Institutions, Culture, and Human Capital in the Long Run: Legacies of China's Imperial Exam System

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Motivation

- Long-term persistence: institutions or historical events can generate long-term persistence in the development process through the cultural elements embedded in these events or institutions
  - Nunn and Wantchekon (2011): slave trade that lasted for over 400 years (between 1400 and 1900) in Africa had resulted in a culture of mistrust
  - Voigtlaender and Voth (2012): sentiments of anti-Semitism in the 1920s were strongest in towns where the Jews were blamed for having poisoning the wells during the Black Death
  - Alesina et al (2013): the descendants of societies that traditionally practiced plough agriculture have much less equal gender norms today
- Strong correlation between the historical performance in China's civil examination system (1368-1905) and human capital outcomes today Figure 1, despite the change in educational institutions from one deeply embedded in Confucian classics to Western-style education

Figure 1. Correlation between Historical Success in China's Civil Exam and Human Capital Outcomes Today

- Number of *jinshi* (1368-1905) and years of schooling (2010) are highly correlated: **0.24** ***
- Number of *jinshi* (1368-1905) and % of college students (2010) are highly correlated: **0.16** ***

Motivation

- Consolidated in the Song dynasty (960-1276 A.D.), China's civil exam system or *keju* was designed to recruit learned talents into the government in a society where government service was considered the most honorable and worthwhile occupation of all (officials > peasants > artisans > merchants)
- Openness of the Civil Exam System and the social mobility it facilitated attracted talents from all walks of life and focused the nation's intellectual resources toward examination and bureaucratic activity (Needham, *Science and Civilization in China Vol. 3*, 1959)
  - "The one idea of every merchant's son was to become a scholar, to enter the imperial examination, and to rise high in the bureaucracy" (Needham, *The Grand Titration: Science and Society in East and West*, 1969)
  - "The failure of merchants to rise to power in China leads to the failure of China to develop European-style technology" (Needham, 1959)

Motivation

- *Keju* exam drew heavily on Confucian classics and rote learning and is thus not suited to formal logical thinking and scientific progress (Hartwell, 1971, Needham, 1975; Lin, 1995)
  - Lack of "useful knowledge" grounded in a broad epistemic base (Mokyr, 2002)
  - Explains why China's technological progress failed to sustain its supremacy to Europe after 1400 (Mokyr, 1990)
    - The "Needham Puzzle": *"Why did modern science, the mathematization of hypotheses about Nature, with all its implications for advanced technology, take its meteoric rise only in the West at the time of Galileo [but] had not developed in Chinese civilization or Indian civilization?"* (Needham, 1969)

Research Question

- But due to intense competition (and the upward social mobility it created) *keju* had bred a culture or norms of valuing education, which may have had a profound impact in the long run
  - "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; . . . . . and the preservation of Chinese civilization in spite of barbarian conquest." (Bertrand Russell, *The Problem of China*, 1922)
- Our specific hypothesis is to test:
  - Whether *keju* has a positive effect on human capital outcomes in the long run and
  - Whether culture is an important channel of this transmission

Key Preliminary Findings

- *Keju* has a persistent effect on human capital outcomes to this day
  - Prefectures producing more *jinshi* historically outperform others in a number of key human capital indicators, viz., years of schooling, share of college students, and literacy rate
- The effect of *keju* is causal
  - Using the geographic distribution of the natural endowments required for the traditional block printing (ink, bamboo, and mulberry) in the Ming dynasty to instrument the number of *jinshi*
- Suggestive evidence that culture (of valuing education) is the primary channel of the persistent *keju* effect
- The *keju* culture is transmitted both vertically through kinship and horizontally among peers
  - Elite families (measured by surname-prefecture) having produced more *jinshi* historically attain higher average years of schooling net of the horizontal effect of *jinshi*
- Conditions under which the *keju* culture was strongly or weakly transmitted
  - The effect of *keju* culture on human capital is stronger in regions where the returns to education are higher
  - Culture could be mitigated by negative shocks, e.g., during the Cultural Revolution of 1966-1971, effect of *keju* is smaller in regions with higher incidence of mass fighting (武斗)

Roadmap

1. **Historical background**
2. The effect of *keju* on contemporary human capital: baseline results
3. Identifying the causal effect of *keju*: the role of printing
4. The cultural channel between *keju* and contemporary human capital outcomes
5. Accounting for the transmission of the *keju* culture
   1. Vertical and horizontal transmission
   2. Conditions of cultural transmission
6. Conclusion

1.1. Hierarchy of Civil Exam System in Ming-Qing China

- In 19th century China, the gentry class accounted for 2% of the total population, but their income accounted for 24% of total GNP
- A gentry's income is 16 times that of a commoner (Chang, 1962)

