

**WHO HAS ‘THE RIGHT STUFF’?
HUMAN CAPITAL, ENTREPRENEURSHIP AND INSTITUTIONAL CHANGE IN CHINA**

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Abstract

While it is well established that the institutional environment matters to entrepreneurship, our understanding of the connection between macro-level institutions and the types of human capital that are deployed in entrepreneurship is limited. In this paper I argue that through their impact on barriers to entry and to growth in entrepreneurship, institutions will influence the types of individuals (specifically their level of human capital) who choose to engage in entrepreneurial activities. Using unique data from university-educated Chinese engineers, this paper shows that when institutional change reduces the barriers to the growth of entrepreneurial firms, individuals with higher human capital tend to become entrepreneurs. By exploiting a natural experiment – a shift in policies shaping returns to entrepreneurship as embodied in the 1999 Chinese constitutional amendment (that made illegal prior practices that retarded the growth of entrepreneurial firms) – it is possible to implement a differences-in-differences approach to analyze the causal impact of policy changes on the transition to entrepreneurship. Unique data were collected through survey responses from 2,966 alumni who graduated from a leading technical university in China between 1947 and 2007. The results show that the greatest increase in the transition to entrepreneurship was generated by individuals belonging to the top quartiles of a talent distribution. Moreover, firms created by such individuals have higher productivity and are more innovative.

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Introduction

Nations, regions, even cities typically encourage entrepreneurship in the expectation that it drives economic growth as well as competition (Schumpeter 1934, Schumpeter 1942, Simeon Djankov, Porta, Lopez-de-Silanes, Shleifer 2002). The institutional arrangements to enhance entrepreneurship are framed in terms of easing constraints to allow those who previously could not overcome certain obstacles (yet who had entrepreneurial ability) to become entrepreneurs (Acemoglu, Johnson, Robinson 2002, Evans, Jovanovic 1989, Holtz-Eakin, Joulfaian, Rosen 1994).¹ Yet, this view is contradicted by evidence of high levels of entrepreneurship in some of the poorest, least developed countries that have high constraints to entry (Gollin 2002). One explanation for this puzzle is that economic development is associated with better wage employment opportunities and higher opportunity costs to striking out as an entrepreneur.² Consistent with this scenario, the current paper proposes and tests the idea that institutional reform is less about lowering barriers for entry and more about lowering barriers to new firm growth to tempt talented individuals to take the risk by providing higher returns to entrepreneurship.

There is an important gap in our understanding of the mechanisms by which institutional change affects entrepreneurship. This paper asks how a particular institutional change draws in individuals to entrepreneurship and where those individuals are located on a talent distribution. The gap in our understanding is in which institutional arrangements, those that lower barriers to entry or those that lower barriers to growth, are more effective in enhancing entrepreneurial behavior. Specifically, does a reform lowering barriers to growth draw more talented individuals to become entrepreneurs by increasing the expected returns?

One role of institutions may be to shape the costs and incentives guiding entrepreneurial endeavors (Baumol 1990). Previous literature has presented the idea that some are “pushed” into entrepreneurship, where the individual cannot get a traditional employment job (Amit & Muller 1995). If

¹ In institutional economics, institutions are defined as the laws, norms, or beliefs which form the ‘rules of the game’ (North 1990, Williamson 2000). There are also traditions of sociological institutionalism and historical institutionalism developed within sociology and political science.

² Iyigun and Owen (1998) propose that risk-averse individuals will choose the wage sector over entrepreneurship in a developed economy.

the individual can gather the necessary resources to start a firm, then self-employment becomes a last resort. Alternatively, “pull” entrepreneurship has been distinguished, where an individual is drawn into entrepreneurship because of the attractiveness of an opportunity that is too good to pass up (Amit, Muller 1995). Understanding how the institutional environment affects which individuals leave traditional employment to become entrepreneurs is not just a theoretical curiosity. It has important implications for the performance of start-up firms in the economy. It is also important for policymakers interested in how firm productivity, strategy, and competition via new entrants are affected by government interventions.

The challenge to answering this question is finding an empirical setting with sufficient variation in the institutional environment for entrepreneurship and also detailed human capital or work history data on a comparable set of individuals at risk for entrepreneurship. An ideal empirical setting would be where individuals of known ability levels are randomly assigned to different institutional environments and then tracked over time. Lacking this, a context is needed where there was an exogenous shift in the institutional environment (ideally in the direction of increasing the expected returns to entrepreneurship) and where we have measures of human capital levels. One setting in which the first requirement is fulfilled is in China where a 1999 Chinese Constitutional amendment aimed to end discriminatory practices against domestic private firms. This shift is exploited and data developed to satisfy the second requirement by collecting a unique, detailed survey.

The key finding of this paper is that a stronger increase occurred in the propensity for entrepreneurship among those with higher human capital levels (as measured by graduate degrees, promotion, GPA, salary, work experience, or parent’s education) when expected returns to entrepreneurship increased. In addition, these higher human capital individuals were more likely to found firms which were more profitable, larger, and more innovative. The rest of the paper proceeds as follows: First, the literatures on institutions and on work history as they relate to entrepreneurship are each briefly reviewed followed by the hypotheses, and then I describe the empirical setting. The next section describes in detail the data and the variables used followed by the analysis and results. Finally in the

discussion and conclusion sections I describe the robustness checks, address alternative explanations and mechanisms, and discuss the theoretical implications of the findings.

THEORY AND HYPOTHESES

Institutions and Entrepreneurship

Institutions are defined as the laws, norms, or beliefs which form the ‘rules of the game’ (North 1990, Williamson 2000). By altering the constraints and structure of incentives in an economy, institutions direct self-interested behavior towards either more or less economically productive activity (Baumol 1990, Nee 1996). While lively debate surrounds the quest to determine the best institutions for economic development and entrepreneurship, consensus is growing that institutions, particularly property rights and financial liberalization, play an important role in shaping incentives for economically productive entrepreneurial behavior (Acemoglu, Johnson, Robinson 2002, Acemoglu, Johnson 2005, Klapper, Amit, Guillen, Quesada 2007, Porta, Lopez-de-Silanes, Shleifer, Vishny 1998). Theory and evidence linking institutions to entrepreneurial decisions have lagged behind (Klapper, Amit, Guillen, Quesada 2007).

In contrast, a rapidly growing literature examines the link between career experience, human capital and entry into entrepreneurship (Beckman, Burton 2007, Boeker 1989, Haveman 1993, Haveman, Cohen 1994, Phillips 2002). This literature yields mixed results. On one hand, Evans and Leighton (1989) use the National Longitudinal Survey of Young Men and find that those who transitioned to self-employment had relatively lower wages. Similarly, Amit and colleagues find that individuals who became entrepreneurs had lower salaries in their previous job (Amit, Glosten, Muller 1990, Amit, Muller, Cockburn 1995).³ In contrast, Hamilton (2000) examines the returns to self-employment and finds little evidence for wage differences between would-be entrepreneurs and non-entrepreneurs. Groysberg and coauthors (2007) find that high performance research analysts in investment banks are more likely than non-star analysts to become entrepreneurs. Lazear (2004) uses a database of Stanford’s Graduate School

³ However, the authors acknowledge the difficulty in using such a correlation to identify the impact of opportunity costs on the transition to entrepreneurship, including unobserved ability and lower wages due to effort being expended on the new startup rather than in the current job.

of Business alumni and suggests that entrepreneurs tend to be generalists and have more varied work experiences. The evidence on opportunity costs (as measured by previous salaries) and whether low or high human capital individuals have higher propensities for entrepreneurship appears mixed.

Beyond salary and performance, some literature has begun to examine the contexts which are more conducive to producing or selecting for potential entrepreneurs (Thornton 1999). Scholars have theorized about the employment conditions under which employees choose to commercialize their ideas in external spin-offs rather than within the firm (Anton, Yao 1995, Klepper, Sleeper 2002, Klepper 2001, Hellmann, 2006, Klepper, Thompson 2006).⁴ The literature has emphasized both the characteristics of the individuals (Evans, Leighton 1989, Roberts, 1991, Shane, Khurana 2003, Zucker, Darby, Brewer 1998, Stuart, Ding 2005) as well as parent firms (Burton, Sørensen, Beckman 2002, Gompers, Lerner, Scharfstein 2005, Sørensen 2007) or job roles and context (Dobrev, Barnett 2005) as important determinants of the likelihood to spin off new ventures.

Almost no work has made the connection between the broader contexts which influence people of particular characteristics and not others to found firms. Some signs exist that the institutional environment also matters (Nanda, 2008). Human capital is clearly an important determinant of the likelihood of entrepreneurship, yet the relationship between human capital, institutional environments, and entrepreneurship is unclear. It may be that only through linking macro-level, institutional effects together with micro-level, individual effects that the previously conflicting patterns may become clearer. Evidence from less-developed countries (LDCs) is useful for three reasons. First, LDCs more frequently see larger variations in the institutional environment in the direction of lowering barriers to entry and in terms of lowering barriers to growth, allowing opportunities for identification. Second, typically LDCs have not yet developed well-organized industry associations to lobby for reforms, reducing concerns of reverse causation. Third, more variation exists in the human capital distribution in less-developed

⁴ Hellmann (2006) develops a model for why employees leave their employers to become entrepreneurs and also captures the idea that the external entrepreneurial environment may encourage spin-offs. Holmes and Schmitz (1990, 1995) develop models of occupational choice consistent with those holding higher entrepreneurial ability (or with good matches with their business) becoming entrepreneurs. Similarly, the Lucas (1978) model unambiguously predicts the most able will become entrepreneurs.

countries where some families are able to send their children overseas for a high quality education yet overall enrollment in tertiary education is lower.

Very little prior work has examined the link between human capital and institutional change. Existing work either explicitly or implicitly takes ability for commercial/market productivity as being largely of a different type than ability that allows individuals to overcome the barriers to entrepreneurship in less-developed institutional environments.⁵ While this view might be correct, what if a large component to ability is common or transferable across the two activities?⁶ The Roy (1951) model is relevant for theories of occupational choice and has been widely used and extended (Borjas 1987, Roy 1951, Heckman, Honore 1990, Jovanovic 1994). The basic model assumes that individuals form predictions of their earnings in two sectors under consideration and choose the one that provides higher utility. The model examines sorting into wage employment and entrepreneurship on the basis of known heterogeneous abilities. The institutional environment may be modeled as altering the relative payoff to skills in entrepreneurship and changing the resulting self-selection. A relatively simple formal model based on a Roy Model linking talent, institutional change and entrepreneurial decisions can be found in Appendix A, but the main insights are conveyed via the more conceptual model below.⁷

Insert Figure 1 here

First, consider two simple alternative formulations of the relationship between human capital and institutional change. Figure 1 shows the hypothesized relationships between shifts in the institutional environment for entrepreneurship and increased entrepreneurial behavior. The top graph of Figure 1 (1A) shows human capital levels on the x-axis and the costs of starting a business on the y-axis. One curve is shown which represents the income that can be earned via wage employment which increases at a

⁵ Or ability is viewed as uncorrelated with the endowments (such as government connections, family wealth, or the ability to navigate bureaucratic hurdles) that allow one to overcome barriers to entry.

⁶ Stuart and Ding (2005) show that scientific advisory board membership is highly correlated with academic quality and patenting.

⁷ Changes in the institutional environment for entrepreneurship will raise (or lower), the returns to talent in entrepreneurship which will impact the payoff to entrepreneurship differentially according to human capital. Institutional reforms may have the effect of broadening the number of individuals engaged in entrepreneurship either among the same types of people who were already becoming entrepreneurs or they may induce those of different ability levels to become entrepreneurs.

decreasing rate with talent. The horizontal lines represent the average costs of starting a business under different institutional environments. The new institutional environment lowers the average costs (or effort costs) of starting a firm. If this is true, then if the change in the institutional environment reduces the barriers to entrepreneurship, the increase in entrepreneurship comes primarily from those who are relatively lower on the talent distribution. The traditional mechanism focused on in the literature lowers barriers to entry (i.e. decreased costs to entrepreneurship), driving more low ability individuals to entrepreneurship. For example, individuals may want to become entrepreneurs but cannot overcome credit constraints or hurdles to registering a new business. Institutional reform then acts to lower the barriers, in which case we would find an increase in relatively less talented individuals becoming entrepreneurs. Recent work shows that in response to an increased cost of external financing, the greatest decrease in entrepreneurial behavior came from those of lowest ability (Nanda 2008). This result indicates that decreasing the cost of start-up capital has its greatest impact among lower ability entrepreneurs.

Hypothesis 1: An institutional change reducing barriers to entry will increase the propensity for entrepreneurship among individuals located relatively lower in the talent distribution.

An alternative mechanism for increased entrepreneurship is higher returns to entrepreneurship leading to relatively more talented entrepreneurs. This view sees institutions for entrepreneurship as raising the expected returns conditional on entrepreneurial entry rather than lowering the bar to enter in the first place. According to this idea, overcoming fixed start-up costs is relatively easy, but the difficulty is in growing the firm to a significant size or in appropriating the returns that the firm generates. In this situation, institutional reform has the effect of increasing expected returns for entrepreneurs and higher outcomes then encourage more individuals of higher human capital and with better wage employment options to become entrepreneurs.⁸ The level of expected returns (rather than fixed start-up costs) may be more important for more talented potential entrepreneurs.

