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ZEF-Discussion Papers on Development Policy No. 230

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On the train to brain gain in rural China

Bonn, January 2017

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Yi Zhang and Julia Anna Matz, On the train to brain gain in rural China, ZEF – Discussion Papers on Development Policy No. 230, Center for Development Research, Bonn, January 2017, pp. 39.

ISSN: 1436-9931

Published by:
Zentrum für Entwicklungsforschung (ZEF)
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Acknowledgements

We thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention; the Carolina Population Center, University of North Carolina at Chapel Hill; the National Institutes of Health (NIH; R01-HD30880, DK056350, and R01-HD38700); and the Fogarty International Center, NIH, for financial support for the collection and preparation of the China Health and Nutrition Survey data. Furthermore, we are grateful to the aforementioned, the China-Japan Friendship Hospital, and the Chinese Ministry of Health for their support while working with the survey data. Yi Zhang gratefully acknowledges financial support from the China Scholarship Council that funded his doctoral research but was not involved in completing this piece of research in any way. We are grateful to Joachim von Braun, Benjamin Elsner, and participants of various seminars and workshops for their comments and discussions. All errors are ours.

Abstract

This study investigates the well-researched relationship between migration and the formation of human capital in the source region using a novel instrument: the existence of a local train station. We make use of Chinese panel data and of the fact that the decision to build a new train station is taken by the central government and unrelated to characteristics of a rural village receiving the station. As an intermediate result we find that train stations are negatively related to migration outflows, thus indicating that the facilitation of local employment through economic integration outweighs the reduction of migratory costs. Investigating variation within villages over time in the instrumental variables approach for the central research question, we see a positive effect of out-migration on educational attainment in the source region. Additional results suggest that the effect is stronger for male and young stayers.

Keywords: Migration, human capital formation, instrumental variables, China

JEL codes: D10, I25, J61

1. Introduction

China has witnessed immense internal migration from the rural to the urban areas since the 1980s, mostly of individuals of working age, resulting in the rural labor force ageing relatively more than the urban one (Lavely 2001) and relating to another issue that economists have been highly interested in: the effect of migration on the accumulation of human capital (e.g. Coleman 2008, de Brauw and Giles 2008, Frisbie 1975, Hashim 2007, Lu 2012, Zhao 1997). This relationship is especially interesting as migration may exacerbate existing inequalities in the investment in human capital between rural areas with lower educational attainment and urban areas with higher levels of human capital on average. Furthermore, the question whether migration is harmful or beneficial for the source region, i.e. the discussion of whether migration leads to a 'brain drain' or 'brain grain', respectively, is highly controversial and has been the topic of a large body of literature (e.g. Batista et al. 2012, Beine et al. 2008, 2011, Fan and Stark 2007, Marchiori et al. 2013, Stark et al. 1997).

This study adds evidence on the effect of migration on the investment in human capital in the source region using panel data from rural China and the availability of train stations as an instrument for migration flows. To begin with, the availability of railroad services is negatively related to migration, most likely due to enhanced economic integration and thereby better employment prospects. Furthermore, the results of the instrumental variables approach provide robust evidence for a positive association between migration from and education in the source region.

Rural-urban migration may not only transfer existing human capital from the countryside to cities, it may also impact on investment in human capital in the source region. To begin with the possible positive channels for the effect of migration on educational attainment, migration of household members may relax credit constraints associated with the education of children due to remittances being sent (Acosta 2006, Edwards and Ureta 2003, Hu 2012). Yang (2008), for example, studies how sudden shocks in exchange rates affected children's schooling and educational expenditure in the Philippines through their effect on remittances during the Asian financial crisis in 1997 and finds positive effects of remittances on human capital accumulation, and López-Córdova (2005) shows that municipalities in Mexico receiving relatively high remittances have higher literacy and school attendance rates among children aged 6 to 14. Similarly, Dimova et al. (2015) find agricultural child labor to decrease in response to out-migration due to the receipt of remittances enabling payment for outside labor. Furthermore, while the majority of the

