary anthropology Giuliano and Nunn (2017) find that the long-term persistence of culture hinges fundamentally on the stability of the environment. To examine if negative historical shocks may have a significant effect on the transmission of *keju* culture we select three major shocks that occurred at different times in the history of China. The first is Taiping Rebellion—the largest peasant rebellion in China that occurred around the mid-19^{th} century. The second is the forced opening up of China via "treaty ports" by the Western powers after the First Opium War of the 1840s.[52] Last but not least we test the uneven strengths of the *keju* transmission using the Cultural Revolution, which occurred during the Communist period (1966-1976).

[52]As a result of a series of "unequal treaties" signed between China and a number of Western countries following the former's defeat in the Opium War, China was forced to open up to the West for trade and other forms of exchanges (such as religion) via the designated treaty ports. Initially restricted to only 5, the number of treaty ports eventually grew to 104 by the 1930s.

The Taiping Rebellion is chosen not so much for the colossal death toll (over 70 million, Cao, 2000), but rather because the damage was concentrated in regions where *keju* culture had been strongest historically—the lower Yangtze and south central China in the provinces of Jiangxi and Anhui (Cao, 2000). We choose treaty ports to be our second historical shock because Western culture and values may have diffused more strongly in prefectures where a treaty port had been established and thus may have undermined the traditional Confucian values in the treaty port prefectures. The extent to which a prefecture was afflicted by the Taiping Rebellion is indicated by the number of battles fought in that prefecture, whereas the extent to which Western culture and values had diffused in a prefecture is indicated by whether a prefecture was historically designated a treaty port.

We employ the Cultural Revolution as yet another historical shock with the hypothesized effect of weakening the transmission of the *keju* norm, given that this political movement was conceived precisely to attack the Confucian culture and denounce the merits of education. To achieve these goals, young people were encouraged to burn books, to accuse and attack scholars, to destroy historical relics, and, above all to condemn Confucius. During its initial phase (1967-1969), the Revolution was pursued with extreme violence, resulting in mass fighting and eventually the killings of nearly 300,000 people. Intellectuals and scholars were salient targets in this collective violence as they were either beaten to death or sent to rural labor camps to perform hard labor. Not until 1977 when the revolution ended did China's educational system return to normalcy (Meng and Gregory, 2002; Walder, 2014).

To measure the potential disruption the Cultural Revolution may have brought to bear upon the transmission of *keju* culture, we employ the spatial variation in "mass killings" (*jiti shalu*) in this period as proxy (Figure 6). Data on mass killings are collected by Andrew Walder (2014) from county and prefecture gazetteers published in the 1980s and 1990s. Intuitively, the severer the mass killings the weaker the transmission of *keju* culture would be.

[Figure 6 about here]

We report the 2SLS results of these various historical shocks in Table 11 (with the OLS estimates in Table A3 in the Appendix). The interaction of the Taiping Rebellion with the *jinshi* measure is insignificant (column (1)), suggesting that the Taiping Rebellion has not weakened the transmission of *keju* culture, possibly because

it did not specifically target people who valued education, and so as soon as peace resumed, people began investing in human capital again. In column (2) of Table 11 we present the result of treaty ports. Similar to the Taiping Rebellion, treaty ports (interacting with *jinshi*) have no significant effect on contemporary schooling. A possible explanation is that, while modernization in the treaty ports may have placed a premium on the Western curriculum, it did not fundamentally change the value Chinese parents placed upon education.

Of the three historical shocks, only the Cultural Revolution has significantly weakened the persistence of *keju* culture (column (3)).[53] In terms of magnitude, an increase in mass killings of one standard deviation (s.d.= 2.093, corresponding to eight more deaths per 10,000 people) reduces the effect of *jinshi* density on years of schooling by a substantial 8.7% (0.042*2.093). This is likely due to the fact that the Cultural Revolution not only disrupted educational opportunities but also threatened the lives of those who valued education, which greatly dampened the *keju* culture of valuing education.

[Table 11 about here]

5.2 Environmental Shocks and Cultural Transmission: A Natural Experiment Based on China's Cultural Revolution

To find out why only the Cultural Revolution has significantly impacted the transmission of *keju* culture we conduct a natural experiment based on the intuition of a theoretical model of cultural transmission developed by Doepke and Zilibotti (2008, 2014), according to which altruistic parents would instill in their children the kind of values and preferences that would best prepare them for the future economic environment when they grow up, rather than shape their children's values after their own regardless of the environment (Bisin and Verdier, 2001; Hauk and Saez-Marti, 2002). Whether or not the Cultural Revolution and the associated "mass killings" may have seriously dampened the enthusiasm of many parents for education requires empirical verification.

[53]The significantly positive effect of the Cultural Revolution on today's schooling is likely a result of reverse causality. Given that the main goal of the Cultural Revolution was to denounce education, places with initially higher average educational attainment would likely have witnessed more severe mass killings.

While we do not have a measure to directly gauge parental response to political shocks in their children's investment, we can use ancestral *jinshi* density as a proxy, based on the assumption that families with stronger *jinshi* ancestors would place a greater emphasis on their descendants' education. Hence, interacting ancestral *jinshi* density with the spatial variation in "mass killings" would provide us with a strong clue about the parental response to the shock of the Cultural Revolution. In order to examine the effect of the Cultural Revolution more specifically, we further exploit the variation in age cohorts using data from the 2005 1% mini-census to conduct a natural experiment, based on the hypothesis that the Cultural Revolution affects the schooling of only the cohort born between 1945 and 1967 (aged between 9 and 22 during the Cultural Revolution), but not those born before 1945 (the cohort who would already have graduated from college by the time the Cultural Revolution erupted) or after 1967 (when the Cultural Revolution ended).

We report the results in Table 12. In columns (1) to (4) of Panel A we interact the casualty of mass killings with the number of patrilineal *jinshi* ancestors of the surveyed respondents, and in Panel B matrilineal *jinshi* ancestors—our key variables of interest. Column (1) reports the overall result without any cohort classifications, whereas the other three columns ((2)-(4)) report the coefficients of the pre-, during, and post-Cultural Revolution cohorts, respectively. In light of the vast number of observations we set the minimum level of significance at 5%. As expected, the interaction of mass killings and *jinshi* ancestors is significantly negative in the overall sample. An increase in mass killings of one standard deviation (s.d.= 2.093, corresponding to eight additional deaths per 10,000 people) reduces the effect of patrilineal *jinshi* ancestors on years of schooling by 1.7% (0.008%*2.093), and by a magnitude of 1.9% (0.009%*2.093) in the case of matrilineal ancestors (column (1)). However, once we decompose the overall result into parts corresponding to different cohorts it becomes clear that the significance comes exclusively from the cohort we expect to be profoundly affected by the Cultural Revolution (column (3)). The pertinent coefficient of either the pre- or the post-Cultural Revolution cohort is insignificant (columns (2) and (4)). Perhaps the Cultural Revolution was an extreme case, but the finding here is more in line with the theory explaining why to provide the best possible future for their children altruistic parents would respond to shocks in the economic environment (Doepke and Zilibotti, 2008, 2014) than with the "imperfect empathy" theory that parents would shape their children's values after their own regardless of

the environment (Bisin and Verdier, 2001; Hauk and Saez-Marti, 2002). In short, in an attempt to protect their children parents responded to the Cultural Revolution by reducing their usual emphasis on education.

[Table 12 about here]

As for the post-Cultural Revolution cohort, the interaction between mass killings' casualty and *jinshi* ancestors (both patrilineal and matrilineal) is close to zero, suggesting that the educated elite families were once again responding to the environmental change by resuming the drilling of the values of *keju* culture into their children. Last but not least, to find out how *keju* culture itself fared during the Cultural Revolution we interact *jinshi* density with mass killings' casualty in Panel C. Similar to the previous findings, the coefficient of this interaction term is significant only for the "treated" cohort. But unlike the previous result, the coefficient for the post-Cultural Revolution cohort remains significantly negative (albeit only marginally), suggesting that the society as a whole may take much longer to readjust to normal conditions than individual families (particularly the elite educated ones)—a topic for future research.[54]

6 Conclusion

We observed a strong positive correlation between historical exam success several centuries ago and human capital outcomes in China today. Specifically, we documented a positive correlation between prefectures with a strong historical tradition in exam success and years of schooling today, controlling for a rich multitude of confounding covariates. Moreover, using average river distance to a prefecture's nearest locations of pine and bamboo—the main ingredients for printing—as instrument, we further showed that the documented relationship is causal.