In the bottom (1B) section of Figure 1, the x-axis is again the talent distribution, but this time the

⁸ This effect may be attenuated over time however, if an increase in high quality firms translates into more wage employment opportunities or if more competition drives back down the expected returns.

y-axis represents the expected returns to entrepreneurship. The upper line represents an institutional change that raises the net mean returns to entrepreneurship. Examples of this type of institutional change are those that lower barriers to firm growth such as policies awarding government contracts to small businesses, industrial policies aimed at small businesses and institutions conducive to merger and acquisition or initial public offerings, or decreased tax rates targeted at high growth entrepreneurial firms.⁹ Figure 1B represents the expected returns to entrepreneurship as a flat line for simplicity.¹⁰ If the mechanism in Figure 1B is correct then certain institutions affect the level of entrepreneurship through improving returns to entrepreneurship relative to traditional employment. An environment where we increase the returns to entrepreneurship relative to wage work should draw more entrepreneurs from relatively higher in the talent distribution.

Hypothesis 2: An institutional change reducing barriers to growth (or to the returns from growth) will increase entrepreneurship among individuals located relatively higher in the talent distribution.

A difference may exist in the types of firms created by those who are induced to enter entrepreneurship by a different institutional environment. The effects of selection processes in entrepreneurship on competition and strategy can be quite strong. Banerjee and Munshi (2004) find differences in the level of capital stock, productivity and the capital intensity of production between two communities of garment knitters in India, arguing that they are driven by selection processes of higher ability individuals in one community and lower opportunity cost of capital in the other community. Certain institutional environments may be required for more talented individuals to be able to start high performance firms. High human capital individuals will be more likely to start firms if they can attain higher performance in entrepreneurship, which is more likely when barriers to growth are lowered. If

⁹ By barriers to growth, what is meant more precisely are barriers which depress the entrepreneur's financial returns relative to wage employment. While start-ups could grow (in terms of employees or revenue) without providing higher payoffs to the entrepreneurs, *in general* barriers preventing entrepreneurial firms from reaching their efficient size (or helping state-owned firms to maintain market share) will tend to alter returns to talent for the entrepreneur as well.

¹⁰ This line may possibly be more accurately represented as an upward sloping curve. A large number of variations in the shape or height of the curve are possible. A bi-modal distribution is possible as well with high ability entrepreneurs making very high returns in a poor institutional environment. The simplest case is chosen here to make the point that an increase in the returns to ability in entrepreneurship should draw in higher ability entrepreneurs.

more talented individuals are increasingly entering entrepreneurship due to increasing expected returns, then the start-ups they create should have higher performance levels on average. The idea that higher human capital should result in higher entrepreneurial productivity seems straightforward, but could be attenuated for a number of reasons.¹¹ On the other hand, if talent as demonstrated in prior wage work has no bearing on entrepreneurial performance, then this result would call into question whether the expectation of higher performance is driving the increased entry.

If there is no component of human capital that is transferrable from the wage sector to the act of entrepreneurship, then this would make both finding empirical results and policy prescriptions more difficult. Thus, the type of human capital or talent which is of interest is a component which is transferrable from wage work to entrepreneurship. If the marginal individual being drawn into entrepreneurship is shifting higher in the talent distribution, then one should also expect that talent or human capital measures should be associated with higher firm performance levels.

Hypothesis 3: Individuals who show evidence of higher talent in their wage employment careers will experience higher returns to talent after an institutional change lowering barriers to growth and will start firms that have higher performance.

China's Institutional Reform

The Chinese context provides a particularly interesting and appropriate empirical context to study given the high degree of institutional variation (relative to well-developed economies), and its importance in the world economy.¹² As a case for looking at human capital and institutional constraints on entrepreneurship, China offers a natural experiment in the 1999 amendment to the Constitution that lowered barriers to growth and altered the history of discrimination against the growth of domestic private firms. The Chinese context also offers an earlier 1988 policy shift reducing high barriers to entry.

China's reforms in the late 1980s and early 1990s eliminated restrictions on entrepreneurship and provided legitimacy to private business. Most significantly, in 1988 the state officially recognized the

¹¹ An association may not be found if competition increases which drives down survival or profit margins, or if higher ability individuals are attempting riskier start-ups.

¹² The vast majority of the related literature on market entry/entrepreneurship and innovation focuses on well developed economies. High-tech entrepreneurship and innovation in transitional and developing countries are rarely part of the scholarly dialogue which still largely thinks of new products being developed in rich countries and moved to low-wage countries (Lu 2000, Puga, Trefler August 2005, Vernon 1966).

growing number of private businesses (saying qiye) with eight or more employees (Xu and Zhao, 2008).¹³ Significant increases in entrepreneurship occurred in the years that followed. Yet the years before 1999 had been characterized by direct discrimination in favor of foreign-invested and state-owned firms (Huang 2003). In the spring of 1999, the Second Plenary of the Ninth People's Congress approved an amendment to the Constitution which put the private sector on the same legal footing as the public sector (*People's Daily*, April 9, 1999, Liu, 2008). The amendment essentially did three things: 1) officially ended discriminatory practices against domestic owned private firms; 2) provided some assurance that private property would be defended; and 3) signaled to local governments the importance of entrepreneurship. The original clause in the Constitution was changed from "the private economy is a supplement to public ownership" to "the non-public sector, including individual and private businesses, is an important component of the socialist market economy" (*China Daily*, March 16, 1999, Qian 2000). Local governments responded and incorporated the promotion of technology commercialization in their local science policies after this act was passed (Liu, White 2001). Immediately after the amendment, local governments were reported to start to relax restrictions on private enterprises (*People's Daily*, April 9, 1999).¹⁴

Yingqiu Liu, Professor of Economics at the Chinese Academy of Social Sciences (CASS), notes that the amendment created a more level playing field for businesses for the first time since the Communist revolution (Liu 2008). A large number of provincial governments issued documents promoting the rapid growth and development of private enterprises. In 2000, Zeng Peiyan, minister at the

¹³ Prior to the reform private businesses with fewer than eight employees were permitted. It is widely recognized that even before 1988 many private businesses had more than 8 employees, but the risk of being discovered was removed in 1988. Township and village enterprises spread during this time and many firms registered as publicly owned (known as "wearing the red hat") to avoid discrimination. Wang (2008) uses a reform in the mid-1990s which allowed employees to purchase their state-owned rental housing at subsidized prices to examine the impact of credit constraints and mobility costs on entry into entrepreneurship.

¹⁴ For instance, the Jiangsu Provincial Government adopted a new policy to give private enterprises equal treatment as state-owned and collective enterprises in the areas of granting business scopes and credit access (*People's Daily*, April 9, 1999). A proliferation of science parks and technology business incubators occurred following the Constitutional change, as well as associated tax incentives for R&D and licensing activities all of which supported the growth of entrepreneurial firms. Local governments had freedom and their own incentives to experiment and the programs seen as more successful such as tax breaks and industrial science parks spread rapidly to encourage private entrepreneurship (Segal 2002).

State Development Planning Commission, issued a statement saying “[We will] eliminate all restrictive and discriminatory regulations that are not friendly towards private investment and private economic development. In the area of stock listings, private enterprise should enjoy equal opportunity which was enjoyed by the state-owned enterprises.”

Overall, the institutional environment shifted to encourage the growth of entrepreneurial firms through office space, R&D tax incentives, and later stage funding. In contrast changes after 1988 lowered entry barriers and legitimized entrepreneurship, broadly defined, but without as many specific institutions and policies to support growth of already established entrepreneurial firms. Also since 2000, property-rights became clarified, there was a policy push to encourage R&D and high tech firms and after 1998 private equity firms were easier to set up.

As suggested by interviews with entrepreneurs and investors in China, 1999 was widely perceived as a key year. Chinese entrepreneurs and investors suggested that there was a perception that China had moved towards an institutional environment which could support rapid growth technology start-ups like those making individuals very rich during the dotcom boom in the US. The perception spread that one could now become very wealthy through the creation of technology start-ups in China, whereas that was not possible in the past (although creating smaller scale start-ups was certainly possible). The institutional environment prior to 1999 was not prohibitive for entry, but it did make growth difficult. One Chinese entrepreneur reported that she had to get each new product approved.¹⁵

I spent an entire year just looking for the right office space...because ...each product must be registered and approved by the government. It's an expensive and time consuming procedure. I eventually found space for the company's first store in a children's museum which was perfect since they were selling toy bears aimed at children. This also allowed the start-up to hide from government inspectors. – Beijing entrepreneur

The institutional environment post-2000 appears to have been much more attractive for high human capital individuals. One pair of founders had very high human capital with one being a lawyer and

¹⁵ These survey data were combined with interviews. The Tsinghua Alumni Association set up 42 interviews in Beijing, Shanghai and Xi'an. Interviews were requested with technology entrepreneurs, including some who had not been successful. The representativeness of these interviews cannot be established and primarily those who did become entrepreneurs were interviewed. Presumably any bias might be more on the basis of performance than on the basis of reasons for selection into entrepreneurship in one year and not another.

an MBA and the other having a Ph.D. They started the company in 2003 and the female co-founder said that:

I spent 20 years in the Bay area in life sciences companies. In the mid-1990s I came back to China to survey biotech companies in China and found that the environment was not ready yet. – Shanghai entrepreneur

The analyses will exploit both the 1988 reform lowering entry barriers and most importantly, the 1999 amendment supporting the growth of existing firms and moving away from practices that discriminated against private firms and kept them at a smaller size.¹⁶ A discussion of the limitations of using this reform as an identification strategy and robustness checks to allay those concerns is contained in the discussion section below.

METHODOLOGY

To address these hypotheses, a sample from a well-defined at-risk population with detailed work history data on both non-entrepreneurs and entrepreneurs, over significant periods of time is used. The empirical context for the study is a sample of alumni from a prestigious university in China. A survey of alumni has the advantage of being a well-defined population, not biased by government collection towards classification of private firms as state-owned and not selected based on success in entrepreneurship or in traditional employment. Such a survey allows us to track the work experiences after graduation of both entrepreneurs and non-entrepreneurs over long periods of time. Research universities are also important institutions for educating technologists and providing a setting for students and faculty to exchange ideas. In the U.S., alumni from leading research universities are responsible for numerous new ventures (Hsu, Roberts, Eesley 2007). The Chinese sample provides data on individuals with high enough human capital levels that many have a real choice between career paths, including entrepreneurship.

In cooperation with the Alumni Association, we undertook a survey of alumni from Tsinghua University, located in Beijing, China. The survey instrument itself was developed collaboratively by the

¹⁶ A more detailed discussion of the Chinese context, particularly as it pertains to entrepreneurship and science and technology policy is in a separate paper (Eesley, 2008) and has been written about elsewhere (Wang 2008, Qian 2000, Huang 2008, Steinfeld 1998).

author, a fellow Chinese Ph.D. student at our institution, an M.I.T. professor, and a professor of management at Tsinghua University. Some overlapping questions were asked from the M.I.T. alumni survey to enable future comparison (Hsu, Roberts, Eesley 2007). It was translated into Mandarin and checked by several Chinese speaking associates for accuracy and communications clarity. The Tsinghua Alumni Association has assisted with endorsing, mailing, and collecting the survey results. The survey was sent to all alumni with an address on record (a total of 30,000 according to the alumni association). Our dataset includes alumni across all university departments. The respondents could mail back the paper copy or complete the survey online. In the initial section, completed by all alumni respondents, alumni were asked if they participated in founding a company, “where founding indicates that you were present at the start of the company and other founders would consider you a co-founder.” Respondents also answered questions about privatizing a state-owned enterprise since this is also considered to be “entrepreneurship” in China. Those responding positively to either question were asked to fill out the Founders Survey section. The working definition of entrepreneurship here is more focused and narrower than a representative national sample of self-employment.¹⁷ The survey also asked a question about whether the individual had gone overseas to work or go to school. Those who responded positively to that question were directed to fill out the “Returnee” section of the survey. The survey packet included a personalized letter from the authors, signed by the University President, the questionnaire, and a postage-paid envelope with address labels. A total of 2,966 surveys have been received online and via paper and email (including 718 entrepreneurs).¹⁸ Of the 2,966, I eliminate (for certain analyses) the 144 alumni who responded from outside of China since changes in policies in China should have less effect on them. Our final number of observations for the main analysis is the 1,821 alumni who responded to all of the variables used.

¹⁷ Self-employment is interesting in itself, but typically includes professional occupations such as consultants, lawyers and physicians which do not fit as well with a model of choosing riskier entrepreneurial activities.

¹⁸ The results include 963 alumni responses received via the online survey and 2,003 responses received via email or hardcopy.