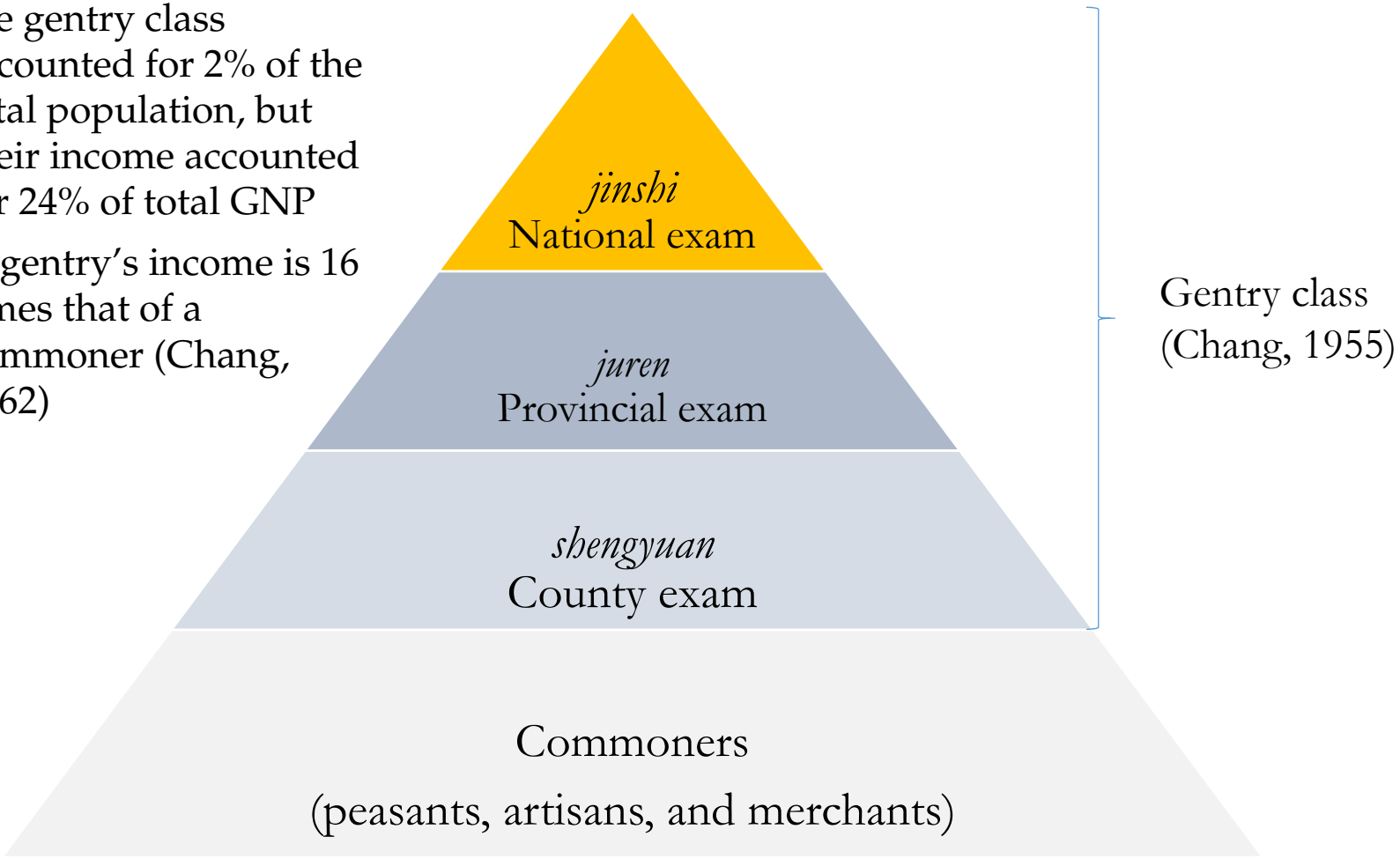

Figure 2. Hierarchy of Civil Exam System in Ming-Qing China

1.1. Hierarchy of Civil Exam System in Ming-Qing China

- An upper gentry's income is about 3 times of the middle gentry and 8 times of the lower gentry (Chang, 1962)
- Officialdom was guaranteed only for the *jinshi*

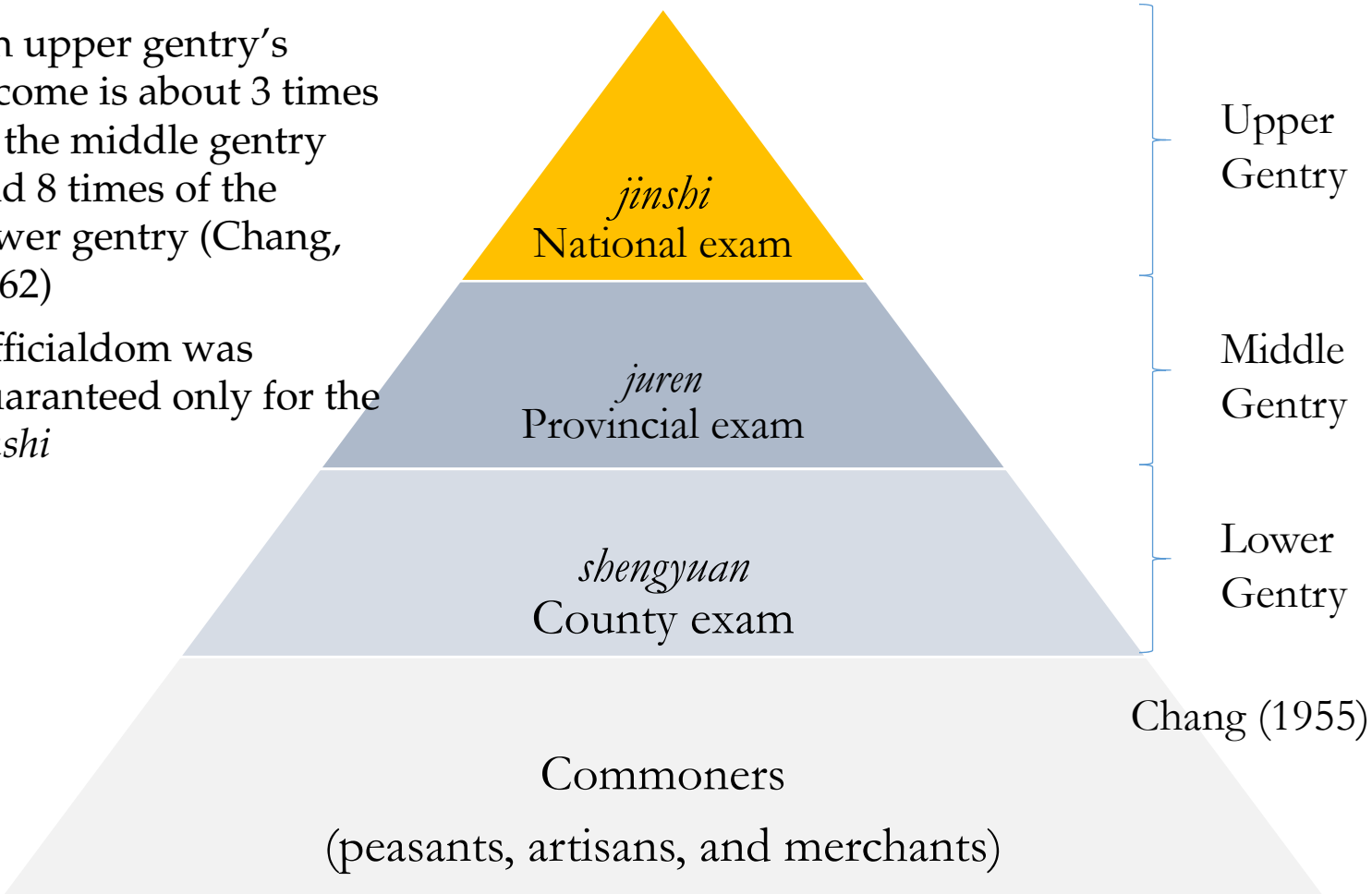

Figure 2. Hierarchy of Civil Exam System in Ming-Qing China

A Famous *Jinshi* in Late Qing

- Zeng Guofan was an eminent official, military general, and devout Confucian scholar of the late Qing
- He obtained his *Jinshi* title at 27

Because a man's temperament is inborn, it is very hard to change. The only way to improve upon it is by studying. (人之气质,由于天生,本难改变,惟读书可以改变)
Zeng Guofan, *Zeng Guofan Letters*, mid 19th century

1.2. Cultural Ethos of the *keju* System

- Given that social mobility in imperial China could only be acquired through the competitive civil exam, millions competed for academic success after studying assiduously for many years (Elman, 2000)
  - Mean age of passing the *jinshi* degree was 30 (some say 35) and mean mortality rate for the gentry class was 58 (Chang, 1955)
  - Extremely competitive: odds of *jinshi* (1.6/10000) is significantly lower than admissions into Tsinghua & Peking Universities (66 /10000)
- Over time, *keju* had fostered a culture of valuing education for being the passport to social mobility (Ho, 1962; Elman, 2000)
  - 45% of the *juren* and 37.6% of the *jinshi* came from families without ancestors having achieved the same exam success (Ho, 1967)