Given that human capital advantages, once gained, can persist over time through a variety of means (genetic, family values, and so forth), we controlled for both historical (ancestors') and contemporary (parents') human capital. Not surprisingly, we find that they do significantly account for the observed persistence. Human capital is, however, not the only channel that matters. In fact culture has also played an impor-

[54]Indeed, we do find that an increase in mass killings of one standard deviation has had a much larger effect on the post-Cultural Revolution cohort (0.048%*2.093 $\sim$ 10%) than on the Cultural Revolution cohort (0.023%*2.093 $\sim$ 4.8%).

tant role in the observed persistence. This is feasible because of the exceptional social status conferred on a *jinshi*, so much so that *keju* had likely bred a distinct culture of valuing education (*juren* has had the same but arguably smaller effect). This culture has persisted to this day, as is evidenced by the strong, positive correlation between *jinshi* density and the subjective importance people in China attach to education today. To validate the culture channel, we further conducted a quasi-experiment on several thousand college students of diverse geographical origins studying in Beijing, and confirmed that *jinshi* density in their own hometowns does bear significantly upon their cognitive and non-cognitive performance.

Last but not least we also documented the conditions under which *keju* culture has shown greater resilience, vis-à-vis those that undermine its transmission. Specifically, we found that the Cultural Revolution, which targeted Confucianism and education, has demonstrably weakened an otherwise extremely persistent culture of valuing education and its expected returns. Our natural experiment shows that, in order to protect their children in an uncertain political environment, parents of families with *jinshi* ancestors decidedly reduced their usual emphasis on their children's education during the Cultural Revolution.

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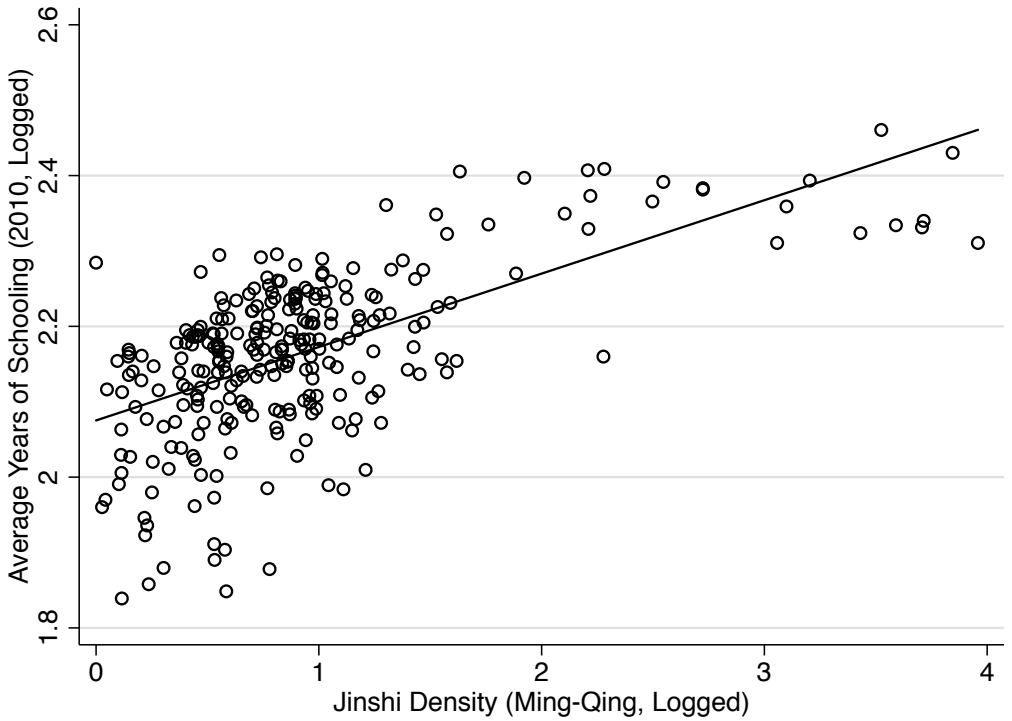


Figure 1. Correlation between Historical Success in China's Civil Exam (*Keju*) and Human Capital Today

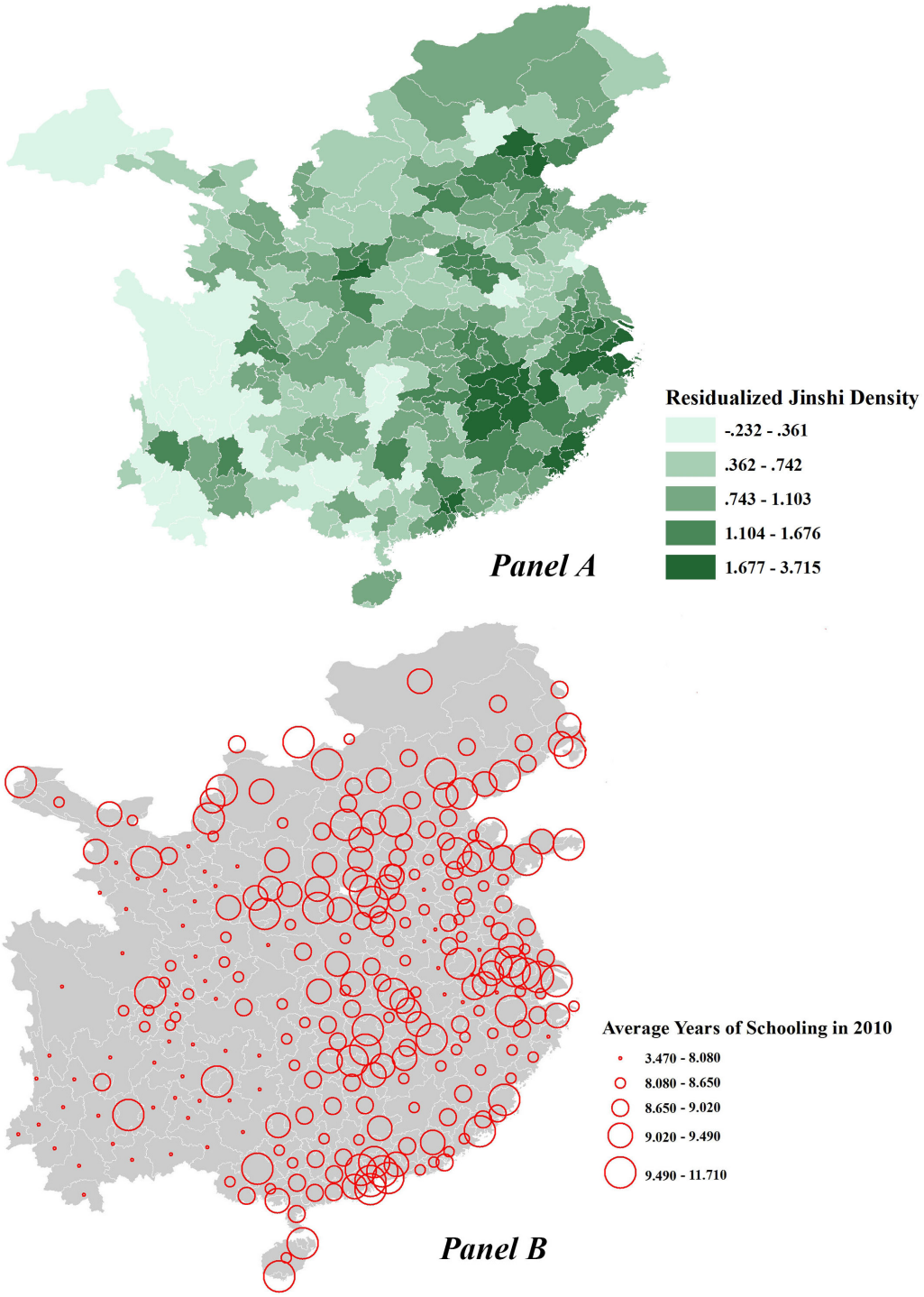


Figure 2. Historical Success in *Keju* (Residualized *Jinshi* Density) and Contemporary Human Capital

