Entrepreneurial Reluctance: Talent and Firm Creation in China*

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Date: October 6, 2021

Abstract

How likely are talented individuals to create firms and why? We study this question by linking administrative college admissions data for 1.8 million individuals with the universe of firm registration records in China and studying who created firms by their mid-30s. Given the same college background, we find that individuals with higher college entrance exam scores—the most important measure of talent and a subject of great debate in this context—are less likely to create firms; however, when they do, their firms are more successful than those of their lower-score counterparts. Other results suggest that higher-score individuals receive higher wages and are more likely to join the state sector. Among several hypotheses, the most plausible interpretation is that the score is positively associated with both entrepreneurial ability and wage-job ability but that higher-score individuals are attracted to waged jobs, particularly those of the state sector. Our findings speak to whether the exam score measures ability and how the reward structure of a society governs the allocation of ability.

*We thank Ying Bai, Ting Chen, Julie Cullen, Gordon Dahl, Alexia Delfino, Hanming Fang, Roger Gordon, Josh Graff Zivin, Elizabeth Lyons, David Mckenzie, Rohini Pande, Yona Rubinstein, Imran Rasul, Andrei Shleifer, John Van Reenen, Michael Song, Yang Song, Noam Yuchtman, Xiaobo Zhang, Yu Zheng, Xiaodong Zhu, and especially Xiao Ma for their comments. We also benefit from the seminar and conference presentations at the Bank of Canada-Tsinghua-Toronto conference, CEFPA, CEPR/LEAP, Fudan, Georgetown-World Bank, HKUST, LSE, Luohan Academy, NBER, Nottingham, Peking University, Queen Mary, SITE Stockholm, Stanford China Center, UBC, UCL, UCSD, and USC for their comments.

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1 Introduction

In recent years, a growing literature in economics has shown that the talent of entrepreneurs is important for both firm-level productivity and aggregate-level economic growth (Bertrand and Schoar 2003; Bloom and Van Reenen 2007; Gennaioli et al. 2013; Queiró 2018; see a survey by Syverson (2011)), suggesting that the allocation of talent to the entrepreneurial sector may improve economic efficiency. It is not clear, however, whether talented individuals are more or less likely to become entrepreneurs. In fact, an influential theoretical literature has long noted that talented individuals are often attracted to non-entrepreneurial sectors, which can lead to misallocation of human capital (Baumol 1990; Murphy, Shleifer and Vishny 1991, 1993; Acemoglu 1995). Despite its importance to productivity and economic growth, the association between individual-level ability and entrepreneurship has not been extensively examined.[1]

There are several empirical challenges to such an examination. First, it is difficult to measure talent and entrepreneurship using typical survey data. Most survey data do not differentiate firm creation from self-employment, even though the former is more important for the study of opportunistic entrepreneurship (e.g., Schoar 2010; Levine and Rubinstein 2017). Surveys of individuals or households also do not provide much information on the firms created by these individuals, making it difficult to study firm success. In addition, because firm creation is of low probability, we need a large sample size of household surveys to have a sufficient number of entrepreneurs in the sample. In addition to these data and measurement issues, there are also identification challenges. Similar to the issues that arise from estimating a Mincer wage equation, it is also difficult to separate the impact of talent from that of education and family background on firm creation.

In this paper, we study whether talented individuals are more or less likely to become entrepreneurs by linking two administrative datasets from China—the universe of college admission records during 1999–2003 and the universe of Chinese firms and their owners. Our analysis uses a random sample of 20% of the linked data, including 1.8 million college graduates who created approximately 170,000 firms by 2015.[2] The median age of firm creators in our sample was 33 in

[1]There are a few studies of this relationship that use survey data from the United States, including Hartog, Van Pragg and Van Der Sluis (2010), Levine and Rubinstein (2017) and Hegde and Tumlinson (2021). We compare our research design and findings with theirs when discussing the literature.

[2]Our firm data include firms that have exited.

2015, very close to the median age of college-educated firm owners in the entire firm registration data (33.9).[3] The linked administrative data have good measures of talent, education, firm creation, and firm success as well as personal attributes. We supplement this linked administrative data with a large survey of Chinese college graduates that we conducted during 2010–2015 to study waged jobs.

Our measure of talent, the National College Entrance Exam (known as *Gaokao*) score, is the criterion for college admission in China, and it is popularly believed to determine the course of life of the exam taker. China is not unique in having a life-changing exam; several other countries (e.g., Chile, South Korea, Turkey, Vietnam) also rely on exam scores for college admission. Even for the United States, which does not have a centralized college admission system, the SAT score serves as an important criterion for college admission. Despite the importance of test scores in China and other countries, whether these scores measure any general ability is subject to debate, with little empirical evidence on the relationship between test scores and success. In the context of China, we shed light on this debate by studying how the test score associates with both entrepreneurial success and wages.

One advantage of our datasets is that we can separate the effect of the scores from that of colleges (e.g., college education, peer influence). Empirically, we examine how much of the variation in entrepreneurship can be explained by college fixed effects, i.e., the specific college an individual attends. In fact, the data reveal that most of the variation in firm creation comes from within colleges: college fixed effects account for only 1.2% of the variation in firm creation.[4] Even for the exam score, college fixed effects can explain only 46% of the variation, leaving the majority of the variation to occur within colleges. The wide variation in scores within a college is largely driven by uncertainty and policy factors in the college admission process.[5]

Our most important finding is that higher-score individuals are less likely to create firms. The raw correlation between firm creation and the *Gaokao* score is negative. More importantly, after removing college fixed effects, we still find a strong and negative association between the score and firm creation: A one-standard-deviation higher score is associated with a 10% lower probability of creating a firm. The negative score-firm creation relationship holds even when we focus on the creation of more successful (large) firms, and the magnitudes are similar when

[3] Azoula et al. (2020) document that, in the United States, the mean age at founding for the 1-in-1,000 fastest growing new ventures is 45. Our aim, however, concerns more than star firms, and thus, it is reassuring to observe the comparability between our sample and administrative data. Notably, our findings do not counter the belief that experience is useful for establishing successful firms.

[4] In contrast, college fixed effects matter more for wages: They explain 19% of the variation in wages of paid jobs in our survey data.

[5] See more discussion in Section 2.3.

using alternative definitions of firms. We also find that firm creation is positively correlated with observable family background variables (which are generally positively correlated with scores), consistent with existing research that documents the importance of liquidity constraints.[6] The opposite roles of the score and observable family background variables in determining firm creation suggests that unobserved family background variables, such as liquidity constraints, are unlikely to be underlying the negative correlation between the score and firm creation. Moreover, we find that the negative score-firm link holds when we examine the relationship by majors and by college quality, implying that the relationship is general. Notably, the negative slopes appear to be *stronger* for males, urban individuals, and being from a better high school or richer county.

To understand the negative relationship between the score and firm creation, we build a simple theoretical framework following the Roy model (Roy 1951; Borjas 1987). We assume that entrepreneurial ability leads to firm success, but that the correlation between the score and entrepreneurial ability could be positive, negative, or neutral. Our first hypothesis, related to the talent allocation theory discussed above, assumes that the score is positively associated with both entrepreneurial ability and waged-job ability, but the higher-score individuals are attracted to waged jobs, which we call the *opportunity cost* hypothesis. The second hypothesis assumes that the score is negatively associated with entrepreneurial ability and, thus, leads to less firm creation, which we term the *lower entrepreneurial ability* hypothesis. For instance, one can assume that those with higher scores lack the skills of a jack-of-all-trades (e.g., Lazear 2004) or that their entrepreneurial talent is lower than that of their lower-score counterparts. Higher-score individuals could even have a lower level of general talent if they simply obtained higher scores by putting more effort into the exam. The third hypothesis assumes a null correlation between the score and entrepreneurial ability. In this case, higher-score individuals possess unfavorable behavioral traits (e.g., more risk averse or less social) for becoming entrepreneurs, which we term the *personal traits* hypothesis.

Although all three hypotheses could potentially lead to a negative correlation between the score and firm creation, they predict different correlations between the score and firm success. More specifically, the *opportunity cost* hypothesis predicts a positive correlation between the score and firm success, because high-score individuals have higher entrepreneurial ability; the *lower entrepreneurial ability* hypothesis predicts a negative correlation; and the *personal traits* hypothesis predicts a zero correlation. Based on these predictions, we can differentiate the three hypotheses by estimating how the score is correlated with firm success.

Exploring within-college variations, we find that the score is positively correlated with

[6] This literature is large. See, e.g., Blanchflower and Oswald (1998).

entrepreneurial success (starting larger firms and being more likely to expand, enter non-local markets, survive, and be publicly listed), suggesting that talent, as measured by the score, can be turned into entrepreneurial ability. Interestingly, the score matters even more for a stricter definition of success (e.g., becoming publicly listed) than for a broader definition of success (e.g., registered capital size). The positive association between the score and entrepreneurial success supports the opportunity cost hypothesis. We also find direct evidence of the opportunity cost hypothesis: Our survey data show that the score is positively correlated with waged-job success, i.e., higher earnings and other benefits. Moreover, two pieces of evidence reveal that jobs in the state sector are important alternative opportunities for talented individuals. First, higher-score individuals are more likely to join the state sector than their lower-score college peers. Second, the negative relationship between the score and firm creation varies across industries, according to the size of the state share. These findings on firm success are consistent with the opportunity cost hypothesis but not the lower entrepreneurial ability hypothesis. In addition, they are consistent with the observation that many talented individuals choose the state sector in China, which has mixed implications for economic development.[7]

In estimating the firm success function, we also address the challenge of selection into firm creation due to unobserved productivity shocks. Specifically, we apply the Heckman two-step method, using college-cohort peer exposure in entrepreneurship (measured by historical entrepreneurial propensity of peers' home province) as an instrumental variable to predict firm entry. A good instrument should predict firm creation and is excludable from the second-step firm success equation. We find that college-cohort peer exposure in entrepreneurship is indeed a strong predictor for firm creation. We also check exclusion restrictions. Intuitively, given college sorting, the temporal variation across cohorts is exogenous and orthogonal to individual characteristics. To check whether our estimates reflect possible influences of unobserved college-cohort characteristics, we use the lagged and forward college-cohort peer exposures as placebos and find that they do not predict firm success.[8] The results from the two-step strategy that corrects selection bias yield marginally smaller estimates, suggesting that selection bias due to unobserved productivity shocks, conditional on the score, is not qualitatively large.

[7]On the one hand, talented bureaucrats are an important source of the Chinese state capacity. When a large number of talented individuals choose to work in a bureaucracy, however, the government sector can generate brain drain. Quantifying these two forces, however, is beyond the scope of this study.

[8]This exercise has similarities with the analyses in Enikolopov, Makarin and Petrova (2020), in which they use city-cohort variation in studying together with VKontakte (VK) founders to predict the penetration of VK, while controlling for the connections in the previous or following cohorts. In addition, we explore variations in more and less close exposure to check exclusion restriction. See the discussion in 5.1.

In our final empirical exercise, using our survey data, we test whether the personal traits hypothesis also could explain the negative association between the score and firm creation. We find that, within college, higher-score individuals have a higher GPA and are more likely to receive academic awards and to become a Chinese Communist Party (CCP) member. We do not, however, find strong correlations between the score and risk attitudes or participation in social activities. Overall, these results suggest that scores are not correlated with behavioral traits in a way that is particularly unfavorable (or favorable) for becoming an entrepreneur. Admittedly, however, we cannot measure every personal trait using surveys.

Our study speaks to an important question in education: Do test scores measure any general ability? Our answer is "yes." Our finding on individual ability and firm success is consistent with a growing literature that emphasizes the role of entrepreneurial human capital in determining firm performance. In addition, we find that the score has a positive return for waged jobs, controlling for college fixed effects. Although an extensive literature shows how education affects income and occupation choices, we are not aware of many studies that have differentiated the effect of ability from that of education.[9] As in other countries, whether the score captures any ability has been subject to debate, and there is a perception of "higher score, lower ability" (*gaofen dineng*). Our finding suggests that such stigmatization is not empirically grounded.