1.2. Cultural Ethos of the *keju* System (Cont'd)

- The culture found its full expression in almost every aspect of people's daily life and folklore traditions
  - Degree holders (especially the *jinshi*) were highly honored in local communities (arches, gateways, temples erected to honor them)
  - Fathers reminded their sons that in order to be successful they must study hard: "golden mansions and Yan Ru-yu (a legendary beauty) are both to be found in books" (Elman, 2000)
  - Even prior to kindergarten Chinese children learn characters by reciting the Three Character Primer (三字经)—an ancient Confucian textbook for children
  - Educational investments received the highest priority in families and lineage organizations' resource allocation (Wakefield, 1998)

1.3. The Persistence of Culture

- Culture remains stable over a long period of time
  - By providing the "rule-of-thumb" in decision-making, culture (traditional values, religious beliefs) economizes on the costs of decision-making in an uncertain and complex environment (Boyd and Richerson, 1985)
  - Institutions shape culture, and the effect of culture may persist even after the abolishment of the institution from which the culture emanates
    - Shiller et al. (1992) and Alesina et al. (2007) on the effect of the communist regime on people's attitudes
    - Becker et al. (2011) and Grosjean (2011) on the effect of Hapsburg Austrian Empire on social trust
    - Guiso et al. (2014) Italian cities that experienced self-government in the Middle Ages have higher level of civic capital today than similar cities that did not

1.3. The Persistence of Culture

- Thus, although the institution of *keju* was abolished in 1905, the ethos of valuing education may have persisted to this day
- Abundant anecdotal evidences
  - Students from East Asia spent more time studying, and invested more resources in private tutoring than their European or American counterparts (Stevenson and Lee, 1990)
  - Within China, the share of family income spent on education in 2006 was 13% on average, with distinctly higher percentages (about 18%) in provinces that produced significantly more *jinshi* historically (Jiangsu, Fujian, Jiangxi, Shandong, and Shanxi) (CGSS 2006)
  - Like the *jinshi* before them, students who obtain high scores in the National College Entrance Exam are highly honored by their families and local communities (Yu and Suen, 2005)

Roadmap

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2.1. Sample

- 287 prefectures covering Ming-Qing China Proper (18 provinces)

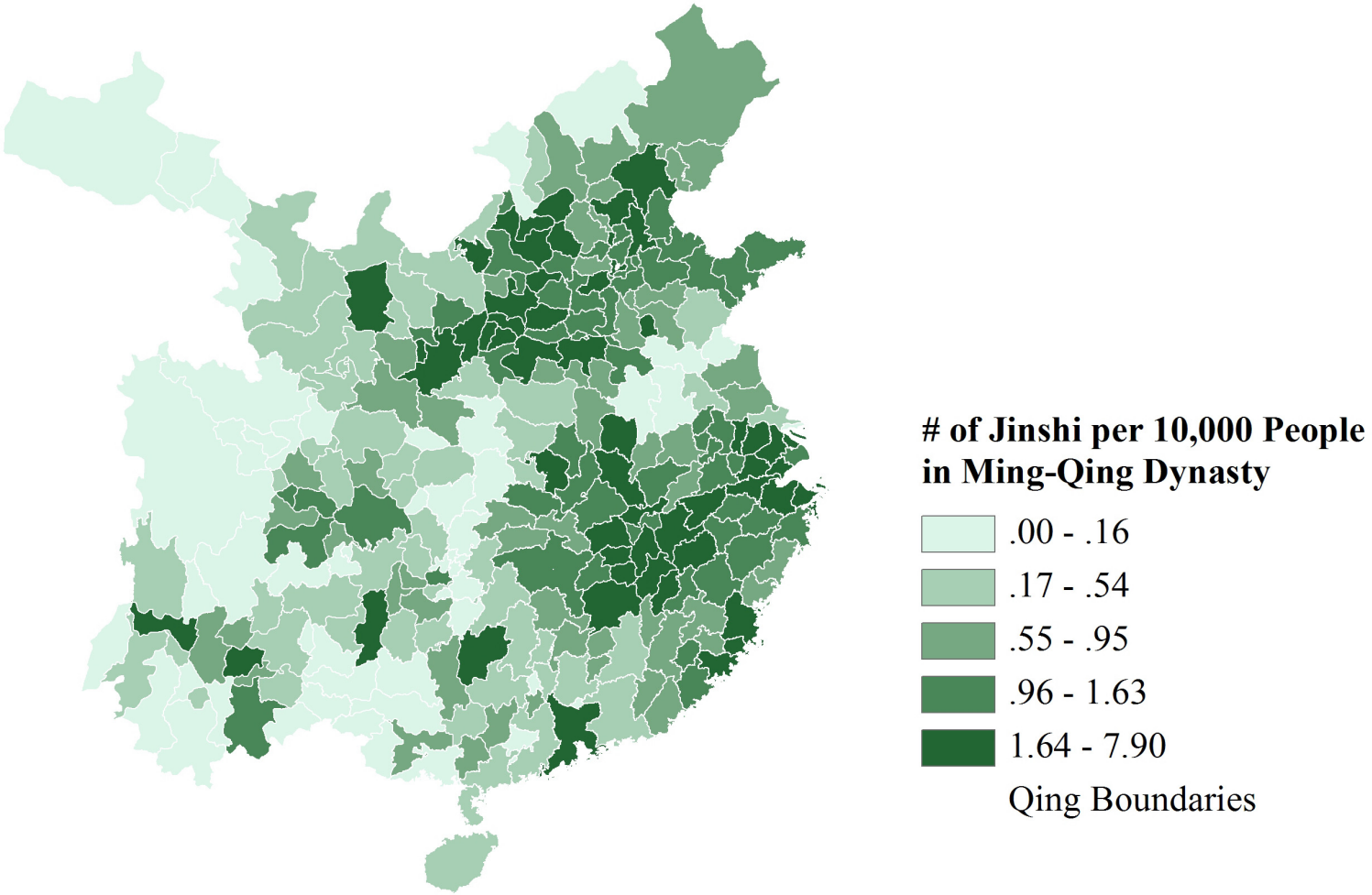

Figure 3. Sample of Prefectures covering Ming-Qing China Proper

2.2. Empirical Model and Variables

$$y_i = \beta keju_i + \gamma X_i + \upsilon_i$$

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- Years of schooling (Census 2010)
- % of college students (Census 2010)
- Literacy rate (Census 2010)

$$y_i = \beta keju_i + \gamma X_i + \upsilon_i$$

2.2. Empirical Model and Variables

$$y_i = \beta keju_i + \gamma X_i + \upsilon_i$$

- Total number of *jinshi* in a given prefecture (normalized by population) in 1368-1905
- Source: *Mingqing jinshi Timinglu Suoyin* (Directory of Ming-Qing Imperial Exam Graduates)

