Entrepreneurial Reluctance: Talent and Firm Creation in China

Chong-en Bai (Tsinghua) Ruixue Jia (LSE/UCSD)
Hongbin Li (Stanford) Xin Wang (CUHK)

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Motivation

A growing literature documents that entrepreneurial talent has important consequences on both individual firm productivity & overall economic growth.

- Bertrand and Schoar 2003; Bloom and Van Reenen 2007; Syverson 2011; Gennaioli et al. 2013...

Implication: important to allocate talent to the entrepreneur sector.

But are talented individuals in a society more likely to become entrepreneurs?

- Yes, especially for incorporated/large business.
  - e.g., Levine and Rubinstein 2017, 2019.
- No. They may be attracted by non-entrepreneur sectors.
  - e.g., Murphy, Shleifer and Vishny 1991; Baumol, Litan and Schramm 2007.

Challenges

Are talented individuals in a society more likely to create firms?

Measurement is data demanding

- how to measure talent and firm creation (a small-prob. event).
- usually little information on the firms if one relies on survey data.

Identification challenges

- ability vs. education and family background

This Paper: Are talents in China more likely to create firms? Why?

A setting we partially address the measurement and identification challenges

Measuring firm creation

- admin data on the universe of firms,
- useful info. on firm success.

Measuring talent

- college entrance exam score
- arguably the most important measure and is popularly believed to determine the course of one's life

Talent vs. education

- focus on within-college analyses (fixing education). College FEs account for
  - 1.2% of the variation in firm creation (admin), but 19% for wages (survey).
  - 46% of the variation in exam scores (admin).

Talent vs. family background

- compare score and status proxies (male, urban, highsch, birth-cnty income).

Academic Talent and Firm Creation in China: Context

Empirical setting

- exam + college admission records in 1999-2003, aged ∼33 in 2015
- the universe of Chinese firms and their owners from the 1980s to 2015.
  - those with college edu in the admin data, median age: 33.9

We examine:

- Fixing college, are higher-entrance-scores students more/less likely to create firms by mid-30s?
- Why?

U.S. counterpart: SAT scores + college records + firms

- not aware of similar studies
- finance: college-mean SAT score and mutual funds Chevalier and Ellison 1999

Preview

1. Main facts
   - F1: Fixing education, higher-score students are less likely to create firms, even when restricting firms to be the very large ones.
   - F2: The negative score-firm link is stronger for men/urban/those from better highsch.
     - level diff: Men/urban/those from better high schools are more likely to create firms on average.

2. Interpret the findings with a conceptual framework
   - the "lower entrepreneurial ability": corr(s, entrepreneur-ability)< 0
   - the "opportunity cost": corr(s, e-ability)> 0, corr(s, wage-ability)> 0.
   - the "risk aversion": corr(s, e-ability)$= 0$, scores reflect other traits like risk attitudes.

   The interpretations speak to talent allocation & the education system.

3. Testing the interpretations
   - firm success (admin), wages and risk attitudes (survey)

Takeaways

The empirical results fit better with H2: opportunity cost

- Higher-score students are attracted away by non-entrepreneur sectors.
  - Public sector plays a larger role, but private sector also matters.
- shedding light on the big-picture of talent allocation in China.

H1 and H3: important, suggesting better students have a lower entrepreneurial ability and are more risk averse.

- not supported by evidence on firm success (admin) and risk attitudes (survey)
- Firms established by higher-score individuals are more successful.

Other factors like credit constraints and risk attitudes matter for firm creation, but do not fit the score-firm relationships.

Outline

1. Linked Data and Descriptive Patterns
2. Two Main Findings
3. Conceptual Framework
4. Testing the Hypotheses

Linking Admin Data

Linked

- Start with 14.2 million (out 23m) records accepted by 2,056 colleges.

Challenge 1: unlinked (4.7m)

- Strategy: later restricting to prov-years with rates$>$95%, $>$99%.

Challenge 2: repeated exam takers

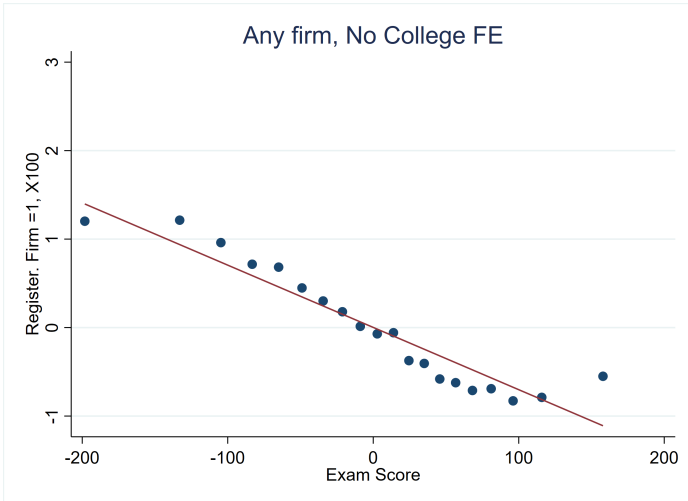
- Strategy: included in baseline (using the last-time score); later excluding repeated takers.

9.1 million college students (9.5m records) for whom we know their firm creation outcomes.

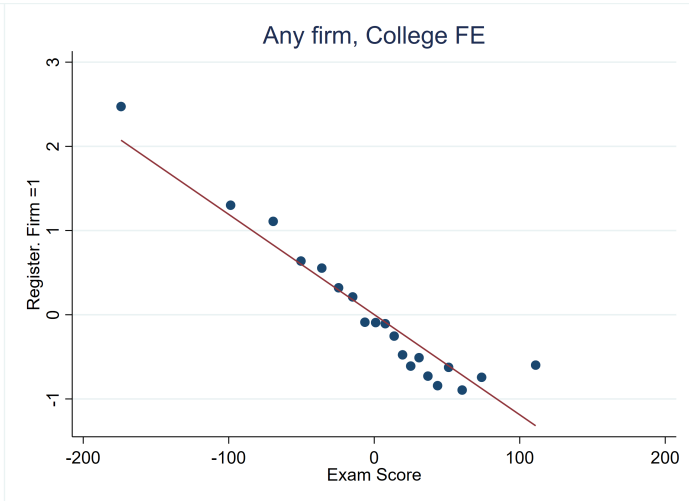
We use 20% random sample: 1.8 million individuals summary