In the vast literature on entrepreneurship, evidence of individual-level ability and firm creation is still elusive. Using data from the National Longitudinal Survey of Youth, Hartog, Van Pragg and Van Der Sluis (2010), Levine and Rubinstein (2017), and Hegde and Tumlinson (2021) investigate the relationship between ability and entrepreneurship.[10] Our approach is closest to that of Levine and Rubinstein (2017), although we employ a within-college design to mitigate the confounding roles of colleges, recognized by the literature. Most importantly, different from our results, Levine and Rubinstein (2017) find that individuals with higher scores in the Armed Forces Qualifications Test are more likely to own incorporated businesses.[11] This contrast with our finding might be the

[9]It has long been understood that, when using test scores to proxy ability, one has to realize the relationship between test scores and schooling (e.g., Hansen, Heckman and Mullen, 2004).

[10]For the measurement of entrepreneurship, Hartog, Van Pragg and Van Der Sluis (2010) and Hegde and Tumlinson (2021) include self-employment as entrepreneurship, whereas Levine and Rubinstein (2017) highlight that the relationship between ability and entrepreneurship differs, depending on whether one includes self-employment as entrepreneurship or not. For the determinants of entrepreneurship, Hartog, Van Pragg and Van Der Sluis (2010) study different ability measures and highlight the importance of general ability and balanced ability. Levine and Rubinstein (2017) emphasize the interaction between cognitive ability and risk-taking attributes, whereas Hegde and Tumlinson (2021) note the importance of information friction in regard to ability that affects selection into entrepreneurship.

[11]In a different setting, Shu (2016) finds that higher-GPA graduates from MIT are more attracted to science and engineering than to the finance sector, which also suggests that talented individuals are not deterred from entering the sector that is more closely related to productivity.

result of institutional differences between the two countries; e.g., the state sector is more prevalent in China. We indeed find that higher-score individuals are less likely to create firms in industries for which the state plays a more dominant role. In the Chinese context, the dominance of the state sector potentially hinders economic development (e.g., Huang 2008, Hsieh and Song 2015). Brandt, Kambourov, and Storesletten (2020) construct a quantitative model that highlights the importance of entry barriers to explain productivity differences across regions and show that these barriers are related to the size of the state sector. Our study provides individual-level support for these macro approaches.

In addition, our study joins the recent empirical literature that tries to understand talent allocation in a variety of settings (e.g., Hsieh et al. (2019) on racial discrimination in the United States, Ashraf et al. (2021) on gender norms across countries). More broadly, our study is related to a burgeoning literature using administrative data from developed countries to study the social and economic background of politicians (Dal Bó et al. 2017) and inventors (Aghion et al. 2017; Bell et al. 2019). Our findings suggest an important role of the state in shaping talent allocation, which could be a useful perspective to enrich our understanding of talent allocation across countries.

2 Background and Data

2.1 *Gaokao* and Firm Owner Data

China has a centralized college admission system: All 2,000 or so colleges in China admit students based mainly on the score of a centralized college entrance exam (i.e., *Gaokao*). At the end of their senior year (Grade 12), normally in early June every year, students need to take the college entrance exam in either the sciences (exam subjects are Chinese, English, advanced math, and sciences) or the social sciences (exam subjects are Chinese, English, basic math, and social sciences) track; students choose their tracks in Grade 10. The score on the exam, written and graded by provincial education authorities, determines the college, if any, a student will attend. Because the exams and admissions are administered by each province every year, the exam scores are comparable only for students from the same province, same year, and same track (social or natural sciences).

We employ administrative data that cover the entire universe of all participants in *Gaokao* from 1999 to 2003 and their college admission outcomes across 2,056 colleges. Out of the 23 million records, including those who failed to go to any college, 14.2 million were accepted by some college, which are the data that we use. The data provide detailed information on student exam performance, including total score, subject scores, and name of college and major (if admitted) as well as student biographical information, such as gender, *Hukou* (urban/rural status), birth year, and high school name.[12]

To track firm creation and performance, we use the administrative data of all firms ever registered in China by February 2015.[13] These data include 28 million firms, 11 million of which had been deregistered by 2015, which we also observe and use as a proxy for exit. The administrative registration records provide information on the owners (known as shareholders), who can be individuals or firms. We call individual owners firm creators or entrepreneurs. We also know whether a firm invested in another firm as an owner, which we define as an "expansion." The data also include some basic firm information, such as industry, location, and registered capital size.

The college entrance exam and admission data are linked to the firm owner data by an encrypted national identity number in both datasets. Of the 14.2 million records, we succeed in linking 9.5 million records,[14] with 9.1 million unique individuals. The extra 400,000 records are repeat exam takers, for whom we focus on the first-time score because we are interested in the score as a proxy for ability.[15] For the purpose of de-identification, we randomly sampled 20% of the linked administrative data (i.e., 1.8 million individuals) for our analyses.

2.2 College Graduate Survey 2010–2015

We supplement the administrative data with our own college graduate survey data, which include information on wages. We conducted large-scale surveys of college graduates during the graduation months (May and June) during 2010–2015, which cover approximately 30,000 students from 90 colleges, around 14,800 of whom reported detailed information on their first jobs. We designed the

[12]It should be noted that the college dropout rate is very low in China and, thus, is not an important issue in our context. In fact, the college education system in China is known for being "strict entrance, easy out." The overall graduation rate for Chinese colleges is above 95%.The Beijing-based Mycos Institute estimated that, in 2011, China's college dropout rate was 3%, whereas the Ministry of Education reported that the dropout rate that year was 0.75%.

[13]For small businesses, an individual may face a trade-off between staying self-employed (not studied in this paper) and registering a firm. Putting aside the fact that certain industries require registration for doing business, an important benefit of registering a firm is limited liability. Notably, however, remaining self-employed without registering a firm may have implications that contribute to tax evasion. We consider both small and big firms, for which registration is required.

[14]Matching of the two datasets is not perfect due to missing (3.9 million) or invalid identifying numbers (0.8 million). The missing of identifying numbers usually occurs at a province-year level. We further restrict our analyses to province-years, with few missing numbers as a robustness check.

[15]As we will show later, missing data and repeat exam takers do not affect our results. In addition, a small share of students received extra points due to non-exam experience such as being ethnic minority. Our score measure excludes these extra points.

surveys to evaluate the elite college premium and intentionally asked about *Gaokao* scores (see Jia and Li (forthcoming) for a detailed description of these surveys and how the first job is important for future jobs). Moreover, the surveys include information on student performance and behaviors in college. Although these surveys cover only a limited number of colleges, this is not a major issue for us, as our main interest is a comparison of students who attended the same colleges.

2.3 Variables and Summary Statistics

Firm Variables We present firm-level variables in Panels A and B of Table 1. By 2015, the 1.8 million college graduates in our data had established 170,087 firms, and the probability of creating any firm is 7.2%. The median firm was established in 2010, or around six years after college graduation. The top five industries are wholesale and retail (30.9%), leasing and business services (20.2%), scientific research and technology services (14%), manufacturing (8.5%), and information technology and services (6.8%). The remaining 15 industries accounted for 20% of the total.

In light of the recent literature that emphasizes the importance of large firms with transformative entrepreneurship, it is important to consider firm size. We use registered capital as a proxy for firm size,[16] which is the maximum liability that a firm has and, hence, matters for doing business. After a firm is registered, the owners can choose to update their registered capital size, but we observe only the most current number in 2015. If a firm exited before 2015, its registered capital size refers to the most recent information before the exit. Using registered capital as a measure of firm size, we find that 25th and 75th percentiles are RMB 200,000 (1 USD = 7 RMB) and 2 million. Of the college graduates, 1.6% had established firms over RMB 2 million and only 0.4% above RMB 15 million. We call firms with registered capital over RMB 2 million medium-sized firms and those above RMB 15 million large firms, which are relative concepts for trackability.

In addition to firm size, we use a few alternative variables to measure firm success. The first is whether the firm was registered outside one's home province. It is well recognized that provincial governments tend to protect local firms from the competition of other firms (e.g., Young 2000). Thus, being able to start a firm outside one's home province indicates success. In our sample, less than half (or 39%) of the firms were registered outside one's home province, suggesting that, due to local protection, it is not easy to establish a firm beyond one's home province. The second variable is expansion, which is defined as one firm's investing in another firm as an owner. In our sample, 5% of firms expanded this way. The third variable is whether a firm became publicly listed. This

[16]Unfortunately, the firm registration data do not include employment.

measure can be considered a proxy for extreme success, as it is a rare event, with a chance of 3.6 per 10,000 firms. Finally, we use deregistration information to proxy firm exits. The exit probability varies greatly by firm age: 90% survived beyond three years, but only 60% survived beyond 10 years. Notably, each measure has its own limitations. For instance, the size of the registered capital partly reflects credit access; deregistration is only a noisy measure of exit. Altogether, however, the five variables allow us to achieve a good understanding of entrepreneurial success.

It is useful to note that most of the variation in firm creation comes from within colleges. College fixed effects account for only 1.2% of the variation in firm creation. To benchmark this, we find that college fixed effects explain over 19% of the variation in wages in our college graduate survey. This suggests that the choice of entering the entrepreneurial sector varies greatly at the individual level.

Exam Scores Although exam scores are positively correlated with college quality, there is considerable variation in scores within colleges. To see this variation, Figure 1(a) shows the distribution of exam scores (after controlling for province-year-track fixed effects) of eight college groups (top 10, 11–20, 21–50, etc.). On average, better colleges accepted higher-score students. College fixed effects, however, can explain only less than half (46%) of the variation in exam scores. Exam scores also vary greatly within colleges, and there is a lot of overlapping of scores across different tiers of colleges (Figure 1(a)). To measure the variation, we report in Panel C of Table 1 the mean and standard deviation of the exam scores, which are 436.9 and 101.4 respectively. Once we control for province-year-tracks fixed effects, the standard deviation drops to 88.9. It goes down to 68.4 after we also control for the college fixed effects, and 66.7 if we add 12 major fixed effects. Similarly, Figure 1(b) also shows a remaining large variation of the score after we control for all of the fixed effects.

The large within-college variation of scores could be based on a few institutional reasons. First, college application and admission is a highly uncertain process. In our study period, students in most provinces applied for colleges before they knew their exam scores. Each exam taker needed to indicate college preference, via a pencil-and-bubble sheet, for up to three colleges (and three majors in each college) within a few days. Each student could be accepted by only one college, and priority was given to the first choice in the bubble sheet (second and third choices were nearly useless). As a result, the matching between score and college was far from ideal.[17] Second, scores

[17] Such uncertainty was mitigated only in recent years, when the admission system was reformed to become a parallel system that, thanks to computer technology, allows students to apply to a few more colleges.

for each college vary greatly across provinces due to the uneven distribution of admission quotas. Each province is assigned a quota for each college by the central government. Due to political and historical considerations, major metropolitan areas, such as Beijing and Shanghai, and minority provinces, such as Tibet, Xinjiang, and Yunnan, typically get a larger quota, especially for elite colleges. Finally, there is a college-major tradeoff. Some students may choose a lower-ranked college for a popular major. For example, within any college, admission scores for popular majors, such as economics, finance, law, and STEM, are normally higher than those for humanities.[18]

Personal Background We report summary statistics of personal attributes in Panel C of Table 1. As seen in the table, 54% of college students are male, slightly higher than the male share in the population (51.3% in 2001), and 53% of students have urban *Hukou*, much higher than the urban share in the population (37% in 2001), which is consistent with the fact that fewer rural students are able to attend college. The median age of firm creators in our sample was 33 in 2015, very close to the median age of college-educated firm owners in the entire firm registration data (33.9).

We run regressions to examine how the *Gaokao* score varies with owner characteristics. As shown in Appendix Table A, although males do better across colleges (Column (1)), females and males do not differ in their *Gaokao* score within colleges (Column (2)). Rural students have higher scores, both across and within colleges, most likely because only better students from rural areas can attend high school and take the college entrance exam.

We use two variables to proxy family socioeconomic status. The first one is high school quality, as wealthier families are more likely to be able to afford elite high schools. For instance, Ye (2015) shows that the parents of those in better high schools receive more years of education and are better paid. We measure high school quality using the share of students in each high school who are admitted by the top-100 colleges in China.[19] As reported in Table 1, the bottom 25% and top 25% of high schools have 4.8% and 19.4%, respectively, of their students admitted by the top-100 colleges, indicating wide variation across high schools. In addition, we use the income per capita of 2001 in one's birth county as a measure of income. Not surprisingly, students from better high schools and wealthier counties tend to have higher scores, both across and within colleges, as shown in Appendix Table A.