2.2. Empirical Model and Variables

Historical Controls:

- Economic Prosperity
  - Agricultural suitability
  - Population Density in Qing Dynasty
  - Urbanization Level in 1920s
  - Proportion of First-class *Jinshi*
- Western Influence
  - Treaty Ports
- Educational Infrastructure
  - Number of Schools in 1907
  - Exam Quotas for *Shengyuan*
- Negative Shocks
  - Frequency of Wars

Contemporary Controls:

- Economic Prosperity
  - GDP Per Capita
  - Fiscal Expenditure on Education
- Geography
  - Distance to Coast
  - Terrain Ruggedness Index

$$y_i = \beta keju_i + \gamma X_i + \upsilon_i$$

2.3. Summary Statistics

Table 1. Summary Statistics

Variables	#	Mean	Std.	Source
Average Years of Schooling	261	8.811	0.954	2010 Census Summary Statistics
Number of *jinshi* (log)	261	-0.138	0.830	Directory of Ming-Qing Imperial Exam Graduates(Mingqing *jinshi* Timinglu Suoyin)
Urbanization Level in 1920s (log)	261	-4.618	1.645	Rozman, Gilbert. 1973. Urban Networks in Ch'ing China and Tokugawa Japan.
Population Density (log)	261	-4.633	0.892	Cao, Shuji. 2000. History of Population in China (zhongguo renkou shi). Volume 5. Shanghai: Fudan University Press.
Agricultural Suitability	261	11.857	5.122	FAO, Global Agro-Ecological Zones Database, http://www.fao.org/nr/gaez/en/
Treaty Ports (Duration)	261	16.862	27.935	Wu, Songdi, 2006. Treaty Port Cities and Their Hinterland and the Modernization in China (*Zhongguo Bainian Jingji Pingtu: Gangkou Chengshi Jiqi Fudi Yu Zhongguo Xiandaihua*)
Number of Schools in 1907	261	3.959	1.540	Stauffer, Milton T. 1922. The Christian Occupation of China: A General Survey of the Numerical Strength and Geographical Distribution of the Christian Forces in China.
Proportion of First-class *Jinshi*	261	0.263	0.109	Zhu, Baojiong and Xie, Peilin, 1981. Official Directory of Ming-Qing Imperial Exam Graduates (Ming-Qing *jinshi* Timinglu Suoyin)
Exam Quotas for *Shengyuan*	261	95.033	53.038	Chang, Chung-li, and Zhongli Zhang, 1962. The income of the Chinese gentry. University of Washington Press.
Frequency of Wars	261	0.993	0.737	"Military History of China"Writing Group. Chronology of Warfare in Dynastic China (Zhongguo Lidai Zhanzheng Nianbiao). Beijing: China PRC Press.
Distance to Coast	261	12.666	1.200	
Terrain Ruggedness Index	261	208.754	175.326	NASA, Digital Elevation Model (DEM) at 90-meters Resolution, http://www.cgiar-csi.org/data/srtm-90m-digital-elevation-database-v4-1
GDP Per Capita	261	0.912%	0.727	Regional Economy Statistical Yearbook 2011
Fiscal expenditure on education	261	3.013	0.901	Regional Economy Statistical Yearbook 2011

2.4. Matching Prefectural Boundaries between Ming-Qing and Contemporary China

Matching

Figure 4. Matching Prefectural Boundaries between Ming-Qing China and Contemporary China

2.5. Baseline Results

Table 2. The Impact of *Keju* on Contemporary Human Capital: OLS Estimation

	Average years of schooling 1	Average years of schooling 2	Average years of schooling 3	Average years of schooling 4	Ln (college students/pop) 5	Literacy rate 6
Ln (*jinshi*/pop+1)	0.481	0.141			0.120	0.013
	(0.081)***	(0.057)**			(0.041)***	(0.003)***
Ln (*jinshi*/pop in Qing+1)			0.209			
			(0.065)***			
Ln (*jinshi*/area+1)				0.130		
				(0.056)**		
Historical controls	N	Y	Y	Y	Y	Y
Contemporary controls	N	Y	Y	Y	Y	Y
R2	0.16	0.66	0.67	0.66	0.27	0.48
N	286	239	239	239	252	239

* p<0.1; ** p<0.05; *** p<0.01. Except for Column 3, which uses only the number of *jinshi* in the Qing dynasty, all other columns use the number of *jinshi* in the Ming and the Qing dynasties. Robust standard error in parentheses.

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3.1. Endogenous Number of *jinshi*

- Omitted Variables: some unobserved correlates of *jinshi* may also impact directly upon contemporary human capital. For example,
  - State capacity or governance quality in a prefecture
  - Region-specific endowments (natural or genetic) that persistently produce more talents in that region
- Measurement error: *jinshi* may not fully capture the diffusion of (or success in) the *keju* system in a region
  - No systematic records in the number of *juren* (province level degree-holders) at the prefectural level and over time
  - The *shengyuan* (the county candidates) were fixed by quotas in each county

3.2. Printing (Publishing Houses) as Plausible IV

- Availability of reference books was crucial to a student's success in *keju*
  - To do well in the exam, one must consult many more reference books for nuanced, authoritative interpretations of the Confucian classics of *Four Books* and *Five Classics* (Ho, 1962; Elman, 2000; McDermott, 2006)

Table 3. Contents and Related Reference Books of Civil Examination in Ming-Qing Dynasty

Contents	# of Questions	Reference Books
	Provincial and Metropolitan Civil Examinations	
Four Book (stereotyped writing)	3 quotations	Scholars' interpretations of the Confucian classics (e.g. 四集); Collection of model answers from past exam papers (e.g. 近科房菁、考卷)
Five Classics (stereotyped writing)	4 quotations	
Verse Poem*	1 poem	Discourse on poetry writing (e.g.唐省、唐人五言排律)
Discourse	1 quotation	
Documentary style	3 documents	
Judicial term	5 terms	
Policy questions	5 essays	Collection of model essays for policy questions (e.g. 策纂要、策纂)
	National Civil Examination	
Policy questions	1 essay	Ibid

*After 1787 by Emperor *Qianlong*. Source: Elman (2000, p. 522); Shen (2009, 2012)

3.2. Printing (Publishing Houses) as Plausible IV

- The supply of books depended heavily on the development of the local printing industry
  - No nationwide publishing houses. Presses were highly localized and unevenly distributed, and books were hardly traded due to prohibitive transportation costs (Wu, 1943)
  - Local schools (e.g. county schools) had only limited collections of books: students had to obtain books from private book sellers (Ho, 1962; McDermott, 2006)
  - As most books in the Ming-Qing period were printed using the traditional block-printing technology (雕版印刷术), it depended heavily on the supply of ink and paper
  - Which in turn was determined by the *location* of pine carbon (for producing ink) and bamboo and mulberry (for producing paper) (Tsien, 1985)

