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Working Paper

Does Higher Education Make You More Entrepreneurial? Causal Evidence from China

IZA Discussion Papers, No. 14310

Provided in Cooperation with:

IZA – Institute of Labor Economics

Suggested Citation: Huang, Bin; Tani, Massimiliano; Zhu, Yu (2021) : Does Higher Education Make You More Entrepreneurial? Causal Evidence from China, IZA Discussion Papers, No. 14310, Institute of Labor Economics (IZA), Bonn

This Version is available at:

<https://hdl.handle.net/10419/236341>

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DISCUSSION PAPER SERIES

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APRIL 2021

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Does Higher Education Make You More Entrepreneurial? Causal Evidence from China

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ISSN: 2365-9793

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ABSTRACT

Does Higher Education Make You More Entrepreneurial? Causal Evidence from China*

Using the 2017 China Household Finance Survey (CHFS), we estimate the effect of higher education on entrepreneurship for prime-aged males. We distinguish between own-account workers and employers of small and large businesses, respectively, and use the higher education expansion in China starting in 1999 and instruments of pre-school hukou status to help identify causal effects. While our Inverse Probability Weighted Regression Adjustment estimates show that people with more education are less likely to enter entrepreneurship in general, obtaining any qualification beyond the baseline of compulsory schooling significant increases large business ownership later in life, with the maximum effect corresponding to a 3-fold increase found for university graduates. We attribute this effect to graduates taking full advantage of the opportunities presented by access to education earlier on in their lives.

JEL Classification: I25, J24, L26

Keywords: higher education, entrepreneurship, higher education expansion, China, Inverse Probability Weighted Regression Adjustment (IPWRA)

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* We thank the Survey and Research Centre for China Household Finance at the Southwestern University of Finance and Economics (SWUFE) and the China Institute for Educational Finance Research (CIEFR) Peking University for data access. Yu Zhu thanks the UNSW Canberra Rector-funded Visiting Fellowship for financial support. All errors are our own. Declarations of interest: none.

1. Introduction

Entrepreneurship generates desirable economic outcomes like job creation, competitiveness and productivity growth (Blanchflower, 2000; OECD, 2008; QAA, 2018), and is associated with various, and at times discordant, determinants. Entrepreneurship arises within both genders (Kourlisky and Walstad, 1998; Zhang et al, 2009) and across all ages (Bönte et al, 2009; Azoulay et al, 2020). It reflects family backgrounds (Matthews and Moser, 1995; Zellweger et al, 2011), socio-economic status (Field et al, 2013), and countries of origin (Mestres, 2010; Dana, 2011; Wahba and Zenou, 2012). Entrepreneurs thrive in the informal sector (Webb et al, 2009) but also in high-tech (Huffman and Quigley, 2012; Braguinsky et al, 2012) and non-profit industries (Dees, 1998; Austin et al, 2006). They operate in market-oriented (Lee, 2000; Decker et al, 2014; Garcia, 2014) as well as centrally planned economies (Djankov et al, 2006), in both low (Desai, 2011) and high-income countries (Wong, Ho and Autio, 2005; Acs, Desai and Hessels, 2008).

Besides ‘trait’ and ‘personality’ determinants typically observed in adult life, a new line of research has begun to investigate the role of early life experiences in influencing the propensity for entrepreneurship in adulthood. This literature builds on evidence that childhood strongly affects cognitive and non-cognitive skills, which in turn affect later individual choices and labour market outcomes (Heckman, 2006; Doyle et al, 2009; Heckman et al, 2013), and combines it with the idea that entrepreneurship responds to contingent situations (Gilad and Levine, 1986). The resulting approach, which so far has predominantly explored the role of adverse conditions, highlights that negative experiences foster resilience. Hence, they can promote entrepreneurship (Powell and Baker, 2014; Renko et al, 2016). Supporting empirical evidence is found among migrants (Shepherd et al, 2020), even when negative experiences have been life threatening, as in the case of famine (Cheng et al, 2020).

We contribute to this new stream by focusing on complementary conditions experienced during childhood: namely, benign macroeconomic circumstances and a large positive institutional shock easing access to education. In particular, we use a policy shift that raised higher education (HE) enrollments in China between 1998 and 2008 by a factor of six, from 1.08 million to 6.08 million, and trace the effects of the reform on the probability of entrepreneurship vs. wage employment among children and young adults using data from the 2017 China Household Finance Survey (CHFS). We restrict the analysis to individuals aged 6-28 at the outset of the reform, thereby ensuring that respondents in that age group had no plausible influence on the shift in educational policy. The estimates obtained can be therefore interpreted as causal long-term effects.

The change in educational policy links our study to the large literature focusing on the effects of education on entrepreneurship (Dickson et al, 2008; Doms, Lewis and Robb, 2010; Millan et al, 2014). Evidence is conflicting depending on whether aggregate- (Audretsch and Thurik, 2001; European Commission, 2006) or individual-level data are used (Robinson and Sexton, 1994; Davidsson and Honig, 2008; Masakure, 2015), including the case of China (Yueh 2009, Sun et al 2016; Demurger and Xu 2011; Chu and Wen 2017 and 2019¹). This arises as education likely has offsetting effect on individuals' self-selection into entrepreneurship. On the one hand, more education enhances managerial ability, which in turn raises the probability of entrepreneurship. On the other hand, more education increases the opportunity cost of entrepreneurship, as wage employment offers higher earnings and more attractive working conditions when individuals are better educated (van der Sluis et al 2008), especially in low- and middle-income countries. We

¹ Chu and Wen (2019) use the 2013 China Household Income Project (CHIP) database and a Fuzzy Regression Discontinuity Design based on the China's HE expansion. They suggest that college education decreases overall and self-employed type of entrepreneurship, but increases boss-type entrepreneurship. Unfortunately, none of these coefficients are precisely estimated, even though the 12-percentage point effect of the expansion on college attainment is statistically significant at the 10% level.

contribute to the literature by disentangling these opposite influences thanks to the focus on a large and exogenous change in education policy and the use of an instrumental variable approach to overcome the endogeneity of schooling choices.

Our empirical analysis also takes advantage of the richness of the CHFS to study the effect of HE on three types of entrepreneurship: self-employment (i.e. own-account workers), and ownership of individual businesses and limited liability companies (LLCs) respectively. Such distinction is rare and, when carried out, separates only entrepreneurs with and without employees (Cheng and Smyth, 2020). Yet, it matters to better identify the relationship between the entrepreneurs' education and the economic value and influence of their companies.

Finally, we explore the effect for different types of education in terms of level and vocational orientation rather than imposing an arbitrary linearity assumption in the effect of years of schooling on entrepreneurship, as widely adopted in the literature. As a result, we estimate 4 average treatment effects corresponding to vocational senior high school, academic senior high school, vocational college and bachelor's degrees and above respectively, all relative to the benchmark category of compulsory education or below.

Consistently with existing research, we find that more educated workers are less likely to enter entrepreneurship relative to wage employment. However, this is reversed when we focus on ownership of larger businesses. In this case, the positive and significant effect of higher educational qualifications on large business ownership is shown to differ by the level and academic-vocational orientation of the qualification, with the largest effect for graduates with at least a Bachelor's degree. We show that failure to distinguish between the different types of entrepreneurships results in the misleading conclusion on the sign and scale of the effect of education on entrepreneurship, as the positive and significant effect on limited liability companies

(LLC) tends to be dominated by the corresponding negative effects on self-employment and individual business ownership. This measurement issue might partially explain the lack of consensus in the literature on the causal effect of education on entrepreneurship. In line with the hypothesis that the HE expansion had a spillover effect on upper-secondary education, there also appears to be more modest but statistically significant positive effect on LLC ownership even for those who only completed either academic or vocational senior high schools.

The remainder of the paper is organized as follows. Section 2 briefly summarizes the HE reform. Section 3 presents the data and the sample. Section 4 outlines the IPWRA methodology. Section 5 presents the empirical results. Finally, Section 6 concludes.

2. The 1999 Higher Education expansion

China introduced compulsory education legislation in 1986, making it mandatory to complete 6 years of primary education and 3 years of Junior High Schools. Upon completion of compulsory schooling, student who wish to continue with education take an exit exam. Their performances are used to stream students into either the academically oriented Senior High Schools or Vocational High Schools, normally lasting 3 and 2 years respectively (OECD 2016).