[18]In the analysis, we control for the majors, and thus, the first two institutional reasons are the main driver for the within-college variation in exam scores.

[19]These are designated by the government as the Project-211 colleges, the top-100 colleges in the 21^{st} century.

3 Score and Firm Creation

In this section, we present the findings of our test for whether higher-score individuals are more likely to become entrepreneurs. Empirically, we examine the sign and size of the correlation between the *Gaokao* score and firm creation at the individual level and how it varies by major and college tier.

Descriptive Results We first visualize the relationship between the college entrance exam score and firm creation, both unconditional and conditional on the colleges, recognizing that the former relationship reflects both the within- and between-college effects. We use three definitions of firms: any size, medium-sized, and large firms. We isolate province-year-track fixed effects so that the scores are comparable.

Descriptive results suggest that the correlation between firm creation and exam score is generally negative, but even more so when we control for college fixed effects. As shown in Figure 2(a), the score-firm creation correlation is strongly negative when all firms count. This negative correlation is even larger within colleges (Figure 2(b)). Moreover, within colleges, regardless of how we define firms, higher-score students are less likely to create them, as evidenced in Figures 2(b) and 2(d).[20]

Baseline Estimates To estimate the link between scores and firm creation within colleges, we employ the following specification at the individual level:

$$Firm_{i,pyt,c} = \beta Score_{i,pyt,c} + \alpha X_i + \lambda_{pyt} + \theta_c + \epsilon_{i,pyt,c}, \quad (1)$$

where $Firm_{i,pyt,c}$ is a dummy variable that indicates whether individual i of province-year-track (pyt) in college (c) created a firm. Again, the dependent variables are the creation of firms by size. The key independent variable of interest is the exam score ($Score_{i,pyt,c}$). X_i indicates one's personal characteristics, which include gender, *Hukou* (rural vs. urban), high school quality, birth county's GDP per capita, and age fixed effects. Although we do not have measures such as parental income, it is reasonable to assume that those from better high schools and wealthier counties have higher socioeconomic status. Because $Score_{i,pyt,c}$ is comparable only within province-year-track, we always control for province-year-track fixed effects (λ_{pyt}) in our analysis. Our assumption here is that the ability distributions are similar across provinces so that the top 10 percentile in the score distribution in Province A can be compared with the top 10 percentile in Province B.[21] θ_c indicates

[20] In addition, Appendix Figure B.1 shows that the negative association between the score and firm creation within colleges holds after controlling for 12 major fixed effects.

[21] Our results are robust to examining the relationship by province.

college fixed effects. We report standard errors that are clustered at the college level. We also control for the major fixed effects in X_i in some specifications.

The estimation results reported in Table 2 show that the score is negatively correlated with firm creation. To make interpretations easier, we report the coefficient for one-standard-deviation difference in the exam score (i.e., 68 points in a college). As shown in Column (1), within a college, a one-standard-deviation higher exam score decreases the probability of creating any firm by 0.76 percentage points, or over 10% of the mean (7.21). The estimates remain stable when we control for all personal characteristics (Column (2)) and add 12 major fixed effects (Column (3)). If we define firms as those with registered capital of no less than RMB 2 million or 15 million, the magnitudes of the estimates benchmarked to the mean are actually very similar, still around 10% of the mean (Columns (4)–(9)).

In addition, we find that personal attributes matter for firm creation. The gender difference is large: Females are only half as likely to create a firm as are males. Students from urban areas and better high schools are more likely to create firms than are their counterparts, albeit the difference is less striking than the gender difference, suggesting that students with an advantageous social and economic background also have an advantage in creating firms. These results are not surprising and are consistent with existing literature that emphasizes the role of liquidity constraints in firm creation. We note, however, that higher-score individuals come from less financially constrained families but are less likely to create firms. Next, we examine heterogeneities by personal characteristics, which further suggests that liquidity constraints are unlikely to be the primary reason to explain the negative relationship between the score and firm creation.

Heterogeneities by Personal Background We examine how the relationship between the score and firm creation vary by gender, urban/rural origins, high school quality, and birth-county GDP per capita. Here, we also allow for the impacts of these characteristics to differ across colleges by including the interactions of these variables with college fixed effects. As reported in Columns (1)–(4) of Table 3, the negative relationship between the score and firm creation holds across these characteristics. Notably, the negative slopes appear to be stronger for males, urban individuals, and those from better high schools and richer counties. Among the heterogeneous patterns, the gender slopes are particularly striking: The slope for males (−0.907) is around 65% higher than that for females (−0.549). Again, these patterns hold when we focus on large firms in Columns (5)–(8). These heterogeneities further suggest that the score-firm relationship is unlikely to be explained by liquidity constraints, which would have implied opposite patterns.

Major and College Rank Theoretically, the relationship between the score and firm creation may differ by college major and college quality due to different opportunity costs. In the above analysis, we control for major and college dummies and find that the score-firm creation correlation holds. We now go a step further to allow the effect of scores on firm creation to vary across major and college quality. To track our analysis, we categorize the 12 majors into three groups: STEM, economics-finance-law, and humanities. STEM majors account for 51% of college students, consistent with the fact that Chinese higher education encourages a large number of students to enter STEM fields. Economics-finance-law majors account for 27% of the students and humanity majors, for the remaining 21%. We also divide colleges into three groups by quality: the top 10, those ranked 11–100, and the rest.

The relationship between the exam score and firm creation does not change dramatically across major and college quality. As shown in Table 4, students who are economics-finance-law majors have a higher mean probability of firm creation, consistent with the conjecture that the choice of these majors indicates a preference for entrepreneurship. Most importantly, the negative relationship between scores and firm creation holds within each major. For instance, for creating any firm (Columns (1)–(3)), a one-standard-deviation higher exam score within a college decreases the probability of creating firms by 8.8% for STEM majors, 7.6% for economics-finance-law majors, and 12% for humanities majors. Similarly, as shown in Table 5, those who go to better colleges are more likely to start a firm, but the negative association between the score and firm creation holds for each college-quality group. Thus, the negative score-entrepreneur relationship is general in terms of different majors and colleges.

Potential Data Issues We check the sensitivity of our analysis by considering a number of data issues. First, to check whether missing data due to matching is an issue, we restrict our analysis to province-years with missing probabilities lower than 5% and 1%. As reported in Panels A and B of Appendix Table B.2, the results remain similar, suggesting that the missing data may not have been a critical issue in our case.

Second, we exclude repeat exam takers from our analysis to examine whether including them caused a problem. Again, we obtain results very similar to our baseline estimates (reported in Appendix Table B.3).

Third, as indicated in Figure 1, there are a small number of students on the tails of the within-college score distribution. Although the negative link through the entire range of scores in Figure 2(b) suggests that outliers may not be an issue, as another test, we conduct an analysis in which we remove 10% of observations from both tails. The estimated negative correlations become even stronger, as shown in Appendix Table B.4.

Finally, our firm data include family firms. The concern is that college graduates may come to these firms through succession rather than through creation. The data suggest that the share of family succession in our sample is likely to be small, as over 98.2% of the firms were established after the exam year of the students. We also can gauge the extent of family succession by examining the age difference between shareholders. In this exercise, we exclude potential family firms, i.e., firms that were established before the owner took the exam and firms with an age difference between our college-educated owner and the eldest shareholder in a firm of more than 20 years. Excluding these firms, we again find that a one-standard-deviation higher exam score is associated with a 10% lower probability of firm creation (Appendix Table B.5).

4 A Conceptual Framework

What can we learn from the negative relationship between the score and firm creation? In particular, is the relationship between the score and entrepreneurial ability positive, negative, or null? We consider three competing hypotheses that express this relationship, which we term the *"opportunity cost"*, *"lower entrepreneurial ability"*, and *"personal traits"* hypotheses.

To better understand how these three hypotheses work to generate the negative correlation between the score and firm creation, we present a stylized framework built on the influential Roy model (Roy 1951; Borjas 1987). Our model considers all three hypotheses and delivers testable predictions which we then bring to the data in the next section.

Setup An individual with score S chooses to either establish a firm or become a worker. The score feeds into two different abilities for work, the entrepreneurial ability (A_E) and wage ability (A_W). We allow for a flexible mapping between the score and these abilities, specified as

$$A_E = e^{aS+\varepsilon_1} \text{ and } A_W = e^{bS+\varepsilon_0}, \tag{2}$$

where a and b can have any sign, reflecting that the correlations between the score, entrepreneurial, and wage abilities can be positive, negative, or zero. $\varepsilon_1 \sim N\left(0, \sigma_1^2\right)$ and $\varepsilon_0 \sim N(0, \sigma_0^2)$ denote the unobserved factors that also may influence the two abilities, which we call idiosyncratic productivity shocks. We assume that ε_1 and ε_0 follow joint normal distribution and have a correlation coefficient ρ.

If one chooses to start a firm, then the entrepreneurial ability (A_E) and physical capital K are used to produce the output Y with the production function

$$Y = A_E^{\beta} K^{\alpha},$$

where β captures the return to entrepreneurial ability.

A firm owner maximizes the following expected returns by choosing the optimal size of capital K,

$$R = A_E^{\beta} K^{\alpha} - rK,$$

where r is the price of capital. Solving this, we get the optimal amount of capital

$$K^* = \left(\frac{\alpha A_E^{\beta}}{r} \right)^{\frac{1}{1-\alpha}}. \tag{3}$$

Given that $A_E = e^{aS+\varepsilon_1}$, we obtain the expected returns as

$$\begin{aligned} \ln R^* &= \tfrac{1}{1-\alpha} \ln A_E^{\beta} + \ln \Gamma \\ &= \tfrac{1}{1-\alpha} aS\beta + \ln \Gamma + \tfrac{1}{1-\alpha} \beta \varepsilon_1, \end{aligned} \tag{4}$$

where $\Gamma = (1-\alpha) \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha}}$.

Alternatively, if one chooses to become a waged worker, then wage is a function of wage ability A_W or

$$W = A_W^{\mu},$$

where μ captures the return to wage ability.

We can allow for risk preferences regarding the choice of becoming an entrepreneur by introducing a risk parameter in the utility function (e.g., $U = \frac{C^{1-\gamma}}{1-\gamma}$), where C is the expected income from creating a firm and γ captures the degree of risk aversion, which can be correlated with S. Alternatively, as a simpler way to capture personal traits, such as risk aversion, we assume the utility function regarding wage income includes an element $\delta(S)$, where δ refers to the extra utility of being a waged worker (e.g., the utility of avoiding risks of firm creation). Thus, the utility of being a worker can be written as

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

and taking a log, we get

$$\begin{aligned} \ln V &= \mu \ln A_W + \delta(S) \\ &= bS\mu + \delta(S) + \mu \varepsilon_0. \end{aligned} \tag{5}$$

Choosing to Create a Firm An individual will choose to create a firm iff $lnR^* \geq lnV$, which means $v = \frac{\beta}{1-\alpha}\varepsilon_1 - \mu\varepsilon_0 \geq -\frac{1}{1-\alpha} aS\beta + \mu bS + \delta(S) - \ln \Gamma$. Note that by assumption, v is also normally distributed, $v \sim \mathcal{N}(0, \Big((\frac{\beta}{1-\alpha}\sigma_1)^2 + (\mu\sigma_0)^2 - 2\rho(\frac{\beta\mu}{1-\alpha})\sigma_0\sigma_1\Big)$. Thus, we have the probability of creating a firm:

$$\mathbb{P}(Firm) = 1 - \Phi\left(\frac{-\frac{1}{1-\alpha}aS\beta + \mu bS + \delta(S) - \ln\Gamma}{\sqrt{(\frac{\beta}{1-\alpha}\sigma_1)^2 + (\mu\sigma_0)^2 - 2\rho(\frac{\beta\mu}{1-\alpha})\sigma_0\sigma_1}}\right) \tag{6}$$

where Φ is the cumulative distribution function of the standard normal distribution function.