3.3. Instrumental Variable

- Our IV is thus the average distance of a prefecture to its nearest location of the three printing endowments

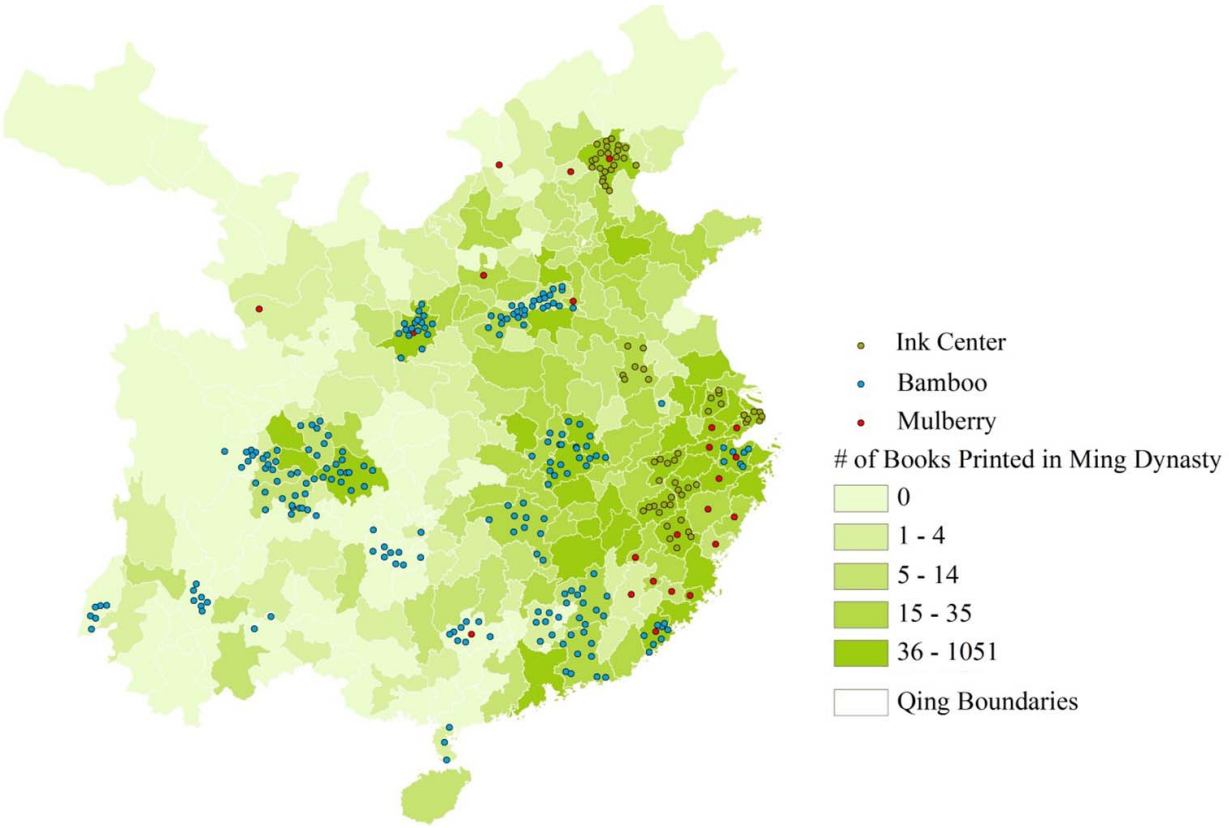

Figure 5. Number of Printed Books and Production Centers of Ink/Bamboo/Mulberry in the Ming Dynasty

Table 4. Printing and *Keju* in Ming-Qing China: First-stage Relationships

	Ln (*jinshi*/pop+1) 1	Ln (*jinshi*/pop+1) 2	Ln (*jinshi*/pop+1) 3	Ln (*jinshi*/pop+1) 4	Ln (*jinshi*/pop+1) 5
Ln (printed books+1)	0.258				
	(0.029)***				
Distance to ink		-0.001			
		(0.000)***			
Distance to bamboo			-0.001		
			(0.000)***		
Distance to mulberry				-0.001	
				(0.000)***	
Distance to printing endowments					-0.002
					(0.000)***
Controls	Yes	Yes	Yes	Yes	Yes
R2	0.60	0.52	0.43	0.46	0.51
N	242	252	252	252	252

* p<0.1; ** p<0.05; *** p<0.01. Distance to the printing endowments is the mean of the distance to ink, bamboo and mulberry. Robust standard error in parentheses.

3.4. Testing for Exclusion Restrictions

- Exclusion Restrictions for using Ming-Qing printing as IV
  - Concern that the distribution of the printing centers in Ming-Qing China may directly impact subsequent knowledge diffusion and accordingly human capital distribution
  - By the end of the 19th century, traditional Chinese printing was eradicated by Western (modern) printing technology
  - The spatial distribution of Chinese printing industry changed completely : Shanghai replaced the previous Nanjing, Hangzhou, Jianyang, Huizhou, etc., to become the new (modern) printing center (Reed, 2004)

Table 5. Testing the Exclusion Restrictions of the Instrumental Variables

	Average years of schooling				
	1	2	3	4	5
Ln (printed books+1)	-0.012				
	(0.033)				
Distance to ink		-0.000			
		(0.000)			
Distance to bamboo			-0.000		
			(0.000)		
Distance to mulberry				-0.000	
				(0.000)	
Distance to printing endowments					-0.001
					(0.000)
Ln (*jinshi*/pop+1)	0.154	0.102	0.133	0.084	0.059
	(0.069)**	(0.065)	(0.056)**	(0.057)	(0.061)
Controls	Yes	Yes	Yes	Yes	Yes
R2	0.67	0.66	0.66	0.66	0.66
N	229	239	239	239	239

* p<0.1; ** p<0.05; *** p<0.01. The results remain unchanged when using the dependent variables of literacy rate and share of college students. Robust standard error in parentheses.