- who had created 170,087 firms by 2015.
- median birth year: 1982

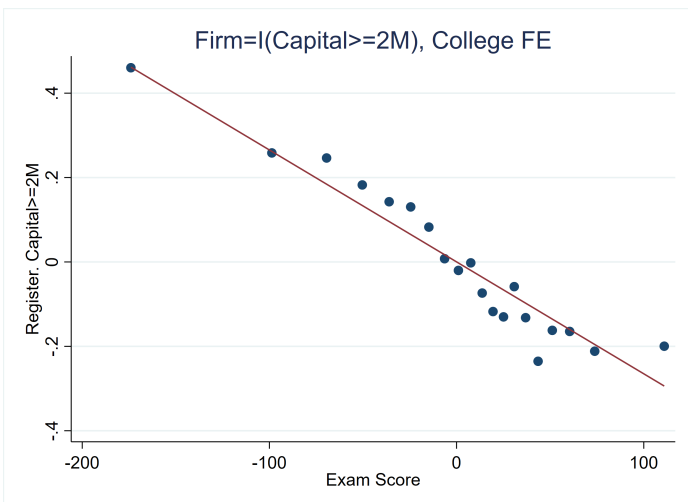
Descriptive Patterns: without and w. college FE



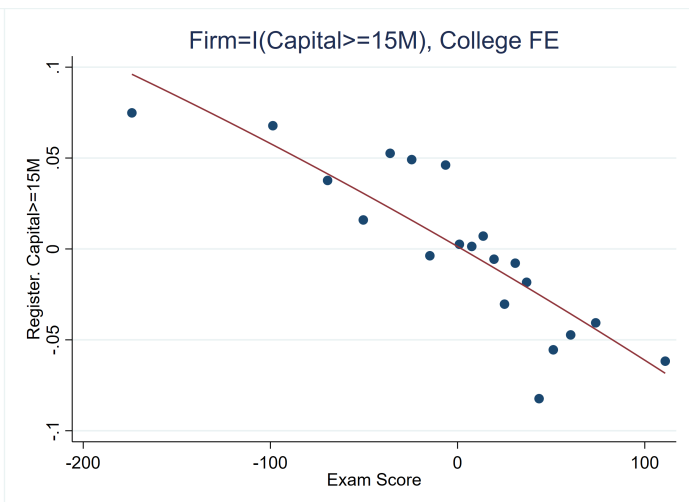
(a) no college FE, any firm



(b) college FE, any firm



(c) college FE, regis. K $\geq$2M



(d) college FE, regis. K $\geq$15M

Scores and Firm Creation within Colleges

individual i from prov-year-track (pyt) and college (c):

$$Firm_{i,pyt,c} = \beta Score_{i,pyt,c} + \alpha X_i + \lambda_{pyt} + \theta_c + \epsilon_{i,pyt,c},$$

- $Firm_{i,pyt,c}$: definitions can vary by firm size
- X_i: age FE, gender, rural/urban, high school quality, ln GDP per capita (birth county)
- λ_{pyt}: prov-year-track FEs
- θ_c: college FEs
- w/o or w major FE

Next:

- (1) Baseline
  - By majors; By college ranks
- (2) Heterogeneity by personal background

F1 – Scores and Firm Creation within Colleges: Baseline

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Any Firm			Firm=I(Capital≥2M)			Firm=I(Capital≥15M)	
mean		7.12			1.64			0.40	
Exam score (sd)	-0.774	-0.802	-0.762	-0.172	-0.180	-0.180	-0.037	-0.039	-0.043
	(0.033)	(0.034)	(0.033)	(0.011)	(0.012)	(0.012)	(0.005)	(0.005)	(0.005)
Female		-3.403	-3.535		-0.850	-0.865		-0.184	-0.184
		(0.063)	(0.064)		(0.024)	(0.025)		(0.011)	(0.011)
Rural		-0.254	-0.196		-0.235	-0.221		-0.092	-0.085
		(0.049)	(0.049)		(0.022)	(0.022)		(0.011)	(0.011)
High school quality (sd)		0.265	0.279		0.132	0.130		0.045	0.045
		(0.032)	(0.032)		(0.014)	(0.014)		(0.007)	(0.007)
ln GDP per capita		0.095	0.090		0.039	0.038		0.012	0.011
(birth county, 2001)		(0.031)	(0.030)		(0.014)	(0.014)		(0.006)	(0.006)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
age FE		Y	Y		Y	Y		Y	Y
major FE			Y			Y			Y
Obs. (excl singletons)	1,814,534	1,814,498	1,799,656	1,814,534	1,814,498	1,799,656	1,814,534	1,814,498	1,799,656

- 1σ more in the exam score within a college $\downarrow$ the prob of creating firms by 10%.
- Personal traits matter: female, rural and those from lower-quality hs are less likely to create firms.
  - Scores are positively ass. w. highsch quality and county development.

F1 – Scores and Firm Creation within Colleges: by majors

Dependent var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Any firm			Firm=I(capital≥2M)			Firm=I(capital≥15M)		
	STEM	Econ-Fin-Law	Humanity	STEM	Econ-Fin-Law	Humanity	STEM	Econ-Fin-Law	Humanity
Mean Dependent var.	6.50	8.21	7.52	1.52	2.02	1.41	0.35	0.55	0.28
Exam score (sd)	-0.630	-0.622	-0.908	-0.171	-0.221	-0.165	-0.052	-0.053	-0.027
	(0.043)	(0.059)	(0.054)	(0.017)	(0.026)	(0.018)	(0.008)	(0.012)	(0.009)
college FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
other personal controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	928,355	498,328	371,761	928,355	498,328	371,761	928,355	498,328	371,761

The negative link holds within each field.

- STEM and Econ-Fin-Law attract higher-score students.
- Econ-Fin-Law students create more firms on average.

F1 – Scores and Firm Creation within Colleges: by college ranks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Any Firm			Firm=I(Capital≥2M)			Firm=I(Capital≥15M)	
mean	8.33	7.69	7.1	2.27	1.98	1.57	0.6	0.49	0.38
college rank	Top 10	11-100	100+	Top 10	11-100	100+	Top 10	11-100	100+
Exam score (sd)	-0.768	-1.351	-0.643	-0.192	-0.321	-0.153	-0.044	-0.071	-0.033
	(0.209)	(0.090)	(0.033)	(0.076)	(0.032)	(0.012)	(0.035)	(0.017)	(0.005)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
other personal controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	34,762	266,666	1,500,371	34,762	266,666	1,513,061	34,762	266,666	1,513,061

The negative link holds within each tier.

F2 – Scores and Firm Creation by Personal Background



(e) Male vs. Female (f) Urban vs. Rural (g) Better vs. Worse Highsch

The negative score-firm creation slope ▸ Estimates

- for women is 60% that for men
- for those from below-median highsch is 66% that for those from above-median highsch
- for the rural is 87% that for their urban counterparts.