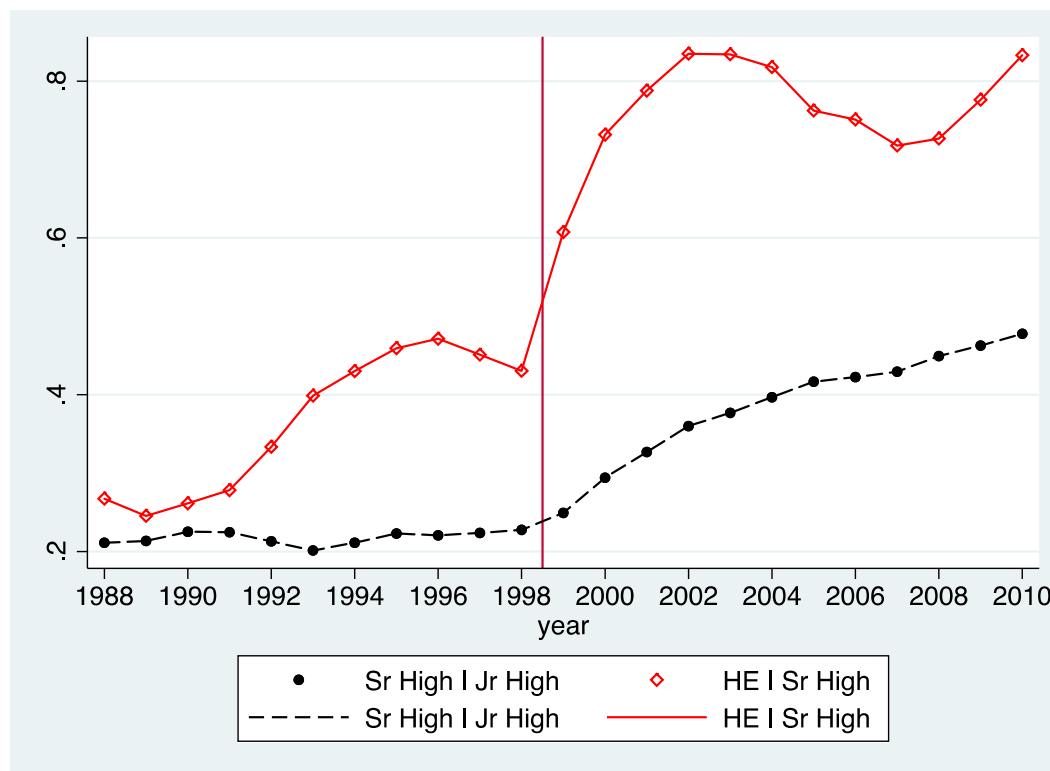
HE institutions in China are predominately publicly-funded and can be roughly divided into two groups: 4-year universities, and 3-year vocational colleges. Conditional on obtaining Senior High School qualifications or their vocational equivalents, students can apply to colleges and universities through a centralised admissions system, which proceeds sequentially in tiers on the basis of one's performance in standardized National College Entrance Examinations (*gaokao*), with little regard for gender, *hukou* status and family background.²

² For details of the Chinese College Admissions system, see Zhu (2014).

HE in China was exceedingly elitist till the early 1990s, when the gross high education participation rate was less than 3%. The growth of the HE sector was tightly controlled by the Ministry of Education, which sets provincial, university and subject quotas annually (OECD, 2016). Between 1995 and 1998, college enrolment only grew by an annual rate of 4.7%, even with the introduction of a modest tuition fee (Che and Zhang 2018).

As a response to the rising youth unemployment in the aftermath of the 1997 Asian Financial Crisis, the Ministry of Education suddenly announced a 47% increase in university places in the spring of 1999. This took everyone by surprise, and HE institutions around the country were only given a few months to prepare for the surge in intakes (Wan 2006, Wu and Zhao 2010, and Li et al 2017). This was followed by further increases of 38% and 22% in 2000 and 2001 respectively, and more modest double-digit growth in subsequent years (Che and Zhang 2018). In the decade starting in 1998, annual HE enrolment grew from 1.08 million to 6.08 million. Figure 1 shows the conditional annual enrolment rate over the period 1988-2010, which corresponds to range of birth cohorts in our sample assuming that people enrol in HE at age 18. As a result of the HE expansion, there is a remarkable near-doubling in the HE enrolment conditional on completing Senior High School, from just over 40% in 1998 to almost 80% in 2001. The more steady increase in the conditional enrolment rate in Senior High School is also worth noting, as it is consistent with a significant spillover of the HE expansion on upper-secondary education, which is a prerequisite for HE.

Figure 1: Conditional enrolment (progression) rate over time, by level of qualifications



Note: data resources: China Statistic Yearbook 2010 and 2017, <http://www.stats.gov.cn/tjsj/ndsj/2010/indexch.htm>, <http://www.stats.gov.cn/tjsj/ndsj/2016/indexch.htm>. Data for 1988-2009 is from yearbook 2010, data for 2010 is from yearbook 2017.

The HE expansion also offered different opportunities for students living in urban centres or the countryside, as shown by the phenomenal 3.3 year urban-rural gap in educational attainment among our sample members in Table 1.³ As a result, to identify the causal effect of education on earnings, the ideal variable is the pre-schooling *hukou* status, which predates the schooling decision. In contrast, the current *hukou* status is subject to endogeneity bias, as it can be changed through migration, marriage, acquirement of properties in cities, and most importantly, through

³ It is widely known that rural students are highly disadvantaged in terms of education resources in China. For instance, despite the significant improvements in recent years, the public expenditure per Senior High School student in rural areas was still 25.2% lower than the national average in 2017 (National Bureau of Statistics 2017a). In addition, in 2016, the Senior High School student-teacher ratios were 12.70, 14.11 and 13.58 in cities, towns and rural areas respectively (National Bureau of Statistics 2017b).

obtaining HE qualifications (Xing, 2013). To recover the pre-school *hukou* status at age 12 for all sample members, who are all subject to the 9-year compulsory education regime starting in 1986, we apply an instrumental variable approach, as later discussed.

3. Data and sample

The 2017 CHFS is a large nationally representative survey of over 40,000 households, with detailed information about household income, expenses, assets, liabilities, insurance and securities. Using a stratified three-stage probability proportional to population size (PPS) random sample design, CHFS covers all counties⁴ in mainland China except Tibet, Xinjiang and Inner Mongolia counties in the first stage of sampling. The subsequent stages of sampling involve selecting residential committees/villages and then households respectively from the sampling units chosen at each previous stage.

To limit the heterogeneity of the working sample, the analysis is restricted to men who are aged 25 or above in 2017, and who were born in 1970 or later.⁵ Females are excluded from the analysis because of their much lower incidence of entrepreneurship relative to men, and gender-specific motivations and challenges when undertaking this occupational choice (see Berg and Englund 2015). Younger men are also removed from the analysis, as early careers choices tend to be unstable.⁶

To analyse the long-term effects of exposure to HE education we use information on current and historical *hukou* status and place by merging in prefecture city level statistics on GDP and average

⁴ Districts in cities at prefecture level or above have the same status as counties in the Chinese administrative hierarchy.

⁵ Following Huang and Zhu (2020), we exclude people who were born before 1970, to avoid complications with early retirement, disruptions to education from Cultural Revolution (1966-1976), and potential biases arising from the introduction of 9-year compulsory education in 1986.

⁶ The normal age at graduation is 22-23 for undergraduates with 4-year Bachelors, and 24-26 for postgraduates with Master's degrees lasting at least two years.

salaries, which date back to 1999.⁷ After excluding missing values on key variables, such as monthly earnings, years of education, *hukou* status and employment status, we end up with a combined working sample of 13,314 prime-aged men who are active participants in the labor market, either as an employee or an entrepreneur.

One unique feature of the CHFS is the possibility to define 3 different types of entrepreneurship:

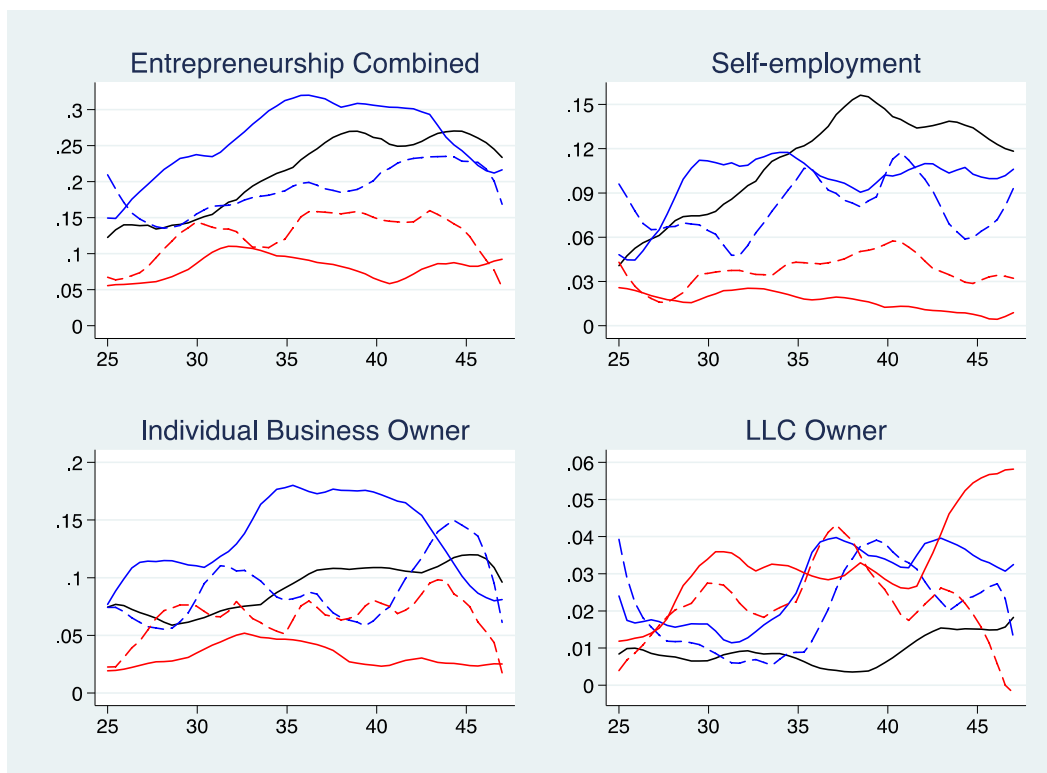
- 1) self-employed (i.e. own-account workers);
- 2) owner of independent businesses (*Geti Gongshang Hu*), typically small business owners;
and
- 3) owner of limited liability companies (LLC, *Siyang Qiye*), typically larger business owners.