The response rate is 10%.¹⁹ One approach to assessing non-response bias involves extrapolation. This method is useful when trying to determine the direction of bias and a survey of non-respondents or archival methods cannot be conducted (Lehman 1963, Donald 1960, Pace 1939, Rogelberg, Luong). It rests on the assumption that individuals who respond less readily resemble non-respondents, so a common method is comparing characteristics of respondents who answered quickly with those who answered following a reminder or stimulus at a later time.²⁰

Although one limitation of our data is that it is cross-sectional in the sense of coming from a survey given at one point in time, on the other hand, our respondents graduated from the university and founded companies over an impressive span of time. The advantages of this dataset include a panel of detailed work history and education variables, information on family background, coverage over many years of graduates, detailed data on funding and performance measures for multiple founding attempts, and less bias than government surveys where Chinese entrepreneurs are known to misreport their earnings

¹⁹ The actual response rate is likely to be much higher once incorrect addresses and deceased alumni are subtracted from the original total. Organizational surveys often have low response rates, particularly those of top management members. While low response rates can introduce bias, I examine specifically whether there is systematic bias in respondent characteristics (Tomaskovic-Devey, Leiter, Thompson 1994). Response rates to surveys of managers in China have tended to be in the lower range (Peng, Luo 2000, Tan, Litschert 1994). Zhejiang University officials told us that when they survey their alumni response rates of 5% are average. In the U.S. response rates for entrepreneur surveys are often lower than those for managers.

²⁰ Appendix A shows *t*-tests of the null hypothesis that the average (observed) characteristics of the responders and non-responders are roughly the same statistically. Only the variables *gpa rank*, *age*, *entrepreneur*, *privatized*, and *high salary* show statistically significant differences in means at below the 1% level. It appears that non-respondents were more likely to be entrepreneurs, were slightly older, had higher salaries, less likely to have been academics, and slightly more likely to have held a greater number of job positions, to have a higher GPA, and more likely to come from more wealthy families. Years of education is significant, but the means are very similar. Older founders appear to have been equally likely as younger founders to respond. The 10th, 25th, 50th, 75th, and 90th percentiles of graduation years were also checked and are similar; offering some reassurance that there were not large differences over time in the response rates. Since there is evidence of some non-response bias, weights were created using logistic regression and calculated as one over the predicted probabilities of responding. Results are robust to using and also not using these weights. Finally Appendix C shows a histogram of respondents by bachelor's graduation year. One can see the impact of the Cultural Revolution when Tsinghua was largely disrupted between 1966 and 1976 when regular admissions resumed. In comparison to a representative sample of rural and urban households from the China Health and Nutrition Survey (<http://www.cpc.unc.edu/projects/china>) the Tsinghua sample is 8.7 years older on average, much more likely to be male, less likely to be married, more highly educated, and slightly more likely to have founded a firm. The differences in age and education most likely contribute to differences in the entrepreneurship rates. The data were also benchmarked against a representative sample from the National Bureau of Statistics (NBS 1999 survey). In comparison the Tsinghua sample is significantly older, less likely to be self-employed, has more years of education, but similar in terms of parent's education and parental self-employment. It appears that the sample is not weighted towards more recent alumni. A non-respondent survey is also in progress.

and firm status as state-owned (*wearing the red hat*) to avoid discriminatory practices. Forty-five questions were asked about prior firm founding history and the entrepreneur's most recent start-up including: industry category, work experience, relationships among the cofounders, sources of entrepreneurial ideas, timing and sources of financing events, commercialization strategy changes, causes of failure, exit routes, revenues and number of employees. In addition, the data include notes from interviews with 42 people (including entrepreneurs, investors, and government officials), along with follow-up phone calls to probe more deeply.

Measures and Data

Insert Figures 2 and 3 here

In this context the descriptive statistics alone are interesting. Figure 2 previews the main findings of the paper by showing the increase in the rate of higher human capital individuals becoming entrepreneurs in the more recent time period. The figure reinforces the story that institutional change pulled individuals from higher in the talent distribution into entrepreneurship through improved outcomes. It appears that there was some increase just prior to 1999. Interestingly, the increase in the proportion of those with graduate degrees becoming entrepreneurs follows closely the increases in founder income (these coefficients are taken from the corresponding year dummy variables of a regression on founder salary). This adds support to the idea that improved returns to entrepreneurship may be driving the increase. Figure 3 shows the increases in the proportion of 'at risk' individuals becoming entrepreneurs in each year. Table 1 shows the industry breakdown for the firms. Internet, electronics and software firms are the most common, which fits with the technical training of these graduates.²¹ The average number of employees per firm as of 2007 is 628 (median=20). Approximately 34% of the firms have 10 employees or fewer. The mean annual revenues of each firm were 495,000 RMB (the median is 70,000 RMB or \$20,290 at an approximate 2007 PPP exchange rate of 3.45 RMB/dollar). Seventeen percent of the firms

²¹ The industries also provide evidence that the respondents have started firms rather than reporting on primarily "sole proprietorships" and self-employment activities.

claimed to hold at least 1 patent. Median profit levels were reported as 20% of gross revenues. Table 2 presents pair-wise correlations. Table 3 presents independent variable definitions and summary statistics.

Insert Tables 2 and 3 about here

ANALYSES AND RESULTS

To determine whether changes took place in the market development of the institutional environment over time which had a differential impact on those with higher human capital, a differences-in-differences regression analysis is performed. The differences-in-differences estimate is identified by interacting the *post-1999* variable with the various human capital measures to see how the propensity for entrepreneurship for more talented individuals changed in the post period relative to those lower in the talent distribution.²² The dependent variable is the event of founding a firm for the first time.²³

Since the most recent graduation classes have not had much time to gain work experience and found firms, right-side censoring is a concern. The analyses in Tables 4 and 5 employ Cox (1972) hazard regression models for two reasons. First, the model is semi-parametric, so that we can estimate the impact of independent variables on the hazard of founding a firm while being agnostic about the baseline hazard function. Second, the model explicitly takes the timing of events into account (by estimating the probability of founding a firm in a given year conditional on not having founded a firm up until that time period), and adjusts for the right-censoring of the data. In these regressions subjects start being “at risk” of founding a firm at the time of their graduation, and a “failure” event occurs the year the individual founds a first firm (otherwise, the founding year is considered censored for that individual as of the year

²² Identification of a panel differences-in-differences estimator requires the assumption that trends are parallel before and after the reform. A placebo regression (Appendix I) using 1997 as the reform year provides some evidence that pre-reform trends among higher human capital individuals were not significantly different. Including year interaction terms with *years of education* and *income residuals* also provide evidence that trends in these coefficients are relatively flat in the post-reform period also.

²³ Privatizing an SOE is also an entrepreneurial act in China since it often requires all the same behaviors of taking on risk, raising funding, recruiting new employees or cofounders, becoming the residual claimant, and redefining the product market strategy. Any performance analysis would need to control for higher beginning asset levels of SOEs, but conceptually this paper is interested in transitions to entrepreneurial behavior rather than performance. The results are robust to limiting the sample to only pure startups as well. A total of 47 of the firms reported on in the survey were privatized SOEs.

2008).²⁴ Reported coefficients are hazard ratios, with values above 1.0 representing increases in the hazard of founding a firm and vice-versa for values below 1.0. The main results are robust to using a logit as well. The specification of the model is as follows:

$$\lambda(t | X) = \lambda_o(t) \exp(X' \beta) \tag{1}$$

where the vector X includes our founder and work experience characteristics. $\lambda(t | X)$ is the rate at which founders will start a firm at any particular date, given that they have not founded a firm up until that point in time. Equation (1) specifies the hazard rate as the product of two components: a function of the period length (i.e. delay time since graduation), $\lambda_o(t)$ or baseline hazard, and a function of the observable characteristics, denoted by the vector X . The Cox nonparametric estimation allows the estimation of β without needing to make a distributional assumption about $\lambda_o(t)$.

 Insert Table 4 about here

Observable Human Capital Measures

Table 4 examines the impact of observable measures of human capital. Next we ask whether the 1988 reform reducing entry barriers (legalizing private firms with more than eight employees) increased entrepreneurship among relatively lower human capital individuals. Table 4 shows Cox hazard rate regression results, but just including individuals at-risk for founding a firm between 1988 and 1999. The results are best seen as tentative evidence for *HI*, that those founding firms during this period were more likely to be drawn from the lower end of the talent distribution.

Table 5 examines the impact of lowering barriers to growth and the 1999 Constitutional amendment. In Model 5-1, looking first at the controls, individuals were less likely to transition from jobs in academia to entrepreneurship. Academic jobs are traditionally prestigious positions within Chinese society. Those able to secure such positions would be reluctant to risk their careers on

²⁴ The statistics literature (Breslow, Lubin, Marek, Langholz 1983) suggests little loss of efficiency so long as approximately 20% of a sample has experienced the event of interest (over 20% of the sample have founded a firm).

entrepreneurship. Individuals who had worked in a higher number of different positions and who were male, or who had worked in academic jobs in the past, had higher rates of transitioning into entrepreneurship. Having a higher number of prior job positions has also been found in the US to correlate with entrepreneurship (Lazear, 2004).²⁵ All models include dummy variables for the Bachelor's degree academic major, graduation year, and current region. Turning to the main independent variables, those with *Master's degrees* were significantly less likely to become entrepreneurs.²⁶ Model 5-1 shows the results for the differences-in-differences estimation by including an interaction term between *Master's degree* and a dummy variable which equals 1 if the individual was 'at risk' of founding a first firm in 2000 to 2007 (to be at risk the individual must not have founded a firm previously and below age 65). The interaction term is greater than one and statistically significant, indicating that there was a stronger effect on those with *Master's degrees* for increasing the probability for entrepreneurial behavior. The coefficient on *Master's degree* alone is below one and significant indicating that before the institutional change, those with *Master's degrees* were less likely to found firms. The same interaction was included with *Doctorate degree*. Dummy variables equal to one for those who were at risk for entering entrepreneurship for the first time between 1991 and 1999 and between 2000 and 2007 are included (1978-1990 is the omitted category).

In Models 5-2 through 5-7, the results for the controls are largely the same, with one exception. In some of the models individuals are significantly less likely to transition from a government job to entrepreneurship. Like academic jobs, positions in government have been historically very prestigious

²⁵ Interestingly, in Table 5, individuals with parents who were entrepreneurs are not more likely to become entrepreneurs themselves. A positive association between parental self-employment and entrepreneurship has been found repeatedly in the US and Europe, but does not appear to hold in the Chinese context. One good explanation may be that during the time period when these individuals' parents could conceivably have founded companies, most entrepreneurship was illegal in China.

²⁶ Human capital as measured by education (Fairlie, Woodruff 2007, Fairlie, Robb 2008, Baumol 2004, Dunn, Holtz-Eakin 2000, Murphy, Shleifer, Vishny 1991, Roberts, 1991) or work experience is clearly related to entrepreneurship. Macroeconomists also have a long tradition of examining the impact of education on growth (Bils, Klenow 2000). Recent reviews of the literature on education and entrepreneurship and on the returns to education more generally have been compiled by others (van der Sluis, J., van Praag, Vijverberg 2004, Card 1999). Murphy et al. (1991) acknowledge that the direction of causality may be reversed here, however: countries with faster growth may provide more engineering jobs and may support more engineering education. Roberts (1991) shows a curvilinear relationship between education level of high-tech entrepreneurs and their firms' overall performance, with Master's degree recipients doing best.

and stable so this is expected.²⁷ In some models, returnees who were educated or worked abroad are also less likely to found firms. Models 5-2 through 5-7 substitute a series of measures of human capital into the equation. In general, they show the robustness of the results to various observable measures of human capital including parents' education (found in the psychology literature to correlate with the child's test scores), whether the individual was promoted to general or technical manager, higher GPA, higher salary and whether the individual held one of the higher ranking student leader positions. The results are also robust to including an indicator for whether the parents' education level was above the median. The number of years of work experience is the only measure where the result does not come out as significant. In all models, the coefficient on the human capital measure (not the interaction term) is below one and significant indicating a lower likelihood of founding a firm for those with higher human capital during the *pre-1999* period. The main results are mostly robust to the calculation of robust standard errors.

If the impact of the market development of the institutional environment was to raise returns to entrepreneurship rather than lower the barriers to entry, then the coefficient on the interaction terms between human capital and the post-period should be greater than one. This is indeed the case and the size of the effect is large. This result can be interpreted as consistent with increase in the propensity for entrepreneurship among individuals higher in the talent distribution.

Insert Table 5 about here

Unobservable Ability

Any study of human capital and entrepreneurship must reflect concern about unobserved ability levels. At least four drawbacks exist to using the observable measures. The first is that the observable measures of human capital are not pure measures of underlying ability and may be conflated by the influence that family background may have on both the likelihood of being able to afford and attend graduate school and having access to the resources necessary to become an entrepreneur. Similarly, being promoted, having a higher salary and even a higher GPA could potentially be influenced by the family

²⁷ There is an on-going debate; however, about the extent to which elites in transitional economies have been able to translate their power into economic benefits and the mechanisms that allow such a transfer (Walder 2002) (Walder 2003, Nee 1996).

socio-economic status and likelihood of paying for tutoring or having important family connections.²⁸

The second concern with the observable measures is that with the market development of the institutional environment, the salaries available in the wage sector should have been improving as well and in that case, increasingly, only those who are truly talented (or who happen upon very good entrepreneurial opportunities) would become entrepreneurs, even if the institutional environment for entrepreneurship was not improving. Third, there may be shifts in the marginal individual getting a graduate degree, or becoming promoted as conditions change. Fourth, it may be more convenient to have a more continuous underlying measure of talent to be able to test changes in the shape of the distribution of those becoming entrepreneurs. To address these possibilities, the next section explores the impact of other, “unobservable” measures of underlying ability.