skilled labor force may leave the source region for destinations where the return to education is higher, i.e. a 'brain drain' may take place (Marchiori et al. 2013), the prospect of migrating to an urban area (or abroad) where high-skilled employment is more prevalent than in rural areas may increase the possible payoff of education and, thus, also educational attainment. This would imply migration encouraging the formation of human capital (Mountford 1997), thereby leading to a 'brain gain' if some of these prospective migrants end up staying (Stark 2005, Stark et al. 1997, 1998). Beine et al. (2001, 2008, 2011) empirically investigate the possibility of a 'beneficial brain drain' using both cross-sectional and panel data for a large set of developing countries and find evidence for higher emigration rates being positively associated with the accumulation of human capital. While Batista et al. (2012) similarly argue that the existing figures on the brain drain are too high and that significant gains from migration are possible for the source country if out- and return migration are allowed, Schiff (2005) argues, based on partial and general equilibrium analyses, in favor of the opposite, that is, of the effects of a brain gain not being able to outweigh those of a brain drain with respect to welfare and growth.

Conversely, there are also channels through which migration may negatively impact on the formation of human capital. For example, besides the possible direct negative effect of migration through highly skilled individuals leaving and the average level of education in the remaining part of the population decreasing, there may also be indirect effects. Firstly, there are possible labor market effects: when the educated leave a rural area, local wages for highly skilled labor increase due to a shortage of labor (Elsner 2013), which, in turn, also increases rural wages for unskilled labor, thereby increasing the cost of migration and possibly lowering the investment in human capital due to lower relative returns (Zhang et al. 2011). In addition, the possibility of low-skilled employment in a destination with a higher wage level decreases the relative attractiveness of high-skilled employment in the source region, thereby decreasing the investment in human capital (Azarnert 2012). Furthermore, migration of parents may have adverse effects on the educational involvement of their children (Djajić 2003). Hanson and Woodruff (2003), for example, argue that parental migration leads to a lower intensity of parental supervision, resulting in a reduction of study for children, and Antman (2011) argues that children may have to increase work hours and sacrifice study time to make up for the migrated parent's lost work input. Similarly, Zhao (2012) finds a negative relationship between parental migration and the performance of students with respect to test scores and McKenzie and Rapoport (2011) state that children in migrant families are less likely to attend school than children in non-migrant households. On the other hand, positive effects of short-term parental migration on the educational performance of children in lower secondary school

in Poland are found, both directly on the offspring of these migrants (Clifton-Sprigg 2014) and on their peers (Clifton-Sprigg 2015), and Murphy (2014) finds that the children of parents, who migrate also with the purpose of enabling a good education for their children, place great emphasis on their educational attainment in China. Prolonged migration, however, is found to be negatively associated with the educational performance of children (Clifton-Sprigg 2014).

Besides these arguments for both positive and negative impacts of migration on education in the source region; the direction of the net effect is a challenging empirical question due to causality also possibly running in the opposite direction. To be specific, while the prospect of migration is proposed to have an effect on the level of human capital accumulation by changing investment incentives (Dustmann and Glitz 2011, Rapoport and Docquier 2006), education levels may in turn also impact on the likelihood of migration. The most promising strategies to identify the causal effect of migratory movements on the accumulation of human capital in the source region are natural (quasi-) experiments and the use of instrumental variables. While a number of instruments have been proposed (e.g. Hanson and Woodruff 2003, Hildebrandt et al. 2005, McKenzie and Rapoport 2011, Mishra 2007, Taylor and López-Feldman 2010), this paper adds to the literature by suggesting a novel instrument for internal migration: the availability of train services in the area. The latter is a valid instrument here as decisions on investments in educational facilities and infrastructure are taken at different levels of government in China. In addition, even if train stations were not always placed randomly but in response to economic development and, further, lead to economic growth (Banerjee et al. 2012, Donaldson forthcoming, Hornung 2015) and thereby possibly to more education, our data do not provide evidence for this being a concern here. To be specific, we find evidence of a negative relationship between train stations and educational attainment of stayers in a reduced form controlling for the unobserved heterogeneity across villages. Furthermore, and in contrast to de Brauw and Giles (2008), who also use a large panel dataset from China and an instrumental variables approach and find a robust negative relationship between the opportunity to migrate and high school enrollment, our empirical findings suggest that the exposure to migration encourages the accumulation of human capital measured by educational attainment. While our overall finding of a positive relationship between migration and education is similar to the conclusions of Hanson and Woodruff (2003) who use historical migration rates and find children in households with migrants to exhibit more years of schooling, our instrumental variable works in a different direction than theirs. In addition, we identify this effect within villages over time and support our

results in numerous sensitivity checks using different measures of the exposure to migration and varying specifications.