Scores and Firm Creation: Additional Results

The negative sore-firm creation link holds when

- keeping prov-years with linking $>$ 95% or 99% ▸ More
- excluding repeated exam takers ▸ More
- excluding students on the (10-90) tails ▸ More

What have we learned?

F1. Within colleges, higher-scores students are less likely to create firms.

F2. The negative relationship is stronger for the more advantaged groups.

Possible interpretations:

1. the "lower entrepreneurial ability": corr(s, entrepreneur ability)< 0
2. the "opportunity cost": corr(s, entrepreneur ability)> 0 but talents are rewarded (more) by waged jobs.
3. the "risk aversion": corr(s, entrepreneur ability)$= 0$, scores reflect other traits like risk attitudes.

The interpretations matter for understanding talent allocation & the education system.

A Conceptual Framework: intuition

An individual of X and score (S) decide to create a firm or become a worker.
We allow for a flexible mapping b/w score and abilities:

$$A_E = e^{aS} \text{ and } A_W = e^{bS},$$

- a can be of any sign, $b > 0$
- $A_E \rightarrow lnR_E$, $A_W \rightarrow lnW$

risk preference: $V_W = W * e^{\delta(X,S)}$

1. the *"lower entrepreneurial ability"* hypothesis assumes that $a < 0$;
2. the *"opportunity cost"* hypothesis refers to $b > 0$;
   - $b\mu(X) > \frac{1}{1-\alpha} a\beta(X)$
3. the *"risk attitudes"* hypothesis refers to $\delta_s(X, S) > 0$.

Testable Implications

Testing *"lower entrepreneurial ability"* – the sign of a.

- $\ln K^* = \frac{1}{1-\alpha}\left[aS\beta(X) + \ln\alpha - \ln r\right]$
- Other proxies for firm success
- Need to address endogenous entry.

Testing opportunity cost – the sign of b.

- Wages from surveys

Testing *"risk attitude"* – corr (score, risk)

- Attitudes in survey data

Testing *"lower entrepreneurial ability"*

Testable Implication: higher-score students are worse business owners.

But estimations conditional on entry may be biased.

- we assume i.i.d shocks in occ. choice, but we do not know.

Method:

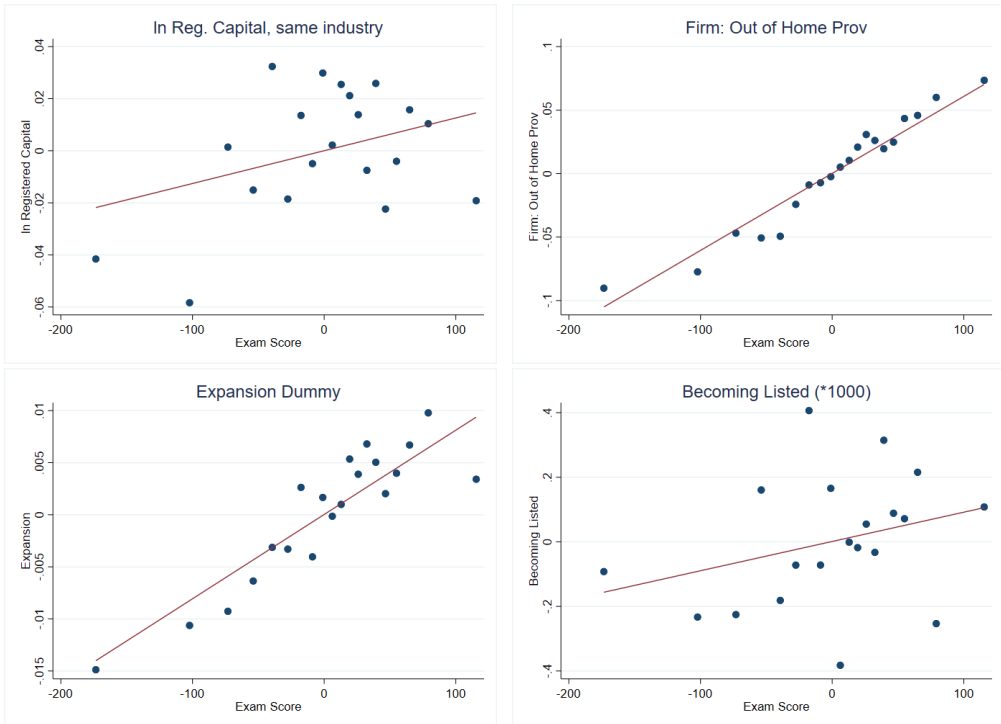
- present estimates for existing firms
- use a Heckman two step for correction based on instrument
  - feasible thanks to the rich data

Testing *"lower entrepreneurial ability"*

$$\ln K_{f,i,pyt,c} = \gamma Score_{f,i,pyt,c} + \alpha X_i + \lambda_{pyt} + \theta_c + \epsilon_{i,pyt,c},$$

(1) K is a noisy measure of success. We also look at (2) firm location, (3) expansion and (4) becoming listed

- plus (5) a survival analysis on firm exit



Testing *"lower entrepreneurial ability"*

Estimations conditional on entry may be biased.

Strategy: estimate $Pr(Firm = 1|Z_{i,pyt,c}) = \Phi(Z_{i,pyt,c})$

- where $Z_{i,pyt,c}$ includes all controls and an instrument.

The rich admin data provides hope for an instrument.

- peer composition in the same college-cohort: $\left(\frac{\sum_{j \neq i} FirmPropensity_{j,prov}}{n-1}\right)_{c,t}$
- control for college FEs
- Provincial propensity of firm creation is calculated as #firms est. before 1999 per 100 adults

The idea: college sorting is natural, but the composition of a cohort given c is likely to be exogenous.

Exclusion restriction? ▸ More

Testing *"lower entrepreneurial ability"*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Validity of the instrument		**Selection**	**A. Heckman two-step estimates**				
Dependent Var.	peer origin$_{c,t}$	(sd)	firm creation	ln Reg Capital within ind	Reg Capital within ind	Out of Home Prov	Expand	Listed (*1000)
mean dependent var				4.281	632	0.394	0.049	0.359
Exam score (sd)	0.0275	0.0006		0.0048	22.79	0.0392	0.0050	0.0625
	(0.0048)	(0.0004)		(0.0039)	(13.22)	(0.0010)	(0.0005)	(0.0446)
peer$_{c,t}$ (sd)			0.0239					
			(0.0044)					
λ (inverse mills ratio)				0.0937	332.3	-0.0025	-0.0744	-3.6286
				(0.2620)	(895.4)	(0.0706)	(0.0348)	(3.0387)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y
other personal controls	Y	Y	Y	Y	Y	Y	Y	Y
college FE		Y	Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053
				B. Estimates conditional on entry				
				ln Reg Capital within ind	Reg Capital within ind	Out of Home Prov	Expand	Listed (*1000)
Exam score (sd)				0.0056	22.94	0.0405	0.0051	0.0651
				(0.0046)	(12.74)	(0.0017)	(0.0005)	(0.0378)
prov-track-year FE				Y	Y	Y	Y	Y
age FE				Y	Y	Y	Y	Y
other personal controls				Y	Y	Y	Y	Y
college FE				Y	Y	Y	Y	Y
Obs. (excl singletons)				169,341	169,341	169,358	169,358	169,358