From equation (6), we can see that a negative link between the score and firm creation (dP/dS) is equivalent to the following inequality,

$$\frac{1}{1-\alpha}a\beta - b\mu - \delta_s(S) < 0. \tag{7}$$

The negative link between the score and firm creation ($d\mathbb{P}/dS$) could be due to three channels:

(1) The first channel is the *"opportunity cost"* hypothesis, which assumes $a > 0$ and $b > 0$, and $\frac{1}{1-\alpha}a\beta < b\mu$. Here, the score is positively correlated with both entrepreneurial and wage ability, but the return of wage ability to the score rises faster with the score than that of entrepreneurial ability, leading to a negative relationship between the score and firm creation. In other words, talent is allocated to the non-entrepreneurial sector due to high opportunity cost.

(2) The second channel, or the *"lower entrepreneurial ability"* hypothesis, assumes a negative correlation between the score and entrepreneurial ability, which refers to $a < 0$. There can be a variety of reasons for why higher-score individuals have lower entrepreneurial ability. For instance, those with higher scores may lack the skills of a jack-of-all-trades. Another possibility is that individuals achieve higher scores mainly through effort that we cannot observe. If one could isolate effort from the scores, one might find that higher-score individuals have lower entrepreneurial ability.

(3) The third channel, the *"personal traits"* hypothesis, does not assume any correlation between the score and entrepreneurial ability. Instead, the score reflects other personal traits that are unfavorable to becoming an entrepreneur, or $\delta_s(S) > 0$. For example, those who score higher might be more risk averse or are from family backgrounds that limit their chances of starting a firm.

Testable Implications To test the *"opportunity cost"* hypothesis versus the *"negative entrepreneurial ability"* hypothesis, we recover the sign of a by studying the relationship between the score and firm success. A positive a supports the opportunity cost hypothesis, whereas a negative a supports the negative entrepreneurial ability hypothesis. Another test of the *"opportunity cost"* hypothesis is in regard to the sign of b. We can estimate the sign of b by estimating a Mincer log wage equation, having the score (S) as an explanatory variable.

The *"opportunity cost"* hypothesis also predicts $\frac{1}{1-\alpha}a\beta < b\mu$. Although we do not have income data to directly estimate each parameter, we could check the relative returns (β and μ) by examining the relationship between the score and firm creation by industries. Under the assumption that the mapping precisions between the score and ability (a and b) are similar across industries, a wide variation in the relationships between the score and firm creation across industries supports the importance of relative returns (β and μ).

We could test the *"personal traits"* hypothesis by directly examining the relationship between the score and personal traits, which will help us to get a sense of the sign of $\delta_s(S)$. We link the score to variables such as students' in-college academic performance, CCP membership, participation in social activities in college, and risk attitudes.

Selection Bias In the estimation of the impact of the score on firm success, there could be selection bias, i.e., people self-select into creating firms due to productivity shocks we cannot observe. To determine this, we can derive the following relationship between the expected return of firm creation as a function of a and S:

$$\begin{aligned} E[\ln R^*| \text{ starting a firm}] &= \ln\Gamma + \frac{\beta}{1-\alpha}aS + \frac{\beta}{1-\alpha}\mathbf{E}[\epsilon_1 | \frac{v}{\sigma_v} > z] \\ &= \ln\Gamma + \frac{\beta}{1-\alpha}aS + \frac{\beta}{1-\alpha}\sigma_1\mathbf{E}\Big[\frac{\epsilon_1}{\sigma_1} | \frac{v}{\sigma_v} > z\Big] \\ &= \ln\Gamma + \frac{\beta}{1-\alpha}aS + \frac{\beta}{1-\alpha}\sigma_1\rho_{1v}\frac{\phi(z)}{1-\Phi(z)}, \end{aligned} \tag{8}$$

where $\phi(\cdot)$ is the marginal distribution of the normal distribution, ρ_{1v} is the correlation between ϵ_1 and v, and $z = \frac{-\frac{1}{1-\alpha}aS\beta+\mu bS+\delta(S)-\ln\Gamma}{\sqrt{(\frac{\beta}{1-\alpha}\sigma_1)^2+(\mu\sigma_0)^2-2\rho(\frac{\beta\mu}{1-\alpha})\sigma_0\sigma_1}}$.

The estimated sign of the marginal effect of the score on firm success $d(\ln R^*|\text{ starting a firm})/dS$ has two terms. An important test would be the sign of the first term, which is the same as a given that $\frac{\beta}{1-\alpha} > 0$. The second term is the selection bias, as the probability z is a function of the score. We will address the selection bias empirically.

5 Testing the Hypotheses

In this section, we examine which hypotheses are most consistent with the fact that higher-score individuals are less likely to create firms. We first examine firm success, which helps to establish the relationship between the score and entrepreneurial ability and to separate the three hypotheses. We then investigate state sector versus private sector employment as potential opportunities to pull higher-score individuals away from becoming entrepreneurs. Finally, we check whether higher-score individuals possess certain personal traits that may deter entrepreneurship.

5.1 Score and Entrepreneurial Ability: Evidence from Firm Success

We first examine whether the score measures the talent that is useful for entrepreneurial success. If higher-score individuals have higher entrepreneurial ability, we should expect to see that their firms are more successful, as illustrated by equation (8).

Empirical Strategies Empirically, we examine the relationship between the score and firm success using the following specification:

$$y_{f,i,pyt,c} = \gamma Score_{f,i,pyt,c} + \alpha X_i + \lambda_{pyt} + \theta_c + \epsilon_{i,pyt,c}, \tag{9}$$

where $y_{f,i,pyt,c}$ refers to different success measures for firm f created by individual i. Similar to our analyses above, we remove the impact of colleges by including the college fixed effects.

Equation (9) could potentially be subject to selection bias because we observe only firms that are self-selected into existence and the selection could be correlated with the score. To correct the potential selection bias, we employ the Heckman two-stage estimation method (Heckman 1976). In the first stage, we estimate the probability of entry, which is

$$Pr(Firm = 1|Z_{i,pyt,c}) = \Phi(Z_{i,pyt,c}), \tag{10}$$

where $Z_{i,pyt,c}$ includes X_i, λ_{pyt}, θ_c in equation (9) as well as an instrumental variable (IV) described below. We then estimate the second-stage firm success equation, correcting for (entry) selection by using the inverse Mills ratio estimated from the first stage.

We use the geographic origins of peers within the same college-cohort (indicated by peer origin$_{c,t}$) as an IV to predict firm entry. Essentially, we employ two sources of variation: the variation in entrepreneurship intensity across provinces and the geographic composition of peers in a college. Intuitively, within a college, the temporal composition of students' geographic origin measures entrepreneurship exposure and has some randomness we can empirically demonstrate.

Specifically, we define the instrument as

$$\text{peer-origin}_{c,t}=\left(\frac{\sum_{j\neq i} EntrepreneurProp_{j,prov}}{n-1}\right)_{c,t},$$

where n refers to the number of students in a college-cohort, and $EntrepreneurProp_{j,prov}$ is calculated as the number of entrepreneurs who had established firms before 1999, divided by the adult population in a province. We use this historical information of entrepreneurial propensity to further minimize the potential issue of reflection.

The differences between the estimates in Columns (1) and (2) of Table 6 illustrate the strength of this IV. Regression results indeed suggest randomness of our instrumental variable. As shown by Column (1) of Table 6, without controlling for college fixed effects, we find that the score is strongly correlated with the IV, peer-origin$_c$. In contrast, the correlation is close to zero once we control for the college fixed effects (Column (2)), suggesting that the within-college peer exposure is close to being random. The randomness is also confirmed by the fact that given the same college, peer-origin$_{c,t}$ is also orthogonal to other personal characteristics (reported in Appendix Table C.1). Moreover, within a college, peer-origin$_{c,t}$ is a strong predictor of firm creation (Column (3)). In terms of the marginal effect, a one-standard-deviation increase in $peer_{c,t}$ is associated with a 2.4-percentage-point higher probability of firm creation, or 25% of the mean.

Results for Firm Success We use a few measures for firm success and find that they are all positively correlated with the score. Our first measure is firm size.[22] Employing log capital size demeaned by province-industry mean as the outcome (Columns (4) of Table 6), we find that a one-standard-deviation increase in within-college scores is associated with a 0.7% larger registered capital. The positive links between score and firm success are stronger when we use alternative measures of firm success, including whether a firm is located outside one's home province, firm expansion, and becoming publicly listed. For these three measures, we find positive and sizable correlations between the exam score and firm success (Columns (5)–(7)): A one-standard-deviation higher within-college exam score increases the probability of investing out of one's home province and of expansion by about 10% (i.e., 0.036/0.394 and 0.005/0.049). In regard to the rare event of becoming listed, the estimate is less precise, but the magnitude of the increase is even larger, about 19% (0.069/0.359) of the mean.

As a comparison, we also report simple OLS estimates (conditional on entry) without correcting for selection bias. The results reported in Panel B of Table 6 and Appendix Figure C.2 show that the OLS estimates are similar to the Heckman estimates, suggesting that, conditional on the score, selection bias due to unobserved productivity shocks is not quantitatively large.

Validity Checks We also examine the quality of the instrument, i.e., whether peer-origin$_{c,t}$ also correlates with other covariates of firm success. We should note that the finding of no correlation between peer-origin$_{c,t}$ and observables (the score and other personal characteristics) suggests that peer-origin$_{c,t}$ may not be highly correlated with unobservables. Nevertheless, we conduct two exercises to examine this issue.

[22]Because different provinces and industries have different regulations for the minimal entry capital size, we demean a firm's log capital size by the province-industry mean.

First, we conduct placebo tests to check whether our instrument may reflect other characteristics that are correlated with firm success. Similar to the analyses in Enikolopov, Makarin and Petrova (2020), we use the lagged and forward college-cohort exposure to proxy such influences. We use our IV, peer exposure from the current cohort to predict selection while controlling for the two placebo variables. As shown in Table 7, the relationships between the score and various measures of firm success hold. Importantly, the placebo variables are not correlated with firm success in our Heckman estimation, suggesting that they do not have additional effects on success.

Second, as another test of the exclusion restrictions, we create two instruments by the origin of peers, those from the same region versus those from different regions (region means Northern or Southern China). If unobservables are important, we should expect to see a larger two-step estimate when using peer exposure from the same region as the instrument, as these peers are more likely to be exposed to the same environments that affect success. Our results in Appendix Table C.3 show that the magnitudes of the estimates are very similar when using the two instruments, suggesting that the effect of unobservables is not quantitatively important.[23]

Survival Analysis As another way to measure success (or failure), we conduct a survival analysis to study how within-college scores correlate with firm exits (deregistration in our data). We plot the firm survival probabilities for owners with within-college scores in the top 20% in relation to those in the bottom 20%.[24] As shown in Appendix Figure C.4, firms founded by those with higher scores are more likely to survive, and the advantage increases over time. In a Cox regression, the estimated hazard ratio with respect to the increase of one-standard-deviation within-college exam scores is approximately 0.975. The smaller-than-1 ratio means that firms created by higher-score students are less likely to exit.

To summarize, we find that the score is positively correlated with entrepreneurial success, and the importance of the score is more apparent when we use stricter definitions of success. These results suggest that the score indeed measures some general talent that can be turned into entrepreneurial ability.

[23]Another, similar exercise is to divide peers by their success, assuming that less-successful peers are less likely to help their own firms. Again, we find similar patterns when using more- or less-successful peers to predict entry.

[24]Specifically, we first obtain the within-college score distribution by isolating province-year-track fixed effects and year fixed effect. Then, we divide the residual scores into five quartiles.

5.2 Alternative Opportunities

First-job Wages and Benefits Employing our college graduate survey data on first-job wages, we estimate the relationship between the score and log wages, using a within-college specification similar to equation (1).[25] Although the first-job wages are typically compressed, we find that the score is indeed positively correlated with wages. As shown in Columns (1) and (2) of Table 8, a one-standard-deviation increase in the score is associated with 2.6–2.9% higher first-job wages. Further, males, urban individuals, and those from better high schools also have higher wages than their counterparts, confirming their advantages in the job market.