The remainder of the paper is structured as follows: Section 2 introduces the data and presents descriptive statistics. Section 3 outlines our empirical strategy to identify the causal effect of migration on the investment in education, including a detailed discussion of the instrument. Section 4 discusses the main results and various sensitivity and robustness checks, Section 5 concludes.

2. The dataset

We use longitudinal data from the China Health and Nutrition Survey (CHNS) collected between 1989 and 2009 by the Carolina Population Center of the University of North Carolina at Chapel Hill. The survey is based on a multistage cluster sample design where the first layer is made up of nine densely populated provinces that account for 56% of the country's population. Counties of low, middle, and high average income levels are randomly chosen from each province and three rural communities randomly selected from each county.[1] The survey covers approximately 4,400 households with 26,000 individuals per round that are partly followed over time. We restrict the analysis to the rural sample (approximately 2,700 households and 11,000 individuals per round). Furthermore, only the latest five rounds that took place in 1997, 2000, 2004, 2006, and 2009 may be used for this study due to questions on migration of household members only being included from 1997 onwards. Besides information on the migration and education of household members, the survey includes questions on the demographic structure of the household, education, employment, housing conditions, income, agricultural practices, time use, community facilities, and health and nutritional measures.

2.1 Migration

A crucial characteristic defining rural-urban migration in China is the hukou system, a registration system that was introduced in 1958 and regulates where individuals may live and claim rights and benefits, for example from the social welfare system (Liang 2001). The registration system has been significantly relaxed in mid-2014 (China Economic Review 2014) but this policy change only came into effect five years after the last round of data used here.

Irrespective of hukou status, i.e. whether an individual holds an urban or a rural hukou, we define a migrant as a member of a rural household who does not currently live in the household but has migrated to an urban area for the purpose of finding employment, which relates to a definition that has been widely used in the research on migration (Giles and Mu 2007, Lu 2012, Tong and Piotrowski 2012, Ning and Chang 2013, Mu and de Brauw

[1] Note that most rural communities are villages, which is why we use these terms interchangeably throughout the paper.

2015).[2] As we are specifically interested in the relationship between migration and education with respect to informed decisions about payoffs of human capital accumulation in the labor force, we, thus, ignore individuals who have left the household for reasons of marriage, education, military service, or for other reasons for the main investigation. Figure 1 displays the percentage of migrants according to our definition by years of age between 1997 and 2009. While the youngest substantial group of migrants who move from the rural home for employment are 14, the highest share of migrants is found for individuals of just above 20 years of age. We are specifically interested in the effect of exposure to migration on educational decisions of stayers and define our key measure of migration as the share of migrants in village j and province p at time t, i.e. the ratio of the number of migrants from the survey households of a village who have migrated to an urban area for the purpose of employment to the total population in the village (including the migrants) measured as the total number of individuals included in the rosters of a village's household survey used here:

$$share\ of\ migrants_{jpt} = \frac{number\ of\ migrants\ for\ employment\ in\ survey\ households_{jpt}}{number\ of\ individuals\ listed\ in\ survey\ households_{jpt}} \qquad (1)$$

As can be seen in Table 1, this variable takes an average value of 8% and ranges from 0 to 24%, and villages have a mean number of migrants of over seven (out of those that belong to sample households). While we measure migration on the basis of household survey data, it is reassuring to see that our mean relative number of migrants per village of eight percent is similar to the average rate of migrants without local household registration status of six percent as measured by the census in 2000 (Liang and Ma 2004).