Testing *"lower entrepreneurial ability"*

Survival Analysis

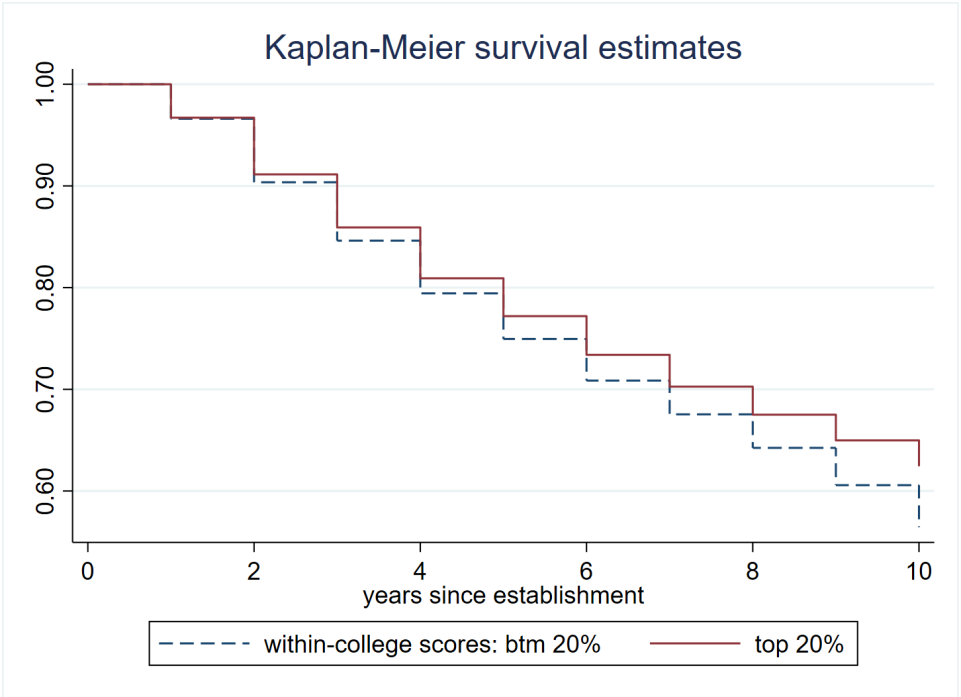


Figure: Within-college comparison

Firms created by higher-score individuals are more likely to survive.

Testing *"lower entrepreneurial ability"*: summary

- On the education system, there exists a perception known as "higher score, lower ability".

- Firms created by higher-score individuals are (1) larger, (2) more likely to overcome protection barrier, (3) survive, (4) expand and (5) even become listed.
  - Thus, difficult to argue $a < 0$.

Testing *"opportunity cost"*

Survey Data:

- We designed the surveys to evaluate elite college premium (Jia and Li 2019)
- College Graduates Survey conducted during 2010-15.
- Cover around 14,600 students from 90 colleges who reported their first-job wages.



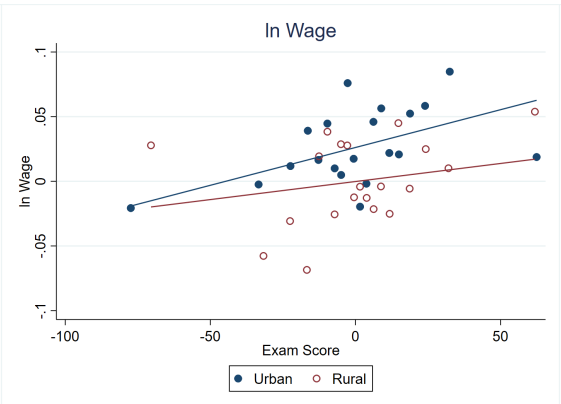
Figure: Within-college comparison

Testing *"opportunity cost"*

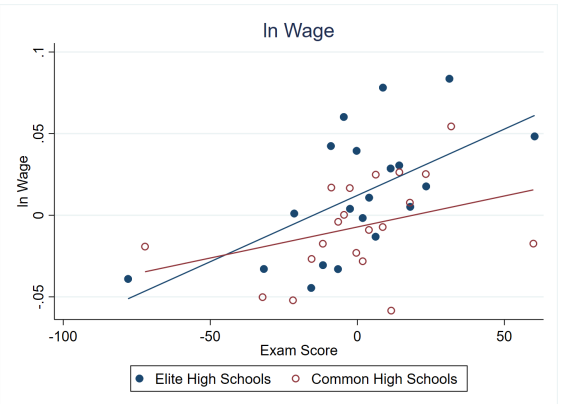
We find $b > 0$ and the heterogenous patterns mirror those on firm creation.



(a) Male vs. Female



(b) Urban vs. Rural



(c) Better vs. Worse Highsch

Testing *"opportunity cost"*

Noisier than admin data, but mirror the score-firm creation patterns.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ln Wage					ln Wage			
Exam score (sd)	0.029	0.035	0.045	0.046	0.034	0.034	0.053	0.054	0.057
	(0.011)	(0.011)	(0.014)	(0.014)	(0.011)	(0.011)	(0.015)	(0.015)	(0.019)
Female×Score			-0.037	-0.036					-0.033
			(0.020)	(0.020)					(0.032)
Rural×Score					-0.015	-0.014			0.018
					(0.017)	(0.018)			(0.026)
Non-key Highsch×Score							-0.032	-0.033	-0.04
							(0.019)	(0.020)	(0.018)
Female			-0.041						
			(0.012)						
Rural					-0.024				
					(0.008)				
Non-key High School							-0.017		
							(0.011)		
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
other personal controls		Y							Y
Female×college FE				Y					Y
Rural×college FE						Y			Y
Non-key Highsch×col FE								Y	Y
Obs. (excl singletons)	14,697	11,149	14,674	14,674	14,140	14,140	11,534	11,534	11,145

Testing *"opportunity cost"*

The state sector plays a larger role, but we cannot reject the role of private sector.