Note that type 2 and 3 are often merged into a single *boss-type entrepreneurship* category, which is normally used in the literature (e.g. Chu and Wen 2019). The separation of these two groups is one of the contributions of our analysis.

Figure 2 shows the smoothed probabilities of each type of entrepreneurship separately (using kernel-weighted local polynomial regression on age), as well as the combined probability of entrepreneurship, by age and level of education. It turns out that distinguishing between small and large businesses is important as they display completely different patterns. While HE (vocational college and degree+) is negatively associated with self-employment and ownership of independent businesses, the relationship is reversed for LLC ownership.

⁷ *County* is used as a shorthand for county, county-level city or city-district, all at the same level of the administrative hierarchy. *City* is used as a shorthand for prefectural city, which is the level between county/city-district and province. Note however, the 4 municipalities of Beijing, Shanghai, Tianjin and Chongqing have the status of provinces.

Figure 2: Types of entrepreneurship by age and education level



Note: Vertical axis shows incidence of entrepreneurship. Horizontal axis indicates age. Black line shows compulsory education. Dashed blue line shows Vocational High School education. Solid blue line shows senior high school. Dashed red line shows Vocational College. Solid red line shows Degree+.

Table 1 reports summary statistics by the current *hukou* status, weighted by the sampling weights.⁸

Of the 13,314 individuals in the working sample, only about 45% currently have urban *hukou* status.⁹ Urban *hukou* holders are 5.2 percentage points (24.4%) less likely to engage in some form of entrepreneurship compared to their rural counterparts. This gap is mostly driven by self-employment. As for business ownership, urban *hukou* holders are 1.6 percentage points (17.2%)

⁸ We report in Table A1 in the Appendix the weighted summary statistics by current *hukou* status for women. Compared to their male counterparts in Table 1, females have lower propensity for all forms of entrepreneurship, especially for LLC ownership where it is more than halved. Estimating causal effect of education on entrepreneurship for women poses additional challenges from an econometric perspective, due to gender inequality in education, which varies by area and grade level (Zeng et al 2014), and gendered preferences in work-life balance, among others (Chung and van der Lippe 2020).

⁹ See Chan (2009) for a review of the history of the *hukou* system and Meng (2012) for a discussion of the key role of *hukou* in China's labour market reforms in recent decades.

less likely to own individual businesses but 0.8 percentage points (47%) more likely to own LLCs. With reference to education, urban *hukou* holders have 3.3 years extra years of schooling, and 41.4 percentage points (298%) more likely to holder HE qualifications, defined as vocational colleges or above. Whereas less than one-fifth of urban *hukou* holders are educated up to Junior High School level, which has become compulsory since 1986, the corresponding share is two-thirds for rural *hukou* holders. The gap at the higher end of the qualification distribution is even more remarkable: urban *hukou* holders are approximately 2, 4 and 10+ times more likely to graduate from three-year vocational colleges, 4-year undergraduate degrees and postgraduate degrees respectively, than rural *hukou* holders.

Due to China's family planning policy which was more strictly enforced in urban areas, urban *hukou* holders in our sample are 1.6 years older but 9.1 percentage point (15%) less likely to be born in 1980 or later- the period of exposure to the HE expansion started in 1999. Only 78% of current urban *hukou* holders were also classified as urban when they were 12, a critical age for educational investment. There is relatively small difference across current *hukou* status in the geographical region of residence, with perhaps the exception of the Northeastern Region where rural *hukou* is under-represented. Urban *hukou* holders live disproportionately in metropolises and provincial capitals whereas rural *hukou* holders mostly live in rural areas or smaller cities and towns. Nevertheless, almost 59% of rural *hukou* holders currently live in cities and towns, of which almost half live in metropolises and provincial capitals. This pattern highlights the scale of internal migration in China.

Table 2 presents the weighted summary statistics by migrant status, where a migrant is defined as someone who currently lives outside his/her home *hukou* county. Migration appears to be positively correlated with all types of entrepreneurship, by approximately 12%, 54% and 138%

more for self-employment, individual business ownership and LLC ownership, respectively. About two-thirds of migration is inter-city, of which half is inter-province. More than 10% of both current non-migrants and migrants have ever changed their home *hukou* county. On the other hand, 27% of non-migrants and 15% of migrants report having ever lived outside *hukou* city for at least 6 months.

A comparison of log per capita GDP and log average salary per capita between current city of residence and birth *hukou* city suggest migrants tend to move from less to more developed areas. This is consistent with theoretical models that emphasize better economic opportunities as key determinants of migration, and further validated by regional patterns suggesting that migrants are over-represented in the most developed Eastern Region and the largest cities. Migrants have 0.7 more years of schooling and are 8.4 percentage points (27%) more likely to hold HE qualifications. They are also slightly younger and more likely to be exposed to the 1999 HE expansion. Migrants are 5 percentage points less likely to hold urban *hukou* than non-migrants, regardless of whether measured at age 12 or time of survey.

Table 3 presents the weighted summary statistics for each type of entrepreneurship (separately and jointly), and for employees. Self-employment, individual business ownership and LLC ownership account for 43.6%, 45.8% and 10.6% of all forms of entrepreneurships respectively. Whereas entrepreneurs have on average less years of schooling than employees, this masks the substantive heterogeneity across types of entrepreneurship. LLC employers come from the most advantaged background, even relative to employees. They are also more heavily over-represented in the Eastern Region and the largest cities, especially the metropolises.

Table 1: Summary Statistics by current *hukou* Status, weighted

	Urban <i>Hukou</i>	Rural <i>Hukou</i>	Total
<i>Entrepreneurship, of which</i>	0.161	0.213	0.190
Self-employed	0.059	0.103	0.083
Owner Individual Business	0.077	0.093	0.086
Owner Private Limited Liability Company (LLC)	0.025	0.017	0.020
Employee	0.839	0.787	0.810
Years of schooling	13.11	9.84	11.30
Higher Education (>=Vocational College)	0.553	0.139	0.324
<i>Breakdown of highest qualifications:</i>			
Primary or below	0.022	0.155	0.095
Junior High	0.173	0.510	0.359
Vocational High	0.112	0.063	0.085
Senior High	0.140	0.134	0.136
Vocational College	0.218	0.071	0.135
Bachelor's Degree	0.295	0.059	0.164
Postgraduate Degree	0.042	0.003	0.020
Age	36.9	35.3	36.0
Born 1980+	0.518	0.609	0.568
Born 1980+ * Linear Time trend	8.61	10.67	9.75
Urban <i>hukou</i> at age 12	0.779	-	0.348
<i>Geographical region:</i>			
Eastern Region	0.426	0.414	0.419
Northeastern Region	0.148	0.077	0.108
Central Region	0.199	0.250	0.228
Western Region	0.227	0.259	0.245
<i>Type of place of residence:</i>			
Metropolis	0.130	0.051	0.086
Provincial capitals	0.388	0.231	0.301
Smaller cities or towns	0.437	0.306	0.365
Rural	0.045	0.412	0.248
Obs	6,308	7,006	13,314
Share (weighted)	44.7%	55.3%	100.00%

Note: Weighted by CHFS sampling weights. Owner of Individual Businesses refers to *Geti Gongshang Hu* while Owner of Private Limited Liability Company (LLC) refers to owner of *Siying Qiye*. Table A2 in the Appendix shows the corresponding unweighted summary statistics.

Table 2: Summary Statistics by migration status, weighted

	Non-migrant	Migrants	Total
<i>Entrepreneurship, of which</i>	0.177	0.252	0.190
Self-employed	0.082	0.092	0.083
Owner Individual Business	0.079	0.122	0.086
Owner Private Limited Liability Company (LLC)	0.016	0.038	0.020
Employee	0.823	0.748	0.810
Migration characteristics:			
Inter-city migration	-	0.679	0.117
Inter-province migration	-	0.334	0.058
Ever changed <i>hukou</i> -county	0.101	0.155	0.110
Ever lived outside <i>hukou</i> -city for 6+ months	0.274	0.145	0.252
Current city of residence log GDP per capita	10.87	11.25	10.94
Birth-city log GDP per capita	10.86	10.80	10.85
Current city of residence log av. salary per capita	11.03	11.17	11.06
Birth-city log av. salary per capita	11.03	11.00	11.03
Other characteristics:			
Years of schooling	11.18	11.86	11.30
Higher Education (>=Vocational College)	0.310	0.394	0.324
<i>Breakdown of highest qualifications (5-categories):</i>			
Compulsory (up to Jr High)	0.469	0.386	0.455
Vocational High	0.085	0.082	0.085
Senior High	0.136	0.138	0.136
Vocational College	0.136	0.159	0.140
Degree+	0.173	0.235	0.184
<i>Geographical region:</i>			
Eastern Region	0.399	0.519	0.419
Northeastern Region	0.110	0.101	0.108
Central Region	0.244	0.151	0.228
Western Region	0.248	0.229	0.245
<i>Type of place of residence:</i>			
Metropolis	0.061	0.209	0.086
Provincial capitals	0.274	0.430	0.301
Smaller cities or towns	0.381	0.286	0.365
Rural	0.284	0.074	0.248
Age	36.2	35.0	36.0
Born 1980+	0.556	0.624	0.568
Born 1980+ * Linear Time trend	9.51	10.88	9.75
Currently urban <i>hukou</i>	0.457	0.400	0.447
Urban <i>hukou</i> at age 12	0.356	0.310	0.348
Obs	10,665	2,649	13,314
Share (unweighted)	80.1%	19.9%	100.00%
Share (weighted)	82.8%	17.2%	100.00%

Note: Weighted by CHFS sampling weights. Owner of Individual Businesses refers to *Geti Gongshang Hu* while Owner of Private Limited Liability Company (LLC) refers to owner of *Siying Qiye*.