Finding a measure of underlying ability is challenging.²⁹ The method used in this paper exploits the data on salaries at the end of each job spell and uses the residuals from a wage regression. It is possible to use higher or lower than expected performance in the most recent job to generate an underlying ability measure. In the first stage, a regression is performed with the most recent (pre-entrepreneurial) income as the dependent variable and independent variables include the year, job type (business, academia, government, etc.), tenure, graduation year, etc. The residuals from this regression can then be thought of as either positive or negative shocks to the salary level relative to what the individual might have expected given her family socio-economic status, education and career choices. General measurement error will also be present, but should reduce the likelihood of a significant finding. Many factors and components of ability or skill will still be amalgamated in this residual term including potentially social skills, social network, and any other individual capabilities which influence higher salaries in the wage sector. Nonetheless, this is a step in the right direction. Since the last (pre-

²⁸ It is important to note that the (self-reported) parents’ wealth level is controlled for, so the estimates are consistent with a story that controlling for family background, via all other observable work history characteristics, then relatively higher ability individuals may have had better outside options yet increasingly chose entrepreneurship.

²⁹ Some have used cross-sectional salary levels; however, these may be more a function of contemporaneous external labor markets, macroeconomic conditions, opportunity costs, or specific career path choices than underlying ability (Elfenbein, Hamilton, Zenger 2008).

entrepreneurship) salary for the entrepreneurs would be farther in the past than for the non-entrepreneurs, a 2:1 matched sample of non-entrepreneurs was created by matching on both graduation year and last job year for the entrepreneurs. This reduces the sample size, but allows for a control for the year that the salary is measured which should control for inflation and trends in the increase in wage sector salaries.

A component of the residuals indicates performance in each job which can be contributed to the individual controlling for education, year and work history.³⁰ The results of the income regression used to generate the residuals are shown in Appendix E. An ordered logit specification is used because the dependent variable is the pre-entrepreneurship salary for each job (six categories for salary bands earned at the end of each job spell).³¹ The regression is of the form:

$$Y_{it} = \alpha + \gamma_i X_{it} + \varepsilon_i$$

where Y_{it} is each individual's total income (including bonuses) in job t and X_{it} is a vector of education, work experience, job type, graduation year, and regional variables. Individuals having worked in business, having higher education levels, overseas educational and work experiences, and a higher parental economic status are all associated with higher salaries.

 Insert Table 6 about here

Panel A of Table 6 shows the results from a quantile regression using the income residuals as the dependent variable and dummy variables equal to 1 if the individual founded a first firm in each of three time periods (Koenker, Hallock 2001).³² This method is largely equivalent to regressing the residuals on

³⁰ Independently, a very similar method is already being used to capture talent levels (Andersson, Freedman, Haltiwanger, Lane, Shaw 2006).

³¹ One might attempt to estimate the unobserved ability by using the multiple employment observations over each individual using fixed effects wage regressions in the first stage. As a robustness check, this method was also implemented. The residual measure described above is positively correlated with individual fixed effects calculated in this way. However, the methodology relies on panel data on salaries prior to entrepreneurship and the survey is essentially a cross-section. In addition, the individual fixed effects have the drawback of being only a time-invariant component of ability and the capability to learn more quickly on the job over time may be more important for entrepreneurship. In cases where the coefficients need to be interpreted, a negative binomial can be preferable to an ordered logit. However, in the negative binomial specification, the idea that the categories are ordered from lower to higher salary categories is not captured.

³² Quantile regression shares many of the attractive properties of ordinary least squares (OLS) or mean regression, yet has the advantage of allowing changes in the shape of the entire conditional distribution to be

a dummy variable for becoming an entrepreneur in each period and allows an examination of the relationship between being located at a point on the talent distribution and founding a firm. The post-1999 time period is the one of interest and the 1990s is used as a comparison as well as the pre-1990 time period. Column 1 (10th percentile) compared to Column 5 (the 90th percentile) shows that those at the bottom of the distribution were more likely to found firms in earlier time periods and those of highest underlying ability are significantly more likely to found firms during the post-1999 time period. Panel B uses quantile regression to show that individuals higher in the talent distribution were associated with more profitable firms. Since heteroscedasticity is one of the motivations for using quantile regression, the bootstrap method (with 100 repetitions) is used to generate standard errors (Horowitz 2001, Rogers 1992). The results support the idea that there was not less entrepreneurship among individuals lower in the distribution of talent. Also the results provide additional evidence for *hypothesis 1*, that these individuals were more likely to found firms in the years after the 1988 reduction in barriers to entry.

Effects on Start-up Firm Productivity

To more directly show that returns to human capital in entrepreneurship increased relative to wage employment is difficult since it is hard to know the salaries of entrepreneurs had they remained in wage jobs. However, Table 7 uses differences-in-differences estimates to see whether the returns in entrepreneurship to human capital increased in the post-period. The dependent variables in Models 7-1 to 7-4 is the natural log of the average profit margin for the firm. Models 7-5 to 7-8 use the log of the income of the founder from the business as the dependent variable. Since these dependent variables take only non-negative values and can be thought of as being censored at zero, a tobit model is used (the results are robust to using a Poisson and not taking the log of the dependent variables).³³ The regressions interact the human capital measures with a dummy variable indicating whether the individual founded the firm in the post-period. The results robustly support the idea that higher human capital individuals appear

examined. The results are robust to using a dummy variable for residuals above or below the median and using a logit specification. Using the residuals as the dependent variable avoids possible concerns about computing standard errors if the residual is entered as an independent variable.

³³ Respondents were asked for profits as a percentage of revenues. Those with negative profits or no revenues can be considered censored at zero.

to have had higher returns to entrepreneurship after the institutional reform. The results become even stronger when run without using robust standard errors.

To further examine how the changing macro-economic environment may affect entrepreneurial activity, yearly data on several measures of the broader economic environment in China were compiled mainly from the Chinese National Bureau of Statistics³⁴ and filled in with data from other sources such as the World Bank and Chinese statistical yearbooks. These variables were regressed on the number of new start-up firms established. Data on new firm formations were from the Tsinghua survey described above. To get enough observations to make the regressions meaningful, the data go back to 1959 through 2007, however, the earliest firm founding in our data was 1964. The results here should be interpreted with caution both due to the small sample size and the unreliable nature of economic data in China, particularly from earlier time periods. These results are reported in Appendix G. Since the dependent variable is a count of the number of new firms established that year, negative binomial regressions are used and the independent variables are lagged by 1 year. Dummy variables for 1988 (indicating the reform allowing eight or more employees in a private firm) and for 1999 are included. The results support the idea that the post-2000 institutional environment led to higher levels of entrepreneurship even when controlling for other macro-economic factors. The macro-economic conditions in China impact both positive and negatively the level of entrepreneurship.³⁵

Insert Table 7 about here

The regressions in Appendix I test whether the human capital measures are transferrable and associated with higher entrepreneurial productivity. In addition to controls for whether the firm was bought, privatized and its age, industry, city, founding year, and graduation year fixed effects are included in all models. For the unobserved ability measure calculated from the wage regression residuals, these residuals are recalculated on just the sample of the founders for the performance analysis. For Model (1) this underlying

³⁴ <http://www.stats.gov.cn/english/>

³⁵ The results show that *higher GDP per capita* (in 0.1 billion RMB), lower *Shanghai Stock Exchange Market Capitalization*, and few *domestic patents issued*, are associated with higher levels of entrepreneurship. Results are robust to contemporaneous and two year lags, except the year dummy variables are not robust to two year lags.

ability measure has a positive and significant effect on the firm profits. Model (2) finds that none of the human capital measures have a significant effect on firm revenues (or the sample size is not large enough to detect it). In Model (3), those with more years of education or who were promoted start firms with greater numbers of employees. The human capital measures are not significantly related to firm survival (in theory there are conflicting effects since those with higher opportunity costs may be quicker to close underperforming firms). Finally, Model (5) uses a logit regression on a dependent variable that indicates whether the founder indicated that intellectual property was important for the start-up or not as an indicator of innovation. Those who had higher education levels, higher wage regression residuals, and who had worked in R&D positions were more likely to start firms where innovation and intellectual property were considered important. In general, the results show evidence that relatively more talented individuals indeed start firms which are higher in productivity.

DISCUSSION

Overall the results support the main thesis of this paper. Reforms in the institutional environment in the period after 2000 reduced constraints to growth and returns to entrepreneurship increased relative to wage employment. The evidence for this is that post-2000 individuals with higher human capital were relatively more likely to engage in entrepreneurship and had higher economic returns.

Five possible mechanisms may be behind an observation of reforms in the institutional environment and increased entrepreneurship. Other empirical work has already used instrumental variables approaches to largely alleviate concerns one through three (Acemoglu, Johnson 2005). First, entrepreneurs may be causing the improvement in institutions (reverse causality). Work on the political economy of private entrepreneurs in China suggests that they have not coalesced into a unified political movement, reducing concerns of lobbying for institutional reforms (Tsai 2005). Second, market opportunities may be driving both changed institutions and increased entrepreneurship. Either anticipated technological opportunities or poor wage employment opportunities may be causing both an increase in entrepreneurship and efforts to improve the institutional environment. This endogeneity concern is not easily ruled out. Three factors together alleviate the concern to some degree. First, prior literature using instrumental variables techniques suggests that there is a direct causal effect of institutions on economic

growth (Acemoglu, Johnson 2005). Next, removing internet and software industries (the most likely candidates for anticipated technological opportunities) only reinforces the results. Also, this story suggests that government bureaucrats saw technological opportunities arising and that they then designed institutions to reduce growth barriers. Yet, despite the 1999 amendment being intended to move China toward a market economy, accounts do not describe it as intending to encourage more talented entrepreneurs (OECD, 2007, Qian, 2000).³⁶ Third, changes in the investor community or competitive environment may be causing changes in the type of entrepreneurs being selected for funding. Fourth, the set of institutions that resulted from market development in the more recent period could be lowering the barriers to entry, which may lead to more individuals of lower quality or with lower payoff ideas to become entrepreneurs. Fifth, the set of institutions in the more recent period could be leading to better outcomes for entrepreneurs and encouraging others who are higher in the talent distribution to become entrepreneurs.

Still other interesting possible alternative explanations and mechanisms merit further analysis: (a) universities and research institutes themselves became more profit oriented and sought to invest in the ventures they knew most about, those of their own students, and the university had better information on underlying ability levels; (b) the demography of the funders/lead investor community itself might have changed and its preferences perhaps leaned towards higher ability individuals or technically skilled entrepreneurs with real marketable research output; (c) the nature of the economic opportunities or competition changed as China liberalized and the available opportunities required those with higher ability levels; (d) increased college student enrollment led to a flood of graduate students with limited wage job opportunities; (e) payoff to skills, demand for innovation/R&D in the economy increased; (f) increased legitimacy may have led higher status individuals to become entrepreneurs and higher status also happens to be correlated with ability. The available evidence is used to address these mechanisms.

University investing. First is the idea that the universities and research institutes became more profit oriented and then invested preferentially in the spinoffs created by their own students or professors

³⁶ Since 1986, the government had attempted to encourage high tech entrepreneurship so this was not new as of 1999 (Zhang, Li, Schoonhoven 2008).

for which they had more information. A question on the survey asked whether Tsinghua played a role in either directly funding the startup or in helping to find funding. Only 13 respondents indicated “yes” to either question. Thus, it seems that university funding does not explain the results.³⁷

Shifting investor community. Second is the notion that the demography or preferences of the investor community may have changed. This explanation is harder to rule out since the question cannot be addressed head-on without data on the demography of investors and their investment preferences. Specifically, the dotcom boom in the U.S. inspired both investors and entrepreneurs to seek out internet and software opportunities in China. To test this explanation, the analyses were re-run, dropping all internet and software firms from the sample and the results hold with coefficients of slightly higher magnitude. Nonetheless, it is important to note that the venture capitalists that we talked with indicated that VCs in China primarily tended to focus on later stage private equity deals and non-technology startups. Certainly changes were occurring in the investor community during this time.³⁸ However, the main effects should have been for later stage firms.³⁹

Changing Opportunities. Next is the idea that the nature of the entrepreneurial opportunities or the competition increased such that potential entrepreneurs located relatively lower in the talent distribution were screened out and the opportunities were only available to entrepreneurs with higher human capital levels. Other forms of this same argument are that perhaps the payoff to skills in

³⁷ Furthermore, during the 1990s the largest increases in university-affiliated start-ups occurred due to funding cuts and the universities’ need to generate operating revenues. During the 2000s, as funding for top universities increased the number of such enterprises declined.

³⁸ In March 1998 China implemented a number of policies to promote venture investments (Batjargal, Liu 2004). The initial venture capital funds within China were backed by the government, however, and had both policy as well as financial objectives. Total annual venture capital investments in China grew from virtually nothing in 1990 to \$858 million in 2000 (Batjargal, Liu 2004).