Table: Relative Risk of Working in Other Sectors

	(1) State Sector	(2) Private Firms	(3) State Sector	(4) Private Firms
Exam score (sd)	1.345	1.238	1.383	1.246
	(0.165)	(0.163)	(0.196)	(0.186)
prov-track-year FE	Y	Y	Y	Y
college FE	Y	Y	Y	Y
age FE	Y	Y	Y	Y
other personal controls		Y		Y
Obs. (excl singletons)	15,735	15,735	11,805	11,805

Testing *"opportunity cost"*: summary

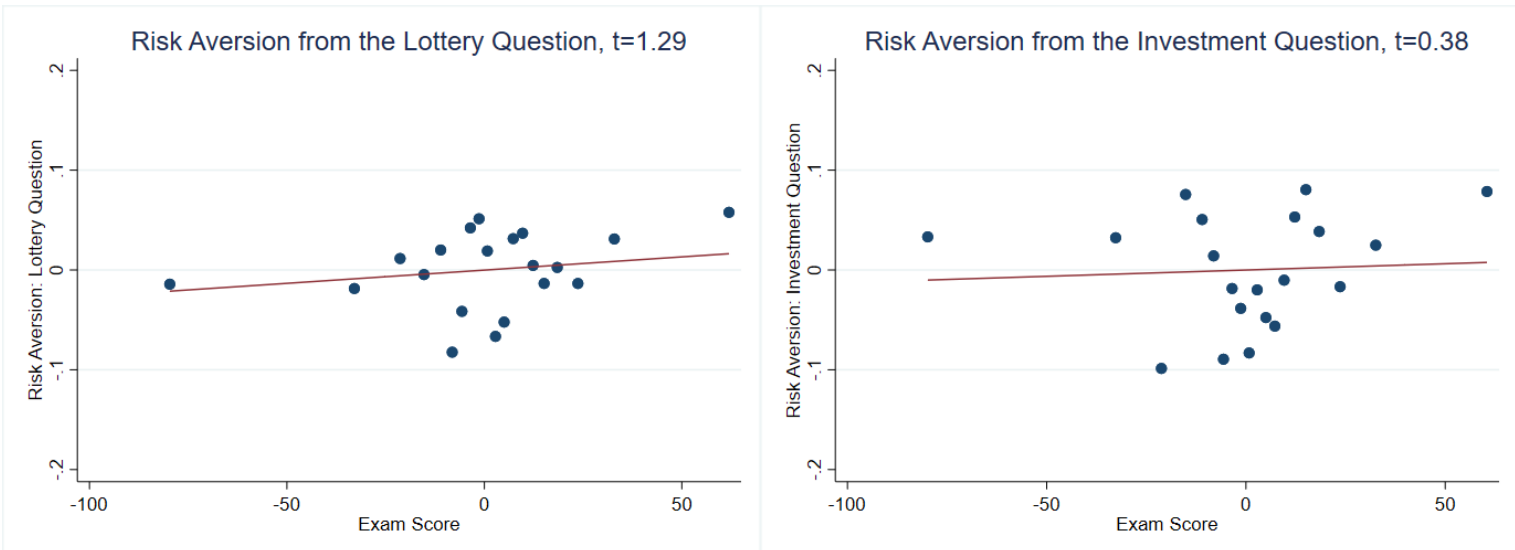
- On the education system, there exists a perception known as "those who study well become an official".

- We find that talents are attracted away by the non-entrepreneur sectors.
  - The state appears to play a larger role, but we cannot reject that of private firms.

Testing *"risk attitudes"*

We asked about risk attitudes in our college survey in 2011.

- Lottery question: do you prefer 0/2000 with half the chance to 1000 with certainty?
- Investment question: rate "it is more important to ensure certain returns in investment than take risks to pursue a higher return?"



(a) Lottery measure

(b) Investment measure

Testing *"risk attitudes"*

Women are more risk averse; No clear pattern b/w scores and risk attitudes.

	(1)	(2)	(3)	(4)
	Not taking the lottery option 0/1		Importance to ensure certain return 1-5	
	0.64		3.09	
Exam score (sd)	0.017	-0.008	0.012	0.074
	(0.013)	(0.032)	(0.037)	(0.060)
Female×Score		0.030		-0.074
		(0.028)		(0.078)
Rural×Score		0.017		-0.103
		(0.043)		(0.083)
Non-key High Sch×Score		0.025		0.081
		(0.041)		(0.061)
Female		0.075		0.087
		(0.016)		(0.034)
Rural		-0.042		-0.061
		(0.015)		(0.037)
Non-key High school		0.008		0.058
		(0.011)		(0.034)
prov-track-year FE	Y	Y	Y	Y
college FE	Y	Y	Y	Y
age FE	Y	Y	Y	Y
Observations	6,249	5,971	6,058	5,793

Testing *"risk attitudes"*: summary

Risk aversion certainly matters for doing business.

- could be underlying our finding on women vs. men.

It cannot explain our focus on score-firm relationship though.

We study scores because the whole society invests so much into this measure.

- certainly only one of many determinants of entrepreneurship

Personal tastes or barriers matter, without which we cannot explain the level differences across gender, Hukou...

- e.g., ceteris paribus, women have lower wages and lower prob. of firm creation.
- We capture them in a reduced-form way: $\delta(X)$.

The Takeaways

The opportunity cost hypothesis fits the data better than the alternatives.

Additional insights:

- Higher-score individuals' firms are more successful.
- Among the alternative opportunities, the state plays a larger role.

Conclusion

A depiction of entrepreneurial choice of academic talent in China.

- A strong and negative link b/w academic talent and firm creation, fixing colleges.
- The negative link is even stronger for men, the urban and those from better highsch.

Interpretations

- Not because higher-score individuals have lower entrepreneurial ability.
  - Firms created by higher-score individuals are larger and more successful.
- But they are attracted away by non-entrepreneur sectors.

Background and Data

Background and Data 1: Academic Talent

Admin data on Natl College Entrance Exam records during 1999-2003 & college admission records across all colleges

- entrance score, college and major
- basic bio info: age, gender, rural/urban, high schools, log GDP per capita (birth county) ▸ corr w scores
- repeated taker or not

Scores after controlling for province-year-track fixed effects

- natural or social science track determined in high schools

Scores and economic status often exhibit opposite patterns.

Background and Data 2: Firm Registration

Admin data on all firms registered in China during the 1980s-2015

- 28 million firms, 11 million of which had been de-registered by 2015.