The score is also rewarded in terms of other non-wage benefits. One important measure of job benefit is the provision of local *Hukou*, which determines whether the worker and family can access local public goods such as education and health care. Using the same within-college specification, we find that higher-score individuals are more likely to get jobs that provide local *Hukou* (Column (3)). This result holds when we exclude those who had been local before going to college (Column (4)) and, thus, do not need a *Hukou* provided by employers.

The Importance of the State Sector One important feature of China's job market is the dominance of the state sector. In our survey, 43.4% of the graduates worked in the state sector, 50.4% worked in private firms, and 6.1% became entrepreneurs.[26] We further examine, using survey data, the choices of wages jobs in the state sector or in the private sector versus becoming an entrepreneur.

We find that the state sector plays a larger role as an alternative opportunity for becoming an entrepreneur than does the private sector. In Columns (5)–(8) of Table 8, we report multinomial logit regression results on how the score is associated with the relative risk of working in the state and private sectors versus becoming an entrepreneur. The relative risk of working in the state sector for individuals with one-standard-deviation higher score is 1.28–1.32 times higher, and it is significantly different from 1 (see the p-values in Columns (5) and (7)). The relative risk for higher-score individuals to work in the private sector is around 1.18, but it is not significantly different from 1 (Columns (6) and (8)).

Score and Firm Creation by Industry We further examine whether the negative link between score and firm creation varies systematically with the size of the state sector across industry. We

[25] All results based on the survey data have considered the sampling weight, i.e., the regressions are weighted by the inverse of sampling weight in our surveys.

[26] Unlike the administrative data that focus on firms, the survey did not differentiate between firm owners and the self-employed.

estimate equation (1) by industry and plot the 19 industry-specific estimates in Figure 3(a). Here, the dependent variable is a dummy that indicates whether an individual created a firm in a certain industry (i.e., the variable is zero if he or she does not create a firm or creates a firm in other industries). To make the estimates comparable, we plot estimates relative to the mean of the dependent variable. As shown, the estimates vary greatly: On one end of the spectrum, with an increase of the score by one standard deviation, the probability of entering the construction, mining, public management, culture, real estate, and residential sectors decreases by 25–35%; on the other end, with an increase of the score by one standard deviation, the probability of entering the restaurant and hotel, science and technology service, and IT sectors decreases by less than 5%.

Our main interest is to determine whether the heterogeneities across industries reflect the degree of *state penetration*, defined as the share of state fixed investment (relative to total investment) in an industry in 2010.[27] The variation across industries partly reflects the importance of human capital across industries, which we control for in the regressions by including as a covariate the average schooling years of employees in each industry.[28] We plot the residual relationship between the estimated correlation between the score and firm creation by industry and the share of state fixed investment, controlling for schooling.[29]

The results in Figure 3(b) indeed show that the negative correlations between the score and firm creations is stronger in industries with a higher state concentration. Our estimates suggest that one log point in state penetration is associated with a −0.059 decrease in the impact, or around 59% of the mean. Thus, these results imply that higher-score individuals are more likely to avoid creating firms in industries with stronger state penetration, which further supports the importance of the state sector among the alternative opportunities.

5.3 Other Hypotheses

Lower Entrepreneurial Ability Hypothesis The conjecture that higher-score individuals have lower entrepreneurial ability is based on a number of reasons. For instance, those with higher scores lack the skills of a jack-of-all-trades; they obtain higher scores by putting more effort into the test, but their actual ability could be lower than their lower-score counterparts. Or it may be that they achieve higher scores because they come from a better socioeconomic background and have

[27]The fixed investment comes from the China statistical yearbook in 2011. Because the size of the state sector is fairly stable within an industry, the pattern we show is robust to using information from alternative years.

[28]We calculate the schooling by industry from the 2010 census.

[29]Because the number of firms varies greatly across industries, the estimate is weighted by the number of firms in each industry.

more resources to help them to prepare for the test. Although we agree that effort and family input can affect scores, our results above on firm success suggest that higher-score individuals actually have higher entrepreneur ability (as well as wage ability). Therefore, our data do not support the lower-entrepreneurial-ability interpretation.

Personal Traits Hypothesis According to the personal traits hypothesis, higher-score individuals in a college possess unfavorable traits for becoming entrepreneurs. For instance, they might be more risk averse or less social, which consequently affects firm creation. This hypothesis cannot be reconciled with our finding that the score-firm creation correlation is more negative in industries with stronger state penetration, unless we can make a strong assumption that the relationship between the score and these traits also varies by industry in the same manner. Nevertheless, using our survey data, we can examine directly the correlations between the score and personal traits, including in-college academic performance, CCP membership, participation in social activities in college, and risk attitudes.

Not surprisingly, we find that higher-score individuals have a higher GPA and are more likely to obtain academic awards than are lower-score college peers (Columns (1) and (2) of Table 9). Higher-score students also are more likely to become a CCP member (Column (3)), consistent with our earlier finding that they are also more likely to enter the state sector, which values more CCP membership. In contrast, we do not find much of a relationship between the score and participation in social activities, measured by having a position in the college student union or in any social organization (Columns (4) and (5) of Table 9).

We also do not find evidence that support the conjecture that higher-score students are more risk averse, an important determinant of entrepreneurship. Conceptually, risk taking should be more relevant for individuals with scores at the two tails of the score distribution within a college, who might get into a college due to their risk-taking behavior. Thus, if the risk conjecture works, the negative link between firm creation and the score should become weaker if we exclude students at the tail of the score distribution in a college. Our result, however, becomes even stronger if we exclude those at the two tails (recall Appendix Table B.4).

We conduct additional tests of the risk attitude conjecture by using direct measures of risk attitudes from the 2011 wave of the College Graduates Survey. We asked two risk attitude questions. The first was, "Do you prefer to obtain RMB 1,000 with certainty or play a lottery to get between 0 and 2,000 with an equal chance?" We assume that one is more risk averse if he or she rejected the lottery option. The second question was, "Do you agree with the statement that ensuring certain returns on investment is more important than is taking more risks to gain higher returns?" Risk aversion is a dummy variable that takes the value of 1 if a student chooses to agree or strongly agree with this statement. We do not find strong correlations between the score and risk attitudes, as shown in Columns (6) and (7). Thus, the relationship between scores and risk attitudes is not obvious.

Overall, the score appears to be positively correlated with favorable personal traits such as GPA, getting academic awards, and CCP membership, whereas their correlations with social activity participation and risk attitudes are not clear. Although we also find that personal traits play an important role in firm creation (Table 2), it seems difficult to use these observed personal traits to explain the negative relationship between the score and firm creation and how this negative relationship varies across industries.

6 Conclusion

By leveraging administrative and survey data and focusing on the most important talent measure in Chinese society, we document a few new findings in this paper. First, given the same college background, individuals with higher college entrance exam scores are *less likely* to create firms. Second, this negative relationship, however, is unlikely because higher-score individuals have lower entrepreneurial ability. On the contrary, firms created by higher-score individuals are more successful than those created by their lower-score peers. Third, the opposite patterns for *ex ante* firm creation and *ex post* firm success are more consistent with the interpretation that scores are positively correlated with entrepreneurial ability but that higher-score students are attracted to non-entrepreneurial sectors, particularly the state sector, evidenced by wage-job sectors and variation across industries in firm creation.

Our findings speak to both whether the exam score measures ability—an important policy-relevant issue in education, and how the reward structure of a society governs allocation of ability—a central question in political economy of development. We do not, however, expect to see the same findings across countries.[30] On the contrary, in light of our findings on the importance of the state, we conjecture that there should be wide variation across countries depending on the role of the state in the economy.

[30] In principle, one can link individual-level SAT (or other exam) scores to firm creation and firm success in the United States or other countries. There are studies that examine SAT scores and mutual fund performance (e.g., Chevalier and Ellison 1999). Such a measure, however, refers to average SAT scores for colleges rather than individual-level scores and, thus,likely combines both college and individual effects.

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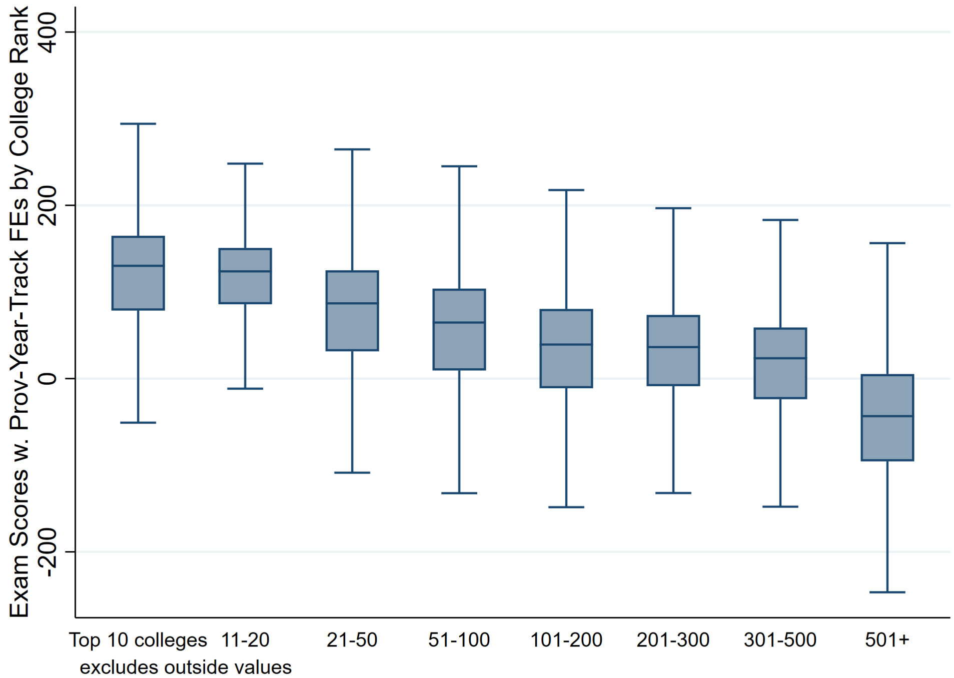
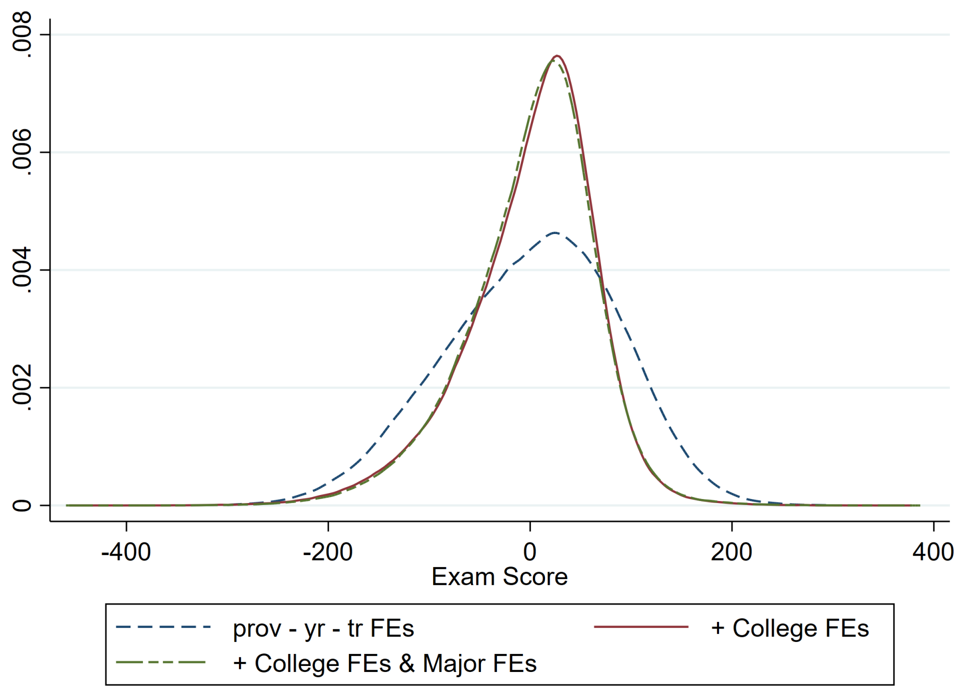
Figure 1: Exam Scores Distribution across and within Colleges