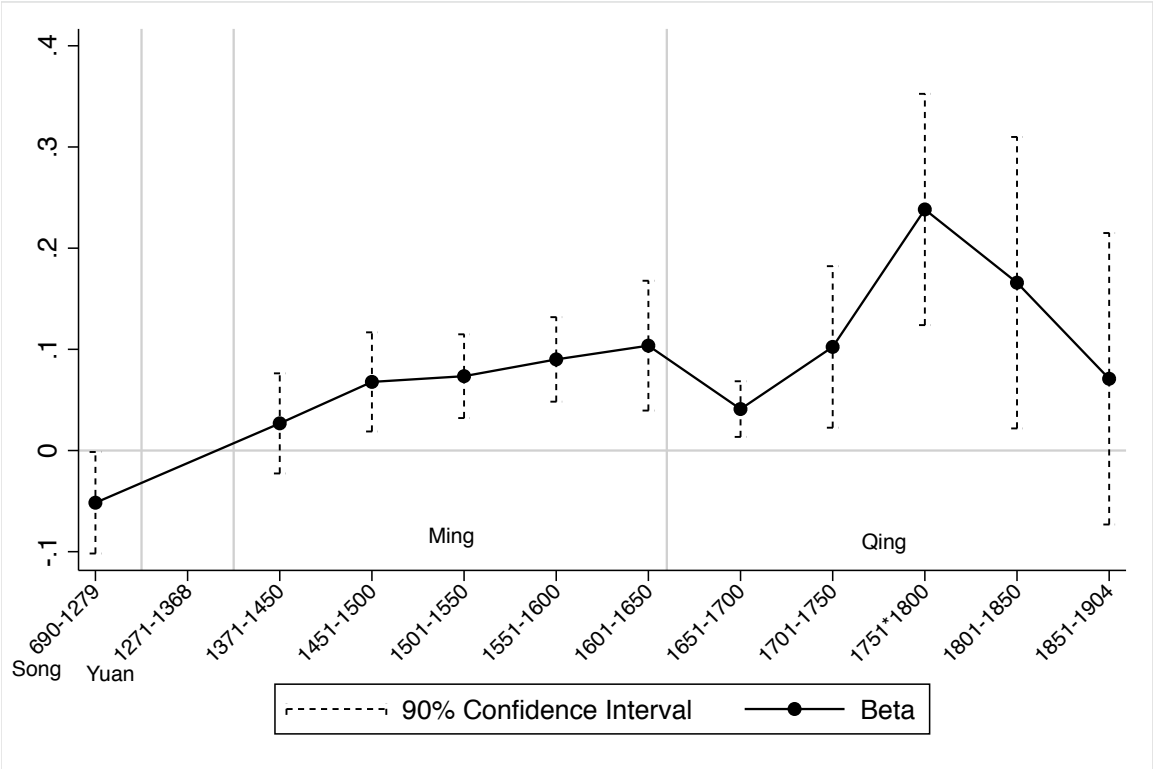
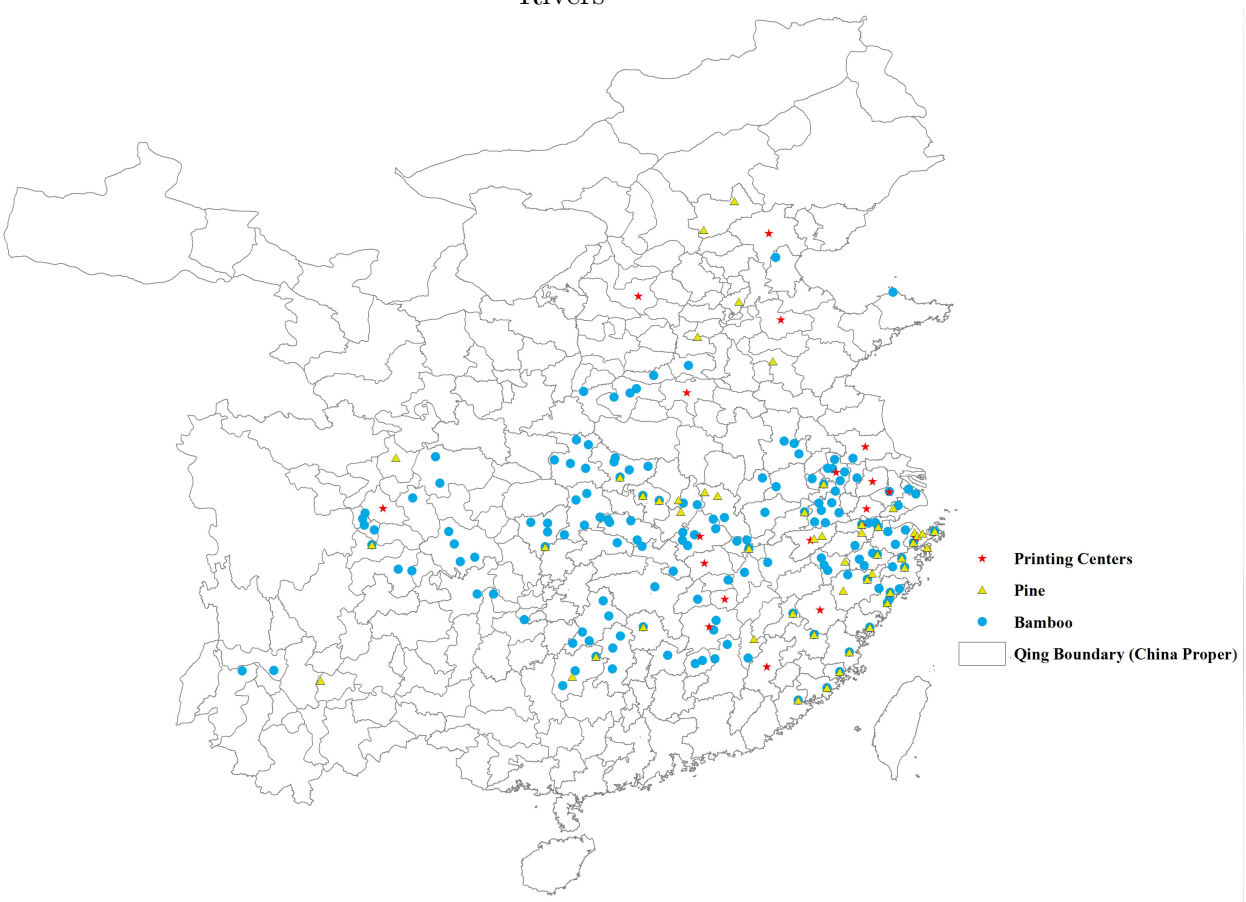
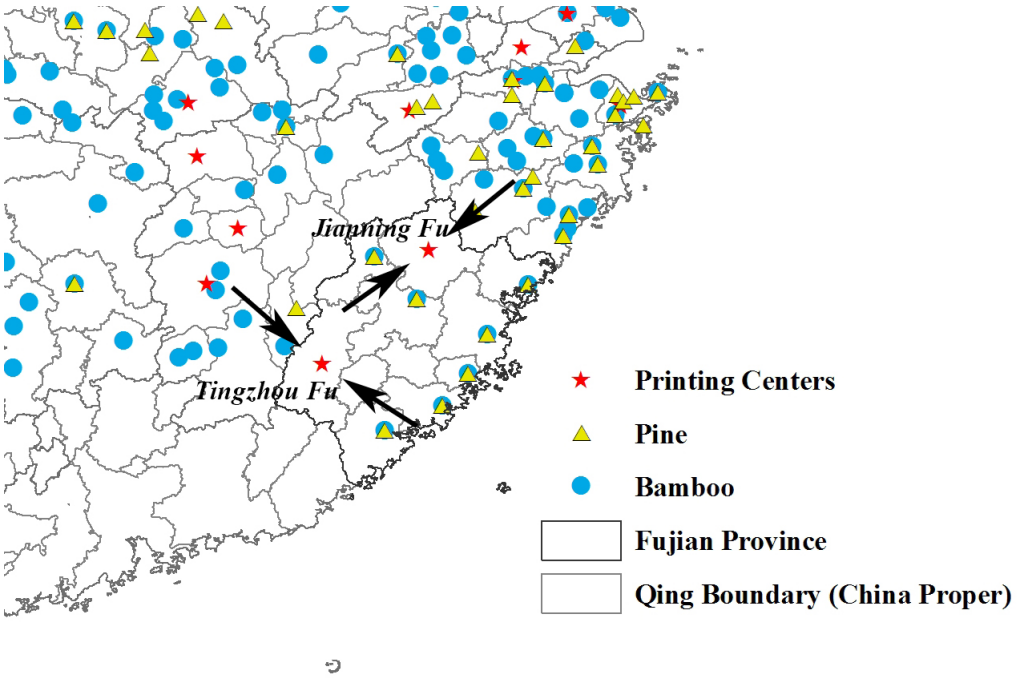