3.5. The Instrumented Results

- Two-stage least square (2SLS) estimation, in which the number of printed books and distance to endowments are used respectively as IV for *jinshi*:

$$y_i = \beta keju_i + \gamma X_i + \upsilon_i$$

$$jinshi_i = \lambda IV_i + \tau X_i + \varepsilon_i$$

- Three-stage least square (3SLS), in which the number of *jinshi* is predicted by the number of books which in turn is predicted by distance to the endowments:

$$y_i = \theta jinshi_i + \zeta X_i + \nu_i$$

$$jinshi_i = \delta books_i + \eta X_i + \mu_i$$

$$books_i = \zeta endowments_i + \psi X_i + \epsilon_i$$

Table 6. The Impact of *Keju* on Contemporary Human Capital: Instrumented Results

	Average Years of Schooling					
	2SLS	2SLS	2SLS	2SLS	3SLS	3SLS
	1	2	3	4	5	6
Ln (*jinshi*/pop+1)	0.526	0.358	0.645	0.436	0.576	0.299
	(0.106)***	(0.127)***	(0.183)***	(0.157)***	(0.122)***	(0.140)**
Controls	N	Y	N	Y	N	Y
R2	0.16	0.50	0.12	0.63	0.12	0.66
Ln (printed books+1)	0.347	0.255			0.468	0.57
	(0.023)***	(0.029)***			(0.042)***	(0.082)***
Controls	N	Y			N	Y
R2	0.48	0.60			0.41	0.33
Distance to printing endowment			-0.002	-0.002	-0.0048	-0.004
			(0.0002)***	(0.0004)***	(0.0004)***	(0.001)***
Controls			N	Y	N	Y
R2			0.32	0.54	0.33	0.50
N	267	238	264	239	246	229

* p<0.1; ** p<0.05; *** p<0.01. Columns 1-2 are the 2SLS results using ln(printed books+1) to instrument ln(*jinshi*/pop+1). Columns 3-4 are the 2SLS results using distance to the printing endowments to instrument ln(*jinshi*/pop+1). Columns 5-6 are the 3SLS results in which ln(*jinshi*/pop+1) is predicted by ln(printed books), which in turn is predicted by distance to the printing endowments. Robust standard error in parentheses.

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4.1. The Culture Channel of *Keju* Persistence

- Verifying the culture channel
  - *Keju* has a significant effect on the cultural norms of valuing education Table 7, and
  - The effect of *keju* on current human capital outcomes comes actually from the cultural norms of valuing education Table 8

Table 7. The Impact of *Keju* on Contemporary Education Norms (CGSS2006)

	Whether education is the most important criteria in judging one's social status (1=yes, 0=not)		Whether the government should spend more on education (1=yes, 0=not)		Ln (annual household expenditure on education) (in RMB yuan)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
	1	2	3	4	5	6
Ln (*jinshi*/pop)	0.011	0.035	0.006	0.108	0.278	0.469
	(0.005)**	(0.019)*	(0.015)	(0.028)***	(0.040)***	(0.210)**
Individual controls	Y	Y	Y	Y	Y	Y
Prefectural controls	Y	Y	Y	Y	Y	Y
Ln (distance to printing endowments)		-1.132		-1.132		-1.123
		(0.022)***		(0.022)***		(0.025)***
Individual controls		Y		Y		Y
Prefectural controls		Y		Y		Y
N	7,947	7,787	7,947	7,787	7,270	7,186

* p<0.1; ** p<0.05; *** p<0.01. Robust standard error in parentheses.

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Table 8. *Keju*, Cultural Norms, and Years of Schooling

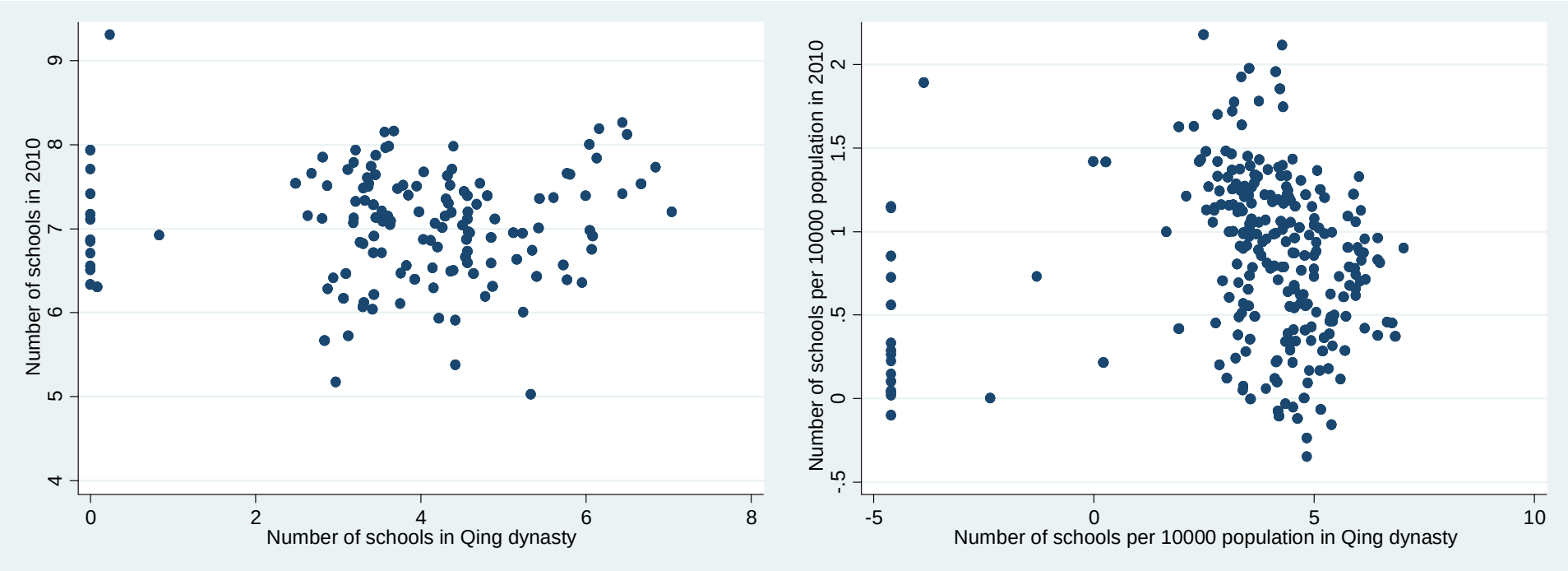
	Years of Schooling				
	OLS	OLS	2SLS	OLS	2SLS
	1	2	3	4	5
Ln (*jinshi*/pop+1)	0.105	0.063	0.246	0.064	0.246
	(0.027)***	(0.102)	(0.278)	(0.103)	(0.278)
Whether education is the most important		0.218	0.215		
criteria in judging one's social status		(0.108)**	(0.109)**		
Whether the government should prioritize		0.193	0.195		
its spending on education		(0.080)**	(0.081)**		
Ln (annual household expenditure		0.026	0.025		
on education)		(0.011)**	(0.011)**		
Norms of valuing education				0.155	0.153
(first principal)				(0.040)***	(0.040)***
Individual controls	Y	Y	Y	Y	Y
Prefectural controls	Y	Y	Y	Y	Y
N	7,217	6607	6607	6607	6607

* p<0.1; ** p<0.05; *** p<0.01. In columns 3 and 6 ln(*jinshi*/pop+1) is instrumented by distance to the printing endowments. Columns 4 and 7 are 3SLS results in which ln(*jinshi*/pop+1) is predicted by ln(printed books) which in turn is predicted by distance to the printing endowments. Norms of valuing education is the first principal component of the above three measures of education culture. Robust standard error in parentheses.