Owners of each firm

- individuals or firms

Registered year/firm industry/location

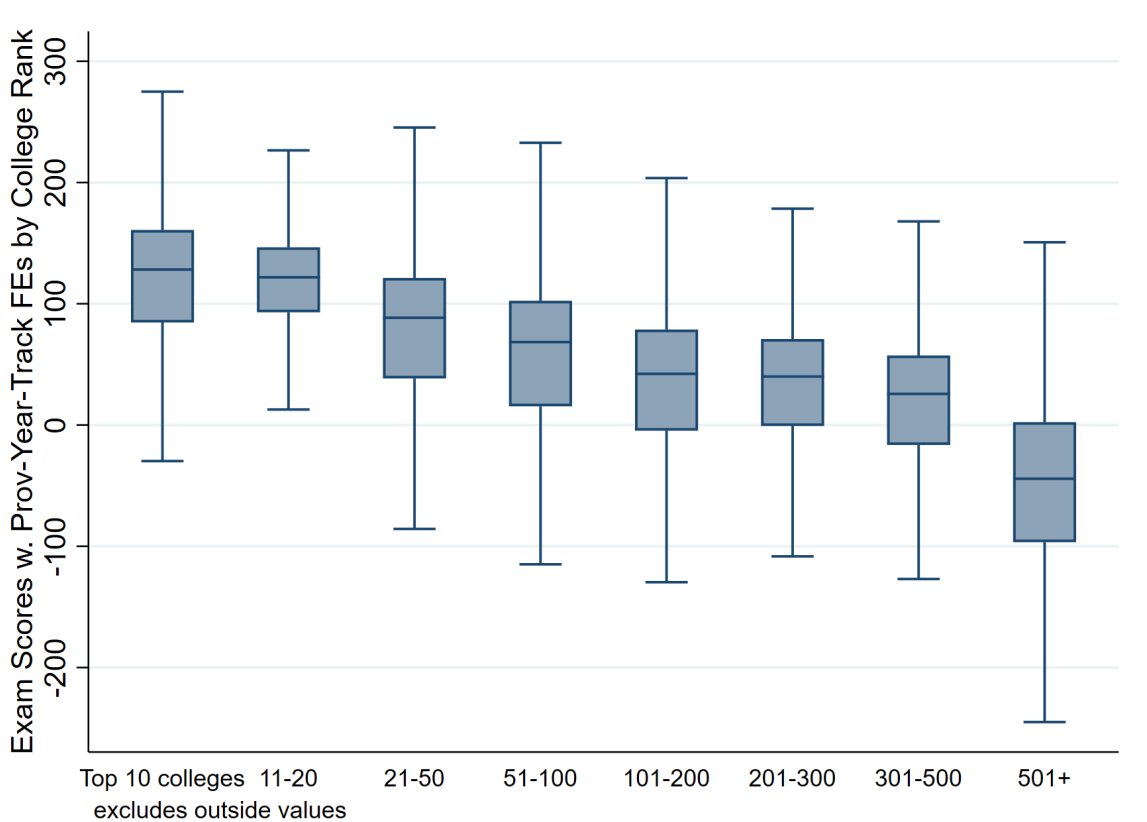
Measures of firm success

1. registered capital (most updated)
   - indicates the max. liability a firm has and hence matters for doing business.
2. being registered out of one's home prov
3. expansion (invest in other firms as a shareholder)
4. becoming publicly listed
5. exit (de-registration)

Descriptive Patterns: across and within Colleges

1. Across-college patterns: college effects + within-college pattern
2. Within-college patterns (our focus) corr w GPA
   - by majors, by college ranks

Figure: Exam Scores Distribution across and within Colleges



Why wide variation within colleges?

- College application and admission are a very uncertain process.
  - In this period, students in most provinces applied for colleges before they knew their exam scores.
  - Each needed to fill a college preference sheet for up to three colleges (and three majors in each college) within a few days.
  - Each could be accepted by at most one college.
  - Priority was given to the first choice in the bubble sheet.

- Political economy of quota assignment
  - Beijing, Shanghai and minority prov (Tibet, Xinjiang and Yunnan) are assigned higher quota.

- Majors
  - Econ, finance, law and STEM are more competitive than those in humanities.
    - Still wide variation within college-majors.

Corr b/w Scores and Personal Controls

	(1)	(2)
	Exam Score	
Mean	443.8	
Female	-4.490	-0.033
	(0.676)	(0.339)
Rural	22.689	20.566
	(0.687)	(0.502)
High school quality (sd)	38.609	15.225
	(0.829)	(0.546)
ln GDP per capita	1.011	0.817
(birth county, 2001)	(0.271)	(0.165)
prov-track-year FE	Y	Y
age FE	Y	Y
college FE		Y
Obs. (excl singletons)	1,814,511	1,814,498

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Summary Statistics: Individuals

A. Information on Individuals	Mean	Std Dev	p25	p75	Obs.
Prob of Creating a Firm (*100)					
Any Firm	7.21	25.87			1,814,547
Firms w. Capital>=RMB 2 Million	1.65	12.73			1,814,547
Firms w. Capital>=RMB 8 Million	0.78	8.82			1,814,547
Firms w. Capital>=RMB 15 Million	0.40	6.29			1,814,547
College Entrance Exam (*Gaokao*) Score	443.8	101.5	377	515	1,814,547
Gaokao Score (w. prov-yr-tr FEs)		87.7			
Gaokao Score (w. prov-yr-tr FEs+college FEs)		65.0			
Gaokao Score (w. prov-yr-tr FEs+college FEs + major FEs)		63.1			
Birth Year	1982.7	1.7	1982	1984	1,814,547
Male	0.54	0.50			1,814,547
Urban	0.53	0.50			1,814,547
High School (Sh. Stud. in Top 100 Colleges)	0.14	0.13	0.048	0.194	1,814,547
ln GDP Per Capita (birth county, 2001)	8.69	0.81	8.206	9.206	1,814,547

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Summary Statistics: Firms

B. Information on Firms	Mean	Std Dev	p25	p75	Obs.
Registered Capital (rmb 10k)	632	6042	20	200	170,087
ln Registered Capital	4.28	1.74	3.04	5.30	170,087
Out of Home Province	0.39	0.49			170,087
Expanding (Investing in Other Firms)	0.05	0.22			170,087
Becoming Listed (*1000)	0.36	18.94			170,087
Establishment Year	2010.6	3.69	2009	2013	169,668
C. Firms by Industry	Percent				
Wholesale and Retail	30.91				
Leasing and business services	20.19				
Scientific research and tech services	13.96				
Manufacturing	8.54				
Info. Trans, software and i.t. services	6.84				
the other 15 industries	19.56				

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Score and Firm Creation: More Results