Table 3: Summary Statistics by employment type, weighted

	Self-employed	Employer Individual Business	Employer LLC	Combined entrepreneurship	Employee
Years of schooling	9.97	10.61	12.56	10.54	11.48
Higher Education (\geq Vocational College)	0.103	0.193	0.440	0.180	0.358
<i>Breakdown of highest qualifications (5-categories):</i>					
Compulsory (up to Jr High)	0.604	0.532	0.260	0.535	0.436
Vocational High	0.099	0.080	0.091	0.090	0.084
Senior High	0.194	0.194	0.209	0.196	0.123
Vocational College	0.061	0.123	0.152	0.099	0.150
Degree+	0.042	0.070	0.288	0.081	0.208
Age	37.7	37.3	37.1	37.5	35.7
Born 1980+	0.452	0.497	0.490	0.477	0.590
Born 1980+ * Linear Time trend	7.42	8.06	8.23	7.780	10.21
Currently urban <i>hukou</i>	0.315	0.402	0.547	0.379	0.463
Urban <i>hukou</i> at age 12	0.230	0.310	0.418	0.286	0.363
<i>Geographical region:</i>					
Eastern Region	0.405	0.465	0.585	0.451	0.412
Northeastern Region	0.122	0.119	0.047	0.113	0.107
Central Region	0.255	0.191	0.119	0.211	0.231
Western Region	0.218	0.225	0.250	0.225	0.250
<i>Type of place of residence:</i>					
Metropolis	0.043	0.064	0.181	0.067	0.091
Provincial capitals	0.245	0.297	0.398	0.285	0.305
Smaller cities or towns	0.462	0.469	0.293	0.447	0.345
Rural	0.250	0.170	0.128	0.201	0.259
Obs	1,037	1,093	253	2,383	10,931
Share (unweighted)	0.078	0.082	0.019	0.179	0.821
Share (weighted)	0.083	0.086	0.020	0.190	0.810

Note: Weighted by CHFS sampling weights. Owner of Individual Businesses refers to *Geti Gongshang Hu* while Owner of Private Limited Liability Company (LLC) refers to owner of *Siyang Qiye*.

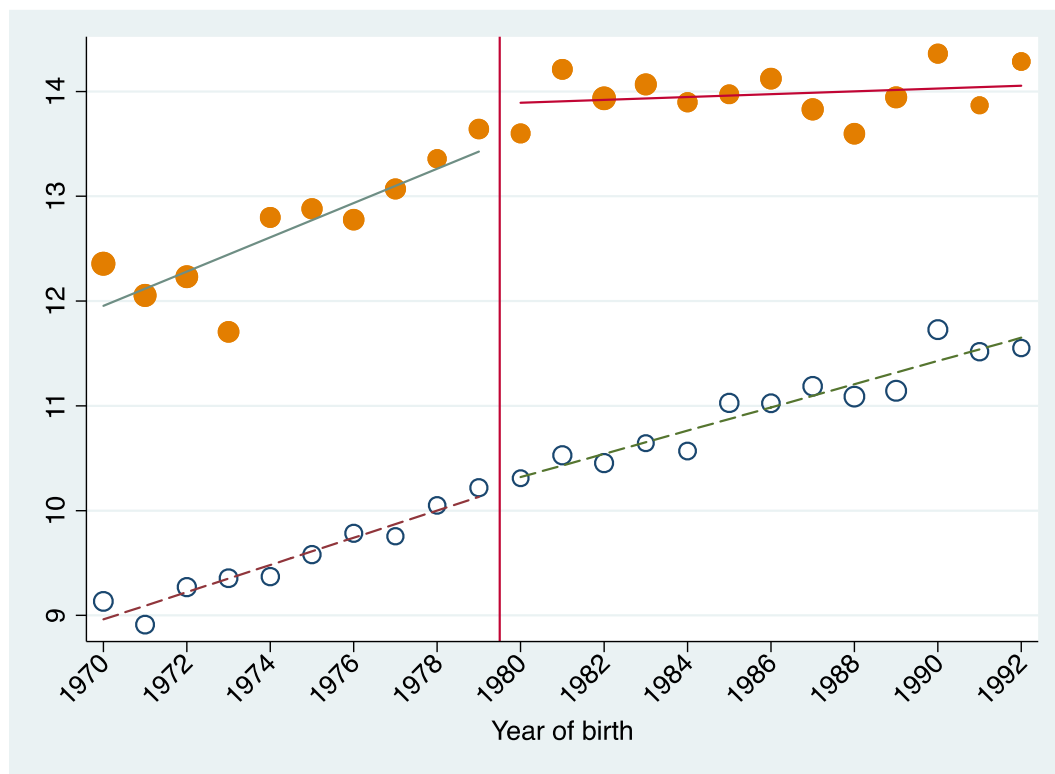
4. Methodology

The empirical approach relies on the Inverse Probability Weighted Regression Adjustment (IPWRA) because of its “doubly robust” property: namely, it only requires either the treatment model or the outcome model (but not both) to be correctly specified in order to have unbiased estimates of the treatment effect (Wooldridge 2010, Cattaneo 2010). An additional advantage of IPWRA is that it allows for multiple treatments, which is particularly appealing in our setting. While the HE expansion would only benefit those who are at the margin of entering or missing

colleges had there not been such dramatic expansion on higher education *directly*, it is likely to have induced an *indirect effect* on upper-secondary education attainment by encouraging people who would otherwise leave school after completing compulsory education to stay in education.

In practice, our treatment effect model involves estimating a multinomial logit of 5 options (the reference category of up to compulsory education, vocational upper-secondary, academic upper-secondary education, vocational college and Bachelor's Degree+) in the first step. Although Stata's *teffects ipwra* routine does not allow multinomial logit in the outcome model, we estimate either a logit or probit outcome model but run the same IPWRA model for each type of entrepreneurship, separately and combined.

Figure 3: Years of Schooling by birth year and *hukou* status at age 12



Note: Solid dots/lines denote urban *hukou* at age 12. Hollowed dots and dashed lines denote rural *hukou* at age 12. Marker size proportional to number of observations. Figure A1 in the Appendix shows different types of entrepreneurship by birth year and *hukou* status at age 12.

To enhance the robustness of the estimates, we perform the IPWRA estimation with exclusion

restrictions, exploiting the fact that the HE expansion impacts people with urban and rural origins differently (Huang and Zhu, 2020). As Figure 3 suggests, before the HE expansion, HE attainment for urban and rural *hukou* holders measured at age 12 run almost in parallel to each other (the difference in trend is statistically insignificant in formal tests), but with a three-year gap. The HE expansion of 1999, which corresponds to birth cohort 1980, has no visible impact on the slope or intercept for rural students. In contrast, the expansion induced an instantaneous jump in the intercept for urban students, although their trend flattens after the expansion. Therefore, the exclusion restrictions rely **only** on the interaction terms of urban *hukou* at age 12 with three variables capturing the timing of the HE expansion, namely a dummy for *post-1980 birth*, a *birth year linear trend* and a *post-1980 birth year linear trend*. The control variables are identical between the treatment equation and the outcome equations, and include both the urban *hukou* at age 12 dummy and the set of HE expansion variables.

Our IPWRA approach might be best regarded as a model of all post-compulsory education choices from the perspective of a junior high school graduate. In a real world with uncertainties about one's own ability and college entrance exam (*gaokao*) outcomes, and importantly with credit constraints given the HE expansion also introduced higher tuition fees, one might be concerned with biased estimates due to failure to account the potential interdependence between the educational choices (e.g. as completing senior high school is a pre-condition for enrolling in HE). We argue that overall, these factors do not pose serious threats to our identification strategy, as the measurement errors arising from uncertainties are plausibly non-systemic and would be dealt with by the exogenous variation caused by the interaction of childhood *hukou* status and the timing of HE expansion in the treatment equation. The availability of various forms of scholarships, student loans and bursaries post HE expansion should also mitigate concerns for credit constraints.

Moreover, we will present more traditional Two Stage Least Squares (2SLS) estimates using the same instruments and control variables as an alternative to the IPWRA approach. The consistency of results across different model specifications lends strong support to the IPWRA approach.

5. Empirical results

5.1. Linear Probability Model (LPM) Estimates

Table 4 presents the Linear Probability Model (LPM) estimates for the three entrepreneurship types separately, and in aggregate.¹⁰ Note that, by construction, the marginal effect on any entrepreneurship is the sum of the corresponding marginal effects of its three components. Effectively, we are decomposing the impact of education on entrepreneurship in general into its various constituting parts.

The variables of interest are Vocational High School, (Academic) Senior High School, Vocational College and Degree+ which includes postgraduate degrees respectively, with Compulsory Education or Below as the omitted category. Compared to the usual empirical specification using years of schooling only, our specification is more flexible, as it does not impose the assumption of linearity on education. It also allows differential returns to academic versus vocational qualifications.