Figure 3. Impact of *Keju* on Years of Schooling in 2010, by Period

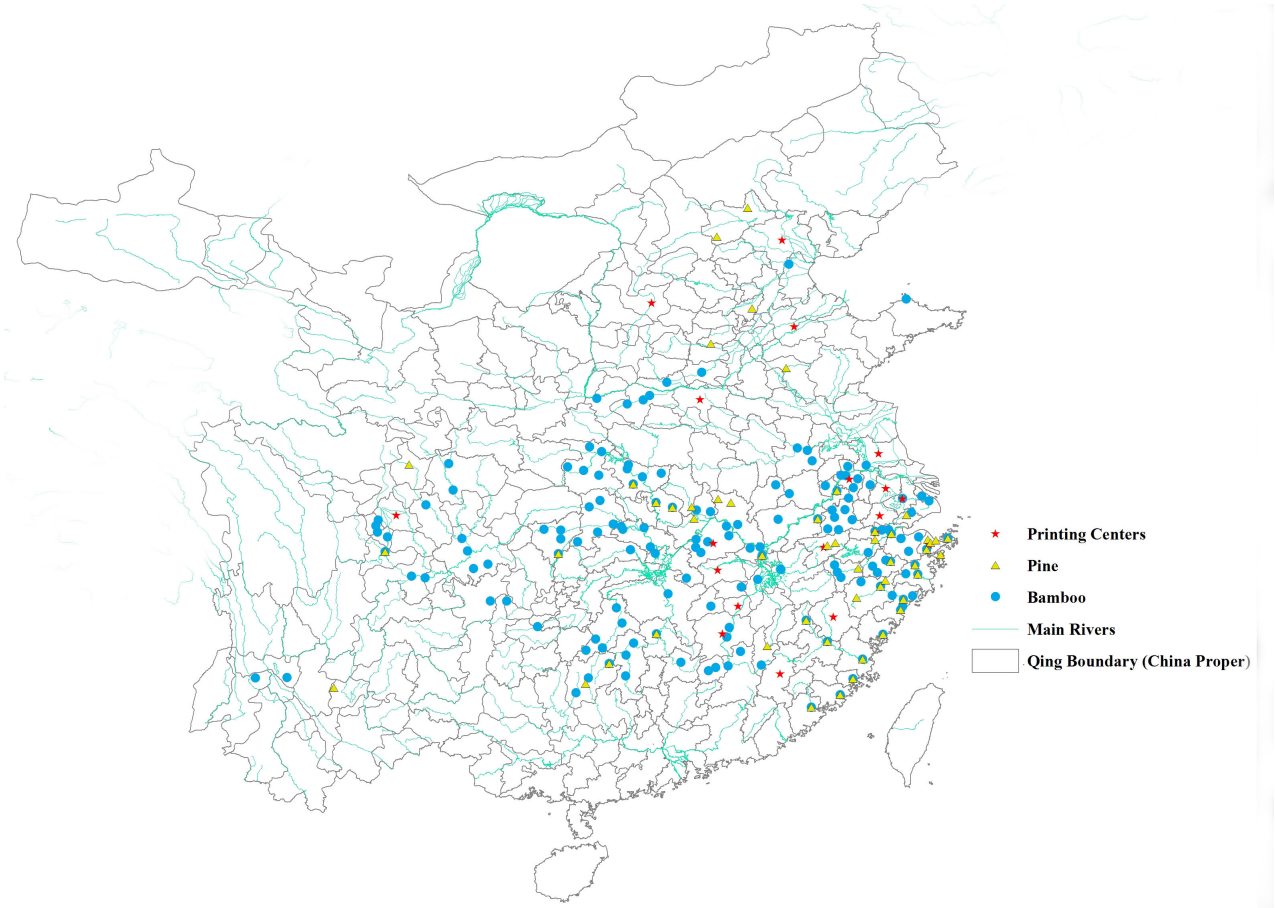
Figure 4. Locations of Pine and Bamboo, Printing Centers, and Major Navigable Rivers



Panel A Locations of Pine and Bamboo and Printing Centers



Panel B Two Examples of Printing Centers' Proximity to Pine and Bamboo Locations



Panel C Locations of Pine and Bamboo and Major Navigable Rivers

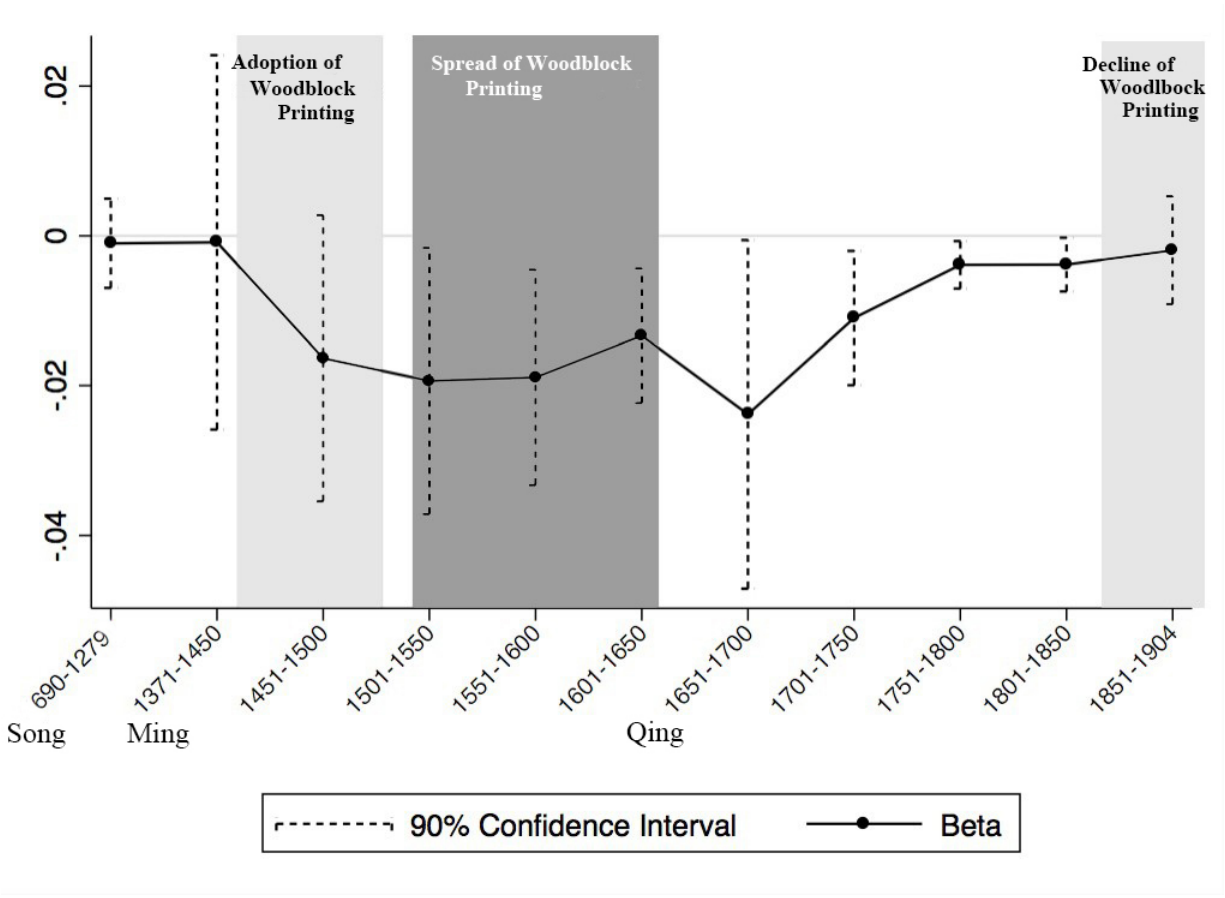


Figure 5. Effects of River Distance to Pine and Bamboo Locations on *Jinshi* Density, by Period

