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DOES A MORE EDUCATED POPULATION ENHANCE ENTREPRENEURSHIP?

Yan Qian[1], Shiyong Zhao[2]

[1]*Faculty of Hospitality and Tourism Management, Macau University of Science and Technology*
[2]*School of Business, and Institute of Development Economics, Macau University of Science and Technology*

Abstract

This paper studies the impact of a population's educational level on the entrepreneurship of an economy. Using a dataset from China's national population censuses from 1990 to 2020 and two-way fixed effects models, we find an inverted U-shaped relationship between the average years of schooling of a population and the entrepreneurship rate. Moreover, we use fractions of the population with different educational levels as key independent variables and find that only a larger population with a *senior high school* education can significantly increase entrepreneurship. A larger fraction of people with a *college education or higher* education, however, does not have a significant effect on entrepreneurship.

Keywords

Entrepreneurship, Education, Human Capital Effect, Opportunity Cost Effect

JEL code: A20, O15, J24, J38

I. Introduction

The question of whether a more educated population enhances or undermines entrepreneurship remains controversial among social scientists. This question is highly policy relevant yet theoretically ambiguous. This approach is policy relevant because economists since Schumpeter (1911) have stressed the important roles played by entrepreneurs in driving economic growth and improving the standard of living. In addition, education has always been highly policy relevant. Davidsson and Honig (2003) show that human capital is a determinant of entrepreneurship. Formal education is one of the most important channels through which human capital is accumulated; thus, it becomes a measure of human capital (Becker, 1964). Many authors have emphasized that entrepreneurs' human capital plays a distinctive role in fostering the growth of entire economies (Lucas, 1978; Murphy, Shleifer, and Vishny, 1991; Gennaioli et al., 2013). However, few studies explore the effect of a population's educational level on entrepreneurship, and evidence in the literature is mixed and inconclusive (Qin and Kong, 2021). The present paper investigates the following question: does a more educated population increase the entrepreneurship rate of an economy?

Our research question is also inspired by a heated policy debate in China on the admission rates of senior high schools. Currently, approximately 50% of junior high school graduates can enroll in senior high schools and thus attend university entrance exams three years later (more than 80% of them will then be admitted by colleges and universities). The other half can choose only vocational schools or go to work directly. The policy debate is as follows: should a higher percentage of junior high school graduates be

admitted to senior high schools? Most Chinese parents want their children to attend senior high schools rather than vocational schools for many reasons, such as a strong preference for university diplomas and concern for low-quality education in vocational schools. Given the importance of entrepreneurship for economic growth and improvements in standards of living, if we can identify an association between different educational levels of the population and entrepreneurship, then we can provide some policy implications for this debate.

From China's population censuses and a 1% sample of population censuses (mini censuses), we are able to determine fractions of the population with different educational levels in each province. In the censuses, the formal education of Chinese adults is divided into five levels: illiterate or quasi-illiterate, primary school, junior high school, senior high school, and college or higher. Different educational levels are converted into different years of schooling in the census reports: illiterate or semi-illiterate, zero; primary school, 6 years; junior high school, 9 years; senior high school, 12 years; and college or higher, 16 years. Then, the average years of schooling of a population can be calculated by a weighted average with fractions of the population with different educational levels as weights. In this way, we have two measures of a population's education: average years of schooling and the percentage of the population with different educational levels.

Entrepreneurship is a complex and broad concept. In the literature, it is usually measured by quantifiable indicators such as the rate of firm creation or the self-employment rate (e.g., Jian et al., 2021; Zhao, 2023). We follow this approach and use the number of newly registered proprietorships per 10,000 people to represent informal entrepreneurship and the number of newly registered private enterprises per 10,000 people to measure formal entrepreneurship. This is a natural differentiation because these two types of entrepreneurial activities require different types of human capital. Similar divisions have been used in previous studies. For example, Levine and Rubinstein (2017) divide firms into incorporated and unincorporated firms. Compared with unincorporated firms, incorporated firms perform activities requiring relatively stronger nonroutine skills such as analytical flexibility and creativity.

Education enhances human capital. A more educated population implies that a greater percentage of people are better equipped with the knowledge and skills necessary to exploit market opportunities and thus create businesses successfully (Davidsson and Honig, 2003). In this sense, a more educated population will increase the entrepreneurship rate. We refer to this positive effect of education on entrepreneurship as the *human capital effect*. However, some early theoretical work argues that what schooling increases is the number of professionals rather than entrepreneurs (Schmitz, 1989; Iyigun and Owen, 1999). People with a higher educational level and thus better human capital typically earn more as salaried employees such as professionals do. More education thus increases the opportunity cost of becoming an entrepreneur. Particularly in China, industry and commerce have long been treated as low-status activities that are not fit for an educated person (while in the West, for the most part, business has been viewed as a respectable activity). Refined, educated people should work for the emperor as government officials, not entrepreneurs. It is a matter of dignity, let alone riches. The influence of history and culture persists today in most parts of China. It is therefore much less likely for highly educated individuals to become entrepreneurs than for persons with only moderate education. This mechanism is labeled the *opportunity cost effect*.