³⁹ There are actually two separate questions here. The first is whether new types of investors entered the market, who were more interested in high quality individuals rather than the merits of the idea alone or its alignment with policy objectives. The second question is whether the existing investors shifted their preferences towards high ability founders. Only twenty-five of the firms in the sample reported venture capital funding, so the relevant investor groups would mainly have been informal (angel investors). Anecdotal evidence from the interviews does not appear to support this notion since the entrepreneurs indicated that most of the informal (angel) investors in China made their money in traditional industries. While they want to diversify into technology firms, many reported that their informal investors were not knowledgeable about technology industries and thus would not be expected to have greater capacity to select based on ability.

entrepreneurship increased or the demand for innovation and R&D in the economy increased.⁴⁰ Again, the fact that the result remains and grows stronger with the elimination of software and internet firms provides some evidence inconsistent with this interpretation. The results also hold when all 193 firms indicating that intellectual property would be important for their success were dropped. The results in Panel A of Table 6 provide evidence against the idea that there was a decrease in entrepreneurship among the lower tail of the talent distribution. Finally, Appendix F shows that there were not increases in the returns to talent in the wage sector after the reform.

Labor Market. On the supply side, the number of students enrolling in tertiary education in China dramatically increased since the 1990s. According to the National Bureau of Statistics of China, restricting the definition to four year colleges and universities, the total number of graduates has gone from 830,000 in 1998 to just over three million in 2005. Since 1999, the number of undergraduate and graduate students has grown at nearly 30% per year.⁴¹ If traditional job demand could not accommodate this increased supply, many of these individuals may have turned to entrepreneurship. However, while possibly true more broadly, this type of explanation does not seem likely for the individuals in this study since alumni from the top engineering school in the country should have had no problems finding employment. Second, for this story to be correct, one would expect that it is primarily the individuals from the lower end of the talent distribution who both have trouble finding acceptable wage employment and thus who opt into entrepreneurship. This implication is contradicted by the data in 6-3 on the increase coming from the higher end of the talent distribution.

Increased legitimacy. An alternative explanation is that the increase in entrepreneurship among more talented individuals is not due to changing incentives in the institutional environment, but rather to the increasing legitimacy of entrepreneurship in China during this time. Changes in legitimacy may be highly correlated with changes in the institutional environment. Xu and Zhao (2008) use a national dataset from 1978-1996 in the China Statistical Yearbook and argue that as entrepreneurship became fully

⁴⁰ It has been argued that Chinese managers imitated some of the practices of Western managers (Guthrie 1999). Some have suggested that there was imitation of the U.S. dotcom entrepreneurs.

⁴¹ However, evidence indicates that quantity has been expanded at the expense of the quality of the graduates (Gereffi, Wadhwa, Rissing, Ong 2008).

legitimized by 1996, particularly at the local level, greater numbers of high-status individuals (Communist party cadres and those with more education) became entrepreneurs at a more rapid rate. However, status and education also tend to correlate with ability. Interviews seem to indicate that by the end of the 1990s, entrepreneurship was already seen as a legitimate career option. According to Xu and Zhao (2008), entrepreneurship was already fully legitimized by the mid-1990s, and legitimate enough by 1996 (when their data end) that government officials and highly educated, high status individuals were becoming entrepreneurs at faster rates than lower status individuals. They measure legitimacy by the state's official recognition of private enterprise in 1988 when private businesses with eight or more employees were granted "organization" status. Their analysis ends in 1996, the year before the state "fully recognized private business as an important component" in the economy. It is reasonable to believe that entrepreneurial activity was seen as quite legitimate by 1997 by when most (74%) of the pre-2000 foundings occurred. Also, a control for the graduation year controls for more recent graduates viewing entrepreneurship as more desirable. Even controlling for such trends, the propensity for higher ability entrepreneurs to found firms appears to increase. Perhaps most convincing are the results in Appendix C. If the effect is due to legitimacy, then one should see higher status individuals (who had more to lose previously) becoming entrepreneurs at a higher rate (Giordano 1983, Xu, Zhao Jan. 2008). Thus, a dummy variable was added indicating whether the individual was high status (government officials, Communist party members, and doctorate degree holders) and this variable is interacted with the dummy for the post-1999 time period. The coefficient is insignificant while the human capital measure remains significant indicating that a change in legitimacy does not appear to explain away the results. Furthermore, the analysis here controls for many status factors, such as level in the government, education and academic positions, so the results indicate that even after controlling for status, still individuals located higher in the talent distribution became entrepreneurs at significantly higher rates post-2000. The current paper offers support for a different explanation for the rise in entrepreneurship, one that focuses more on incentives for more talented individuals to form private businesses and less on the roles of status and legitimacy.

Robustness

Three dimensions appear important for checking robustness on for these results: different talent measures, a subset of the sample where confidence is higher, and different model specifications.

Robustness to different talent measures. For those with prior jobs in business, the data include whether they had been promoted to general manager positions. The results are robust to using many observable ability measures. An alternative measure of “pull” entrepreneurship (Klepper, 2008) is whether the Bachelor’s or Masters major matches the industry of the start-up that the individual founded. This proportion goes from just under 30% before 1999 to 40% post-1999 ($p < 0.05$; $t = 1.759$).

Time invariant underlying ability. The results are robust to using the data on job spells to create a panel of multiple observations on each individual and using the wage regression to generate individual fixed effects. The main results are also robust to using a logit rather than the hazard model. The underlying ability measure is robust to using a negative binomial rather than the ordered logit.

The number of responses was lower for graduates during 1947-1951 and 1970-1980. The first period is the time of the Communist revolution and the second period is the time of the Cultural Revolution during which university activities were impaired. To check whether the results were affected by response bias during these times, the analyses were repeated dropping all observations during these two time periods and the results hold.

Limitations

It is useful to keep in mind three data-related issues: representativeness, response rates and self-reporting. The first issue is the extent to which inferences made from this dataset apply to entrepreneurship in general. The data for this study come from alumni of a very important academic institution in China. It is important to note that these are alumni and therefore the sample is not limited to those currently associated with Tsinghua or to technology coming from Tsinghua. I do not claim generalizability across the spectrum of entrepreneurial activity; however, the sample represents an interesting and important population of individuals.⁴² A second issue is possible response bias. For

⁴² While those with a technical education and knowledge workers are seen as an increasingly important

example, graduates who started a company but were unsuccessful may well not have reported these failed firms, either by omitting them from their responses or by not participating in the study at all. Next is the issue of self-reporting. Older respondents, especially those who have started multiple companies, may display a memory bias in which some companies, possibly those which were relatively unsuccessful, are not reported. This may lead to the appearance that younger entrepreneurs are starting more (though less successful) firms on average. Older entrepreneurs may have been less likely to respond to a university survey if such alumni ties weaken over time.⁴³

Two more conceptual issues should be considered. The first is identification and there are two main concerns. It is not unambiguous that the 1999 policy reform only lowered barriers to growth without also lowering barriers to entry. If the effect of the reform was primarily to lower barriers to entry then the results could be interpreted as consistent with the conventional view. Five pieces of evidence help to allay concerns. First, access to a similar survey of MIT alumni enables a robustness check (Hsu, Roberts, Eesley 2007). During the dotcom boom years of 1998-2000 there was a perception of increased returns to entrepreneurship. Anecdotal reports exist of many MBA students and alumni at elite business schools founding firms. If similar results were not found in the U.S. during this time then it would cast doubt on the robustness of the results. Results for a similar differences-in-differences hazard rate analysis using the MIT alumni dataset reinforce the findings. The interaction term between years of education and a dummy variable equal to 1 if the individual was ‘at-risk’ of a first firm founding during 1998-2000 is greater than one and statistically significant. Results for a placebo regression using the pre-boom years (1995-1998) were insignificant. Second, in the data from Tsinghua, a set of ‘placebo’ regressions were run using 1997 and 1998 as the cutoff year instead of post-1999. As expected, the differences-in-

part of the economy, we know relatively little about what drives them to start technology based enterprises (Roberts 2004). National samples of entrepreneurship may be more representative of entrepreneurship broadly defined, but probably not of technology-based entrepreneurship. Moreover, comparing national samples of entrepreneurship is challenging, as data sampling strategies vary depending on the subject matter of study (compare, for example studies of self-employment (Blau 1987) and manufacturing (Dunne, Roberts, Samuelson 1988)). With these caveats in mind, note that very few datasets exist of entrepreneurial activity in China, especially for technically trained individuals, so in this sense the present study represents a step forward.

⁴³ During the interviews many older alumni assured that they feel a very strong bond with Tsinghua and the Alumni Association which reassures us that there were not large biases in the age of respondents.

differences estimates lose their statistical significance when the wrong year is chosen for the policy change. Third, the results in Tables 6 and 7 more directly test whether increased returns to entrepreneurship occurred after the reform. Fourth, results from income regressions show that there were not higher returns to talent in wage employment during this time period, alleviating concerns that the reform had broader effects (Appendix F). Fifth, qualitative evidence from interviews indicates that lower barriers to entry were not perceived as a result of the reform, but rather that it was possible to create a high growth business during the post-1999 time period. As long as the primary effect was to increase returns to talent in entrepreneurship, if entry barriers were marginally lowered then the interpretation here is still sound. If other changes were happening in China that were both highly co-linear with the changes in the institutional environment post-1999 and acted primarily to increase the returns to human capital in entrepreneurship, they would be difficult to disentangle. It is possible that the analysis may pick up the effects of earlier reforms. If the earlier reforms primarily act in the same direction this would introduce the ‘treatment’ effect in the pre-2000 time period and should be making it harder to see an effect.

Next, unobserved heterogeneity is a valid concern which can never be entirely addressed.⁴⁴ The fixed effects robustness check alleviates this concern, however there may be unobservable attributes of the past work experience which drives the distinction between the measure of talent and are also correlated with entrepreneurship, such as working in a multinational corporation. One of the advantages of our dataset is the relative uniformity of Tsinghua alumni. This should provide some level of uniformity in unobservable characteristics, especially compared to other datasets of entrepreneurs. Academic department dummy variables and a well-defined sample population help alleviate concerns that various sources of unobserved heterogeneity are driving our findings.

Regional variation exists in the institutional environment in China and traditionally movement of individuals across regions was restricted. However, the coastal provinces have experienced quicker

⁴⁴ Propensity score matching models would better address heterogeneity concerns, yet a propensity score matching model is not possible to implement in this context since there is no suitable untreated control group of individuals (untreated here would mean that they did not live in China after 2000 or had already founded a firm prior to 2000).

market development of the institutional environment in many ways and much higher overall economic growth. Future work will take advantage of regional variation of reforms.⁴⁵

Boundary Conditions

The results appear to open up an interesting line of research. However, given the complexity and diversity of entrepreneurs and of institutional environments, lowering barriers to entry is unlikely to draw increased entrepreneurial behavior from those lower in the talent distribution in all research samples. Similarly, lower barriers to growth may not always increase the propensity for entrepreneurship among individuals higher in the talent distribution. Considering the sample used, it is vital to outline certain boundary conditions. The theory should apply outside of the context of Tsinghua graduates so long as at least four boundary conditions hold: 1) the types of skills and talent necessary to overcome entry barriers are not largely orthogonal to those useful for firm growth; 2) feedback loops are weak: that is, increases in the number of entrepreneurial firms do not strongly increase competition or create significantly better wage employment opportunities; 3) the initial relationship between talent and returns to entrepreneurship is not one where primarily those at the top of the talent distribution become entrepreneurs; and 4) sufficient variation exists in the distribution of talent (by measures relevant for wage and entrepreneurial payoffs) in the sample at risk for entrepreneurship.

First if the skills that are useful for generating returns in entrepreneurship are unrelated to the skills (or endowments) needed to overcome entry barriers then the theory will not hold. Second, if increases in entrepreneurship by those of higher ability increase competition significantly then this feedback mechanism should act to bring expected returns to entrepreneurship back down. Similarly, if increased entrepreneurship results in significantly better wage employment opportunities then this will counterbalance the returns to entrepreneurship relative to wage work. Third, in some cases the relationship between human capital and returns to entrepreneurship may be initially represented by a line or curve that begins below the curve for returns to wage work and only intersects at the high end of the

⁴⁵ In recent years some policies allowed movement of technically trained employees across provinces. Therefore, the regional variation does not provide an opportunity for identification when only looking at coastal provinces versus others. Entrepreneurship does not appear to have been higher in the coastal provinces which is consistent with these areas having better wage employment opportunities.

distribution. A shift upwards in the curve for returns to ability in entrepreneurship would then increase entrepreneurship among those of relatively lower talent levels. Finally, for research settings without sufficient variation in the talent distribution it should be more difficult empirically to find results.

Our data comprise a representative sample of Tsinghua alumni not selected based on entry (or successful entry) into entrepreneurship.⁴⁶ While generalizations to all entrepreneurs are challenging, the advantages of this dataset are the systematic survey methodology, the number of years covered, the number of observations and detailed work histories as well as the ability to compare the founders' characteristics with their classmates who had largely the same educational experience but did not become entrepreneurs. The data include individuals who were very successful in their careers as well as many who had low salaries, were fired or never promoted. The Tsinghua dataset is one of the first systematic large-scale records of technology-based entrepreneurial activity in China.