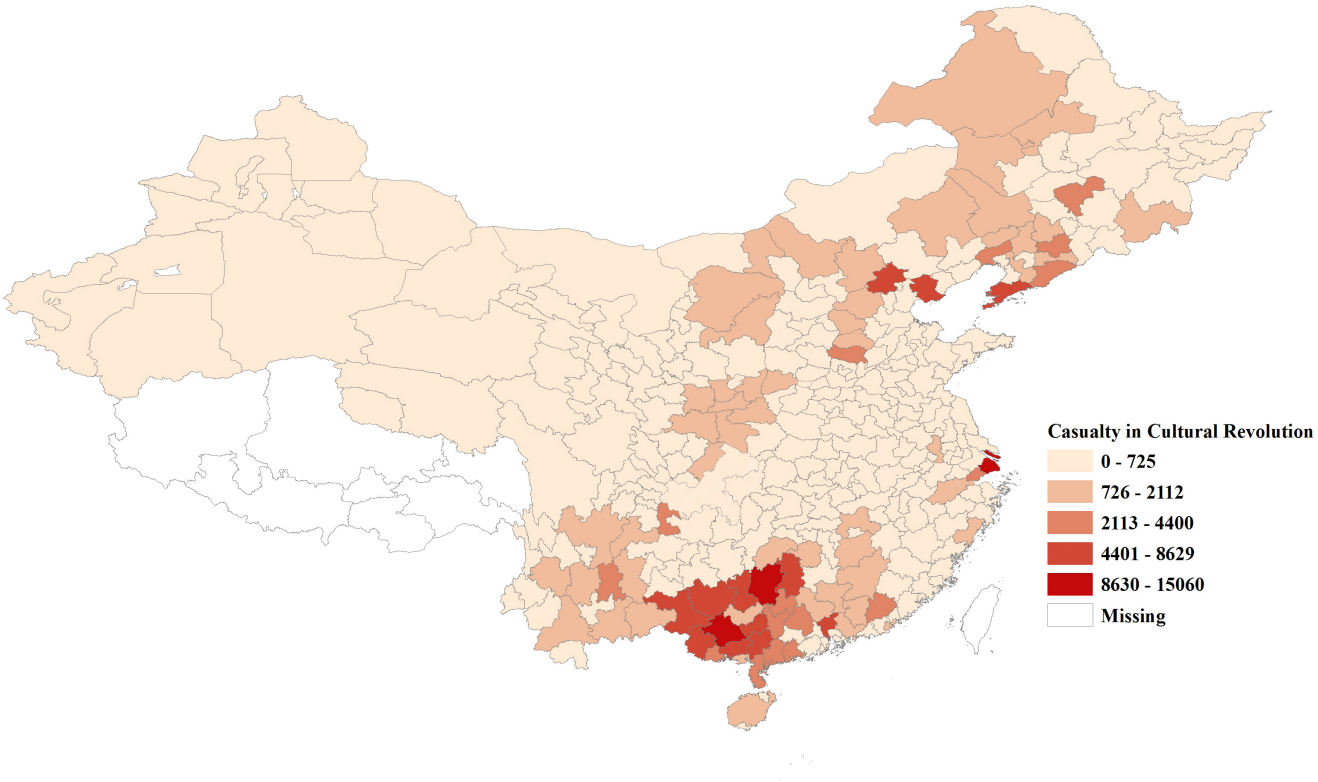


Figure 6. Geographic Distribution of Mass Killings' Casualty during the Cultural Revolution

Table 1. Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Average Years of Schooling in 2010	272	8.712	0.951	5.62	11.71
Jinshi density	272	1.3	1.107	0	8.753
Juren density	272	6.805	5.276	0	34.064
Shengyuan quota density (per exam)	272	0.709	0.395	0	3.132
Agricultural suitability	272	3.014	0.715	0.55	4.838
Commercial Center	272	0.165	0.372	0	1
Population Density	272	0.013	0.011	0	0.064
Urbanization Rate	272	0.052	0.035	0	0.307
Confucian Academies	272	0.291	0.656	0	6.152
Private Book Collections	272	6.213	5.023	0	36
Strength of Clan	272	2.537	23.633	0.003	436.283
Strength of Political Elites	272	0.449	0.566	0.003	2.886
Nighttime Lights in 2010	272	0.727	1.232	-4.072	3.482
Distance to Coast (1,000 km)	272	12.605	1.173	9.731	14.698
Terrain Ruggedness	272	0.205	0.175	0.005	0.821
Shortest River Distance to Pine/Bamboo (km)	272	11.724	7.208	0.087	37.315
Shortest Distance to Major Navigable Rivers (km)	272	2.939	2.667	0.042	17.606
Printed Books	272	35.851	117.117	0	1082

Table 2. Historical Determinants of *Keju* Success

	Jinshi Density (logged)					*Juren* Density (logged)
	(1)	(2)	(3)	(4)	(5)	(6)
Distance to Coast (logged)	-0.073	-0.114	-0.029	-0.060	-0.021	-0.221*
	(0.125)	(0.120)	(0.093)	(0.092)	(0.093)	(0.109)
Terrain Ruggedness	-1.176***	-1.377***	0.702	0.597	0.775	0.817
	(0.408)	(0.344)	(0.524)	(0.548)	(0.493)	(0.825)
Shengyuan Quota Density (logged)		0.545**	0.455*	0.402**	0.193	1.214***
		(0.259)	(0.222)	(0.170)	(0.180)	(0.272)
Population Density (logged)			0.562***	0.495***	0.390***	0.556***
			(0.135)	(0.138)	(0.131)	(0.162)
Urbanization Rate			5.915*	6.499**	4.686*	9.395***
			(3.186)	(3.148)	(2.664)	(3.158)
Agricultural Suitability			-0.146**	-0.140**	-0.087	-0.025
			(0.061)	(0.067)	(0.055)	(0.125)
Commercial Center			-0.091	-0.167*	-0.226*	0.007
			(0.108)	(0.090)	(0.123)	(0.103)
Confucian Academies				0.202**	0.199***	0.117***
				(0.074)	(0.067)	(0.027)
Private Book Collections				0.019	0.017	0.012
				(0.018)	(0.014)	(0.010)
Strength of Clan (logged)					0.077**	0.147***
					(0.032)	(0.038)
Strength of Political Elites (logged)					0.172***	0.156***
					(0.030)	(0.044)
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	272	272	272	272	272	272
Adj. R-squared	0.248	0.258	0.360	0.402	0.485	0.570

Notes: All results are OLS estimates. 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 3. Impact of *Jinshi* Density on Contemporary Human Capital: OLS Estimates

	Average Years of Schooling in 2010 (logged)					
	(1)	(2)	(3)	(4)	(5)	(6)
Jinshi Density (logged)	0.092***	0.065***	0.070***	0.067***	0.058***	
	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	
Jinshi Density (logged, excludes migrant)						0.053***
						(0.019)
						[0.016]
Economic Prosperity						
Population Density (logged)			-0.049***	-0.051***	-0.053***	-0.049***
			(0.016)	(0.016)	(0.015)	(0.015)
			[0.013]	[0.013]	[0.012]	[0.013]
Urbanization Rate			0.062	0.093	0.051	0.234
			(0.163)	(0.156)	(0.164)	(0.180)
			[0.167]	[0.162]	[0.173]	[0.169]
Commercial Center			-0.012	-0.014	-0.020	-0.026*
			(0.014)	(0.014)	(0.013)	(0.014)
			[0.011]	[0.011]	[0.011]	[0.012]
Agricultural Suitability			-0.005	-0.005	-0.003	-0.004
			(0.014)	(0.014)	(0.014)	(0.014)
			[0.009]	[0.009]	[0.009]	[0.009]
Educational Infrastructure						
Confucian Academies				0.005	0.007	0.018***
				(0.006)	(0.006)	(0.004)
				[0.004]	[0.004]	[0.006]
Private Book Collections				0.001	0.001	0.002**
				(0.001)	(0.001)	(0.001)
				[0.001]	[0.001]	[0.001]
Clan and Political Elites						
Strength of Clan (logged)					0.003	0.008
					(0.004)	(0.006)
					[0.003]	[0.004]
Strength of Political Elites (logged)					0.011***	0.016***
					(0.003)	(0.004)
					[0.003]	[0.003]
Baseline Control Variables						
Nighttime Lights in 2010		0.053***	0.059***	0.061***	0.061***	0.072***
		(0.009)	(0.009)	(0.009)	(0.009)	(0.007)
		[0.010]	[0.010]	[0.010]	[0.010]	[0.010]
Distance to Coast (logged)		0.010	0.008	0.007	0.009	0.009
		(0.013)	(0.012)	(0.011)	(0.010)	(0.010)
		[0.008]	[0.008]	[0.008]	[0.007]	[0.008]
Terrain Ruggedness		0.050	-0.072	-0.073	-0.061	-0.018
		(0.067)	(0.065)	(0.065)	(0.060)	(0.063)
		[0.066]	[0.069]	[0.068]	[0.066]	[0.066]

(*Continued*)

Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	272	272	272	272	272	272
Adj. R-squared	0.375	0.734	0.751	0.751	0.759	0.716

Notes: 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 4. Impact of *Keju* on Contemporary Human Capital: Alternative Measures

	Average Years of Schooling in 2010 (logged)					
	(1)	(2)	(3)	(4)	(5)	(6)
Jinshi Density (logged)					0.067***	0.057***
					(0.012)	(0.011)
Juren Density (logged)			0.030***	0.025***	-0.004	0.001
			(0.009)	(0.009)	(0.011)	(0.009)
Shengyuan Quota Density (logged)	0.043	0.018			0.021	0.008
	(0.033)	(0.020)			(0.028)	(0.023)
Baseline Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Additional Control Variables	No	Yes	No	Yes	No	Yes
Provincial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	272	272	272	272	272	272
Adj. R-squared	0.640	0.701	0.670	0.717	0.733	0.757