Dealing with Missing IDs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Any Firm			Firm=I(Capital≥2M)			Firm=I(Capital≥15M)		
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE		Y	Y		Y	Y		Y	Y
age FE			Y			Y			Y
				missing id< 5%					
Gaokao score (sd)	-0.500	-0.782	-0.807	-0.052	-0.167	-0.174	0.008	-0.034	-0.035
	(0.040)	(0.046)	(0.046)	(0.014)	(0.016)	(0.016)	(0.006)	(0.007)	(0.007)
Female			-3.575			-0.927			-0.185
			(0.082)			(0.034)			(0.014)
Rural			-0.187			-0.268			-0.101
			(0.069)			(0.032)			(0.016)
High school quality (sd)			0.168			0.134			0.041
			(0.041)			(0.019)			(0.011)
ln GDP per capita			0.127			0.049			0.012
(birth county, 2001)			(0.047)			(0.022)			(0.010)
Obs. (excl singletons)	943,371	943,355	942,405	943,371	943,355	942,405	943,371	943,355	942,405
				missing id < 1%					
Gaokao score (sd)	-0.620	-0.951	-0.939	-0.076	-0.219	-0.212	0.014	-0.041	-0.038
	(0.059)	(0.068)	(0.098)	(0.022)	(0.026)	(0.038)	(0.009)	(0.012)	(0.023)
Female			-3.829			-0.997			-0.215
			(0.195)			(0.084)			(0.036)
Rural			-0.116			-0.314			-0.130
			(0.162)			(0.067)			(0.011)
High school quality (sd)			0.124			0.120			0.043
			(0.050)			(0.021)			(0.015)
ln GDP per capita			0.047			-0.029			-0.018
(birth county, 2001)			(0.107)			(0.035)			(0.017)
(excl singletons)	428,432	428,416	428,407	428,432	428,416	428,407	428,432	428,416	428,407

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Excluding Repeated Takers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Any Firm			Firm=I(Capital≥2M)			Firm=I(Capital≥15M)		
Gaokao score (sd)	-0.432	-0.715	-0.739	-0.034	-0.164	-0.174	0.009	-0.035	-0.039
	(0.031)	(0.033)	(0.034)	(0.011)	(0.012)	(0.013)	(0.005)	(0.006)	(0.006)
Female			-3.452			-0.861			-0.185
			(0.067)			(0.028)			(0.013)
Rural			-0.267			-0.256			-0.101
			(0.058)			(0.025)			(0.013)
High school quality (sd)			0.288			0.140			0.050
			(0.034)			(0.016)			(0.008)
ln GDP per capita			0.089			0.056			0.023
(birth county, 2001)			(0.035)			(0.017)			(0.008)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE		Y	Y		Y	Y		Y	Y
age FE			Y			Y			Y
Obs. (excl singletons)	1,310,549	1,310,535	1,309,647	1,310,549	1,310,535	1,309,647	1,310,549	1,310,535	1,309,647

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Excluding Tails

	(1)	(2)	(3)	(4)	(5)	(6)
	Any Firm		Firm=I(Capital≥2M)		Firm=I(Capital≥15M)	
Exam score (sd)	-0.926	-0.995	-0.211	-0.231	-0.048	-0.054
	(0.052)	(0.054)	(0.020)	(0.021)	(0.009)	(0.009)
Female		-3.286		-0.834		-0.184
		(0.066)		(0.026)		(0.012)
Rural		-0.210		-0.207		-0.082
		(0.053)		(0.024)		(0.011)
High school quality (sd)		0.336		0.146		0.050
		(0.033)		(0.015)		(0.008)
ln GDP per capita		0.079		0.043		0.011
(birth county, 2001)		(0.035)		(0.015)		(0.007)
prov-track-year FE	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y
age FE		Y		Y		Y
Obs. (excl singletons)	1,468,125	1,468,097	1,468,125	1,468,097	1,468,125	1,468,097

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Score-Firm Creation by X

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Any Firm (mean 7.12)				Firm=I(Capital≥2M) (mean 1.65)				Firm=I(Capital≥15M) (mean 0.40)			
Exam score (sd)	-0.957	-0.800	-0.982	-1.163	-0.199	-0.181	-0.216	-0.241	-0.048	-0.039	-0.051	-0.060
	(0.044)	(0.036)	(0.045)	(0.056)	(0.017)	(0.014)	(0.018)	(0.024)	(0.007)	(0.007)	(0.008)	(0.010)
Female×Score	0.382			0.375	0.054			0.053	0.019			0.019
	(0.039)			(0.039)	(0.018)			(0.018)	(0.008)			(0.008)
Rural×Score		0.102		0.073		0.055		0.048		0.017		0.015
		(0.042)		(0.043)		(0.020)		(0.020)		(0.009)		(0.009)
Below-med Highsch×Score			0.321	0.298			0.059	0.049			0.018	0.015
			(0.045)	(0.045)			(0.021)	(0.020)			(0.009)	(0.009)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Female×college FE	Y			Y	Y			Y	Y			Y
Rural×college FE		Y		Y		Y		Y		Y		Y
Below-med Highsch×col FE			Y	Y			Y	Y			Y	Y
Obs. (excl singletons)	1,814,500	1,814,464	1,814,502	1,814,406	1,814,500	1,814,464	1,814,502	1,814,406	1,814,500	1,814,464	1,814,502	1,814,406

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A Conceptual Framework

A Conceptual Framework: creating a firm

If an individual chooses to start a firm, he or she combines A_E and physical capital K to produce Y:

$$Y_i = A_E^{\beta(X)} K^{\alpha},$$

- β: the return to entrepreneurial ability, which can be affected by personal background (X)

A firm owner's problem:

$$maxR = A_{i,E}^{\beta(X)} K^{\alpha} - rK.$$

Thus, we get the optimal amount of capital:

$$K^* = \left(\frac{\alpha A_E^{\beta(X)}}{r} \right)^{\frac{1}{1-\alpha}}. \tag{1}$$

Given that $A_E = e^{aS}$, we obtain the expected returns:

$$\begin{aligned} \ln R^* &= \tfrac{1}{1-\alpha} \ln A_E \beta(X) - \tfrac{\alpha}{1-\alpha} \ln r + \ln \Gamma \\ &= \tfrac{1}{1-\alpha} aS\beta(X) - \tfrac{\alpha}{1-\alpha} \ln r + \ln \Gamma \end{aligned}$$

A Conceptual Framework: becoming a worker

If an individual chooses to become a worker, his or her wage is a function A_W so that:

$$W = A_W^{\mu(X)},$$

We capture personal preferences like risk attitudes in a reduced-form way by assuming the utility of being a worker is:

$$V = A_W^{\mu(X)} e^{\delta(X,S)},$$

The expected returns from being waged worker:

$$\begin{aligned} \ln V &= \mu(X) \ln A_W + \delta(X, S) \\ &= bS\mu(X) + \delta(X, S). \end{aligned} \tag{2}$$

Creating a firm vs. Becoming a worker

An individual will choose to create a firm iff

$$\frac{1}{1-\alpha} aS\beta(X) - \frac{\alpha}{1-\alpha} \ln r(X) + \ln \Gamma \geq bS\mu(X) + \delta(X,S) + \varepsilon. \qquad (3)$$

ε: individual-level idiosyncratic shocks with c.d.f. $\mathbb{G}(\varepsilon)$.