CONCLUSIONS

The impact of the institutional environment on entrepreneurship has conventionally been seen at its worst as severely constraining entrepreneurial behavior via difficulty in raising start-up capital, insecure property-rights, or unreliable courts and contracts, and at its best as allowing market incentives to work. Yet the very high rate of entrepreneurship in less developed countries leaves a puzzle for this conception of the role of market institutions. The other side of the coin is the puzzle of why certain countries that have rapidly adopted institutions of privatization and financial liberalization have not experienced higher levels of growth from entrepreneurship (McMillan, Woodruff 2002, Frye, Shleifer 1997)? This paper takes a step towards showing the type of institutional change that can induce individuals more likely to succeed to become entrepreneurs.

To shed light on the impact that lowering barriers to growth may have for entrepreneurship among individuals of differing human capital levels, a novel survey was collected including entrepreneurs and non-entrepreneurial alumni covering multiple decades when entrepreneurship began to emerge across China. The analysis uses a differences-in-differences approach, exploiting a natural experiment with the

⁴⁶ The Tsinghua data contain wide variation in firm sizes, number of operating years, and outcomes so they do not share *to the same extent* the limitation of other entrepreneur datasets in only sampling successful founders.

1999 Chinese constitutional reform and detailed data on pre-entrepreneurship work history. This paper is one of the first to combine a dynamic view of institutional change with a view on specifically who is most affected by shifting incentives for entrepreneurship. The main results come in two stages. First, a change in the institutional environment in 1999 which lowered the barriers to entrepreneurial firm growth resulted in a greater increase in talented individuals becoming entrepreneurs. Second, the results show that various measures of human capital are associated with founding firms which are larger, more profitable, and more likely to innovate.

These results are novel, not only for documenting for the first time that a policy change results in higher quality entrepreneurship, but because they change the way we think about the mechanisms through which institutions affect entrepreneurship. The findings change previously held views in three different ways. First, the ability to overcome institutional barriers to entry (either through connections or the capability to navigate a complex bureaucracy) is not orthogonal to the aspects of ability which are important for commercial success in the market, but rather there is much overlap. Second, individuals with stronger resumé and with better employment performance relative to their resumé do carry over those skills to the task of entrepreneurship with the implication that investors and entrepreneurs may want to look for those characteristics. Third, policy may be able to influence not just the rate, but the overall direction of innovative activity and the type of entrepreneurial firms in a society by focusing less on the fixed start-up costs of entrepreneurship and more on the barriers to growth and opportunity costs. Nevertheless, the results are not merely consistent with a standard opportunity cost explanation. Rather, even controlling for opportunity costs and rising salaries in the wage sector, the results in Table 6 show that the institutional shift had an additive effect on its own.

The results have several implications. First, they contribute to the literature on institutions and economic growth by shedding light on one mechanism by which certain institutional environments contribute to economic growth. Institutional reforms alter the selection into entrepreneurship, not only by reducing barriers to entry, but by shifting the directions in which talented individuals channel their energies in society (Baumol 1990). One important implication is that there may be two separate classes

of institutions, one that lowers barriers and costs to entry and another which lowers barriers to entrepreneurial growth. Some have already begun to unbundle institutions, but the distinction between institutions which have different mechanisms of action may be important to consider.⁴⁷ The results have implications for developing economies, particularly those with a manufacturing sector that is looking to upgrade and to foster the emergence of technology-based entrepreneurship as a driver of economic growth. For policy-makers, entrepreneurs, and university officials to blindly apply theories tested in developed country contexts is not without risk. The prior literature may be incorrect in conceptualizing the characteristics which allow one to overcome institutional barriers to entry as being largely orthogonal to those important for commercial success or entrepreneurial ability. Lowering barriers to entry may increase entrepreneurship among individuals lower in the talent distribution (i.e. by reducing the costs of entrepreneurial finance) (Nanda 2008, Wang, 2008). The results may lead to rethinking even the theoretical predictions on liquidity constraints. Even the original model of Evans, Jovanovic (1989) predicts constraints impacting the top quartiles of the ability distribution most strongly, leading to the idea that liquidity constraints may actually be one of many types of constraints to growth, rather than being most binding on entry. Buera (2008) shows that a dynamic model of financial constraints yields more nuanced predictions than standard static models. Testing his model with US data, he shows that welfare costs are not due to individuals with ability not starting businesses, but rather to undercapitalized entrepreneurs. The results here may allow for targeted programs to encourage entrepreneurship among those more likely to create high-impact organizations by focusing on growth of entrepreneurial firms.

For strategy researchers, the findings contribute to our understanding of who is selecting into entrepreneurial firms and also on the type of firms and competition in the market. Previous work finds that institutions which reduce the perceived risk in new sectors appear to result in greater use of novel technology by entrepreneurs (Sine, Haveman, Tolbert 2005). Similarly, the results of this study show that

⁴⁷ Examples of the first category may include government legalization and legitimatization of entrepreneurship, property-rights institutions, and some types of financial and banking reform. Examples of the second category may include subsidies and tax incentives for R&D, science parks and incubators, licensing laws, IP protection, private equity and venture capital reforms, and changes in the regulatory systems for mergers and acquisitions or IPO.

individuals with higher levels of human capital were more likely to indicate that intellectual property would be important for their firms and were more likely to found firms after the reform. Savvy entrepreneurs may capitalize on an awareness of shifts in the institutional environment to begin recruiting more talented cofounders or to anticipate shifts in the competitive landscape. Changes in the institutional environment could alter the basis of competition, or open up new markets if it brings about entrepreneurial entry by a different group of people.⁴⁸ A higher propensity for more talented individuals to become entrepreneurs may result in stronger competition or result in more firms needing to use an innovation strategy to avoid direct competition on price or market share. The results also show that prior conflicting results on the human capital characteristics associated with entrepreneurship may be due to differences in context. Some environments are more conducive for altering the marginal costs, encouraging entrepreneurs to be drawn from relatively lower in the talent distribution. Others alter the marginal benefits and foster entrepreneurship among those with higher levels of human capital. The findings help guide those in larger organizations looking to do more corporate venturing.⁴⁹ A better understanding of the incentives for entrepreneurial behavior is important for product development and corporate entrepreneurship efforts when structuring incentives to attract high ability employees towards risky new business projects. Appendix H summarizes the implications for the competitive environment and for entrepreneurs. This paper provides evidence that entrepreneurship in distinct institutional environments may have different drivers and outcomes.⁵⁰

⁴⁸ Similarly, those interested in national innovation systems (Freeman 1987, Nelson 1993) or the related literature on varieties of capitalism argue that while some capitalist economies are organized for radical innovation and high growth (US), others are better at other outcomes such as equality or incremental innovation (Hall, Soskice 2001).

⁴⁹ Prior work finds larger firms that select and reward managers based on performance grow faster and have higher return on capital (Bandiera, Guiso, Prat, Sadun, 2008, Bertrand, Schoar 2003).

⁵⁰ Previously, other scholars have suggested a necessary ordering to institutional reform, with macroeconomic stability coming first and then financial liberalization needing to be tied to securing property rights and market infrastructure (Johnson, McMillan, Woodruff 2000). China has certainly had macroeconomic stability at least since the Cultural Revolution; however it appears to be a counter example in having experienced rapid growth despite ambiguous property rights. Others have suggested that the idea of one ideal blueprint may be incorrect (Segal 2002, Breznitz 2007). The confusion may reflect the literature's implicit assumption that the same market failures affect *all* potential entrepreneurs equally from creating the *same* types of firms at *all* stages in market development. In the early stages of market development, good wage employment options are not available and lower ability individuals experience a strong push towards entrepreneurship but are resource

A key contribution of this paper is that there may be two different margins at which institutions affect entrepreneurship. Prior literature has examined one margin, where potential entrepreneurs are considering the costs and barriers to entry and are concerned primarily with whether the resources necessary to begin the business can be gathered. Yet there is another margin that has a greater impact on more talented individuals. Most of these individuals are capable enough to creatively acquire the necessary resources to start a business if they wanted to do so. Yet, they have good options in the wage sector and may be concerned more with the relative payoffs and whether the size and type of business they wish to start can be achieved.⁵¹ The results show that entrepreneurs and investors can screen for higher quality co-founders and that policymakers can craft institutions to encourage more market entry by those who are more likely to create high-growth, innovative firms. I provide evidence consistent with a story that the institutional environment may be shaped to encourage a more Schumpeterian type of creative destruction rather than to increase marginal new firm creation by less talented individuals (Schumpeter 1942).

constrained. At a middle stage in market development, better wage opportunities are available and the resources to start small scale firms can be gathered. Different market failures affect different individuals and different firm types at different stages in development.

⁵¹ This is not to imply that potential entrepreneurs care only about pecuniary benefits (Hamilton 2000). Nonetheless, it does appear that monetary outcomes are better for those higher in the ability distribution (Hamilton 2000) and even the non-pecuniary benefits may only accrue if individuals can create the type of firms they prefer to found and run.