Compared to the reference category of only having Junior High School qualification (or below), obtaining vocational or academic upper secondary qualifications has no effect on self-employment, while any types of HE qualifications have a significant negative effect. The effect of education on

¹⁰ We do not report the corresponding estimates for being an employee, which would be a mirror image of any entrepreneurship in the last column. Since the probability of being an employee and any entrepreneurship add up to one by construction, the marginal effects will add up to zero (while the constant terms add up to one).

individual business ownership is very similar to that on self-employment, except that Vocational High School now has only a small negative effect.

Having Senior High School qualifications or above has a significantly positive effect on LLC ownership. It is also worth noting that the effect of Vocational Colleges is only half as much as both Senior High School and degree+, both just under two percentage points. Finally, Vocational Senior High Schools have no effect on the probability of entry into entrepreneurship overall whereas Academic Senior High Schools has a significant positive effect. However, holding any HE qualifications, especially bachelor's degrees and above, turn out to have the largest negative effect on entrepreneurship in general.

Although LLC ownership accounts for little more than 10% of all entrepreneurships, it plays a disproportionately important role in job creation, innovation and economic growth. According to the Third National Economic Census, there are a total of 5.604 million LLCs in the Secondary and Tertiary sector in China, employing 120.50 million workers, or 27.0% of the total workforce in those sectors (NBS 2014).

Table 4: LPM of Selection into Entrepreneurship, 4 Treatments

	(1) Self-employed	(2) Employer Individual Business	(3) Employer LLC	(4) Combined entrepreneurship
Voc Sr High vs	0.001	-0.026**	0.009	-0.016
Compulsory/below	(0.014)	(0.013)	(0.007)	(0.019)
Sr High vs	0.014	0.015	0.018***	0.047***
Compulsory/below	(0.013)	(0.013)	(0.006)	(0.017)
Vocational College vs	-0.054***	-0.028**	0.009*	-0.073***
Compulsory/below	(0.009)	(0.012)	(0.005)	(0.015)
Degree+ vs	-0.064***	-0.071***	0.019***	-0.116***
Compulsory/below	(0.009)	(0.010)	(0.006)	(0.013)
Age	0.007	-0.018	0.001	-0.011
	(0.027)	(0.028)	(0.013)	(0.038)
Age sq	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Post-1980 birth	0.011	0.122	-0.002	0.131
	(0.086)	(0.092)	(0.040)	(0.122)
Post-1980 birth year trend	-0.002	-0.010	-0.000	-0.012
	(0.008)	(0.008)	(0.004)	(0.011)
Urban <i>hukou</i> at age 12	-0.010	-0.001	-0.001	-0.013
	(0.011)	(0.012)	(0.007)	(0.016)
Current rural <i>hukou</i>	0.021	0.008	-0.000	0.029
	(0.013)	(0.013)	(0.007)	(0.018)
Northeastern Region	-0.003	-0.009	-0.014***	-0.026
	(0.013)	(0.013)	(0.005)	(0.017)
Central Region	-0.016	-0.018*	-0.006	-0.039***
	(0.012)	(0.010)	(0.005)	(0.015)
Western Region	-0.024**	-0.011	0.001	-0.034**
	(0.010)	(0.011)	(0.005)	(0.015)
Provincial capitals	0.008	0.038**	0.002	0.047**
	(0.014)	(0.015)	(0.009)	(0.021)
Smaller cities or towns	0.019	0.073***	0.002	0.094***
	(0.017)	(0.019)	(0.012)	(0.026)
Rural	-0.024	0.015	0.003	-0.005
	(0.019)	(0.020)	(0.013)	(0.028)
Current city of residence log	0.023	0.059***	0.024**	0.107***
GDP per capita	(0.018)	(0.020)	(0.012)	(0.026)
Current city of residence log	-0.078*	-0.027	0.018	-0.087
av. salary per capita	(0.045)	(0.051)	(0.026)	(0.066)
Birth-city log GDP per capita	-0.045**	-0.032*	-0.011	-0.087***
	(0.017)	(0.019)	(0.012)	(0.025)
Birth-city log av. salary per	0.049	0.019	-0.023	0.045
capita	(0.039)	(0.045)	(0.025)	(0.058)
Constant	0.529	0.267	-0.092	0.704
	(0.661)	(0.637)	(0.364)	(0.913)
Observations	13314	13314	13314	13314
R^2	0.032	0.025	0.013	0.051

Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results imply that treating different forms of entrepreneurship as a single category might result in the misleading policy conclusion that more investment in HE harms all entrepreneurship. In the

following analysis we will focus on the extent to which the positive relationship between HE and LLC ownership reflects a long-term causal effect.

5.2. Inverse Probability Weighted Regression Adjustment (IPWRA) Estimates

Table 5 presents the IPWRA estimates, focusing on the average treatment effects (ATEs) of educational qualifications. The IPWRA treatments of qualifications on self-employment and individual business ownership are almost indistinguishable from their LPM counterparts in Table 4, except that the negative effect of Vocational Senior High School on the latter is no longer statistically significant. Moreover, the treatment effect of qualifications on entrepreneurship in general is also qualitatively similar to that in the LPM models, although more compressed in magnitude.

In contrast, the IPWRA estimates on LLC ownership are more pronounced and statistically significant for each qualification level. Compared to someone with compulsory education only, obtaining vocational and academic upper secondary qualifications increased LLC ownership by 1.8 and 2.0 percentage points respectively. To the extent that average treatment effect is driven by the HE expansion, the precisely estimated treatment effects of upper secondary qualifications are consistent with a significant positive spillover effect of the expansion on sub-degree level qualifications.

Furthermore, having Vocational College degrees only increases LLC ownership by 1.0 percentage points, a modest positive effect in comparison to the 3.1 percentage points effect of having academic degrees. Note that these are very large effects in relative terms, given that the very precisely estimated 1.0% mean conditional probability of LLC ownership for the reference qualification level of compulsory schooling. This implies that graduating with a bachelor's degree will increase the chance of owning large businesses by 3-fold, relative to an otherwise identical

person with Junior High School diploma only.

Table 6 tests the sensitivity of the effect of education on LLC ownership by the current *hukou* status. For people with the baseline Junior High School qualifications, the probability of LLC ownership for urban *hukou* holders is only about half as much as their rural counterparts. For urban *hukou* holders, having Senior High School or above qualifications significantly increases LLC ownership, with the effect now peaking at Senior High School.

In contrast, a significant positive effect of education on LLC ownership at the 5% level is only found at the degree+ level for rural *hukou* holders, with a 6-fold increase in the probability from the baseline. The difference patterns across *hukou* types might reflect differences in motivation, credit constraint and value of outside options in the form of wage employment. Unfortunately, the CHFS does not include enough information to allow us to disentangle the possible channels.

Table 5: IPWRA All Employment States - Four Treatments

	(1) Self-employed	(2) Employer Individual Business	(3) Employer LLC	(4) Combined Entrepreneurship
ATE				
Voc Sr High vs	-0.011	-0.020	0.018**	-0.013
Compulsory/below	(0.014)	(0.014)	(0.008)	(0.021)
Sr High vs	0.010	0.013	0.020***	0.043**
Compulsory/below	(0.013)	(0.013)	(0.006)	(0.017)
Vocational College vs	-0.044***	-0.024	0.011**	-0.057**
Compulsory/below	(0.017)	(0.016)	(0.005)	(0.023)
Degree+ vs	-0.077***	-0.054***	0.031***	-0.083***
Compulsory/below	(0.009)	(0.014)	(0.009)	(0.023)
Potential Outcome Mean				
Ref: No more than	0.104***	0.106***	0.010***	0.219***
compulsory education	(0.007)	(0.007)	(0.002)	(0.009)
Observations	13,314	13,314	13,314	13,314

Note: Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The full table is presented in Table A3, due to its length. The treatment and outcome equations include the same set of control variables as in Table 4, while the treatment equation additionally controls for the interaction of age 12 *hukou* status and 3 variables capturing the timing of the HE expansion.

Table 6: IPWRA LLC ownership by *hukou* status - Four Treatments

	(1) Urban	(2) Rural
ATE		
Voc Sr High vs Compulsory/below	0.010* (0.006)	0.022 (0.013)
Sr High vs Compulsory/below	0.028*** (0.010)	0.012* (0.006)
Vocational College vs Compulsory/below	0.016** (0.006)	0.009 (0.007)
Degree+ vs Compulsory/below	0.024*** (0.005)	0.075*** (0.024)
Potential Outcome mean		
Ref: No more than compulsory education	0.007*** (0.002)	0.013*** (0.002)
Observations	6,308	7,006

Note: Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3. Alternative Two Stage Least Squares (2SLS) specification

We have used IPWRA to account for multiple education choices due to the rollout of the HE expansion in the preferred empirical model. To provide more evidence on the causal effects, and as robustness check, we also obtained IV estimates focusing on the effect of college and university level increments in enrolment on private LLC ownerships – the novel result relative to the existing literature.¹¹

In particular, the 2SLS specifications in Table 7 either include all respondents without HE in the full sample in the control group, or only include respondents with no more than junior high school education in the subsample which excludes people with vocational or academic senior high school qualifications. While the latter specification is closer to our IPWRA specification in terms of the control group, it precludes any spillover effect of the HE expansion on upper secondary education by sample construction. For each sample, we run two alternative specifications testing whether vocational college and academic degrees have differential effects. Note that this is possible given

¹¹ 2SLS estimates for other forms of entrepreneurship are also qualitatively similar to the corresponding IPWRA results, but are not presented as they reinforce the conclusions of the existing literature.

we have three instruments based on the interaction of age 12 *hukou* status and a set of variables capturing the timing of the HE expansion as explained in the methodology section. Indeed, with three instruments we are also able to run the Sargan over-identification tests for all 2SLS specifications.