[2] While this is not explicitly spelled out in the English translation of the questionnaire, the possible response of a member having left the household to search for employment in the Chinese version is understood as migrating to an urban area to find employment.

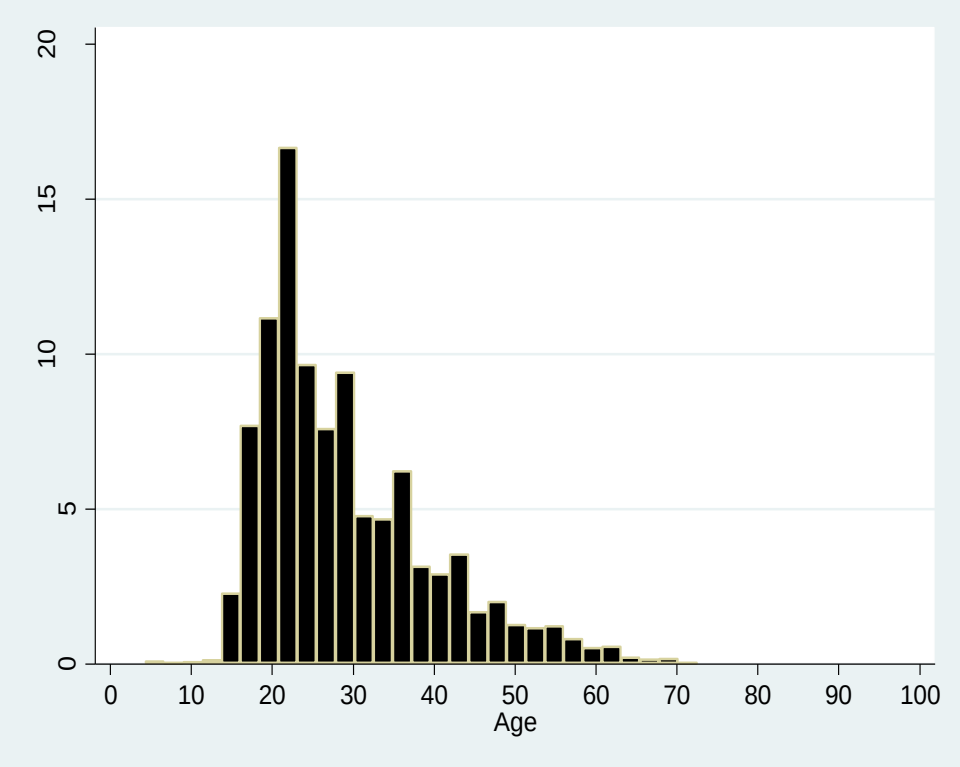

Figure 1: Share of migrants by age group

2.2 Education

Figure 2 displays mean years of schooling of the rural sample by gender and migration status in relation to age. It is easy to see that women generally complete fewer years of education than men and that migrants who leave at a young age (possibly for unskilled jobs in the urban area) are generally less educated than the ones who stay behind (to invest in their human capital). This is supported when taking into account that at age 16, the legal minimum working age in China, migrants have completed seven years of schooling on average, while non-migrants possess over eight years of education. And, furthermore, while non-migrants reach the compulsory minimum level of schooling of nine years at age 18, migrants on average possess only eight years of schooling at this point in their lives. The picture changes and from an age of about 25, however, migrants display more years of education than non-migrants on average.