Notes: All results are OLS estimates. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, strength of clan and political elites. 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. 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***	0.170***						
	(0.031)	(0.036)						
River Distance			-0.017***	-0.017***	-0.092***	-0.084***	-0.102***	-0.099***
to Pine/Bamboo			(0.004)	(0.004)	(0.029)	(0.029)	(0.011)	(0.012)
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	272	272	272	272	272	272	272	272
Adj. R-squared	0.323	0.332	0.132	0.131	0.449	0.463	0.526	0.528

Notes: 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 6. Exclusion Restrictions

Panel A	Commercial Centers	Tea Centers	Silk Centers	Population Density	Population Density in 1953	Urbanization Rate	Urbanization Rate in 1920	Light Density in 2010
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
River Distance	-0.006	0.033	0.046	-0.02	-0.021	-0.001	-0.022	-0.021
to Pine/Bamboo	(0.005)	(0.021)	(0.045)	(0.019)	(0.017)	(0.001)	(0.024)	(0.015)
Number of Observations	272	272	272	272	267	272	272	272
Adj. R-squared	0.314	0.650	0.751	0.628	0.537	0.666	0.301	0.64

Panel B	Suitability (Rice)	Suitability (Wheat)	Suitability (Tea)	Suitability (Mulberry Tree)	Suitability (Maize)	Suitability (Sweet Potato)	Terrain Ruggedness
	(9)	(10)	(11)	(12)	(13)	(14)	(15)
River Distance	-0.012	-0.102	-0.011	-0.008	-0.117	0.004	0.001
to Pine/Bamboo	(0.044)	(0.134)	(0.021)	(0.019)	(0.097)	(0.064)	(0.002)
Number of Observations	272	272	272	272	272	272	272
Adj. R-squared	0.661	0.615	0.622	0.587	0.653	0.833	0.642

Panel C	Distance to Commercial Centers	Distance to Silk Centers	Distance to Tea Centers	Distance to Large Cities in 1920	Distance to National Capital	Distance to Provincial Capital
	(16)	(17)	(18)	(19)	(20)	(21)
River Distance	0.031	0.045	0.051	0.035	-0.035	-0.064
to Pine/Bamboo	(0.034)	(0.086)	(0.091)	(0.083)	(0.085)	(0.080)
Number of Observations	272	272	272	272	272	272
Adj. R-squared	0.647	0.7	0.698	0.7	0.688	0.706

Notes: All results are OLS estimates. 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 7. Impact of *Keju* on Contemporary Human Capital: Instrumented Results

	Reduced-form			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Jinshi Density (logged)				0.104***	0.080***	0.082***
				(0.008)	(0.013)	(0.013)
Distance to Major Navigable Rivers			0.008			0.008
			(0.006)			(0.006)
	First Stage			First Stage		
River Distance to Bamboo/Pine	-0.011***	-0.006***	-0.006***	-0.011***	-0.006***	-0.006***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
First Stage F-stat				78.04	58.07	57.76
First Stage Partial R-squared				0.392	0.282	0.282
Baseline + Additional Controls	No	Yes	Yes	No	Yes	Yes
Provincial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	272	272	272	272	272	272
Adj. R-squared	0.531	0.732	0.735	0.65	0.751	0.752
Cragg-Donald Wald F-statistic				129.156	72.314	72.354

Notes: Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, strength of clan and political elites. 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. Channels of Human Capital Persistence Decomposed

	Years of Schooling (logged)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Jinshi Density (logged)	0.225***	0.164***	0.167***	0.167***	0.153***	0.188***	0.670***	0.324***
	(0.036)	(0.037)	(0.036)	(0.036)	(0.036)	(0.033)	(0.068)	(0.056)
Patrilineal *Jinshi* Ancestors		0.041***	0.041***	0.041***	0.048***		0.117***	
(logged)		(0.007)	(0.007)	(0.007)	(0.008)		(0.010)	
Matrilineal *Jinshi* Ancestors		0.033***	0.030***	0.030***		0.034***		0.044***
(logged)		(0.002)	(0.002)	(0.002)		(0.003)		(0.005)
Father's Years of Schooling			0.017***	0.014***	0.015***	0.015***	0.015***	0.015***
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mother's Years of Schooling			0.033***	0.032***	0.042***	0.029***	0.045***	0.032***
			(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Parents' Income				0.005**	0.004*	0.004*	0.005**	0.005**
				(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Housing Property				0.010***	0.010***	0.010***	0.010***	0.010***
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Strong Clan					0.030	0.282***		
					(0.111)	(0.073)		
Strong Clan					0.041*			
*Patrilineal *Jinshi* Ancestors					(0.016)			
Strong Clan						-0.001		
*Matrilineal *Jinshi* Ancestors						(0.008)		
Jinshi							-0.079***	
*Patrilineal *Jinshi* Ancestors							(0.009)	
Jinshi								-0.018*
*Matrilineal *Jinshi* Ancestors								(0.007)
Baseline + Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	553718	553718	553718	553718	553718	553718	553718	553718
Adj. R-squared	0.235	0.276	0.282	0.283	0.287	0.294	0.277	0.274

Notes: All results are based on OLS estimates from the 2005 1% mini-census data. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, strength of clan and political elites. Individual control variables are 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 0.1%, 1%, and 5%, respectively.

Table 9. The Culture Channel

	2SLS					
Panel A	CGSS		BCSPS		CFPS	
	Whether education is the most important determinant of social status (1=yes, 0=no),	Whether the government should prioritize spending on education (1=yes, 0=no)	Whether education is the most important determinant of social status (1=yes 0=no)	Whether the government should prioritize spending on education (1=yes, 0=no)	How many years of schooling you expected your child to obtain?	Whether the parents provide good learning environment for their child?
	(1)	(2)	(3)	(4)	(5)	(6)
Jinshi Density (logged)	0.277***	0.206***	0.259***	0.061*	0.374***	0.067*
	(0.055)	(0.061)	(0.094)	(0.036)	(0.014)	(0.037)
Number of Observations	8274	8274	4052	4052	3873	7426
Adj. R-squared	0.571	0.223	0.317	0.140	0.653	0.117
Panel B			CFPS			
	Importance of Success	Family Harmony	Patience	Work Ethic	Trust in Neighbor	Trust in Stranger
	(7)	(8)	(9)	(10)	(11)	(12)
Jinshi Density (logged)	0.308	0.139	-0.296	0.325*	0.735	-0.374
	(0.252)	(0.195)	(0.457)	(0.192)	(0.547)	(0.446)
Number of Observations	7015	7015	7012	7015	6404	6389
Adj. R-squared	0.018	0.020	0.077	0.065	0.010	0.040 37
Baseline + Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All results are 2SLS estimates, in which jinshi density is instrumented by a prefecture's shortest river distance to pine/bamboo locations. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, strength of clan and political elites. Individual control variables are age, gender, ethnicity, residential status (rural versus urban), household income, father's education and mother's education. 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 10. Effect of *Keju* on Formation of Cognitive and Non-Cognitive Skills: A Quasi-Experiment based on BCSPS (2008-2012)

	Academic Absence (2=often; 1=sometimes; 0=never)	Intention to Pursue Graduate Studies	Class Ranking	College English Test Scores	Admitted to Graduate Schools
	(1)	(2)	(3)	(4)	(5)
Hometown Jinshi Density (logged)	-0.055***	0.069***	2.857***	0.218***	0.044**
	(0.017)	(0.012)	(0.539)	(0.022)	(0.020)
Entrance Exam Scores (logged)	-0.038	0.337***	5.706***	0.193***	0.048
	(0.057)	(0.036)	(1.562)	(0.060)	(0.074)
Father's Education	0.006	0.013***	0.042	0.006	-0.001
	(0.004)	(0.003)	(0.113)	(0.006)	(0.005)
Mother's Education	-0.003	0.014***	0.092	-0.006	0.006
	(0.004)	(0.003)	(0.138)	(0.006)	(0.006)
Baseline + Additional Control Variables	Yes	Yes	Yes	Yes	Yes
Individual Control Variables	Yes	Yes	Yes	Yes	Yes
Enrollment Cohort Fixed Effects	No	No	No	No	No
University-major-cohort Fixed Effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	9495	12497	12497	6243	3175
Adj. R-squared	0.088	0.288	0.193	0.257	0.369

Notes: All results are 2SLS estimates using the 2008-2012 BCSPS survey of Beijing university students, in which *jinshi* density is instrumented by a prefecture's shortest river distance to pine/bamboo locations. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, and strength of clan and political elites. Individual-level control variables include age, gender, father and mother's years of schooling, and household income. 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 11. Historical Shocks and Cultural Transmission