Table 7 suggests that a binary specification of HE masks the large heterogeneity between vocational college and academic degrees on private LLC ownership. Having a vocational college qualification has a negative though statistically insignificant effect, regardless of the reference qualification. However, obtaining a bachelor's or higher degree leads to a very substantial and statistically significant increase in the incidence of LLC ownership, in the order of 13-14 percentage points, depending on the choice of the reference group. The 2SLS estimates are larger than the corresponding IPWRA estimates, presumably because they represent the Local Average Treatment Effects (LATE) rather than the Average Treatment Effects. It is also worth noting that all instruments are statistically significant both individually and jointly, and that the Sargan over-identification tests fails to reject the null of exogeneity of instruments in all specifications.

Table 7: 2SLS of Effect of Higher Education on Private LLC Ownership

	Full sample		Sample excluding Sr High School	
	(1)	(2)	(3)	(4)
	HE grouped	Voc. College & Degree+	HE grouped	Voc. College & Degree+
Second Stage				
Higher Education	0.055		0.011	
	(0.048)		(0.031)	
Voc. College		-0.017		-0.022
		(0.060)		(0.037)
Degree+		0.142**		0.127*
		(0.064)		(0.067)
Age	0.004	0.007	0.001	0.009
	(0.011)	(0.012)	(0.011)	(0.013)
Age sq	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Post-1980 birth	-0.008	-0.021	0.002	-0.020
	(0.033)	(0.035)	(0.034)	(0.038)
Post-1980 birth year trend	0.000	0.001	0.000	0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Urban hukou at age 12	-0.002	0.002	0.005	0.010*
	(0.004)	(0.005)	(0.005)	(0.006)
Current rural hukou	0.015	0.030	0.003	0.040
	(0.020)	(0.022)	(0.017)	(0.026)
Northeastern Region	-0.013**	-0.011**	-0.013**	-0.009
	(0.005)	(0.006)	(0.005)	(0.006)
Central Region	-0.005	-0.006	-0.006	-0.008*
	(0.004)	(0.004)	(0.004)	(0.005)
Western Region	0.001	0.005	-0.003	0.001
	(0.004)	(0.004)	(0.004)	(0.005)
Provincial capitals	0.006	0.010	0.002	0.007
	(0.007)	(0.008)	(0.007)	(0.008)
Smaller cities or towns	0.007	0.014	-0.000	0.008
	(0.009)	(0.010)	(0.008)	(0.009)
Rural	0.009	0.015	-0.001	0.009
	(0.010)	(0.011)	(0.009)	(0.011)
Current city of residence log GDP per capita	0.025***	0.031***	0.017**	0.021***
	(0.007)	(0.008)	(0.007)	(0.008)
Current city of residence log av. salary per capita	0.017	0.002	0.030*	0.014
	(0.018)	(0.020)	(0.018)	(0.021)
Birth-city log GDP per capita	-0.013*	-0.021**	-0.005	-0.015*
	(0.007)	(0.008)	(0.007)	(0.009)
Birth-city log av. salary per capita	-0.025	-0.016	-0.041**	-0.034*
	(0.016)	(0.017)	(0.017)	(0.018)
Constant	-0.134	-0.145	-0.040	-0.095
	(0.251)	(0.263)	(0.265)	(0.282)
First Stage (exclusion restrictions): Dependent Var=HE				
Post-1980 birth X Urban hukou	0.364***		0.526***	
	(0.052)		(0.055)	
Birth year linear trend X Urban hukou	0.018***		0.025***	
	(0.004)		(0.004)	

Post-1980 birth year trend X Urban <i>hukou</i>	-0.033*** (0.005)		-0.051*** (0.005)	
First Stage (exclusion restrictions): Dependent Var=Voc. College				
Post-1980 birth X Urban <i>hukou</i>		0.204*** (0.044)		0.274*** (0.054)
Birth year linear trend X Urban <i>hukou</i>		0.010*** (0.003)		0.013*** (0.004)
Post-1980 birth year trend X Urban <i>hukou</i>		-0.022*** (0.004)		-0.032*** (0.005)
First Stage (exclusion restrictions): Dependent Var=Degree+				
Post-1980 birth X Urban <i>hukou</i>		0.160*** (0.046)		0.251*** (0.054)
Birth year linear trend X Urban <i>hukou</i>		0.008** (0.003)		0.012** (0.003)
Post-1980 birth year trend X Urban <i>hukou</i>		-0.010*** (0.004)		-0.019*** (0.005)
Diagnostic Tests				
F-stat (p-value)	18.076 (0.000)		43.020 (0.000)	
Shea's Partial R ² (Voc. Col.)		0.0045		0.0134
Shea's Partial R ² (Degree+)		0.0036		0.0041
Endogeneity: χ^2 (p-value)	1.0096 (0.315)	5.8102 (0.055)	0.0103 (0.919)	4.0256 (0.134)
Sargan test: χ^2 (p-value)	5.341 (0.069)	0.101 (0.751)	5.827 (0.054)	1.148 (0.284)
Observations	13,314	13,314	10,402	10,402

6. Conclusion

Using the 2017 China Household Finance Survey, we estimate the long-term effect of an expansion of higher education experienced during childhood on selection into entrepreneurship in China. Positive shocks to education opportunities experienced during childhood have a negative effect on entrepreneurship, validating the opposite hypothesis that negative experiences encourage it (Cheng et al, 2020).

The IPWRA estimates allowing for multiple educational treatments are broadly consistent with the existing literature in the developing context, in the sense that people with more education are in general less likely to enter entrepreneurship relative to wage employment (van der Sluis et al, 2005). However, this general pattern masks heterogeneity across entrepreneurship types. In particular, obtaining any qualification beyond the baseline of compulsory schooling significantly

increases private LLC ownership, with the maximum effect corresponding to a 3-fold increase found for graduates with at least a 4-year bachelor's degree. This is also consistent with Chu and Wen (2019), who find that college education decreases overall and self-employed type of entrepreneurship, but increases *boss-type entrepreneurship*, using a Fuzzy Regression Discontinuity Design on the 2013 China Household Income Project data. However, none of their coefficients are precisely estimated, unlike in our case.

In recent years, the Chinese government has launched a number of policy initiatives to promote entrepreneurship activities among college students and graduates based on the stance that the most important strength for China's future development lays in its vast resource of people. Our findings suggest that HE does facilitate ownership of large private limited liability companies with substantive contributions to employment and economic development, notwithstanding the practical barriers still associated with institutional factors such as the *hukou* system.

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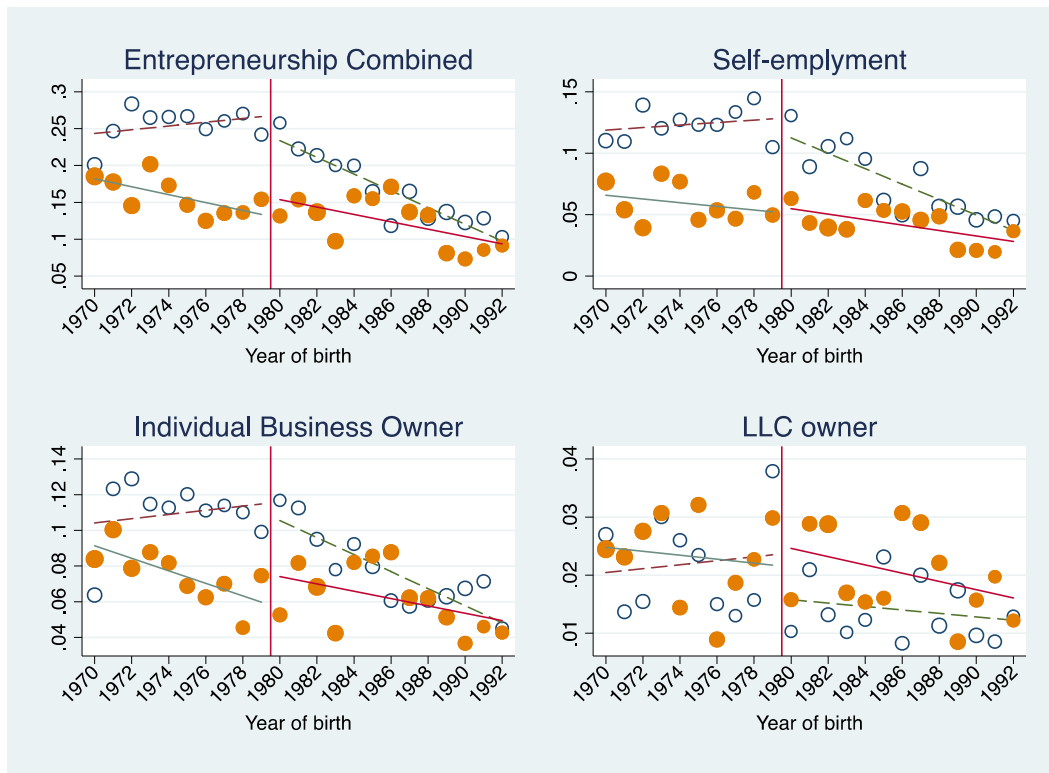
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Appendix

Figure A1: Types of Entrepreneurships by birth year and *hukou* status at age 12



Note: Solid dots/lines denote urban *hukou* at age 12. Hollowed dots and dashed lines denote rural *hukou* at age 12. Marker size proportional to number of observations.