The question of the effect of education on entrepreneurship essentially becomes empirical since there is not a unique prediction. Findings in the literature on this effect are mixed. Block et al. (2013) reported a positive effect of education on the overall probability of self-employment by using a dataset including the United States and 27 European countries. Masakure (2015) reported that university education positively impacts entrepreneurship, whereas some/no education reduces self-employment propensity in Canada. Buenstorf et al. (2017), however, did not find significant differences in the likelihood of entrepreneurship among university dropouts and graduates in Denmark. Van der Sluis et al. (2008) also reported an insignificant impact of formal schooling on selection into entrepreneurship after reviewing almost 100 studies. Habibov et al. (2017) reported a negative effect of university education on the propensity of being self-employed in a dataset of 29 transitional countries.

Compared with previous studies, the present paper is distinctive in the following respects. First, we focus on the regional economies of China, which is a developing and transitional country that has undergone rapid growth and dramatic transformation over the past four decades. An open question is how valid our findings are for the institutional setup of other countries. Second, many studies in the literature address the impact of entrepreneurship education when we search for the keywords education and entrepreneurship. In our present paper, we focus on general education and measure it with formal

schooling. Third, we focus on the effect of a population's education level (rather than entrepreneurs' education at the individual level) on the entrepreneurship rate. We employ China's population census data at the provincial level and find an inverted-U relationship between a population's years of schooling and informal entrepreneurship. The positive effects of years of schooling on both formal and informal entrepreneurship are significant, and the coefficient of the quadratic term of schooling on entrepreneurship is statistically significant at the 1% level. These findings suggest that certain years of schooling are imperative for entrepreneurship, but the effect diminishes as the population becomes more educated.

We then use the percentage of the adult population with different educational levels to represent education. We find that a greater percentage of the population with a senior high school education will experience both formal and informal entrepreneurship. A higher percentage of the population with a college degree or higher decreases informal and formal entrepreneurship. This finding implies that a typical person with a college education or higher would not choose to start a business.

Our findings offer some policy implications for the debate on senior high school admission rates. A higher percentage of the adult population with a *senior high school* education will enhance both formal and informal entrepreneurship. If policymakers are to encourage entrepreneurship, they can achieve the goal by increasing the enrollment rate of senior high schools. In doing so, they can relieve the pressure on junior high school students and their parents and allow them to have more options to choose.

The paper is organized as follows. Section 2 reports our measurement of entrepreneurship, and here, we disaggregate it into formal and informal entrepreneurship. Section 3 presents the causal mechanisms through which a population's educational level may affect entrepreneurship and then proposes our hypothesis. Section 4 presents our econometric strategies. Section 5 reports our empirical results. Section 6 concludes the paper.

2. Entrepreneurship: Formal and informal

An entrepreneur is someone who creates a new business. He or she brings together the factors of production—land, labor, and capital—to create a new product or service (Lazear, 2005). Thus, entrepreneurship refers to an individual's ability to turn ideas into action (Frank et al., 2016). Therefore, entrepreneurship can be measured properly by the creation of new firms (Decker et al., 2014). However, there is no consensus on the measurement of entrepreneurship in the literature. Some researchers use the fraction of people working in private sectors as a proxy for entrepreneurship (Zhao, 2018). However, private sector employment also comes from both entrants and incumbents. The self-employment rate is widely used as a measure of entrepreneurship in the literature (e.g., Le, 1999; Levine and Rubinstein, 2017). However, some authors, such as Zhao (2023), argue that self-employment blurs distinctions between different types of entrepreneurial activities. For example, it makes little distinction between a tycoon and a barber shop in the corner of the street.

Jimenez et al. (2015) use the entry density rate per capita to measure entrepreneurship, which is calculated as the fraction of newly established businesses per thousand working-age people. Like Jimenez et al. (2015), in the present study, we use the number of newly registered private businesses per 10,000 people to measure entrepreneurship. This measure also suffers from deficiencies, as mentioned by Zhao (2023). To mitigate this problem, we then disaggregate all private businesses into two categories. One are smaller-sized proprietorships (*getihu*), and the other are larger-sized private enterprises (*siying qiye*). We refer to the creation of proprietorships as informal entrepreneurship and the creation of private enterprises as formal entrepreneurship.

In China, proprietorships were the only form of legal private business in the early and mid-1980s. China amended its constitution in 1988 to allow for the development of private enterprises, after which formal private enterprises officially registered in 1989. Although proprietorships are legally registered, they are much more loosely regulated than private enterprises are. For example, they do not need to pay any tax if their monthly revenue is less than 30,000 yuan ($4,200), although a fixed amount of tax is imposed on those exceeding that threshold. Proprietorships are usually small in size but large in number. According to a survey conducted in 2021 by the *Enterprise Survey for Innovation and Entrepreneurship* (ESIEC, 2021), the average number of people working in a proprietorship is 2.68 (typically household members). The number of proprietorships reached 110 million by mid-2023, accounting for 67.4% of all businesses in China (the total number of businesses in China was 170 million by then). These numbers suggest that approximately 300 million people are working in proprietorships in China. In addition, 90% of proprietorships focus on the wholesale and retail, accommodation, and catering industries.