(a) Exam Scores by College Ranks



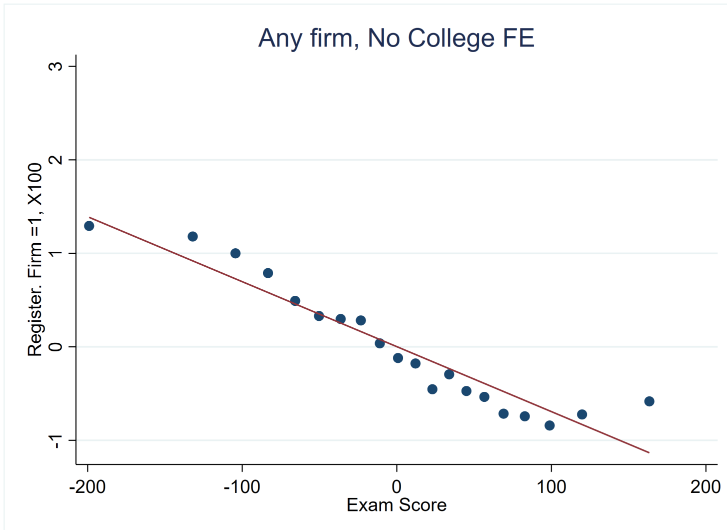
(b) Exam Score Distributions



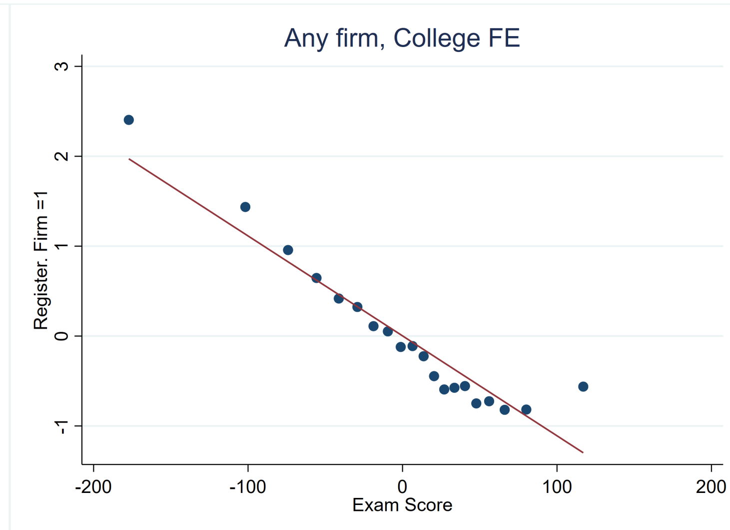
Notes: Figure (a) shows that better colleges have higher-score students on average. Meanwhile, score distributions overlap across different batches of colleges. The two marks outside the box indicates the upper and lower adjacent values. The shaded box ranges from the 25th to the 75th percentiles, where the middle mark indicates the median. Figure (b) confirms the wide variation within colleges.

Figure 2: College Entrance Exam Score vs. Firm Creation

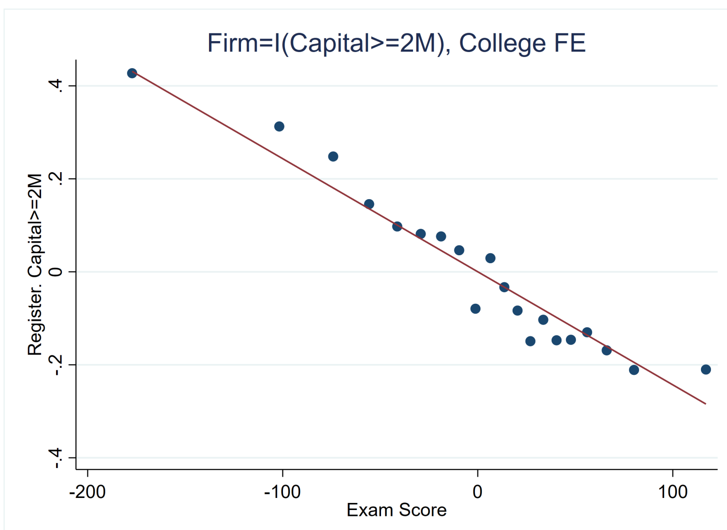
(a) No college FE, any firm



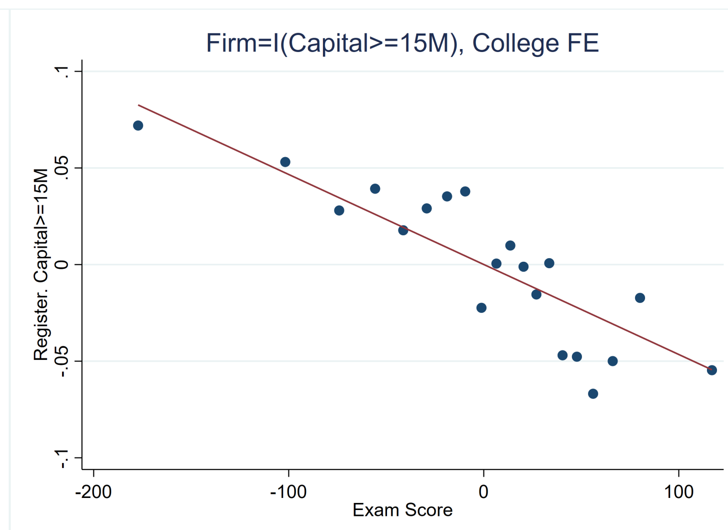
(b) College FE, any firm



(c) College FE, registered capital ≥2M



(d) College FE, registered capital ≥15M

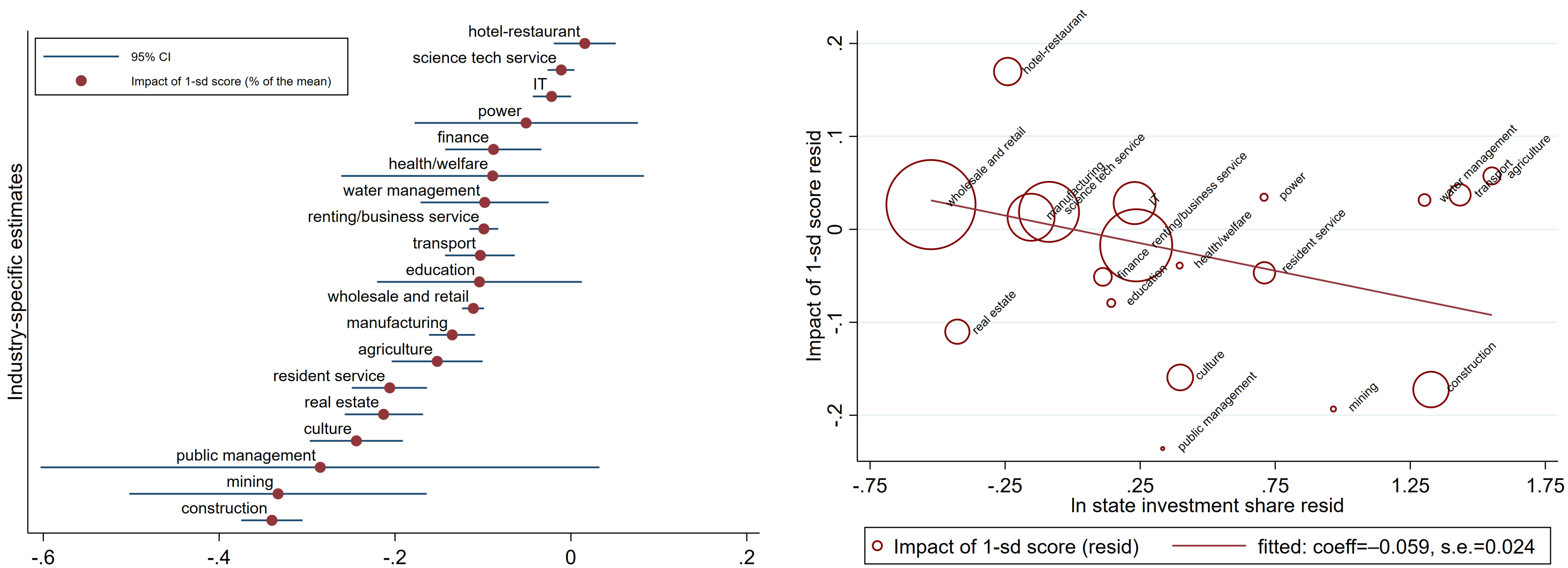


Notes: Firm=I(Capital≥2M/15M) refers to defining a firm only if it is large, i.e., its registered capital no less than RMB 2 million/15 million.

Figure 3: Score-Firm Relationships by Industry

(a) Estimates by industry

(b) Estimates vs. State penetration (controlling schooling by industry)



Notes: Figure (a) plots the estimates by industry where the dependent variable is a dummy indicating entering a certain industry. The coefficients can be interpreted as "one standard deviation score is negatively associated with X% of the dependent variable". Figure (b) plots the correlation between these estimates and the share of state investment by industry, where we control for the average years of schooling of employees by industry. The size of the circles indicates the number of firms in each industry.

Table 1: Summary Statistics

A. Information on Firms	Mean	Std Dev	p25	p75	Obs.
Registered capital	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 as owners)	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
B. 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. transport, software and i.t. services	6.84				
The other 15 industries	19.56				
C. Information on Individuals	Mean	Std Dev	p25	p75	Obs.
Prob of creating a firm (*100)					
Any firm	7.21	25.87			1,814,501
Firms w. capital≥RMB 2M	1.65	12.73			1,814,501
Firms w. capital≥RMB 15M	0.40	6.29			1,814,501
College Entrance Exam Score	436.9	101.4	371	507	1,814,501
Exam score (w. prov-yr-tr FEs)	0.0	88.9	-58	63	1,814,501
Exam score (w. prov-yr-tr FEs+college FEs)	0.0	68.4	-35	44	1,814,501
Exam score (w. prov-yr-tr FEs+college FEs + major FEs)	0.0	66.7	-35	43	1,814,501
Birth year	1982.7	1.7	1982	1984	1,814,501
Male	0.54	0.50			1,814,501
Urban	0.53	0.50			1,814,501
High school (stud% in top-100 colleges)	0.14	0.13	0.048	0.194	1,814,501
ln GDP per capita, birth county	8.67	0.81	8.21	9.21	1,814,501

Notes: Our data links administrative data on college admission during 1999–2003 with that on firm registration records from the 1980s to 2015.

Table 2: Score and Firm Creation, within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Any Firm			Firm=I(Capital≥2M)			Firm=I(Capital≥15M)		
Mean	7.21			1.64			0.40		
Exam score (sd)	-0.756	-0.770	-0.728	-0.165	-0.174	-0.173	-0.032	-0.035	-0.039
	(0.032)	(0.032)	(0.032)	(0.011)	(0.012)	(0.012)	(0.005)	(0.005)	(0.005)
Male		3.402	3.538		0.850	0.866		0.184	0.184
		(0.063)	(0.064)		(0.024)	(0.025)		(0.011)	(0.011)
Urban		0.278	0.218		0.239	0.226		0.094	0.087
		(0.049)	(0.049)		(0.022)	(0.022)		(0.011)	(0.011)
High school quality (sd)		0.260	0.273		0.131	0.129		0.045	0.044
		(0.032)	(0.031)		(0.014)	(0.014)		(0.007)	(0.007)
ln GDP per capita		0.095	0.091		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)	1,814,488	1,814,482	1,799,638	1,814,488	1,814,482	1,799,638	1,814,488	1,814,482	1,799,638

Notes: Conditional on colleges, one's exam score is strongly and negatively associated with firm creation. This finding is robust to defining firms by size and considering personal background and major fixed effects.
Firm=I(Capital≥2M/15M) refers to defining a firm only if it is large, i.e., its registered capital no less than RMB 2 million/15 million. Standard errors in the paraphrases are clustered at the college level.