	Average Years of Schooling in 2010 (logged)		
	(1)	(2)	(3)
Jinshi Density (logged)	0.175	0.213*	0.329***
	(0.126)	(0.114)	(0.122)
Taiping Rebellion	0.042		
	(0.062)		
Jinshi Density *Taiping Rebellion	-0.018		
	(0.068)		
Treaty Ports		0.078	
		(0.050)	
Jinshi Density *Treaty Ports		-0.087	
		(0.065)	
Mass Killings in the CR			0.040**
			(0.019)
Jinshi Density *Mass Killings in the CR			-0.042**
			(0.019)
Baseline + Additional Control Variables	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Number of Observations	269	269	269
Adj. R-squared	0.586	0.546	0.379

Notes: All results are based on 2SLS estimates. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, and strength of clan and political elites. 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 12. Environmental Shock and *Keju* Transmission:
A Natural Experiment Using the Cultural Revolution (CR)

	Years of Schooling (logged)			
	All	Pre-CR Cohort (<1945)	CR Cohort ([1945, 1967])	Post-CR Cohort (>1967)
Panel A	(1)	(2)	(3)	(4)
Jinshi Density (logged)	0.289***	0.564***	0.334***	0.227***
	(0.055)	(0.130)	(0.062)	(0.044)
Patrilineal *Jinshi* Ancestors	0.108***	0.119***	0.101***	0.070**
(logged, PJA)	(0.014)	(0.033)	(0.018)	(0.022)
Mass Killings in the CR (MK)	0.029	0.008	0.044	-0.013
	(0.017)	(0.041)	(0.023)	(0.031)
PJA*MK	-0.008***	-0.006	-0.009**	-0.003
	(0.002)	(0.006)	(0.003)	(0.003)
Number of Observations	2108533	166908	802244	571748
Adj. R-squared	0.274	0.426	0.307	0.304
Panel B	(5)	(6)	(7)	(8)
Jinshi Density (logged)	0.295***	0.610***	0.248***	0.262***
	(0.046)	(0.127)	(0.053)	(0.043)
Matrilineal *Jinshi* Ancestors	0.108***	0.134**	0.130***	0.067***
(logged, MJA)	(0.017)	(0.050)	(0.029)	(0.020)
Mass Killings in the CR (MK)	0.032	-0.023	0.060	-0.020
	(0.022)	(0.047)	(0.040)	(0.032)
MJA*MK	-0.009**	-0.000	-0.012*	-0.002
	(0.003)	(0.008)	(0.005)	(0.003)
Number of Observations	2108533	166908	802244	571748
Adj. R-squared	0.272	0.430	0.308	0.309
Baseline + Additional Controls	Yes	Yes	Yes	Yes
Individual Control Variables	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes

(*Continued*)

Panel C	(9)	(10)	(11)	(12)
Jinshi Density (logged, JD)	0.431***	0.609*	0.378***	0.506**
	(0.080)	(0.292)	(0.078)	(0.157)
Patrilineal *Jinshi* Ancestors	0.047***	0.064**	0.027	0.032***
(logged, PJA)	(0.007)	(0.025)	(0.017)	(0.005)
Matrilineal *Jinshi* Ancestors	0.039***	0.107***	0.043	0.040***
(logged, MJA)	(0.006)	(0.022)	(0.022)	(0.005)
Mass Killings in the CR (MK)	0.004	-0.010	-0.004	0.019
	(0.011)	(0.040)	(0.011)	(0.022)
JD*MK	-0.032**	-0.017	-0.023*	-0.048*
	(0.010)	(0.051)	(0.010)	(0.023)
Number of Observations	2108533	166908	802244	571748
Adj. R-squared	0.280	0.437	0.307	0.322
Baseline + Additional Controls	Yes	Yes	Yes	Yes
Individual Control Variables	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes

Notes: All results are based on OLS estimates from the 2005 1% mini-census data. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, and strength of clan and political elites. Individual control variables are 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 0.1%, 1%, and 5%, respectively.

Appendix (For Online Publication)