4.2. Possible Alternative Channels of *Keju* Persistence

- Persistence of more (and better) educational infrastructures
  - Historically, the more successful regions may have established more (and better) educational infrastructure
  - Availability of educational infrastructure is positively correlated with enrollment and schooling outcomes (Deaton, 1996; Duflo, 2001)
  - But no correlation between the quantity of schools in late Qing and quantity of schools today Figure 6

Figure 6. Number of Schools (per 10,000 population) in the Qing Dynasty and Present (2010)



4.3. Possible Alternative Channels of *Keju* Persistence

- Persistence of talents
  - Regions with more *jinshi* historically may have produced more talents over time
  - A quasi-experiment on the effect of *keju* culture on performance of a sample of undergraduates studying at 15 elite universities in Beijing column 1, Table 9
  - Even after controlling for initial ability (college entrance examination scores) the effect of culture remains significant columns 2 & 4
  - There appear to be complementarities between culture and ability: culture is stronger among the more competent columns 3 & 5
  - Culture has a significant effect on students majoring in liberal arts column 6, whereas ability does not column 7

Table 9. The Impact of Keju on the Performance of a Sample of Undergraduates in 15 Beijing Universities

	2SLS						
	Ranking (Same-cohort Major)			College English Test Scores			
	1	2	3	4	5	6	7
Ln (jinshi/pop+1) (JS)	2.825	2.984	2.931	0.090	0.082	0.061	0.077
	(0.892)***	(0.888)***	(0.891)***	(0.024)***	(0.023)***	(0.014)***	(0.013)***
Ln(Entrance Exam Scores) (EES)		7.038	8.372	0.226	0.389	0.222	0.171
		(1.773)***	(2.101)***	(0.057)***	(0.085)***	(0.055)***	(0.062)***
JS*EES			4.518		0.660		
			(2.138)**		(0.114)***		
Liberal Arts*JS						0.040	
						(0.019)**	
Liberal Arts*EES							0.146
							(0.108)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prefectural controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
University and Major FE	No	No	No	Yes	Yes	Yes	Yes
University FE	Yes	Yes	Yes	No	No	No	No
Major FE	Yes	Yes	Yes	No	No	No	No
Enrollment Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.2	0.2	0.2	0.21	0.23	0.21	0.21
N	11,644	11,644	11,644	5,881	5,881	5,881	5,881

* p<0.1; ** p<0.05; *** p<0.01; In column 3-5, ln(*jinshi*/pop+1) is instrumented by distance to the printing endowments. Robust standard error in parentheses.

Table 10. The Impact of *Keju* on Children's Cognitive Skills (CFPS2010)

	Word Test OLS	Math Test	Word Test 2SLS	Math Test	Word Test 3SLS	Math Test
	1	2	3	4	5	6
Ln (*jinshi*/pop)	1.916	0.161	2.719	0.380	2.353	0.090
	(0.541)***	(0.322)	(1.361)**	(0.832)	(0.998)**	(0.548)
Ln (printed books)					0.328	0.328
					(0.010)***	(0.010)***
Distance to printing endowment			-0.001	-0.001	-0.004	-0.004
			(0.0003)***	(0.0003)***	(0.0002)***	(0.0002)***
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.310	0.500	0.309	0.500	0.313	0.501
N	2,245	2,245	2,245	2,245	2,177	2,177

* p<0.1; ** p<0.05; *** p<0.01; In column 3-4, ln(*jinshi*/pop+1) is instrumented by distance to the printing endowments; Individual Controls include Age, Father's Education, Mother's Education, Family Expenditure on Education, Weight at Birth, Gender (Male=1). Robust standard error in parentheses.

- Historical *jinshi* has a significant effect on children's literacy but not mathematics, as the later requires more innate talent than nurtured endeavor

Roadmap

1. Historical background
2. The effect of *keju* on contemporary human capital: baseline results
3. Identifying the causal effect of *keju*: the role of printing
4. The cultural channel between *keju* and contemporary human capital outcomes
5. **Accounting for the transmission of the *keju* culture**
   1. **Vertical and horizontal transmission**
   2. Conditions of cultural transmission
6. Conclusion

5.1. Family and Peer Transmissions

- Vertical vs. Horizontal Transmission (Bisin and Verdier, 2005, 2010)
  - Vertical Transmission: transmission of cultural traits from parents to children through purposeful socialization decisions inside family ("direct vertical socialization") (Nisbett, 2003; Nunn, 2012)
    - Sons of working mothers display a preference for working wives (Fernandez, Fogli and Olivetti, 2004; Fernandez, 2007)
  - Horizontal Transmission: transmission of cultural traits among peers through social imitation and learning
    - Women's participation in the labor market increases more in areas with higher female labor force participation (Fernandez, 2013; Fogli and Veldkamp, 2011)
- How to compare and verify the different directions of transmission within a unified framework poses a challenge (Bisin and Verdier, 2005; Dohmen, et al., 2012)

5.1. Family and Peer Transmissions

- *Keju* culture could be transmitted both vertically and horizontally
- Horizontal transmission: *jinshi* by prefecture column 1, Table 11
- Vertical transmission: *jinshi* by surname-prefecture (number of *jinshi* in a given prefecture of the same surname)
  - 40 *jinshi* in Guangzhou with the surname Chen (compared to the mean of 7) in Ming-Qing China → years of schooling among the Chens today is also higher (9.304 vs. the mean of 7.724)
  - Vertical transmission twice the magnitude of horizontal transmission column 2
  - Vertical transmission, controlling for prefecture fixed effects column 3
- Vertical transmission is not due to the effect of wealth column 4 but rather through the channel of schooling column 5

Table 11. Evidence on Vertical and Horizontal Cultural Transmissions

	Years of Schooling			Annual Income (log)	
	1	2	3	4	5
jinshi by surname-prefecture (log)		0.093	0.014	0.007	0.003
		(0.016)***	(0.005)**	(0.004)+	(0.004)
jinshi by prefecture (log)	0.084	0.045			
	(0.015)***	(0.016)**			
Years of Schooling					0.343
					(0.001)***
Control variables	Yes	Yes	Yes	Yes	Yes
Prefecture fixed effect	No	No	Yes	Yes	Yes
N	2150997	2150997	2359747	2514697	2359739
R2	0.280	0.281	0.295	0.089	0.186

* p<0.05; ** p<0.01; *** p<0.001; based on 2005 mini-census indivdiual level data. Robust standard error in parentheses.