Table 3: Score and Firm Creation by Personal Background
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Any firm (mean 7.12)				Firm=I(Capital>=15M) (mean:0.40)			
Exam score (sd)	-0.549	-0.649	-0.640	-0.678	-0.026	-0.019	-0.030	-0.032
	(0.030)	(0.040)	(0.033)	(0.036)	(0.006)	(0.007)	(0.006)	(0.006)
Male×Score	-0.358				-0.014			
	(0.040)				(0.008)			
Urban×Score		-0.134				-0.016		
		(0.042)				(0.009)		
Above-med highsch×Score			-0.276				-0.014	
			(0.044)				(0.009)	
Above-med county×Score				-0.134				-0.004
				(0.045)				(0.009)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y
Male×college FE	Y				Y			
Urban×college FE		Y				Y		
Above-med highsch×col FE			Y				Y	
Above-med county×col FE				Y				Y
Observations	1,814,454	1,814,448	1,814,456	1,814,446	1,814,454	1,814,448	1,814,456	1,814,446

Notes: This table shows that the negative relationship between the score and firm creation is stronger for males, urban individuals, those from better high schools and richer counties. Firm=I(Capital≥15M) refers to defining a firm only if it is large, i.e., its registered capital no less than RMB 15 million. Standard errors in the paraphrases are clustered at the college level.

Table 4: Score and Firm Creation by Majors, within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent var.	Any firm			Firm=I(capital≥2M)			Firm=I(capital≥15M)		
Major	STEM	Econ-Fin-Law	Humanity	STEM	Econ-Fin-Law	Humanity	STEM	Econ-Fin-Law	Humanity
Mean	6.50	8.21	7.52	1.52	2.02	1.41	0.35	0.55	0.28
Exam score (sd)	-0.574	-0.625	-0.890	-0.163	-0.208	-0.157	-0.044	-0.052	-0.021
	(0.041)	(0.055)	(0.054)	(0.017)	(0.025)	(0.019)	(0.007)	(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)	928,984	498,634	371,931	928,984	498,634	371,931	928,984	498,634	371,931

Notes: Firm=I(Capital≥2M/15M) refers to defining a firm only if it is large, i.e., its registered capital no less than RMB 2 million/15 million. Other personal controls include gender, rural status, higher school types and log GDP per capita of one's birth county. Standard errors in the paraphrases are clustered at the college level.

Table 5: Score and Firm Creation by College Rank, within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent var.	Any Firm			Firm=I(Capital≥2M)			Firm=I(Capital≥15M)		
College rank	Top 10	11-100	100+	Top 10	11-100	100+	Top 10	11-100	100+
Mean	8.33	7.69	7.1	2.27	1.98	1.57	0.6	0.49	0.38
Exam score (sd)	-0.773	-1.232	-0.624	-0.188	-0.304	-0.149	-0.045	-0.067	-0.029
	(0.222)	(0.085)	(0.031)	(0.086)	(0.031)	(0.012)	(0.034)	(0.016)	(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)	34,761	266,670	1,500,351	34,761	266,670	1,500,351	34,761	266,670	1,500,351

Notes: Other personal controls include gender, rural status, higher school types and log GDP per capita of one's birth county. Standard errors in the paraphrases are clustered at the college level.

Table 6: Score and Firm Success, within Colleges
Administrative Data, Firm-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Validity of the instrument		**Selection**	**A. Heckman two-step estimates**			
Dependent var.	$\text{peer}_{c,t}$ (sd)		marginal effect	ln Reg. capital within prov-ind	Out of home prov	Expand	Listed (*1000)
Mean				4.281	0.394	0.049	0.359
Exam score (sd)	0.0267	0.0006		0.0074	0.0363	0.0051	0.0686
	(0.0048)	(0.0004)		(0.0038)	(0.0010)	(0.0005)	(0.0448)
$\text{peer}_{c,t}$ (sd)			0.0238				
			(0.0044)				
λ (inverse mills ratio)				-0.0037	-0.0044	-0.0747	-3.6334
				(0.2578)	(0.0709)	(0.0349)	(3.0466)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y
other personal controls	Y	Y	Y	Y	Y	Y	Y
college FE		Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074
				B. Estimates conditional on entry			
				ln Reg. capital within prov-ind	Out of home prov	Expand	Listed (*1000)
Exam score (sd)				0.0084	0.0375	0.0053	0.0712
				(0.0043)	(0.0017)	(0.0005)	(0.0398)
prov-track-year FE				Y	Y	Y	Y
age FE				Y	Y	Y	Y
Other personal controls				Y	Y	Y	Y
college FE				Y	Y	Y	Y
Obs. (excl singletons)				169,332	169,349	169,349	169,349

Notes: The table shows that one's score is positively associated with firm success. To address the concern of endogenous entry, we employ the entrepreneurial propensity across provincial origins of one's peers within the same college as an instrument. Columns (1)-(2) show that while one's own score is correlated with the instrument, it is not the case any more within a college-cohort. Column (3) shows that the instrument is indeed a strong predictor for firm creation. Panel A reports the Heckman two-step estimates and Panel B the estimates conditional on entry.
Other personal controls include gender, rural status, higher school types and log GDP per capita of one's birth county. Standard errors in the paraphrases in Panel B are clustered at the college level.

Table 7: Score and Firm Success, within Colleges, Placebo Tests
Administrative Data, Firm-level Analysis

	(1)	(2)	(3)	(4)
	Heckman estimates			
Dependent var.	ln Reg. capital within prov-ind	Out of home prov	Expand	Listed (*1000)
Mean	4.281	0.394	0.049	0.359
peer_c, t (sd)	0.0054	0.0345	0.0056	0.1118
	(0.0066)	(0.0018)	(0.0009)	(0.0906)
peer$_{c,t-1}$ **(sd)**	0.0110	0.0012	0.0016	0.1333
	(0.0164)	(0.0045)	(0.0022)	(0.2254)
peer$_{c,t+1}$ **(sd)**	-0.0131	-0.0024	-0.0024	-0.0836
	(0.0170)	(0.0046)	(0.0023)	(0.2342)
prov-track-year FE	Y	Y	Y	Y
age FE	Y	Y	Y	Y
other personal controls	Y	Y	Y	Y
college FE	Y	Y	Y	Y
Obs. (excl singletons)	1,744,465	1,744,465	1,744,465	1,744,465

Notes: The table shows peer exposure in the previous college-cohort and next college-cohort do not predict firm success once the actual college-cohort is included.
Other personal controls include gender, rural status, higher school types and log GDP per capita of one's birth county. Standard errors in the paraphrases in Panel B are clustered at the college level.

Table 8: Score and Wage-jobs, within Colleges
Survey Data, Individual-level Analysis

	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
	ln Wage		Jobs providing local Hukou			Relative risk		Relative risk	
	all	all	all	non-local		State sector	Private firms	State sector	Private firms
Exam score (sd)	0.029	0.026	0.037	0.023		1.320	1.189	1.282	1.182
	(0.007)	(0.007)	(0.009)	(0.011)	*p*-value	0.017	0.188	0.042	0.224
Male		0.049	0.108	0.117				1.903	1.166
		(0.007)	(0.009)	(0.010)	*p*-value			0.000	0.246
Urban		0.014	-0.040	-0.005				1.389	1.256
		(0.007)	(0.009)	(0.011)	*p*-value			0.004	0.087
Elite high school		0.019	-0.027	-0.014				1.356	1.472
		(0.008)	(0.010)	(0.012)	*p*-value			0.067	0.047
prov-track-year FE	Y	Y	Y	Y		Y	Y	Y	Y
college FE	Y	Y	Y	Y		Y	Y	Y	Y
age FE		Y	Y	Y			Y		Y
Obs. (excl singletons)	14,801	14,094	14,094	9,731		14,651	14,651	14,094	14,094

Notes: This table presents the correlations between scores and first-job wages and benefits, as well as the relative risk of entering different sectors. The reference group for Columns (4)-(8) is being an entrepreneur.
This data comes from the College Graduate Student Survey we conducted during 2010-2015. Standard errors in the paraphrases are clustered at the college level.

Table 9: Score and Other Personal Traits, within Colleges
Survey Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Academic performance		Political membership	Social activity		Risk aversion (2011)	
	GPA	Academic awards	Party membership	Union leader	Union/Social org. leader	Prefer certain pay to a lottery	Ensure certainty in investment
Mean	3.01	0.063	0.265	0.125	0.495	0.636	0.329
Exam score (sd)	0.071	0.016	0.050	0.003	-0.010	0.028	0.039
	(0.012)	(0.007)	(0.019)	(0.007)	(0.014)	(0.031)	(0.028)
Male	-0.278	-0.022	-0.109	-0.019	-0.089	-0.066	-0.036
	(0.016)	(0.006)	(0.024)	(0.009)	(0.013)	(0.029)	(0.023)
Urban	-0.057	-0.001	-0.009	0.035	0.059	0.031	0.002
	(0.013)	(0.006)	(0.017)	(0.009)	(0.012)	(0.034)	(0.039)
Elite high school	-0.002	0.006	0.028	0.032	0.059	-0.015	-0.032
	(0.011)	(0.007)	(0.022)	(0.011)	(0.021)	(0.020)	(0.029)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	12,226	14,094	14,094	14,094	14,094	3,022	3,022

Notes: This table presents the correlations between scores and various personal traits.
This data comes from the College Graduate Student Survey we conducted during 2010-2015. We only asked risk-related questions in 2011. Standard errors in the paraphrases are clustered at the college level.

Online Appendix

Table of Contents

A Correlations b/w the Score and Personal Characteristics

As discussed, the exam score captures both ability and family background. We examine the correlations between one's score and his or her personal characteristics in Table A. Within college, females and males do not differ in the *Gaokao* score, though men do better across colleges. Rural students have higher scores, both across and within colleges, probably because only the better rural students could attend high schools and participate in the exam. Perhaps not surprisingly, students from better high schools and richer counties tend to have higher scores, both across and within colleges.

Table A: Score and Personal Characteristics, across and within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)
	Exam Score	
Mean	443.8	
Male	4.156	-0.104
	(0.651)	(0.337)
Urban	-22.439	-20.387
	(0.669)	(0.491)
High school quality (sd)	38.361	16.112
	(0.811)	(0.534)
ln GDP per capita	1.078	0.928
(birth county, 2001)	(0.266)	(0.170)
age FE	Y	Y
prov-track-year FE	Y	Y
college FE		Y
R-squared	0.365	0.570
Obs. (excl singletons)	1,814,495	1,814,482

Notes: Standard errors in the paraphrases are clustered at the college level.

B Score-Firm Creation: Additional Results

B.1 Including Major Fixed Effects

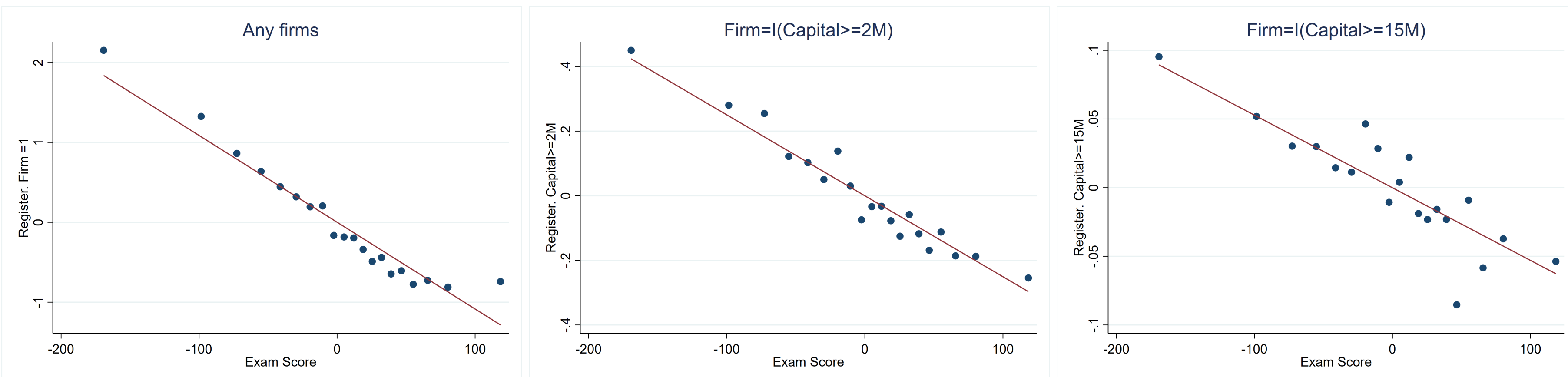
Figure B.1 shows that the negative link between the exam score and firm creation within colleges hold after controlling for 12-major fixed effects. Because major choices reflect one's own preferences, we focus on with-college comparison and report results without and with major fixed effects.