Although private enterprises face additional regulations and taxes compared with proprietorships, they benefit from the company's limited liability status and legal person identity, which limits the owners' legal and financial risk. Their establishment is based on *Company Law*, *Partnership Law*, and *Tentative Regulations on Private Enterprises*. Private enterprises in China take the registration forms of private limited liability companies, private stockholding companies, private partnerships, and wholly private-invested enterprises. By mid-2023, the number of private enterprises exceeded 50 million, accounting for 92.4% of all enterprises. In 2022, the average sales revenue of the 500 largest private enterprises in China was 76.6 billion yuan ($11.4 billion) (ACFIC, 2023).

We are not the first to use a dichotomy to disaggregate entrepreneurship into informal and formal or similar types. Schoar (2010) divides entrepreneurship in emerging economies into "subsistence" and "transformational." Hurst and Pugsley (2011) and Decker et al. (2014) further explain that subsistence entrepreneurs are those who create small businesses that provide employment for the entrepreneur and several family members. They usually have no aspirations for high growth and start their businesses out of nonmonetary reasons such as time flexibility. Transformational entrepreneurs, however, create businesses with the intention to grow and innovate, thus creating jobs for other people and value added for the economy. According to this classification, proprietorship owners in China are very similar to subsistence entrepreneurs, whereas private enterprise owners are similar to transformational entrepreneurs. La Porta and Shleifer (2014) divide self-employed individuals into formal and informal business owners in a cross-section of less developed countries. They find that the productivity of formal firms is greater than that of informal firms. According to the definition and classification of Jimenez et al. (2015), formal entrepreneurship is the creation of legally registered new firms, whereas informal entrepreneurship is the creation of new firms that are not legally registered and are largely unregulated. In parallel with the above differentiations, Levine and Rubinstein (2017) distinguish between "entrepreneurs" and other business owners by disaggregating self-employed individuals into incorporated and unincorporated individuals.

3. Mechanisms and hypothesis

Numerous studies have assumed that higher levels of education result in higher entrepreneurship rates (Reynolds, 1997; Delmar and Davidsson, 2000). They argue that education can play a crucial role in shaping a potential entrepreneur's human capital. For example, Calvo and Wellisz (1980) argue that education enhances managerial ability, which in turn increases the probability of entrepreneurship. Specifically, education provides individuals with knowledge and skills that are valuable in starting and running a business. It can also enhance an individual's ability to assess risks and make informed decisions. Education can foster creativity and innovative thinking, which are vital traits for entrepreneurs. Exposure to diverse fields of study and problem-solving methods can lead to unique business ideas and solutions. As emphasized by Lazear (2005), the entrepreneur must have knowledge of many areas of business, at least at a basic level, because he or she must bring together many different factors of production. Thus, we believe that certain years of formal education are necessary for entrepreneurs. Although entrepreneurship, like any other form of creativity, is difficult to teach, it can be inspired and cultivated through interactions among peers at schools.

In addition to the human capital nurtured in schools, educational institutions as platforms offer valuable networking opportunities for would-be entrepreneurs. Networks play an important role in launching a firm, which has been well documented in the literature, for example, Greve and Salaff (2003). People who have access to a strong network or industry-specific connections through their educational background may find it easier to obtain resources, funding, and potential partners. Many entrepreneurs start businesses with their schoolmates or even classmates. For example, HP cofounders Bill Hewlett and Dave Packard were schoolmates at Stanford University. Moreover, investors and lenders may perceive people with higher educational qualifications as more trustworthy. Improving access to higher education can cultivate social trust in developing countries (Chen, et al., 2023), which lowers the cost of cooperation. Moreover, a more educated adult population also implies a more skilled labor force, which enables entrepreneurs to find workers they need more easily.

The human capital effect of formal schooling on entrepreneurship, however, should not be overemphasized. Iyigun and Owen (1999) posit that entrepreneurs accumulate human capital through a work-experience intensive process, whereas professionals' human capital accumulation

is education intensive. As emphasized by Liang et al. (2018), many of the knowledge and skills entrepreneurs need to possess are "tacit," which are more typically accumulated through interactions and work than professional human capital. The probability of being an entrepreneur increases as labor market experience (rather than education) increases, as shown by Evans and Jovanovic (1989). If people spend more years at school, they do learn more specialized knowledge from textbooks and teachers, but they relatively lack the diverse skills necessary for entrepreneurship. This will act as a disincentive to people who receive more formal education to become entrepreneurs.