Table A1: Summary Statistics by current *hukou* Status for women, weighted

	Urban <i>Hukou</i>	Rural <i>Hukou</i>	Total
<i>Entrepreneurship, of which</i>	0.123	0.177	0.149
Self-employed	0.049	0.092	0.070
Owner Individual Business	0.066	0.076	0.071
Owner Private Limited Liability Company (LLC)	0.008	0.009	0.009
Employee	0.877	0.823	0.851
Years of schooling	13.06	9.83	11.49
Higher Education (\geq Vocational College)	0.562	0.179	0.375
<i>Breakdown of highest qualifications:</i>			
Primary or below	0.035	0.198	0.115
Junior High	0.179	0.444	0.308
Vocational High	0.104	0.063	0.085
Senior High	0.120	0.116	0.118
Vocational College	0.202	0.092	0.148
Bachelor's Degree	0.322	0.082	0.205
Postgraduate Degree	0.038	0.005	0.022
Age	37.0	35.3	36.2
Born 1980+	0.500	0.613	0.555
Born 1980+ * Linear Time trend	8.35	10.71	9.50
Urban <i>hukou</i> at age 12	0.750	-	0.385
<i>Geographical region:</i>			
Eastern Region	0.419	0.431	0.425
Northeastern Region	0.151	0.074	0.113
Central Region	0.197	0.240	0.218
Western Region	0.234	0.255	0.244
<i>Type of place of residence:</i>			
Metropolis	0.136	0.062	0.100
Provincial capitals	0.400	0.243	0.323
Smaller cities or towns	0.439	0.352	0.397
Rural	0.026	0.343	0.180
Obs	5,414	4,643	10,057
Share (weighted)	51.4%	48.6%	100.00%

Note: Weighted by CHFS sampling weights. Owner of Individual Businesses refers to *Geti Gongshang Hu* while Owner of Private Limited Liability Company (LLC) refers to owner of *Siying Qiye*. Table A1 in the Appendix shows the corresponding unweighted summary statistics.

Table A2: Summary Statistics by current *hukou* Status, unweighted

	Urban <i>Hukou</i>	Rural <i>Hukou</i>	Total
<i>Entrepreneurship, of which</i>	0.146	0.209	0.179
Self-employed	0.053	0.100	0.078
Owner Individual Business	0.070	0.093	0.082
Owner Private Limited Liability Company (LLC)	0.023	0.016	0.019
Employee	0.854	0.791	0.821
Years of schooling	13.26	9.92	11.50
Higher Education (>=Vocational College)	0.578	0.147	0.351
<i>Breakdown of highest qualifications:</i>			
Primary or below	0.023	0.148	0.089
Junior High	0.160	0.505	0.342
Vocational High	0.114	0.071	0.092
Senior High	0.125	0.130	0.127
Vocational College	0.226	0.080	0.149
Bachelor's Degree	0.297	0.064	0.174
Postgraduate Degree	0.055	0.004	0.028
Age	36.8	35.4	36.1
Born 1980+	0.525	0.602	0.566
Born 1980+ * Linear Time trend	8.68	10.48	9.63
Urban <i>hukou</i> at age 12	0.792	-	0.375
<i>Geographical region:</i>			
Eastern Region	0.507	0.468	0.487
Northeastern Region	0.132	0.074	0.102
Central Region	0.167	0.232	0.201
Western Region	0.194	0.226	0.211
<i>Type of place of residence:</i>			
Metropolis	0.196	0.071	0.131
Provincial capitals	0.412	0.267	0.336
Smaller cities or towns	0.359	0.302	0.329
Rural	0.033	0.359	0.205
Obs	6,308	7,006	13,314
Share (unweighted)	47.4%	52.6%	100.00%

Note: Owner of Individual Businesses refers to *Geti Gongshang Hu* while Owner of Private Limited Liability Company (LLC) refers to owner of *Siying Qiye*.

Table A3: IPWRA All Employment States, Full Table

	(1)	(2)	(3)	(4)	(5)
	Outcome equations			Treatment equations	
	Self-employed	Employer Individual Business	Employer LLC	Combined entrepreneurship	
ATE					
Voc Sr High vs Compulsory/below	-0.011 (0.014)	-0.020 (0.014)	0.018** (0.008)	-0.013 (0.021)	
Sr High vs Compulsory/below	0.010 (0.013)	0.013 (0.013)	0.020*** (0.006)	0.043** (0.017)	
Vocational College vs Compulsory/below	-0.044*** (0.017)	-0.024 (0.016)	0.011** (0.005)	-0.057** (0.023)	
Degree+ vs Compulsory/below	-0.077*** (0.009)	-0.054*** (0.014)	0.031*** (0.009)	-0.083*** (0.023)	
Potential Outcome mean					
Ref: No more than compulsory education	0.104*** (0.007)	0.106*** (0.007)	0.010*** (0.002)	0.219*** (0.009)	
No more than compulsory education (Reference):					
Age	-0.254 (0.764)	-0.655 (0.650)	0.843 (1.599)	-0.552 (0.520)	
Age sq	0.003 (0.009)	0.008 (0.008)	-0.007 (0.019)	0.007 (0.006)	
Post-1980 birth	2.014 (2.228)	2.576 (1.960)	-3.568 (4.570)	2.568* (1.546)	
Post-1980 birth year trend	-0.194 (0.207)	-0.210 (0.181)	0.420 (0.428)	-0.223 (0.143)	
Urban <i>hukou</i> at age 12	-0.725** (0.359)	0.172 (0.284)	-0.280 (0.819)	-0.324 (0.257)	
Current rural <i>hukou</i>	-0.382 (0.331)	0.012 (0.264)	0.744 (0.772)	-0.188 (0.238)	
Northeastern Region	-0.484* (0.269)	-0.517** (0.244)	0.020 (0.707)	-0.532*** (0.192)	
Central Region	-0.427* (0.243)	-0.173 (0.222)	0.661 (0.694)	-0.290* (0.174)	
Western Region	-0.672** (0.262)	0.091 (0.210)	0.342 (0.537)	-0.315* (0.177)	
Provincial capitals	0.344 (0.380)	0.025 (0.410)	0.358 (0.670)	0.166 (0.312)	
Smaller cities or towns	-0.332 (0.386)	0.540 (0.448)	0.278 (0.910)	0.137 (0.339)	
Rural	-0.759* (0.406)	-0.210 (0.481)	0.219 (1.005)	-0.504 (0.356)	
Current city of residence log GDP per capita	-0.232 (0.379)	1.503*** (0.406)	-0.357 (0.850)	0.681** (0.306)	
Current city of residence log av. salary per capita	-0.275 (1.017)	-2.366* (1.263)	4.705** (1.881)	-1.024 (0.882)	
Birth-city log GDP per capita	-0.058 (0.400)	-0.552 (0.376)	0.325 (0.700)	-0.309 (0.300)	
Birth-city log av. salary per capita	-1.983* (1.173)	0.746 (1.063)	-2.056 (1.659)	-0.868 (0.854)	
Constant	33.197** (16.258)	18.125 (14.313)	-57.555 (40.933)	27.441** (11.303)	

Vocational Senior High School:					
Post-1980 birth X Urban <i>hukou</i>					0.339 (0.703)
Birth year linear trend X Urban <i>hukou</i>					-0.008 (0.053)
Post-1980 birth year trend X Urban <i>hukou</i>					-0.072 (0.064)
Age	-0.045 (1.119)	1.262 (1.430)	-0.957 (2.414)	0.212 (0.905)	-0.479 (0.375)
Age sq	-0.001 (0.013)	-0.015 (0.017)	0.010 (0.029)	-0.003 (0.011)	0.004 (0.004)
Post-1980 birth	1.885 (3.097)	-2.291 (4.569)	-0.447 (8.053)	0.448 (2.704)	1.822 (1.199)
Post-1980 birth year trend	-0.156 (0.292)	0.224 (0.413)	-0.214 (0.705)	-0.059 (0.248)	-0.161 (0.109)
Urban <i>hukou</i> at age 12	-0.832** (0.420)	-0.060 (0.432)	-1.728** (0.679)	-0.747** (0.312)	0.440 (0.342)
Current rural <i>hukou</i>	-0.948* (0.486)	0.442 (0.504)	0.162 (0.693)	-0.279 (0.365)	-2.066*** (0.179)
Northeastern Region	0.047 (0.441)	-0.085 (0.559)	-5.108*** (0.554)	-0.197 (0.385)	-0.388** (0.163)
Central Region	0.034 (0.458)	-1.275* (0.655)	-0.123 (0.541)	-0.500 (0.388)	0.080 (0.146)
Western Region	-0.051 (0.442)	-0.424 (0.479)	-0.181 (0.785)	-0.289 (0.343)	-0.094 (0.150)
Provincial capitals	0.398 (0.687)	1.613** (0.791)	1.355 (2.018)	1.178** (0.576)	-0.157 (0.206)
Smaller cities or towns	0.387 (0.749)	1.703 (1.141)	1.147 (2.271)	1.179 (0.739)	-0.008 (0.244)
Rural	0.469 (0.887)	1.297 (0.951)	0.476 (2.819)	0.882 (0.737)	-0.389 (0.274)
Current city of residence log GDP per capita	1.829** (0.721)	0.894 (0.832)	-1.995 (1.376)	1.072* (0.646)	0.486** (0.223)
Current city of residence log av. salary per capita	-5.512*** (1.752)	-1.249 (2.989)	5.416 (4.402)	-2.395 (1.934)	-0.539 (0.541)
Birth-city log GDP per capita	-1.953*** (0.678)	-0.846 (0.733)	2.091 (1.514)	-1.071* (0.623)	0.313 (0.214)
Birth-city log av. salary per capita	4.789*** (1.617)	1.736 (2.434)	-3.353 (2.905)	2.605 (1.685)	0.584 (0.486)
Constant	10.582 (26.057)	-36.419 (33.552)	-5.248 (48.901)	-7.196 (21.779)	3.225 (9.165)
Academic Senior High School:					
Post-1980 birth X Urban <i>hukou</i>					1.071 (0.676)
Birth year linear trend X Urban <i>hukou</i>					0.020 (0.042)
Post-1980 birth year trend X Urban <i>hukou</i>					-0.127** (0.056)
Age	1.083 (0.982)	1.156 (0.946)	0.697 (1.854)	1.175* (0.707)	0.011 (0.346)
Age sq	-0.012 (0.012)	-0.015 (0.011)	-0.009 (0.022)	-0.014* (0.008)	-0.001 (0.004)
Post-1980 birth	-2.726 (2.963)	-1.261 (2.865)	-0.765 (5.528)	-1.925 (2.152)	-0.535 (1.102)
Post-1980 birth year trend	0.270	0.112	0.010	0.172	0.051