Figure B.1: Score and Firm Creation: With College FEs and Major FEs

(a) With College FE and Major FE, any firm

(b) With College FE and Major FE, reg. capital≥2M

(c) With College FE and Major FE, reg. cap≥15M



We report the relationship between exam scores and firm creation by majors in Table 4.

B.2 Results Excluding Province-Years with Missing IDs

Our findings remain very similar if we restrict data to individuals in province-years whose id missing rates are lower than 5% (Panel A of Table B.2) or even 1% (Panel B of Table B.2.)

Table B.2: Province-Years with Little Missing Info., within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	Any Firm		Firm=I(Capital≥2M)		Firm=I(Capital≥15M)	
prov-track-year FE	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y
age FE and other personal controls		Y		Y		Y
			A. sample: missing id < 5%			
Exam score (sd)	-0.762	-0.766	-0.163	-0.171	-0.029	-0.032
	(0.043)	(0.043)	(0.016)	(0.016)	(0.007)	(0.007)
Obs. (excl singletons)	943,383	943,377	943,383	943,377	943,383	943,377
			B. sample missing id < 1%			
Exam score (sd)	-0.932	-0.908	-0.221	-0.215	-0.037	-0.037
	(0.100)	(0.109)	(0.039)	(0.042)	(0.018)	(0.018)
Obs. (excl singletons)	428,412	428,403	428,412	428,403	428,412	428,403

Notes: Other personal controls include gender, rural status, higher school types and log GDP per capita of one's birth county. Standard errors in the paraphrases are clustered at the college level.

B.3 Results Excluding Repeat Exam Takers

Our findings remain similar after excluding repeat exam takers, as shown in Table B.3.

Table B.3: Excluding Repeated Exam Takers, within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	Any Firm		Firm=I(Capital≥2M)		Firm=I(Capital≥15M)	
Exam score (sd)	-0.729	-0.752	-0.166	-0.175	-0.034	-0.038
	(0.034)	(0.035)	(0.013)	(0.013)	(0.006)	(0.006)
Female		-3.451		-0.861		-0.185
		(0.067)		(0.028)		(0.013)
Rural		-0.275		-0.257		-0.101
		(0.058)		(0.025)		(0.013)
High school quality (sd)		0.284		0.139		0.050
		(0.034)		(0.016)		(0.008)
ln GDP per capita		0.101		0.047		0.017
(birth county, 2001)		(0.034)		(0.016)		(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)	1,310,541	1,310,508	1,310,541	1,310,508	1,310,541	1,310,508

Notes: Standard errors in the paraphrases are clustered at the college level.

B.4 Results Excluding Students with Scores at the Tails

Our baseline finding holds if we restrict data to individuals with scores between 10th-90th percentiles on the score distribution within a college. As shown in Table B.4, the estimates become even stronger if we exclude the students at the tails.

Table B.4: Excluding Students with Scores on the Tails, within Colleges
Administrative Data, Individual-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	Any Firm		Firm=I(Capital≥2M)		Firm=I(Capital≥15M)	
Exam score (sd)	-0.869	-0.924	-0.199	-0.222	-0.041	-0.050
	(0.050)	(0.052)	(0.019)	(0.019)	(0.008)	(0.008)
Female		-3.314		-0.843		-0.182
		(0.066)		(0.027)		(0.012)
Rural		-0.248		-0.226		-0.085
		(0.054)		(0.024)		(0.012)
High school quality (sd)		0.334		0.146		0.050
		(0.033)		(0.015)		(0.008)
ln GDP per capita		0.089		0.048		0.012
(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)	1,466,648	1,466,622	1,466,648	1,466,622	1,466,648	1,466,622

Notes: Standard errors in the paraphrases are clustered at the college level.

B.5 Addressing Family Firms

To address the concern of family firms, we keep a subgroup of firms with two conditions: (1) it was established after one took the exam, (2) the age difference between an individual in our college population and the eldest shareholder of the firm is smaller than 20 years. Such a definition is unlikely to include any family firms. The results are presented in Table B.5.

Table B.5: Restricting the Definition of Firms
Administrative Data, Individual-level Analysis

	(1)	(2)
	Firm est. post exam year and age diff among shareholders <20	
mean	5.89	5.89
Exam score (sd)	-0.598	-0.599
	(0.028)	(0.028)
Male		2.984
		(0.056)
Urban		-0.241
		(0.046)
High school quality (sd)		0.064
		(0.026)
ln GDP per capita		0.015
(birth county, 2001)		(0.026)
prov-track-year FE	Y	Y
college FE	Y	Y
age FE		Y
Obs. (excl singletons)	1,814,488	1,814,482

Notes: Standard errors in the paraphrases are clustered at the college level.

C Additional Evidence

C.1 More Results on IV Validity

If our instrument is valid, we should see no strong correlations between our instrument and scores and other personal characteristics. This is true within colleges. As reported in Column (1) of Table C.1, without controlling for college sorting, personal characteristics are correlated with our peer exposure measure. But such correlations are close to zero within colleges (Column (2)).

Table C.1: Validity Checks of the Instrument

	(1)	(2)
	$\text{peer}_{c,t}$ (sd)	
Exam score (sd)	0.0267	0.0006
	(0.0048)	(0.0004)
Male	0.0042	-0.0004
	(0.0038)	(0.0003)
Urban	0.0595	-0.0002
	(0.0045)	(0.0003)
High school quality (sd)	0.0116	-0.0013
	(0.0052)	(0.0003)
ln GDP per capita	0.0066	-0.0005
(birth county, 2001)	(0.0014)	(0.0002)
prov-track-year FE	Y	Y
age FE	Y	Y
college FE		Y
Obs. (excl singletons)	1,852,993	1,852,993

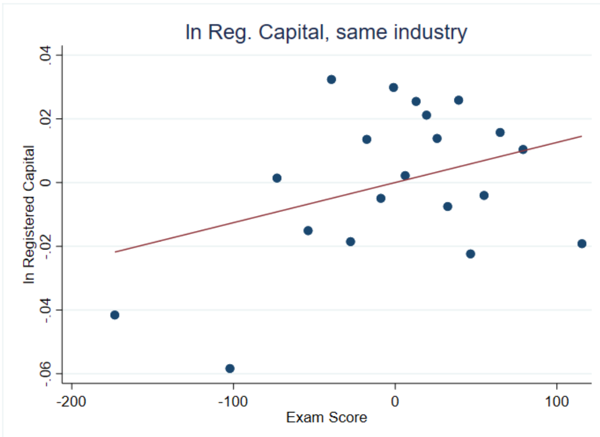
Notes: Standard errors in the paraphrases are clustered at the college level.

C.2 Visualization: Score-Firm Success Conditional on Entry

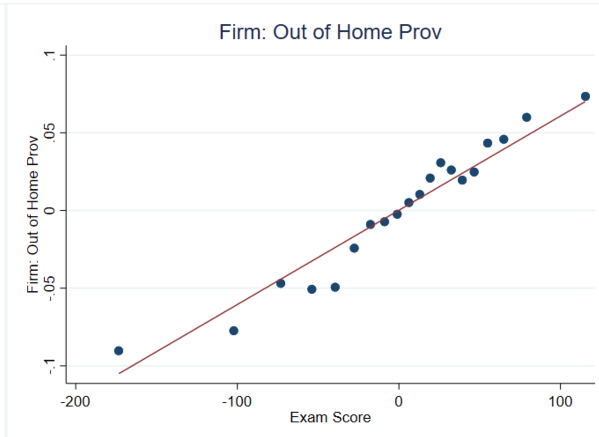
Given entry, exam scores (within colleges) appear positively associated with multiple measures of firm success, including (a) registered capital (demeaned by industry mean), (b) the propensity of creating a firm outside one's home province, (c) the propensity of investing in other firms as a shareholder, and (d) the propensity of becoming publicly listed. Figure C.2 visualizes these correlations.

Figure C.2: Firm Capital Size and Other Success Measures (given entry)

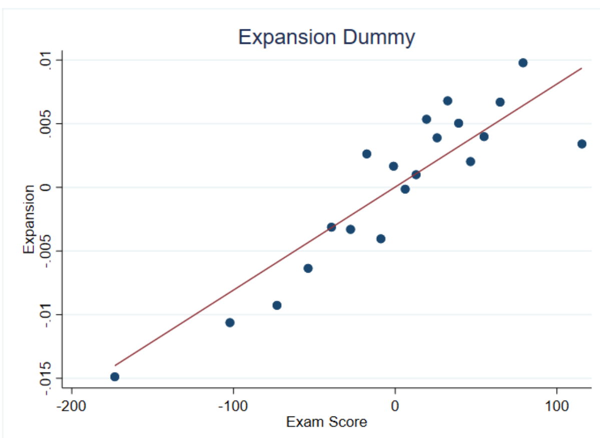
(a) log Registered Capital



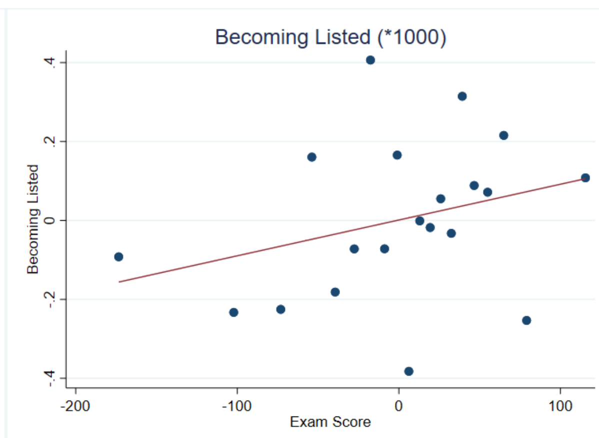
(b) Firms Created Out of Home Provinces



(c) Expansion



(d) Becoming Listed



However, we need to deal with the challenge of selection into entry when evaluating how scores affect firm. As discussed in the paper, we exploit peer composition across cohorts within colleges as an instrument to predict firm entry and use the Heckman two-step method to correct possible selection bias.

C.3 Checking Exclusion Restriction

We exploit peer composition to predict firm entry. To check whether it is a concern that peer composition also matters for firm success, we separate the peers into two groups. Specifically, we divide students' home provinces into Northern China and Southern China. Then, we use peer compositions from both the same part and the other part of China to predict entry. If peer composition matters for success, we would to see a larger impact on success when using the former as an instrument because it is more likely to help with firm success. This is not the case, as presented in Table C.3.

Table C.3: Score and Firm Success, within Colleges
Administrative Data, Firm-level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Var.	ln Reg capital (within prov-ind)		Out of home province		Expand		Listed (*1000)	
instrument: peer composition	Same region	Different region	Same region	Different region	Same region	Different region	Same region	Different region
Gaokao score (sd)	0.0071	0.0070	0.0353	0.0350	0.0051	0.0050	0.0742	0.0739
	(0.0038)	(0.0038)	(0.0060)	(0.0024)	(0.0005)	(0.0005)	(0.0448)	(0.0448)
prov-track-year FE	Y	Y	Y	Y	Y	Y	Y	Y
age FE	Y	Y	Y	Y	Y	Y	Y	Y
college FE	Y	Y	Y	Y	Y	Y	Y	Y
Other personal controls	Y	Y	Y	Y	Y	Y	Y	Y
Obs. (excl singletons)	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074	1,858,074

Notes: Other personal controls include gender, rural status, higher school types and log GDP per capita of one's birth county. Standard errors in the paraphrases are clustered at the college level.

C.4 Survival Analysis

Figure C.4 shows that the firms founded by those with higher scores are more likely to survive, and the difference becomes more important over time. The estimated hazard ratio with respect to within-college exam scores is around 0.975, with a standard error of 0.006, which is consistent with the pattern in the figure.

Figure C.4: Score and Firm Survival, within Colleges
Administrative Data, Firm-level Analysis