It is tempting to argue that the most highly educated people become entrepreneurs because of their talents or that a more highly educated society will have a higher entrepreneurship rate. The complexity of this relationship, however, cannot be underestimated when one considers opportunity cost. The decision to become an entrepreneur is an alternative to a salaried job (Campbell, 1992). An individual with a higher level of education typically earns more as an employee (Gimeno et al., 1997). The man with a junior high school diploma who opens up a restaurant with several employees is labeled an entrepreneur, whereas the company executive with a master's degree is someone else's employee. After all, entrepreneurship typically involves considerable personal risk and sacrifice compared with salaried jobs.

In addition, as argued by Buenstorf et al. (2017), the national context strongly influences people's overall perception of entrepreneurship. Through Chinese history and culture, young people's ambition is to work for governments (thus becoming officials) after successfully completing their studies. Entrepreneurship had been of low status in Chinese people's minds. Since the early 1950s, when China nationalized its economy, entrepreneurship was basically eradicated and even became a political taboo under the communist ideology. The situation has improved since the 1980s, when China initiated market-oriented reforms and opening-up policies. Even so, entrepreneurship is still not the first occupational choice for most young people with a college degree or higher. The opportunity cost of starting a business and becoming an entrepreneur increases as educational attainment increases. In many cases, as argued by Lazear (2005) and Buenstorf et al. (2017), an entrepreneur is created when a job-hunting man has no alternatives.

In summary, we do not expect a simple linear monotonic relationship between a population's educational level and entrepreneurship rate. Rather, the mechanisms presented above suggest an inverted U-shaped relationship between entrepreneurship and a population's education, which occurs because two effects work in opposite directions. As people obtain more years of schooling or higher educational degrees, both the human capital required for entrepreneurship and the opportunity cost of becoming an entrepreneur increase. The human capital effect increases the entrepreneurship rate, whereas the opportunity cost effect decreases it. On net, either effect can dominate, and education can cause the entrepreneurship rate to rise or fall. These two effects offset each other, and the sign and magnitude of the net effect is an empirical question.

Intuitively, a certain level of education is important for people to acquire the human capital needed to start businesses. It is difficult to imagine a high entrepreneurship rate if most people are illiterate in a society. Hence, when a population's average educational level is low, the entrepreneurship rate is expected to be low. The entrepreneurship rate climbs as the population's educational attainment increases, and thus, human capital increases. In this phase, human capital effects dominate. However, as people gain more education, especially those who graduate from colleges and universities, their marginal benefit of choosing a salaried job exceeds the expected gain from being an entrepreneur, i.e., the opportunity cost of choosing entrepreneurship will dominate in this phase. The interaction of the two effects yields the inverted-U prediction. On the basis of the above arguments, we postulate the following hypothesis:

Hypothesis: *The relationship between entrepreneurship in a society and a population's education is inverted-U shaped.*

4. Econometric specifications

4.1 Model

We construct the following two-way fixed effects model to estimate the effect of a population's educational level on entrepreneurship.

$$\text{entrepreneruship}_{it} = \beta \times education_{it} + \boldsymbol{X}'_{it}\boldsymbol{\gamma} + d_i + \lambda_t + u_{it} \quad (1)$$

Here, i denotes the province (i=1, 2, …, 31), and t denotes the year (t=1990, 1995, …, 2020). d_i are provincial fixed effects: they represent all the time-invariant factors that may affect regional entrepreneurship, including the cultural and geographic characteristics of provinces. λ_t represents time fixed effects, including socioeconomic factors that may change over time at the national level. The 1990-year dummy is dropped in the regressions to avoid complete multicollinearity. u_{it} represents the idiosyncratic errors. $\boldsymbol{X}'_{it}$ is a vector of control variables.

It is particularly important to control for time fixed effects in the context of China. Entrepreneurship has been discriminated against in China due to Marxist ideology (Lu and Tao, 2010). The emergence and development of entrepreneurship in China since the early 1980s have been heavily affected by official ideology and government policies.

In 1999, the Chinese government amended its Constitution to include the private economy as "an important component of the socialist market economy." This move upgraded the status of private businesses. Before that, the public sector dominated the national economy, and private businesses were just supplements to the public economy. In 2002, the 16th National Congress of the Chinese Communist Party put forward the so-called "Two Unswervingly," which aims to unswervingly consolidate and develop the economic sector of public ownership and to unswervingly encourage, support and guide the development of the economic sector of nonpublic ownership. In 2004, the government amended the Constitution again and for the first time since 1949 to protect private property according to the law. In 2005, the government proposed 36 measures to encourage the development of private businesses. Five years after 2010, the government enacted 36 new measures to stimulate the development of the private economy. In 2016, the president of the country suggested to governments (officials) that they establish a "benign and uncorrupted" relationship with businesses (entrepreneurs), which required that governments actively provide services to businesses without involving power–money deals. Therefore, the inclusion of year fixed effects mitigates concerns about these macro shocks.