	(0.271)	(0.254)	(0.506)	(0.193)	(0.100)
Urban <i>hukou</i> at age 12	0.435	-0.144	0.048	0.083	0.131
	(0.391)	(0.368)	(0.589)	(0.273)	(0.264)
Current rural <i>hukou</i>	1.009***	0.320	-0.545	0.553**	-1.385***
	(0.376)	(0.349)	(0.596)	(0.266)	(0.152)
Northeastern Region	0.299	0.332	-0.268	0.320	-0.444***
	(0.396)	(0.404)	(0.780)	(0.300)	(0.146)
Central Region	-0.263	-0.132	-0.183	-0.204	0.248**
	(0.383)	(0.346)	(0.625)	(0.266)	(0.123)
Western Region	-0.039	0.037	1.234**	0.146	0.111
	(0.378)	(0.337)	(0.498)	(0.260)	(0.117)
Provincial capitals	0.134	0.383	0.347	0.342	0.013
	(0.692)	(0.512)	(0.678)	(0.412)	(0.189)
Smaller cities or towns	1.044	0.447	1.265	1.042**	0.175
	(0.764)	(0.666)	(1.114)	(0.510)	(0.222)
Rural	-0.044	0.124	1.586	0.293	-0.496**
	(0.848)	(0.735)	(1.156)	(0.557)	(0.246)
Current city of residence log	-0.139	0.170	3.393***	0.644*	0.441**
GDP per capita	(0.460)	(0.446)	(0.868)	(0.359)	(0.186)
Current city of residence log av.	0.245	0.678	-1.728	0.175	-0.332
salary per capita	(1.348)	(1.253)	(2.127)	(0.977)	(0.511)
Birth-city log GDP per capita	0.248	-0.381	-1.410	-0.486	-0.051
	(0.459)	(0.448)	(0.875)	(0.352)	(0.175)
Birth-city log av. salary per	-0.524	-0.852	1.928	-0.222	0.500
capita	(1.062)	(0.982)	(2.078)	(0.788)	(0.466)
Constant	-24.929	-20.518	-41.227	-26.786*	-5.989
	(23.679)	(17.139)	(49.809)	(15.865)	(8.054)

Vocational College:

Post-1980 birth X Urban <i>hukou</i>					2.006***
					(0.635)
Birth year linear trend X Urban					0.031
<i>hukou</i>					(0.049)
Post-1980 birth year trend X					-0.201***
Urban <i>hukou</i>					(0.058)
Age	2.979	2.574*	-0.513	2.401**	-0.182
	(2.363)	(1.540)	(2.212)	(1.211)	(0.338)
Age sq	-0.033	-0.030*	0.004	-0.028**	0.000
	(0.027)	(0.018)	(0.025)	(0.014)	(0.004)
Post-1980 birth	-7.486	-5.898	0.649	-5.889	-0.568
	(6.741)	(4.748)	(6.624)	(3.676)	(1.124)
Post-1980 birth year trend	0.745	0.570	-0.216	0.548	0.024
	(0.658)	(0.393)	(0.642)	(0.337)	(0.102)
Urban <i>hukou</i> at age 12	0.248	0.071	0.743	0.269	0.261
	(0.593)	(0.402)	(0.680)	(0.316)	(0.316)
Current rural <i>hukou</i>	1.183	0.332	0.198	0.687*	-2.686***
	(0.734)	(0.513)	(0.768)	(0.411)	(0.162)
Northeastern Region	-0.744	0.132	-3.012***	-0.374	-0.476***
	(0.833)	(0.601)	(0.753)	(0.556)	(0.148)
Central Region	1.532**	0.216	-1.863*	0.656	-0.004
	(0.625)	(0.559)	(1.040)	(0.407)	(0.134)
Western Region	0.626	-0.731	0.166	-0.245	0.231*
	(0.760)	(0.462)	(0.670)	(0.410)	(0.127)
Provincial capitals	-0.475	0.058	1.523**	0.069	-0.373**
	(0.882)	(0.547)	(0.760)	(0.426)	(0.185)
Smaller cities or towns	-1.004	0.472	2.082**	0.317	-0.388*

	(1.159)	(0.624)	(1.044)	(0.560)	(0.226)
Rural	-0.672	-0.411	2.345	0.096	-0.958***
	(1.177)	(1.029)	(1.668)	(0.667)	(0.245)
Current city of residence log	0.437	0.669	5.487***	1.297**	0.443**
GDP per capita	(1.070)	(0.726)	(1.380)	(0.564)	(0.213)
Current city of residence log av.	-1.178	-0.809	-3.588	-1.183	-0.691
salary per capita	(2.853)	(1.979)	(2.805)	(1.426)	(0.550)
Birth-city log GDP per capita	-0.254	-0.720	-1.491*	-0.946**	0.141
	(0.909)	(0.670)	(0.810)	(0.472)	(0.209)
Birth-city log av. salary per	0.372	0.649	0.564	0.816	1.005*
capita	(2.363)	(1.642)	(2.166)	(1.155)	(0.514)
Constant	-62.368	-54.437	-3.204	-53.228*	-2.894
	(50.962)	(41.715)	(65.104)	(28.646)	(8.090)
Degree+:					
Post-1980 birth X Urban <i>hukou</i>					1.731***
					(0.623)
Birth year linear trend X Urban					0.019
<i>hukou</i>					(0.050)
Post-1980 birth year trend X					-0.180***
Urban <i>hukou</i>					(0.059)
Age	1.569	0.095	0.057	-0.108	-0.486
	(1.753)	(1.847)	(1.655)	(1.201)	(0.329)
Age sq	-0.020	-0.002	0.003	0.003	0.004
	(0.021)	(0.022)	(0.019)	(0.014)	(0.004)
Post-1980 birth	-4.312	4.181	0.024	2.559	0.596
	(4.959)	(5.372)	(4.655)	(3.729)	(1.101)
Post-1980 birth year trend	0.347	-0.288	0.099	-0.120	-0.036
	(0.462)	(0.479)	(0.466)	(0.330)	(0.100)
Urban <i>hukou</i> at age 12	-0.425	0.650	0.367	0.433	0.110
	(0.749)	(0.565)	(0.492)	(0.353)	(0.326)
Current rural <i>hukou</i>	1.629**	1.638**	1.198*	1.909***	-3.651***
	(0.715)	(0.699)	(0.657)	(0.484)	(0.162)
Northeastern Region	0.093	0.713	-2.077***	-0.356	-0.527***
	(0.981)	(0.670)	(0.765)	(0.566)	(0.144)
Central Region	-0.144	1.208*	-1.981***	0.004	0.049
	(0.779)	(0.676)	(0.759)	(0.501)	(0.133)
Western Region	-0.051	-0.445	-0.834	-0.701	-0.065
	(0.612)	(0.833)	(0.634)	(0.493)	(0.130)
Provincial capitals	0.876	2.239***	-0.676	0.325	-0.427**
	(0.839)	(0.760)	(0.768)	(0.606)	(0.178)
Smaller cities or towns	0.388	2.487**	-1.392	0.004	-0.510**
	(0.870)	(1.037)	(1.130)	(0.790)	(0.217)
Rural	-0.800	2.621**	-2.158	-0.324	-1.181***
	(1.235)	(1.180)	(1.425)	(0.920)	(0.248)
Current city of residence log	2.672***	-0.895	0.609	1.145*	0.179
GDP per capita	(0.688)	(0.804)	(0.812)	(0.646)	(0.203)
Current city of residence log av.	-6.947***	5.456***	-0.262	-1.284	0.193
salary per capita	(1.653)	(1.794)	(1.628)	(1.675)	(0.518)
Birth-city log GDP per capita	-3.821***	-0.503	-0.341	-2.275***	0.603***
	(0.829)	(0.655)	(0.703)	(0.660)	(0.191)
Birth-city log av. salary per	10.217***	0.394	-2.060	4.363**	0.188
capita	(1.820)	(1.143)	(1.301)	(1.754)	(0.467)
Constant	-59.896	-56.770	13.437	-25.122	0.921
	(44.175)	(45.259)	(45.242)	(28.830)	(7.877)

Note: N=13,314, Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The multinomial logit treatment

equation in column 5 does not vary across the treatment status defined by the educational attainments.