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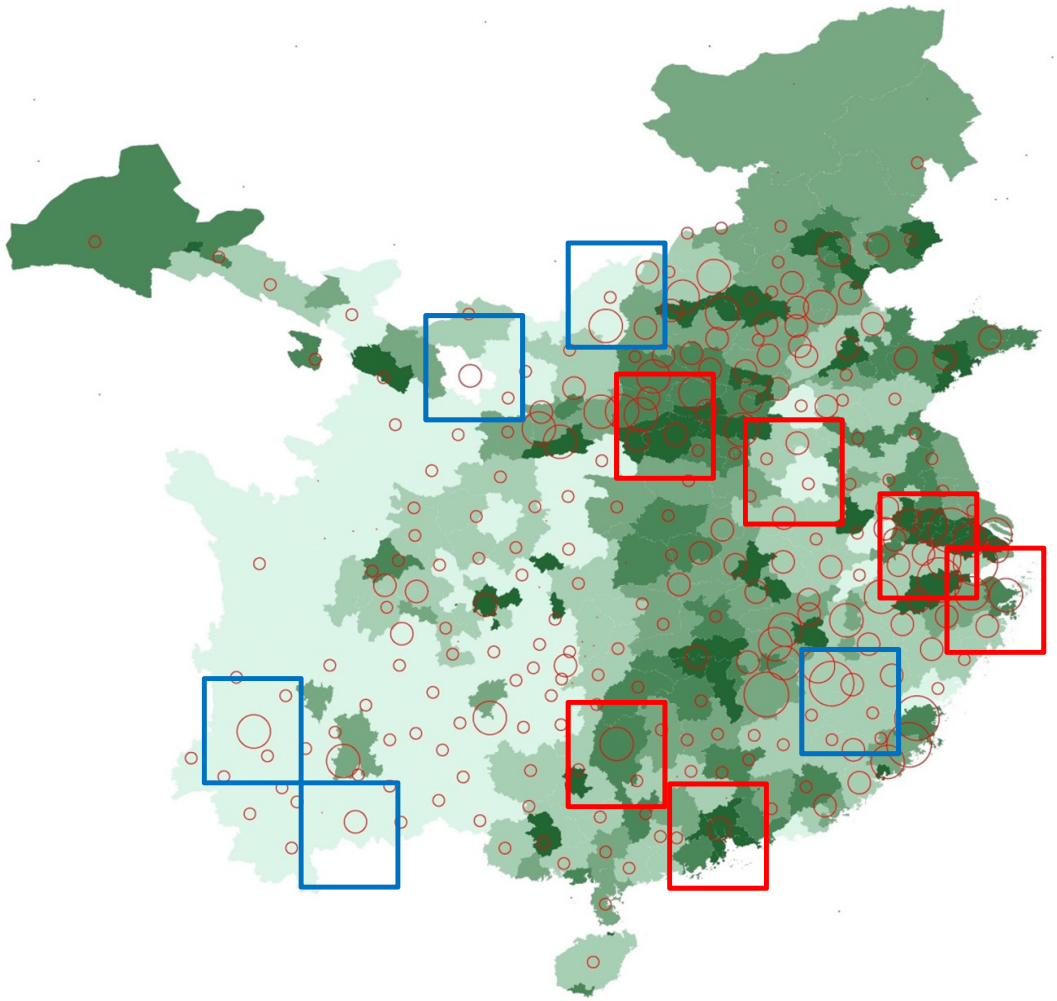
5.2.1 Uneven Conditions of Cultural Transmission



Culture embedded in the *keju* system has persisted more strongly in some areas than in others today

Regions of stronger persistence

Regions of weaker persistence

Average Year of Education in 2000

- .00 - 6.81
- 6.82 - 7.38
- 7.39 - 7.83
- 7.84 - 8.29
- 8.30 - 10.09

# of Jinshi per 10,000 People in Ming-Qing Dynasty

- .00 - .01
- .02 - .94
- .95 - 1.98
- 1.99 - 3.96
- 3.97 - 7.90

Current Municipality Boundary

Figure 7. Number of *jinshi* (1368-1905) and Average Years of Education in 2000

5.2.2 Conditions of Cultural Transmission

- "In standard Models of cultural evolution, the distribution of cultural beliefs in the population evolves through a natural-selection-like process determined by relative payoffs" (Alesina, et al. 2013)
  - The effect of cultural norms of valuing education transmit better in prefectures with higher returns to education columns 1 and 2, Table 12
- Historical shocks could affect the conditions of persistence by altering its relative costs and benefits. Under what conditions would culture persist and when will it change (Nunn, 2012)
  - For example: Voigtlander and Voth (2012) find that the anti-Semitic culture persists less in cities with higher levels of trade or immigration

5.2.2 Conditions of Cultural Transmission (Cont'd)

- Using Cultural Revolution as a robustness check for its targeted attack on the Confucian culture
  - An overriding goal of the Cultural Revolution was to eradicate Confucianisme; young people were especially encouraged to burn books, to accuse and attack scholars, to destroy historical relics and to condemn Confucius
  - The greater the magnitude of mass fighting (*wudou*, 武斗) during the Cultural Revolution, the greater the destruction of the *keju* culture columns 3 and 4
  - Placebo test: No significant effect on the interaction between *keju* and mass fighting for the pre-Cultural Revolution cohort but significant for the post-CR cohort columns 5 and 6

Table 12. Conditions of Cultural Transmission

	Years of Schooling					
	2010 Census		CFPS Full Sample		Pre-Cultural Revolution Cohort (1942-1960)	Post-Cultural Revolution Cohort (1961-1985)
	OLS	2SLS	OLS	2SLS	2SLS	2SLS
	1	2	3	4	5	6
Ln (*jinshi*/pop+1)	0.234	0.560	0.127	0.396	0.280	0.356
	(0.067)***	(0.218)**	(0.046)***	(0.104)***	(0.165)*	(0.157)**
Education Returns	0.700	0.127				
	(0.108)***	(0.118)				
Ln (*jinshi*/pop+1)*Education Returns	0.364	0.278				
	(0.147)**	(0.098)***				
Incidence of Mass Fighting			-0.001	-0.002	0.003	-0.006
in Cultural Revolution			(0.001)	(0.001)**	(0.002)**	(0.001)***
Ln (*jinshi*/pop)*Incidence of Mass			-0.007	-0.009	-0.002	-0.017
Fighting in Cultural Revolution			(0.001)***	(0.002)***	(0.003)	(0.003)***
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.505	0.600	0.360	0.360	0.310	0.300
N	261	261	29,537	29,537	11,699	13,892

* p<0.1; ** p<0.05; *** p<0.01. Columns 1 & 2 are average years of schooling at the prefecture level based on 2010 census, columns 3-6 are years of schooling at the individual level based on 2010 CFPS. Returns to education are estimated at the prefecture level based on 2005 mini-census. Robust standard error in parentheses.

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6. Conclusion

- Using the institution of China's imperial exam as example, the culture deeply embedded in an institution can persist over a long time into the future even long after it is gone
- Prefectures having produced more *jinshi* historically have higher human capital measures today, ranging from years of schooling and share of college graduates to literacy rate
- Similarly, individual attitudes toward the importance of education and educational attainments for social success are significantly stronger in prefectures with more *jinshi* historically
- Result reflects the persistent effect of culture embedded within the *keju* institution, a culture that has been powerfully nurtured over time
- Although *keju* may have impeded the modernization of imperial China, it has had a persistently positive effect on human capital in the long run through the cultural channel