4.2 Dependent and independent variables

Entrepreneurship is our dependent variable. We use the number of newly registered proprietorships per 10,000 people and newly registered private enterprises per 10,000 people to measure informal and formal entrepreneurship, respectively. Both numbers are converted into natural logarithms. We also use two methods to measure a population's educational levels. One is the adult population's average years of formal schooling, and the other is the fraction of the adult population with each educational level.

We also control for various variables that may affect the regional entrepreneurship rate. First, we include the average GDP growth rate during the past three years to control for the economic environment, especially investment opportunities. An entrepreneur's decision to start a business is supposedly affected by recent regional economic performance. A faster economic growth rate is supposed to provide more business opportunities for potential entrepreneurs and simultaneously provide more salaried jobs.

Second, we control for several demographic factors, i.e., the elderly dependency ratio and family size. Liang et al. (2018) argue that the potential age structure of a society is an important determinant of entrepreneurship. The elderly dependency ratio in our paper is measured by the fraction of the population older than 65 in the working-age population (aged 15-64), and it is affected by migration across provinces. Family size is the average number of members in a family, which is affected by birth rates. The birth rate tends to decline as a country's per capita income increases, and in China, it has also been heavily influenced by the "one-child per couple policy," which was implemented for several decades until 2016 (Li et al., 2011). Studies in the

literature, for example, Liang et al. (2018), argue that fewer children in a society may slow down entrepreneurship at present and in the future.

We then include the urbanization rate in the regression equation. Over the sample period, an increasing number of people migrated from rural areas to urban areas. The fact that more people are concentrated in cities or towns may create more business opportunities. Urbanization has been encouraged by both central and local governments. We also control for the government's role in the regional economy by including the ratio of government expenditures to regional GDP in the equation.

Finance and infrastructure are both conducive to entrepreneurship. We use the ratio of loans granted by financial institutions to GDP to measure the level of a region's financial services. We use the length of roads per 10,000 square kilometers of land to proxy for the level of infrastructure. Both measures have been used in studies of entrepreneurship in the literature, such as those of Zhao (2018), Jian et al. (2021) and Zhao (2023).

Many authors emphasize the impact of institutions in general and promarket reform, particularly with respect to entrepreneurship development (Djankov et al., 2006; Cuervo-Cazurra and Dau, 2009; Lu and Tao, 2010). Institutions, however, are difficult to measure with a single indicator. Therefore, we resort to a so-called "*marketization index*" to capture the role of institutions. The measure of the market index is the score for each province's market-supporting institutions, which is compiled by the Beijing Institute for the National Economy. This index consists of 5 subindices and measures the relationships between the government and the market, the development of the nonstate sector, the development of the product market and factor market, the cultivation of market intermediaries and the rule of law.

The definitions of all the variables used are summarized in Table 1.

Table 1. Variables

Variables	Definitions
Informal entrepreneurship	Number of new proprietorships per 10,000 people (log)
Formal entrepreneurship	Number of new private enterprises per 10,000 people (log)
Schooling	Average years of schooling for people aged 15 or above
College	Fraction of population with a college education or above
High	Fraction of population with a senior high school education
Middle	Fraction of population with a junior high school education
Primary	Fraction of population with a primary school education
Previous growth	Average GDP growth rate during previous three years
Elderly	Population aged 65 or older divided by aged between 15-64
Family size	Average number of family members
Urbanization	% of population living in urban areas
Government	Government expenditures as a share of GDP (%)
Loan/GDP	Loan granted by financial institutions divided by GDP
Road/land	Kilometers of road per 10,000 square km of land
Market	Provincial marketization index

Note. (1) In calculating percentage of population with different levels of education, for example, college, the numerator include people who have graduated from college with a diploma, people who once studied at college but did not get diploma, and people who are currently studying at college. The same rule applies to other educational levels. (2) Average years of schooling is calculated according to the following rule: different education levels are assigned with different numbers, college or higher, 16 years; senior high school, 12 years; junior high school, 9 years; and primary school, 6 years. (3) The above calculation rules are defined by National Bureau of Statistics and the Seventh National Population Census Leading Group Office of the State Council.

4.3 Endogeneity discussion

Endogeneity may arise from three sources, namely, measurement error, omitted variable bias, and reverse causality. Measurement error should not be a serious concern in this study because the data on the key variables are from national population censuses. The data were collected by the

national and local statistical authorities in a consistent and comparable manner. Other data used in our study were also from official statistical authorities.

By controlling for time-invariant heterogeneities, we can alleviate the concern of omitted variables to a certain extent. If there are any unobserved time-invariant cultural or endowment factors that cause people to choose entrepreneurship, then this effect will be differenced out by employing fixed effects estimation methods. The time effect is also controlled for in the models since entrepreneurship in China has been heavily influenced by macroeconomic policy changes. Moreover, we include different sets of control variables to test the robustness of the estimates. If the data are at the individual level, then in estimating the causal effect of education on entrepreneurship, potential endogeneity comes from an omitted variable bias due to unobserved ability (Card, 2001). Hence, an IV method should be employed to obtain a consistent estimate of the effect. In the present study, however, the data are at the provincial level; we have no reason to suggest that the average innate ability of a population in a province is significantly different from that of another population. Moreover, even if the average innate abilities are different across provinces, they can be differenced out in fixed effects models if they do not change over time.