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FIGURE 1

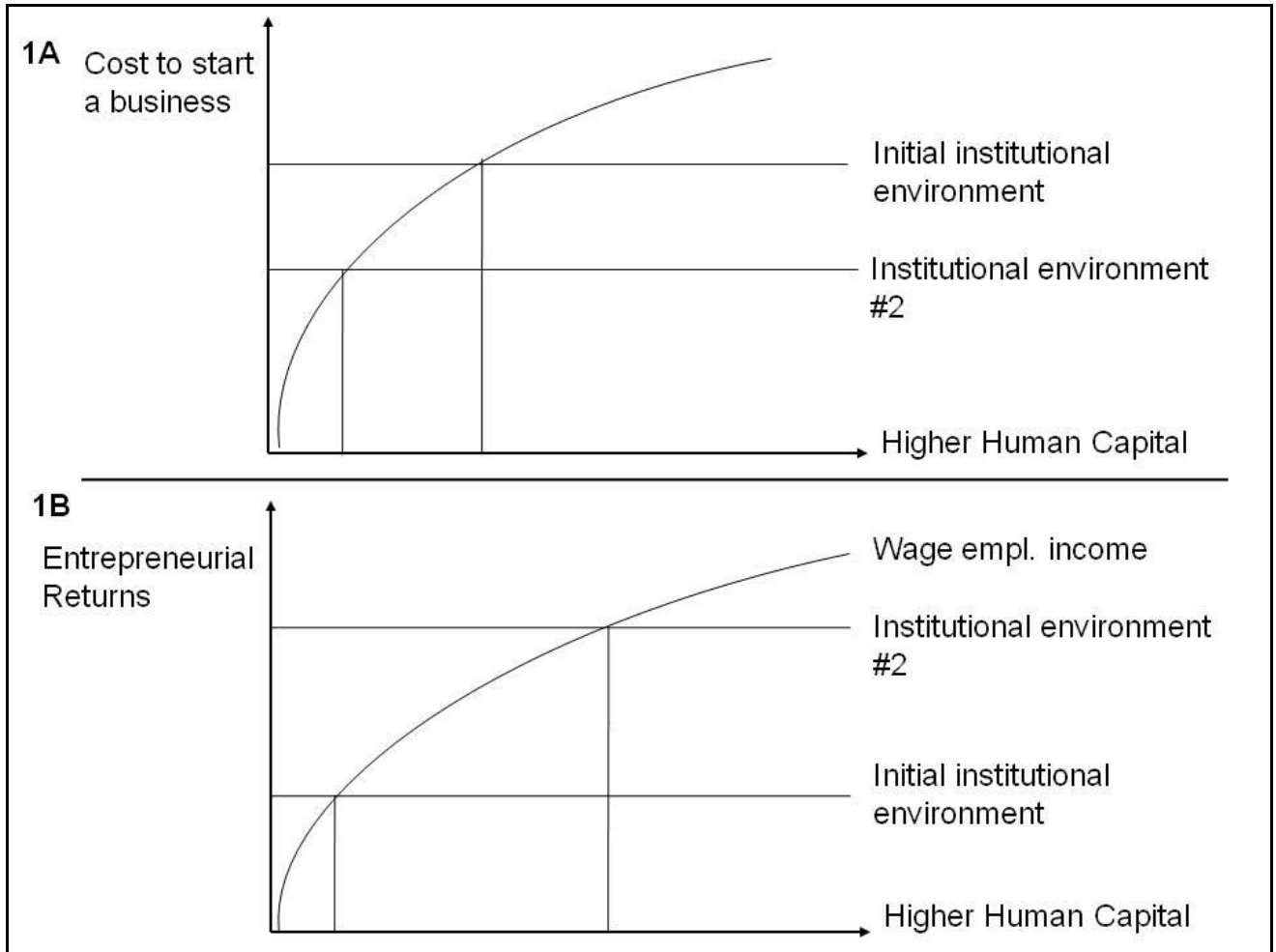


FIGURE 2

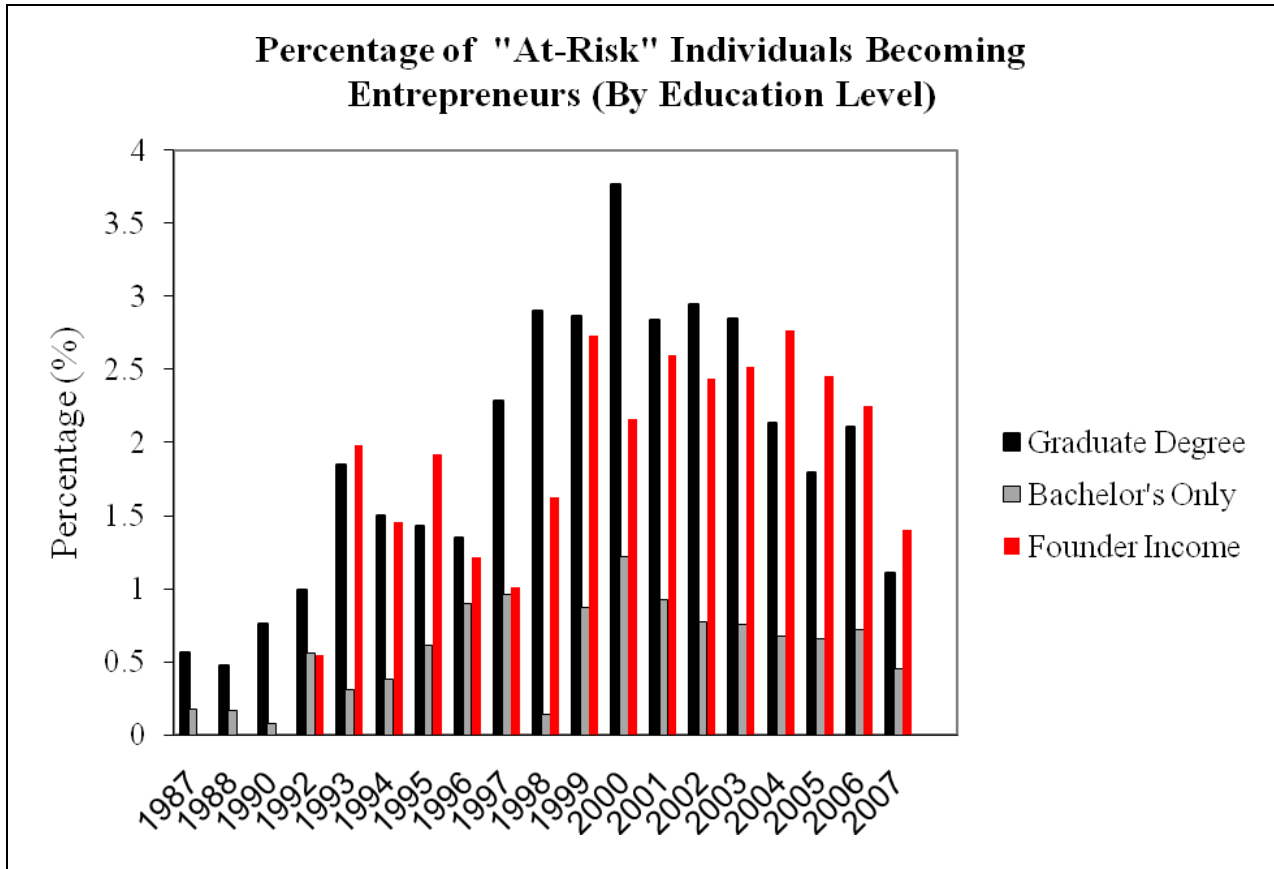


FIGURE 3

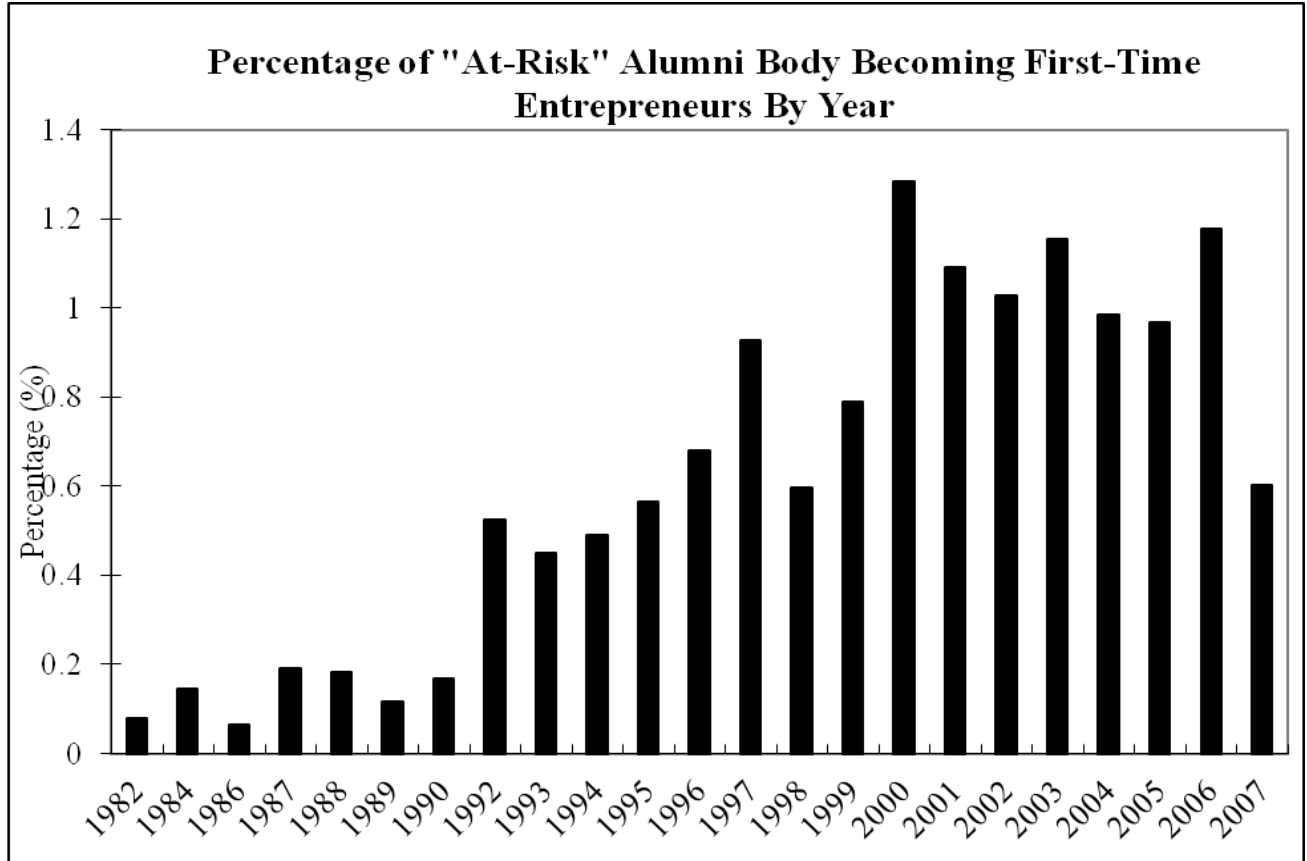


TABLE 1**Industry Breakdown**

Industry	Number of Firms	Percentage
AEROSPACE	3	0.90
ARCHITECTURE	13	3.88
BIOTECH AND DRUGS	7	1.09
CHEMICALS	8	2.39
CONSUMER PRODUCTS	17	5.07
ELECTRIC	12	3.58
ELECTRONICS	69	20.60
ENERGY	14	4.18
FINANCE	10	2.99
INTERNET	33	9.85
LAW, ACCOUNTING	22	6.57
MACHINERY	19	5.67
MANAGEMENT	21	6.27
MATERIALS	13	3.88
MED DEVICES	4	1.19
OTHER MFG	16	4.78
PUBLISHING	11	3.28
SOFTWARE	34	10.15
TELECOM	9	2.69
TOTAL	335	100

TABLE 2
Pairwise Correlations

		1	2	3	4	5	8	9	10	11	12	13	14	15	17	18	19	20	21	
1	<i>Last job academia</i>	1																		
2	<i>Last job business</i>	-0.618	1																	
3	<i>High government</i>	-0.051	-0.080	1																
4	<i>Low government</i>	-0.102	-0.385	-0.105	1															
5	<i>Ever job academia</i>	0.425	-0.085	-0.009	-0.056	1														
8	<i>Number of Positions</i>	-0.149	0.175	-0.011	0.036	0.135	1													
9	<i>Avg. Tenure</i>	0.047	-0.088	-0.036	0.077	-0.117	-0.060	1												
10	<i>Gender</i>	-0.046	0.047	-0.029	0.007	0.008	0.120	0.032	1											
11	<i>Entrepreneur Parents</i>	-0.041	0.002	0.018	-0.004	-0.058	0.054	-0.048	-0.016	1										
12	<i>High Salary</i>	-0.138	0.320	-0.050	-0.180	0.158	0.284	-0.305	0.057	0.009	1									
13	<i>Family economic status</i>	-0.030	-0.018	-0.004	0.030	-0.054	-0.081	0.098	0.154	-0.115	-0.196	1								
14	<i>Student Leader</i>	0.009	-0.028	0.011	0.051	0.011	0.075	-0.130	-0.010	0.043	0.144	-0.070	1							
15	<i>Communist Party</i>	-0.002	-0.092	-0.019	0.114	-0.043	-0.011	0.071	0.034	-0.037	-0.070	0.037	0.008	1						
17	<i>Master's</i>	0.037	0.053	-0.025	-0.032	0.103	0.119	-0.278	-0.013	-0.014	0.317	-0.090	0.234	-0.092	1					
18	<i>PhD</i>	0.273	-0.176	-0.021	-0.022	0.114	-0.017	-0.114	0.030	0.040	0.121	-0.040	0.142	-0.025	0.215	1				
19	<i>Overseas Experience</i>	-0.029	0.088	0.013	-0.101	0.030	0.093	-0.083	0.009	0.059	0.240	-0.097	0.076	-0.044	0.147	0.130	1			
20	<i>Bachelor's Grad Year</i>	-0.159	0.268	0.027	-0.136	0.014	0.098	-0.433	-0.031	0.083	0.460	-0.104	0.242	-0.130	0.457	0.160	0.232	1		
21	<i>Age</i>	0.154	-0.273	-0.028	0.142	-0.023	-0.099	0.438	0.036	-0.087	-0.475	0.117	-0.236	0.136	-0.471	-0.171	-0.240	-0.989	1	

TABLE 3
Summary Statistics and Variable Definitions

VARIABLE	DEFINITION	MEAN	SD
Panel A: Firm and Individual-level measures			
<i>First start-up founded</i>	Year in which first firm was founded (censored if not observed by 2007)	2000.38	5.20
<i>Firm age</i>	Age of the firm	3.50	2.44
<i>Privatized</i>	=1 if firm was privatized	0.10	0.47
<i>Entrepreneur</i>	=1 if the individual was an entrepreneur	0.26	0.46
<i>Entrepreneur Parents</i>	=1 if parents were entrepreneurs	0.09	0.29
<i>Graduation year</i>	Year of graduation (Bachelor's)	1980.66	17.80
<i>Family economic status</i>	Family's economic status in China during college, 4=top 10%, 3=top 10-25%, 2=top 25-50%, 1=bottom 50%	3.78	1.01
<i>Age</i>	Individual's age	49.82	18.35
<i>Gender</i>	Dummy = 1 if male	0.88	0.32
Panel B: Work history-level measures			
<i>Recent Salary</i>	Most recent pre-founding salary (5 categories)	3.32	1.43
<i>Avg. Tenure</i>	Average number of years in each job	7.11	9.45
<i>Number of Positions</i>	Number of different positions (R&D, sales & marketing, general manager, etc.) that were held	2.37	1.26
<i>High government</i>	=1 if ever had job in government (minister, province, Bureau or municipal levels)	0.03	0.17
<i>Low government</i>	=1 if ever had job in government (below municipal level)	0.17	0.38
<i>Last job academia</i>	= 1 if last job was in academia (inclusive of faculty, researcher, staff, etc)	0.19	0.39
<i>Last job business</i>	= 1 if last job was in business	0.62	0.49
<i>Ever job academia</i>	= 1 if ever had job in academia (inclusive of faculty, researcher, staff, etc)	0.32	0.47