Thus, the probability of creating a firm becomes:

$$\mathbb{P}(Firm) = \mathbb{G}\left\{ \left[\frac{1}{1-\alpha} a\beta(X) - b\mu(X) \right] S - \delta(X,S) - \frac{\alpha}{1-\alpha} \ln r(X) + \ln \Gamma \right\} \quad (4)$$

The negative score-firm creation link:

$$\frac{1}{1-\alpha} a\beta(X) - b\mu(X) - \delta_s(X,S) < 0 \qquad (5)$$

Testing the Hypotheses: More Results

Exclusion Restriction

Dependent Var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ln Reg Capital within industry		Reg Capital within industry		Out of Home Prov		Expand		Listed (*1000)	
peer composition (instrument)	North-on-North South-on-South	North-on-South South-on-North	N-on-N S-on-S	N-on-S S-on-N	N-on-N S-on-S	N-on-S S-on-N	N-on-N S-on-S	N-on-S S-on-N	N-on-N S-on-S	N-on-S S-on-N
Exam score (sd)	0.0045	0.0044	22.64	22.76	0.0381	0.0378	0.0050	0.0049	0.0686	0.0683
	(0.0039)	(0.0039)	-13.23	-13.24	-0.0059	(0.0024)	(0.0005)	(0.0005)	(0.0444)	(0.0447)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
other personal controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053	1,858,053

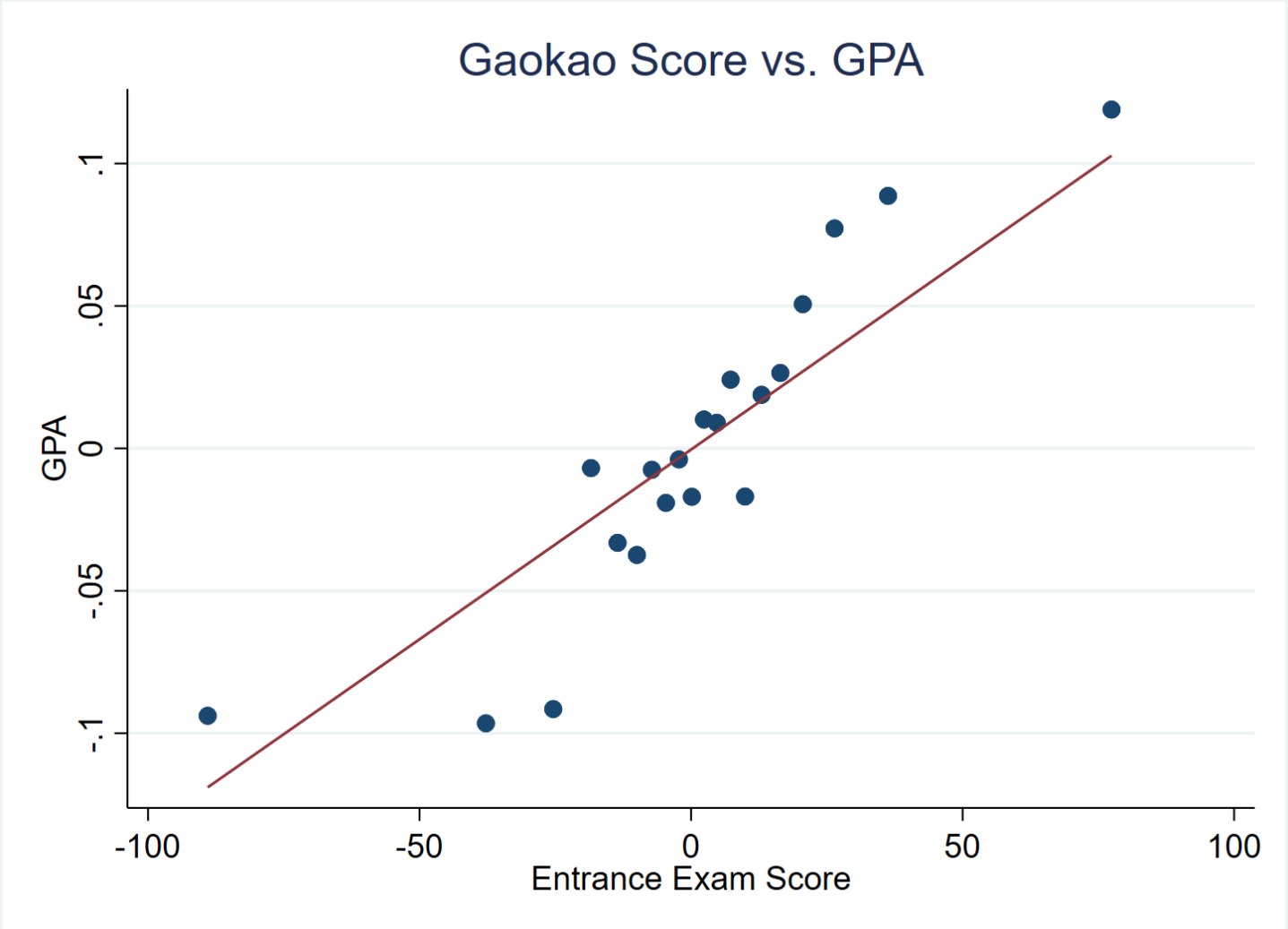
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Scores vs. Other Characteristics in College

	(1) GPA (std)	(2) Failed a subject in college	(3) Univ.-level award	(4) Positions in the student union	(5) Party member
Mean		0.394	0.076	0.322	0.264
Exam Score (std)	0.280	-0.108	0.034	0.019	0.038
	(0.037)	(0.011)	(0.006)	(0.009)	(0.011)
age FE, gender, Hukou, highsch type	Y	Y	Y	Y	Y
prov-track-year FE	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y
Observations	25,994	30,471	30,471	30,471	30,471
R-squared	0.216	0.158	0.049	0.09	0.148

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Score-GPA within colleges



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Position in the literature

1. Talent allocation
   - Consistent with the existing theory
   - More nuanced: public sector plays a larger role; private sectors matters too.

2. Entrepreneurship literature
   - Often difficult to separate individual ability from education (network, signaling)

3. Understanding the test-based education system
   - Little is known what these scores measure.