Reverse causality entails more discussions. Our approach used here assumes that a population's educational levels are exogenous and at least predetermined. One could think that causation may work in another direction, where entrepreneurship increases the educational level of a society rather than the level of education. It is possible that entrepreneurs choose to receive more education after they start their own businesses. For example, it is very likely that an entrepreneur with a bachelor's degree chooses to receive more education and obtain a master's or doctoral degree after he starts his business, thus marginally increasing the population's educational level. From the point of view of bias, however, this is unlikely to be a concern because the number of years assigned to college or higher is the same. After all, those with a *college education or higher* belong to the same educational level according to our classification.

If an entrepreneur graduates (or drops out) from primary school or junior high school without being admitted to high school, then typically, he will be unable to change his educational level in the official educational system of China. If an entrepreneur graduates from high school without being admitted by a college, in principle, he could reattend the national college entrance exam and be admitted by a college (thus increasing his official educational level), but chances are slim because they have to prepare for the exam while working full-time as busy entrepreneurs.

Logically, it is possible that a province that is more favorable for entrepreneurship could attract more migrants from other provinces. These migrants may have a significantly higher (or lower) educational level than those in the host provinces. This effect should be small for two reasons. First, the flow of migrants crossing provincial borders is relatively small relative to the size of the host province's population, which makes much of a difference. For example, the percentage of migrants in the native population was less than 15% for 26 out of 31 provinces according to the 2020 China population census. Second, even if there is a large flow of migrants, their average educational level is not very different from the educational level of the population as a whole. For example, Guangdong and Zhejiang are the two most entrepreneurial provinces in China; migrants account for approximately 25% of their population, but their average education level is only moderately different from the national average. According to the 2020 population census, the average number of years of schooling for the whole population of the country aged 15 years or above was 9.91, with 10.38 for Guangdong and 9.79 for Zhejiang. This is not surprising because more entrepreneurial regions typically attract more migrants, but migrants are particularly younger, not particularly more (or less) educated. Both young college graduates and middle school graduates flood into these entrepreneurial regions (such as Guangdong and Zhejiang) to hunt for jobs. As a consequence, migration is not a factor that heavily influences a region's educational level. Hence, migration is unlikely to cause much bias in the estimates.

It is safe to say that a population's educational level causes entrepreneurship rather than the other way around. This causal effect occurs because education (at least partly) determines a population's human capital and opportunity cost of entrepreneurship decisions. The population's education level in a region, however, is mostly determined by the density of senior high schools and universities. China enacted its 9-year compulsory education system (6-year primary school plus 3-year junior high school) in 1986, and since 2006, it has become a law. Therefore, provincial differences in education increasingly center on differences in high schools and

universities, especially universities. The acceptance rate of a university is much higher for local students than for students from other provinces. Most university graduates work in the province where they attend the university. Moreover, the distribution of colleges and universities in China is highly skewed geographically and concentrated in large cities. The Chinese government significantly increased the enrollment rate of universities in 1999, which subsequently increased the overall level of education of the whole population. This higher education expansion is, of course, an exogenous policy.

In summary, the educational level of a population is essentially exogenous and at least a predetermined variable from the point of view of entrepreneurship. In addition, our data are aggregated at the provincial level; therefore, the self-selection problem arising from individual-level data can be avoided.

4. The data

The data on the number of newly registered proprietorships and private enterprises are from *CnOpenData*. The data on education and demography are from the China Population Census (1990, 2000, 2010, and 2020) and from a 1% sample of the China Population Census (1995, 2005, and 2015). Other data are from China Statistical Yearbooks (relevant years and provinces). The sample includes 31 provinces in China.

Since its founding in 1949, the People's Republic of China has conducted seven population censuses (1953, 1964, 1982, 1990, 2000, 2010, and 2020) and four 1% sample censuses (1987, 1995, 2005, and 2015). Our sample does not include data before 1990 because entrepreneurship was rather limited before the 1990s. Entrepreneurship was virtually eradicated and was a political taboo before the late 1970s. It was not until the early 1980s that private businesses were allowed to exist. In 1990, the average number of newly registered proprietorships per 10,000 people was negligible at 0.05. The average number of newly registered private enterprises per 10,000 people was less than one in 1990. Since then, entrepreneurship has been developing rapidly. In 2020, the number of new proprietorships and new private enterprises per 10,000 people reached 94 and 49, respectively.

The descriptive statistics in Table 1 show that most variables exhibit large variations across provinces and over time. This is plausible because of China's vast territory and dramatic institutional transformations. For example, Chinese people's average years of schooling were only 5.48 in 1990 but rose to 9.94 in 2020. Over the same period, the percentage of the population with a college education or higher increased tenfold from 1.8% to 18.5%. Cross-sectional comparisons revealed that the percentage of people with a college education or higher was as low as 12.8% (Guangxi) in 2020 and as high as 45.0% (Beijing) in the same year.