TABLE 4
Years 1988 – 1999

Independent Variables	Dependent Variable = Start-up founded (subjects start being at risk upon graduation)					
	Note: reported coefficients are hazard ratios (N=1,540 individuals)					
	(4-1)	(4-2)	(4-3)	(4-4)	(4-5)	(4-6)
<i>Master's degree</i>	0.675* (0.158)					0.562** (0.152)
<i>Doctorate degree</i>	0.344** (0.166)					0.641 (0.323)
<i>Low work exper. (0-10 yrs.)</i>		1.333 (0.351)				1.500 (0.442)
<i>High work exper. (>30 yrs.)</i>		0.060*** (0.039)				dropped -
<i>Promoted</i>			0.689 (0.251)			0.686 (0.270)
<i>High GPA (above median)</i>				0.685* (0.150)		1.288 (0.325)
<i>Last Salary (Pre-founding)</i>					0.667*** (0.065)	0.694*** (0.071)
<i>Overseas</i>	0.914 (0.247)	0.745 (0.199)	0.807 (0.217)	0.775 (0.211)	1.154 (0.329)	0.929 (0.280)
<i>Last job acad.</i>	0.973 (0.413)	0.744 (0.314)	8.30E-01 (0.349)	1.02E+00 (0.434)	8.62E-01 (0.408)	0.778 (0.384)
<i>Last job govt</i>	0.504 (0.219)	0.513 (0.219)	0.509 (0.217)	0.425* (0.194)	0.340** (0.169)	0.402* (0.206)
<i>High govt.(ever)</i>	0.841 (0.504)	0.964 (0.578)	0.883 (0.528)	0.807 (0.485)	0.987 (0.602)	0.916 (0.557)
<i>Low govt (ever)</i>	1.202 (0.356)	0.985 (0.289)	1.079 (0.313)	0.927 (0.277)	1.137 (0.358)	0.963 (0.318)
<i>Ever job academia</i>	1.312 (0.419)	1.105 (0.352)	1.155 (0.367)	1.184 (0.380)	1.227 (0.405)	1.425 (0.492)
<i>Number of positions</i>	1.530*** (0.120)	1.489*** (0.115)	1.499*** (0.118)	1.527*** (0.126)	1.414*** (0.120)	1.288*** (0.117)
<i>Gender</i>	1.062 (0.428)	0.934 (0.375)	1.018 (0.410)	1.134 (0.456)	1.118 (0.478)	1.045 (0.464)
<i>Family Wealth</i>	0.753*** (0.078)	0.769*** (0.078)	0.750*** (0.077)	0.798** (0.083)	0.768** (0.089)	0.787* (0.097)
<i>Communist Party</i>	0.76 (0.167)	0.807 (0.176)	0.77 (0.169)	0.774 (0.173)	0.776 (0.185)	0.808 (0.195)
<i>Bach.Grad. Yr.</i>	1.154*** (0.023)	1.090*** (0.026)	1.145*** (0.022)	1.107*** (0.022)	1.099*** (0.025)	1.067** (0.029)

Note: coefficients below 1.0 represent a decreased likelihood of entrepreneurship; 102 failures; 30,716 total years at risk; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All models include controls for Bachelor's graduation year (age), and region fixed effects

TABLE 5
Cox Hazard Rate Regressions

Independent Variables	Dependent Variable = Start-up founded (subjects start being at risk upon graduation)													
	Note: reported coefficients are hazard ratios, coefficients above 1.0 represent an increased likelihood of entrepreneurship; (N=1,821)													
	(4-1)	(4-2)	(4-3)	(4-4)	(4-5)	(4-6)	(4-7)							
<i>Master's degree</i>	0.444***	(0.121)												
<i>Master's x POST</i>	1.771*	(0.581)												
<i>Doctorate degree</i>	1.131	(0.630)												
<i>Doctorate x POST</i>	0.889	(0.549)												
<i>Parents' edu.</i>		0.724***	(0.040)											
<i>Parent edu.xPOST</i>		1.417***	(0.089)											
<i>Log (Work exp.)</i>			0.832***	(0.022)										
<i>Log(Work) xPOST</i>			0.999	(0.027)										
<i>Promoted</i>					0.216***	(0.112)								
<i>Promoted x POST</i>					3.361**	(1.953)								
<i>High GPA</i>							0.350***	(0.111)						
<i>GPA x POST</i>							1.811*	(0.651)						
<i>Highest salary (pre-founding)</i>									0.771**	(0.079)				
<i>Salary x POST</i>									1.225*	(0.147)				
<i>Student leader</i>												0.718**	(0.097)	
<i>Leader x POST</i>												1.336*	(0.209)	
<i>Years 2000-07</i>	0.054***	(0.016)	0.002***	(0.001)	0.060***	(0.019)	0.012***	(0.007)	0.020***	(0.006)	0.007***	(0.004)	0.027***	(0.007)
<i>Years 1991-99</i>	0.064***	(0.010)	0.043***	(0.008)	0.056***	(0.012)	0.067***	(0.011)	0.064***	(0.012)	0.050***	(0.009)	0.068***	(0.012)
<i>Overseas</i>	0.860	(0.151)	0.675**	(0.135)	0.555***	(0.124)	0.622**	(0.123)	0.595**	(0.120)	0.754	(0.150)	0.615**	(0.122)
<i>Last job acad.</i>	0.734	(0.233)	0.390***	(0.138)	0.205***	(0.085)	0.440**	(0.157)	0.512*	(0.184)	0.369**	(0.144)	0.482**	(0.170)
<i>Last job govt.</i>	0.657	(0.190)	0.879	(0.278)	0.377**	(0.144)	0.607	(0.190)	0.563*	(0.185)	0.654	(0.220)	0.599	(0.188)
<i>High govt.(ever)</i>	0.772	(0.288)	0.896	(0.356)	1.139	(0.452)	0.913	(0.361)	1.015	(0.383)	0.775	(0.320)	0.954	(0.370)
<i>Low govt (ever)</i>	1.322	(0.301)	1.143	(0.274)	0.916	(0.256)	1.306	(0.306)	1.385	(0.333)	1.310	(0.328)	1.417	(0.333)
<i>Ever job acad.</i>	1.195	(0.265)	1.517**	(0.313)	1.531*	(0.352)	1.491**	(0.302)	1.236	(0.262)	1.423*	(0.301)	1.506**	(0.309)
<i>Num. positions</i>	1.361***	(0.077)	1.305***	(0.075)	1.353***	(0.088)	1.412***	(0.088)	1.324***	(0.077)	1.300***	(0.080)	1.345***	(0.077)
<i>Gender</i>	1.437	(0.454)	2.551***	(0.859)	1.820	(0.668)	1.990**	(0.638)	2.633***	(0.879)	2.083**	(0.710)	2.151**	(0.696)
<i>Entrep. parent</i>	0.947	(0.071)	0.54	(0.236)	0.486	(0.246)	0.450*	(0.197)	0.482*	(0.213)	0.5.9	(0.261)	0.488*	(0.210)
<i>Family Wealth</i>	0.971	(0.141)	1.078	(0.097)	1.110	(0.090)	1.015	(0.076)	0.953	(0.074)	0.982	(0.079)	1.001	(0.075)
<i>Communist Party</i>	0.86	(0.151)	0.929	(0.141)	1.080	(0.182)	0.967	(0.144)	1.025	(0.153)	0.803	(0.124)	1.033	(0.155)

Note: POST=Years 2000-07; 308 failures; 44,248 total years at risk; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All models include controls for Bachelor's graduation year (age), Bachelor's Major (academic department), and region fixed effects.

TABLE 6
Quantile Regression on Unobservable Human Capital

<i>Panel A</i>	<i>Dependent variable = income residuals</i>				
<i>Percentiles</i>	<i>10</i>	<i>25</i>	<i>50</i>	<i>75</i>	<i>90</i>
<i>Founded in 1978-89</i>	0.737*** (0.229)	0.502*** (0.151)	0.085** (0.039)	-0.362** (0.175)	-1.427* (0.777)
<i>Founded in 1990-99</i>	0.771*** (0.143)	0.344*** (0.131)	0.034 (0.063)	-0.094 (0.201)	0.206 (0.655)
<i>Founded in 2000-07</i>	0.571*** (0.181)	0.740*** (0.158)	0.429*** (0.122)	0.736*** (0.189)	0.586** (0.232)
Constant	-1.556*** (0.110)	-0.894*** (0.098)	-0.156*** (0.049)	0.420*** (0.110)	1.184*** (0.107)
Observations	595	595	595	595	595
Pseudo R-squared	0.058	0.034	0.021	0.042	0.023
<i>Panel B</i>	<i>Dependent variable = income residuals (Entrepreneurs only)</i>				
<i>Percentiles</i>	<i>10</i>	<i>25</i>	<i>50</i>	<i>75</i>	<i>90</i>
<i>Ln(profit)</i>	0.215 (0.295)	0.093 (0.234)	0.195 (0.155)	0.242** (0.123)	0.246** (0.126)
<i>Controls</i>					
<i>Ln(firm age)</i>	0.479 (0.483)	0.332 (0.434)	0.273 (0.403)	0.241 (0.379)	0.196 (0.415)
<i>Ln(registered capital)</i>	0.154 (0.207)	0.110 (0.146)	-0.037 (0.109)	-0.022 (0.109)	0.010 (0.104)
<i>Privatized</i>	1.308 (1.182)	0.406 (0.901)	0.687 (0.690)	0.435 (0.666)	0.242 (0.752)
<i>Bought</i>	0.857 (1.324)	0.537 (1.189)	0.616 (0.847)	0.690 (0.566)	0.852 (0.544)
<i>Ln(income from firm)</i>	-0.068 (0.112)	-0.074 (0.089)	-0.05 (0.063)	-0.015 (0.062)	-0.050 (0.053)
Constant	-90.977 (98.614)	-61.093 (86.086)	-28.173 (62.509)	-17.581 (62.713)	-28.286 (70.683)
Observations	132	132	132	132	132
Pseudo R-squared	0.461	0.360	0.293	0.418	0.601

The top of the talent distribution was more likely to found a firm after 1999 and conditional on founding a firm, had higher profits. Dependent variable is the residual from the income regression in Appendix E. Bootstrapped standard errors (100 repetitions); Panel B uses newly generated residuals from the sample of entrepreneurs only and includes founding year, industry, coastal region, Beijing and Shanghai controls; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Sample includes non-entrepreneurs matched on graduation year and job ending year.

TABLE 7
Tobit Models: Returns to Human Capital in Entrepreneurship Increase Post-1999

Independent Variables	Log(profit margin)				Log(income from start-up)			
	(7-1)	(7-2)	(7-3)	(7-4)	(7-5)	(7-6)	(7-7)	(7-8)
<i>POST-1999 founding</i>	-0.301 (0.455)	-0.448 (0.598)	-0.753 (0.563)	-2.200** (0.937)	-1.329 (0.977)	-0.139 (0.686)	1.027 (0.819)	-6.443*** (1.861)
<i>Master's degree</i>				-0.269 (0.340)	-1.037 (0.905)			0.090 (0.928)
<i>POST x Master's degree</i>				-0.111 (0.412)	1.783* (1.039)			0.163 (1.054)
<i>High GPA</i>		-0.279 (0.427)		-0.523 (0.589)		-1.191 (0.737)		-1.417 (0.903)
<i>POST x High GPA</i>		0.639 (0.453)		0.866 (0.595)		2.348*** (0.887)		2.376** (1.042)
<i>Income residual</i>			0.073 (0.255)	--			-3.239*** (0.901)	--
<i>POST x income residual</i>			0.152 (0.312)	--			2.624** (0.987)	--
<i>Promoted</i>				-0.900 (0.611)				-1.123 (1.182)
<i>POST x Promoted</i>				1.751** (0.768)				5.803*** (1.678)
<i>Privatized</i>	-0.297 (0.400)	-0.385 (0.363)	-0.083 (0.758)	-0.423 (0.388)	0.986 (1.043)	0.921 (1.015)	-1.307 (1.432)	1.264 (1.141)
<i>Bought</i>	-0.079 (0.586)	-0.106 (0.620)	-0.022 (0.660)	-0.189 (0.577)	3.233*** (1.165)	2.919*** (1.034)	3.004** (1.430)	2.721*** (0.975)
<i>Log(revenues)</i>	0.275*** (0.089)	0.274*** (0.093)	0.234** (0.098)	0.242*** (0.089)	0.334* (0.194)	0.324 (0.203)	0.058 (0.249)	0.207 (0.155)
<i>Log(registered capital)</i>	-0.226** (0.111)	-0.225** (0.112)	-0.305** (0.126)	-0.210* (0.111)	-0.036 (0.256)	0.044 (0.253)	-0.451 (0.377)	0.029 (0.252)
<i>Log(employees)</i>	0.027 (0.152)	0.024 (0.156)	-0.056 (0.175)	-0.001 (0.154)	0.116 (0.392)	0.021 (0.416)	1.018* (0.548)	-0.015 (0.351)
<i>Log(firm age)</i>	0.438 (0.486)	0.614 (0.541)	0.087 (0.562)	0.388 (0.583)	2.742* (1.413)	0.804 (0.561)	1.157 (0.782)	0.635 (0.513)
<i>Overseas</i>	--	-0.175 (0.299)	0.272 (0.404)	-0.234 (0.274)	0.772 (0.978)	0.557 (0.935)	1.119 (1.147)	0.283 (0.891)
<i>Coastal province</i>	0.137 (0.254)	0.222 (0.262)	-0.592 (0.385)	0.191 (0.260)	-0.563 (1.002)	-0.709 (1.106)	0.657 (1.320)	-0.396 (1.056)
<i>Bach. Grad. year</i>	0.011 (0.012)	0.013 (0.012)	0.022** (0.011)	0.021* (0.012)	-0.052 (0.036)	-0.037 (0.037)	-0.028 (0.039)	-0.008 (0.035)
<i>Constant</i>	-237.31 (239.94)	-320.76 (278.33)	-152.01 (267.88)	-213.95 (301.93)	-876.14 (643.57)	76.92 (75.60)	50.50 (77.01)	23.04 (70.12)
Observations	149	147	94	147	150	148	93	148
R-squared	0.27	0.27	0.31	0.35	0.15	0.15	0.17	0.18

Standard errors are robust. The dependent variable is potentially censored below zero. Main results are robust to a Poisson specification (as well as not taking the natural log). All independent variables are not run together due to collinearity. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All models include controls for year and region fixed effects.