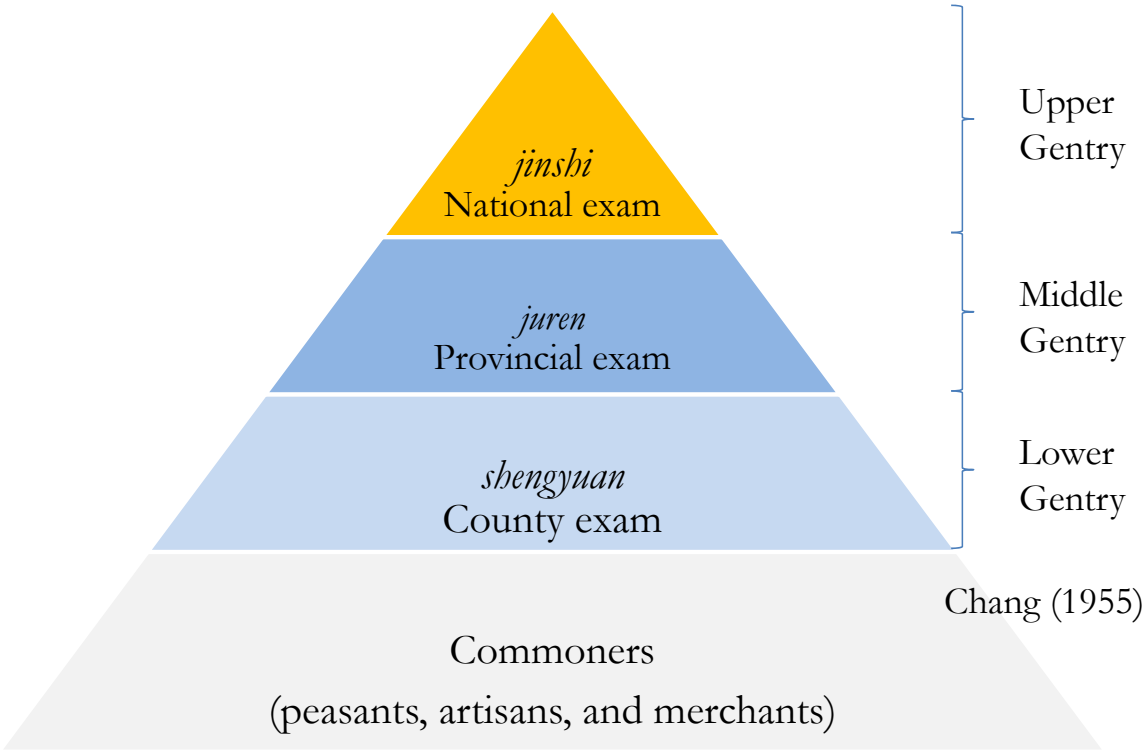


Figure A1. The Hierarchy of *Keju*

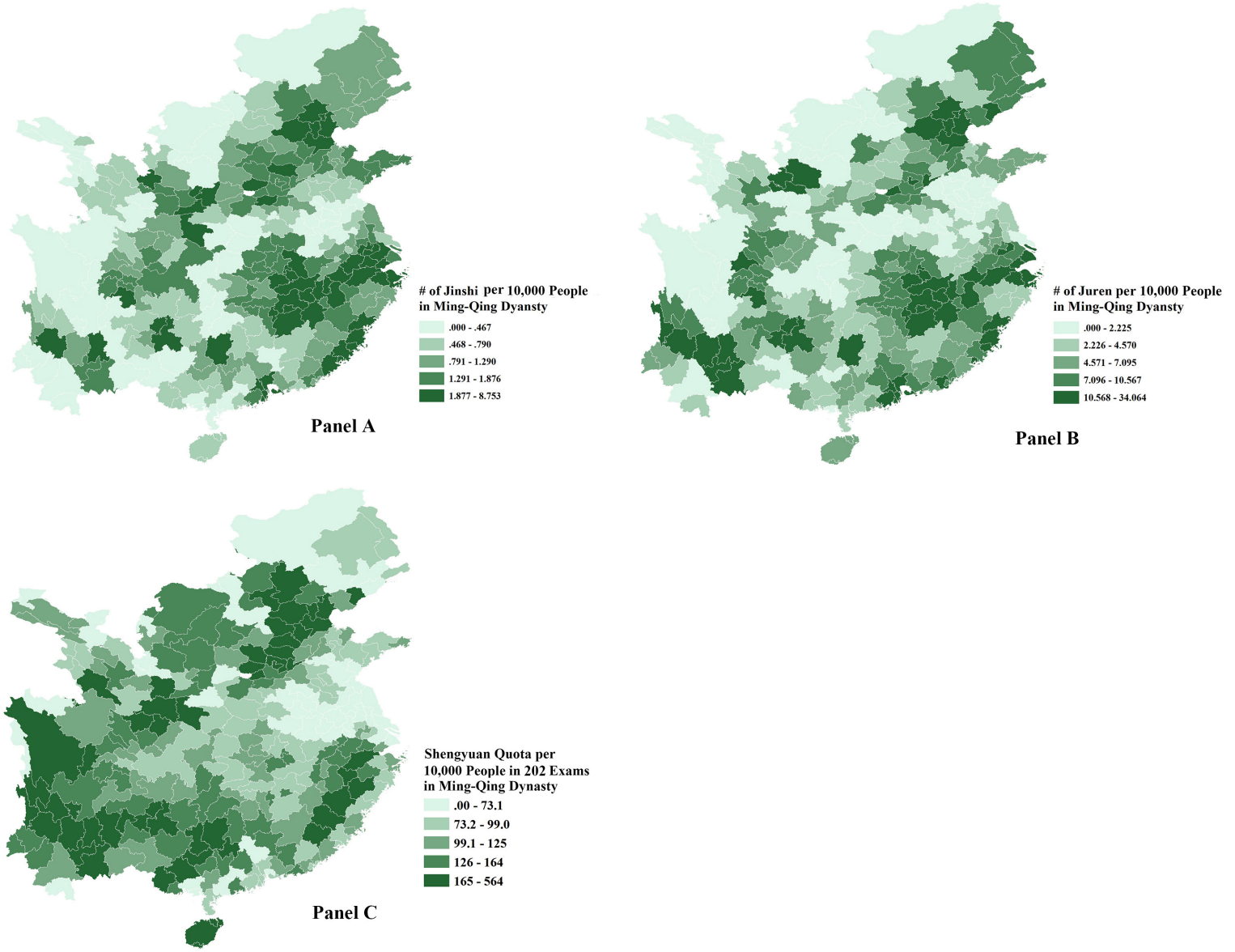


Figure A2. Regional Distributions of *Jinshi*, *Juren* and *Shengyuan* Quota Densities in the Ming-Qing Period

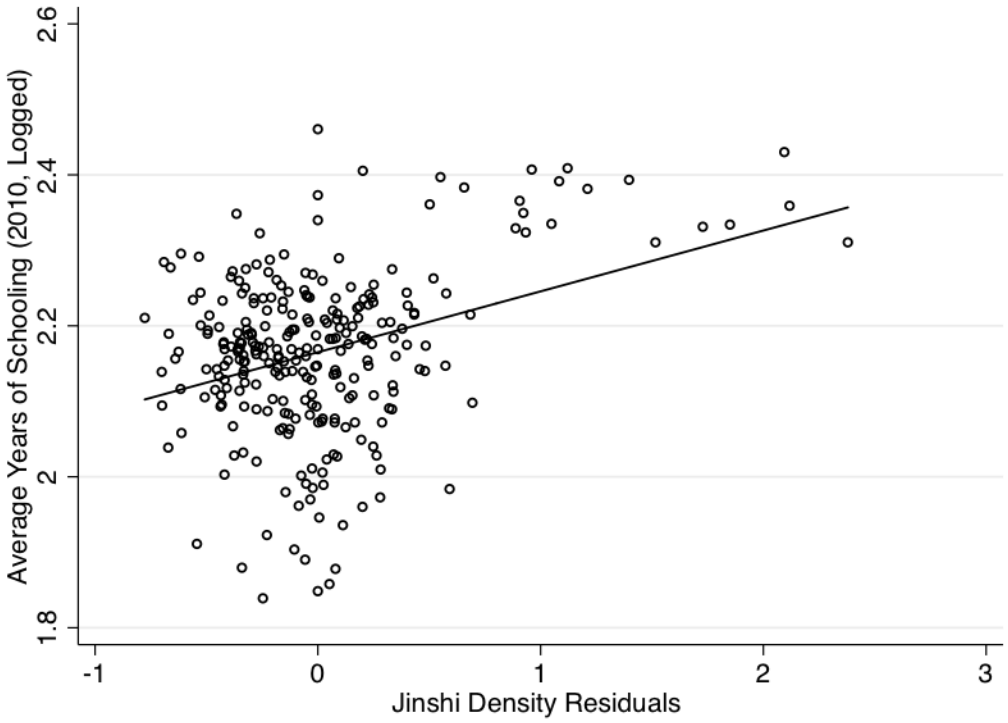


Figure A3 Correlation between Residuals of *Jinshi* Density (Ming-Qing) and Average Years of Schooling in 2010

Table A1. Channels of Culture: OLS Estimates

Panel A	CGSS		BCSPS		CFPS	
	Whether education is the most important determinant of social status (1=yes, 0=no),	Whether the government should prioritize spending on education (1=yes, 0=no)	Whether education is the most important determinant of social status (1=yes 0=no)	Whether the government should prioritize spending on education (1=yes, 0=no)	How many years of schooling you expected your child to obtain?	Whether the parents provide good learning environment for their child?
	(1)	(2)	(3)	(4)	(5)	(6)
Jinshi Density (logged)	0.285***	0.193***	0.089**	0.075***	0.306***	0.099***
	(0.037)	(0.035)	(0.041)	(0.020)	(0.008)	(0.020)
Number of Observations	8274	8274	4052	4052	3873	7426
Adj. R-squared	0.571	0.223	0.320	0.140	0.659	0.118
Panel B			CFPS			
	Importance of Success	Family Harmony	Patience	Work Ethic	Trust in Neighbor	Trust in Stranger
	(7)	(8)	(9)	(10)	(11)	(12)
Jinshi Density (logged)	0.062	0.035	0.078	0.024	-0.167*	0.183
	(0.048)	(0.028)	(0.099)	(0.027)	(0.089)	(0.113)
Number of Observations	7015	7015	7012	7015	6404	6389
Adj. R-squared	0.024	0.023	0.087	0.016	0.030	0.049
Baseline + Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All results are OLS estimates. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, strength of clan and political elites. Individual control variables are age, gender, ethnicity, residential status (rural versus urban), household income, father's education and mother's education. 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 A2. Effect of *Keju* on Formation of Cognitive and Non-Cognitive Skills: A Quasi-Experiment based on BCSPS (2008-2012), OLS Estimates

	Academic Absence (2=often; 1=sometimes; 0=never)	Intention to Pursue Graduate Studies	Class Ranking	College English Test Scores	Admitted to Graduate Schools
	(1)	(2)	(3)	(4)	(5)
Hometown Jinshi Density (logged)	-0.022**	0.024***	1.402***	0.290***	0.026**
	(0.009)	(0.007)	(0.418)	(0.022)	(0.012)
Entrance Exam Scores (logged)	-0.039	0.340***	5.798***	0.193***	0.048
	(0.057)	(0.035)	(1.588)	(0.061)	(0.075)
Father's Education	0.006	0.013***	0.033	0.007	-0.001
	(0.004)	(0.003)	(0.112)	(0.006)	(0.005)
Mother's Education	-0.004	0.015***	0.118	-0.008	0.007
	(0.004)	(0.003)	(0.139)	(0.006)	(0.006)
Baseline + Additional Controls	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes
Enrollment Cohort Fixed Effects	No	No	No	No	No
University-major-cohort Fixed Effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	9495	12497	12497	6243	3175
Adj. R-squared	0.090	0.291	0.194	0.261	0.369

Notes: All results are OLS estimates using the 2008-2012 BCSPS survey of Beijing university students. Baseline controls include nighttime lights, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, strength of clan and political elites. Individual-level control variables include age, gender, father and mother's years of schooling, and household income. Robust standard error adjusted for clustering at the prefecture level are given in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Table A3. Historical Shocks and Cultural Transmission, OLS Estimates

	Average Years of Schooling in 2010 (logged)		
	(1)	(2)	(3)
Jinshi Density (logged)	0.052***	0.048***	0.084***
	(0.013)	(0.012)	(0.016)
Taiping Rebellion	0.017		
	(0.028)		
Jinshi Density *Taiping Rebellion	0.000		
	(0.014)		
Treaty Ports		0.016	
		(0.010)	
Jinshi Density *Treaty Ports		0.002	
		(0.009)	
Mass Killings in the CR			0.011***
			(0.003)
Jinshi Density * Mass Killings in the CR			-0.007**
			(0.003)
Baseline + Additional Control Variables	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Number of Observations	272	272	272
Adj. R-squared	0.766	0.768	0.773

Notes: All results are based on OLS estimates. Baseline controls include nighttime lights in 2010, agricultural suitability, distance to coast, and terrain ruggedness. Additional controls are commercial center, population density, urbanization rate, Confucian academies, private book collections, and strength of clan and political elites. 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.