Table 2. Summary statistics

Variables	Obs.	Mean	Std. dev.	Min	Max
Informal entrepreneurship	216	1.14	2.95	-5.10	5.24
Formal entrepreneurship	217	1.76	1.58	-2.18	4.93
Schooling	217	7.67	1.79	1.81	12.4
College	217	8.32	7.53	0.57	45.0
Senior high	217	12.3	4.47	1.89	24.8
Junior high	217	32.9	8.70	3.85	48.2
Primary	217	31.7	8.07	10.3	49.6
Previous growth	217	10.2	3.12	3.9	24.4
Elderly	217	12.1	4.20	5.25	25.5
Family size	217	3.36	0.60	2.22	5.20
Urbanization	217	45.3	19.0	0	94.1
Minorities	217	14.9	21.0	0.22	95.9
Government	217	20.7	16.7	4.92	132
Loan/GDP	217	1.17	0.46	0.36	2.76
Road/land	217	5,727	4,924	153	21,968
Market	186	6.29	2.54	0	11.9

5. Empirical results

In this section, we present the empirical results. We first estimate Eq. (1) with the population's average years of schooling and its quadratic term as the key independent variables and then perform regressions with fractions of the population at different educational levels as the key explanatory variables. In all regressions, we control for both province- and year-fixed effects. This specification allows us to exclude all time-invariant provincial features and year shocks that unanimously affect all regions. All standard errors we report are robust standard errors.

5.1 Effect of years of schooling on informal and formal entrepreneurship

In the first column of Table 3, we include only years of schooling and its quadratic as independent variables, and the dependent variable is informal entrepreneurship. The estimates show that years of schooling have a positive but diminishing effect on informal entrepreneurship. Both estimates are statistically significant at the 1% level. This shows that the first year of schooling increases informal entrepreneurship by 128%. Then, the effect of one more year of schooling diminishes.

In columns 2 and 3 of Table 3, we include different sets of control variables in the regression. Schooling still has a positive but diminishing effect on informal entrepreneurship, and all estimates are statistically significant at the 1% level. Moreover, the coefficient of schooling increases as more control variables are included. Taking column 3 as an example, the first year of schooling increases informal entrepreneurship by 156%. The mean value of schooling in the sample is 7.67 years. Because the effect of schooling on informal entrepreneurship is diminishing, when years of schooling increase from 8-9 years, informal entrepreneurship increases by only 2.8% (calculated as 1.564-2*0.096*8=0.028).

The first three columns of Table 3 show that the estimates of schooling and its quadratic are robust to the inclusion of various combinations of control variables. A population's average years of schooling has a positive but diminishing effect on informal entrepreneurship. With respect to informal entrepreneurship, our hypothesis is verified.

In columns (4)-(6), we conduct the same regressions with formal entrepreneurship as the dependent variable. The results are basically the same except that the coefficient of the quadratic term of schooling is statistically significant only when all the control variables are included (Model (6)). Taking Model (6) as an example, the first year of schooling increases formal entrepreneurship by 62%.

In summary, the findings in Table 3 show that a population's years of schooling have a positive but diminishing effect on both informal and formal entrepreneurship. Our hypothesis of an inverted-U shaped relationship between schooling and entrepreneurship is not refuted by the evidence.

Table 3. Effect of years of schooling on entrepreneurship, 31 provinces, 1990-2020

Regressors	Dependent variables					
	Informal entrepreneurship			Formal entrepreneurship		
	(1)	(2)	(3)	(4)	(5)	(6)
Schooling	1.282***	1.458***	1.569***	0.414***	0.371*	0.620***
	(4.19)	(4.31)	(4.04)	(2.60)	(1.92)	(2.64)
Schooling squared	-0.071***	-0.067***	-0.096***	-0.023	-0.017	-0.04***
	(-3.12)	(-3.06)	(-3.33)	(-1.67)	(-1.15)	(-2.82)
Control set1	No	Yes	-	No	Yes	-
Control set 2	No	No	Yes	No	No	Yes
Schooling mean	7.67	7.67	7.67	7.67	7.67	7.67
Observations	216	216	185	217	217	124
Within R-squared	0.96	0.97	0.95	0.96	0.97	0.97

Notes. All regressions include province and year fixed effects. All standard errors are clustered at the province level. Numbers in parentheses are t-statistics. *, ** and *** denote 10%, 5% and 1% significance levels. Control set 1 includes the following control variables: average GDP growth of previous three years, elderly dependency ratio, family size, urbanization rate, and minority population share. Control set 2 includes all variables in control set 1 and the following

control variables: government expenditure as a share of GDP, loan granted by financial institutions as a share of GDP, mileage of road per 10,000 square kilometer of land (in natural log), and marketization index.

5.2 Effect of educational level on informal and formal entrepreneurship

We then use fractions of the population with different educational levels as the key independent variables. The results are presented in Tables 4 and 5. In Table 4, the dependent variable is informal entrepreneurship, and in Table 5, the dependent variable is formal entrepreneurship. The results in both tables show similar patterns. If the fraction of the population with a college education or higher increases by one percentage point, informal entrepreneurship decreases by 10%, and formal entrepreneurship decreases by 6%, as shown by Model (7) and Model (12), respectively. Both estimates are statistically significant at the 1% level.

This finding is not surprising since a graduate with a college degree or higher will typically not choose to start a business. In 1990, Chinese people with a college education accounted for only 1.83% of the total population, and this figure rose to 18.5% in 2020, which is still lower than that of developed countries. Our finding is consistent with those of Chu and Wen (2019) and Huang et al. (2021), who find that college education decreases overall and self-employed types of entrepreneurship. Jimenez et al. (2015) also find from a cross-section of countries that tertiary education has a negative effect on informal entrepreneurship.

We then individually estimate the effects of senior high school, junior high school and primary education on entrepreneurship. When the percentage of the population with a senior high school education increases by 1 percentage point, informal and formal entrepreneurship increases by 14% and 7.8%, respectively. The fraction of people with a primary school education, however, does not significantly affect entrepreneurship.

When we control for all four levels of education in models (11) and (16), both results show that only senior high school education has a significant effect on entrepreneurship. If the fraction of the population with a senior high school education increases by 1 percentage point, then informal and formal entrepreneurship increases by 12.4% and 5.5%, respectively. The fraction of the population with a college education or higher does not significantly affect entrepreneurship. This finding is consistent with that of Chu and Wen (2019), who use microlevel data and find that "the impact of college education on the probability of a person being an entrepreneur is not statistically significant."

Our findings in Tables 4 and 5 indirectly support our hypothesis, which shows an inverted-U shaped relationship between education and entrepreneurship.

Table 4. Effect of education on informal entrepreneurship, 31 provinces, 1990-2020

Dependent variable: Informal entrepreneurship (new proprietorships per 10,000 in log)					
Regressors	(7)	(8)	(9)	(10)	(11)
College	-0.10***				-0.037
	(-3.27)				(-0.78)
Senior high		0.140***			0.124***
		(3.33)			(2.77)
Junior high			0.067**		0.014
			(2.52)		(0.41)
Primary				0.001	0.035
				(0.03)	(1.40)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	185	185	185	185	185
Within R-sq.	0.95	0.95	0.95	0.95	0.95

Notes. All regressions include province and year fixed effects. All standard errors are clustered at the province level. Numbers in parentheses are t-statistics. ** and *** denote 5% and 1% significance levels. Controls variables included in all models in this table are as follows: average GDP growth of previous three years, elderly dependency ratio, family size, urbanization rate, government expenditures as a share of GDP, loan granted by financial institutions as a share of GDP, log mileage of road per 10,000 square kilometers of land, share of ethnic minorities population, and marketization index.

Table 5. Effect of education on formal entrepreneurship, 31 provinces, 1990-2020

Dependent variable: Formal entrepreneurship (new private enterprises per 10,000 in logarithm)					
Regressors	(12)	(13)	(14)	(15)	(16)
College	-0.060***				-0.019
	(-3.32)				(0.89)
Senior high		0.078***			0.055***
		(4.94)			(2.87)
Junior high			0.044***		0.016
			(3.70)		(1.29)
Primary				-0.013	0.002
				(-130)	(0.17)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	186	186	186	186	186
Within R-squared	0.97	0.97	0.97	0.96	0.97

Notes. All regressions include province and year fixed effects. All standard errors are clustered at the province level. Numbers in parentheses are t-statistics. ** and *** denote 5% and 1% significance levels. Controls variables included in all models in this table are as follows: average GDP growth of previous three years, elderly dependency ratio, family size, urbanization rate, government expenditures as a share of GDP, loan granted by financial institutions as a share of GDP, log mileage of road per 10,000 square kilometers of land, share of ethnic minorities population, and marketization index.

7. Conclusion

Employing China's population census data, we find that informal entrepreneurship (newly registered proprietorships per capita) displays an inverted-U-shaped relationship with a population's average years of schooling over the sample period. The diminishing effect of years of schooling on formal entrepreneurship (newly registered private enterprises per capita), however, is not statistically significant. This difference is because formal entrepreneurship, relative to informal entrepreneurship, is cultivated by a more educated society. When we use fractions of the population with different educational levels as the independent variables, we find that a higher percentage of people with senior high school education will increase both informal and formal entrepreneurship. A greater percentage of people with a college education or higher inhibits informal entrepreneurship but does not have any significant effect on formal entrepreneurship. Our findings have strong policy implications. The government can increase both informal and formal entrepreneurship by increasing senior high school admission rates; however, increasing university enrollment rates has no significant positive effect on either type of entrepreneurship

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