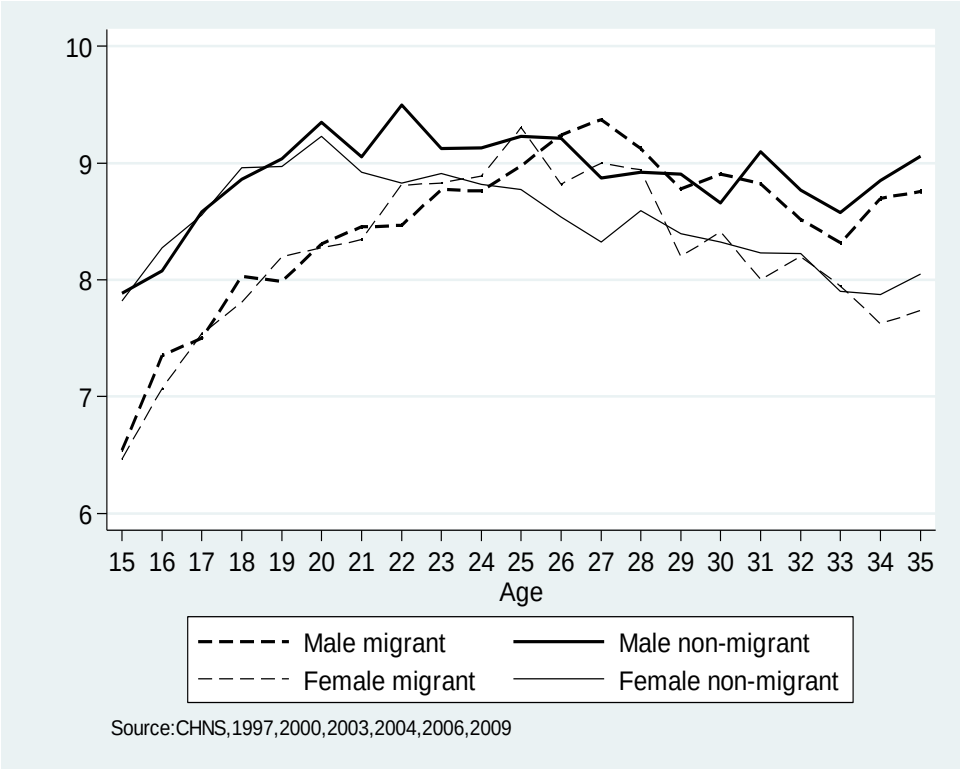

Figure 2: Mean years of schooling of migrants and non-migrants by gender

The fact that China's educational system is strongly regulated is beneficial to our analysis. To be specific, as the legal minimum schooling age is 6 (Brown and Park, 2002),, the majority of children would have finished primary school at age 12, middle school at an age of 15 years, and high school at age 18. Due to the compulsory minimum education of nine years in China (Connelly and Zheng 2003), primary and middle schools are highly subsidized by the government and parents face only relatively small monetary costs of sending children to school (Tsang 1996). Attending high school, on the other hand, is not compulsory and associated with tuition fees that may amount to a large fraction of annual household income. Thus, many young adults, when facing the opportunity cost of continued education, decide to drop out and look for employment (Glewwe and Jacoby 2004).

Table 1: Descriptive statistics

	Mean	Min.	Median	Max.	Std. Dev.	N
Village level						
size of the village's population	3,242.17	379.11	1,996.38	28,305.25	3,980.96	147
number of migrants for employment in survey households (village total)	7.23	0	6.08	24.28	5.54	147
number of individuals listed in survey households (village total)	89	48	88.60	150	19.73	147
share of migrants	0.08	0	0.06	0.24	0.05	147
primary school	0.77	0	0.95	1	0.31	147
middle school	0.29	0	0	1	0.37	147
high school	0.14	0	0	1	0.29	147
rural town	0.27	0	0	1	0.44	147
near trade area	0.34	0	0.24	1	0.35	147
labor share in agriculture	44.89	0	54	86.92	27.33	147
labor share in local enterprises	22.35	0	17.39	91.41	19.54	146
Household level						
education of the head	8.16	0	9	18	3.03	1,305
education of the head's spouse	6.2	0	6	17	3.84	1,305
number of siblings	1.85	0	2	6	0.89	1,305
household size	4.71	2	4.25	22	1.69	1,305
household income	24,578.94	44.7	17,414.05	855,270.6	35,009.48	1,305
Individual level						
years of schooling	9.04	0	9	18	2.56	2,463
age	21.67	18	22	25	2.34	2,463
female	0.47	0	0	1	0.5	2,463
Province level						
median urban household income	21,706.99	14,702.4	20468.57	35,694.9	6,383.07	9

Another factor that aids our analysis is the hukou system. Even though the discrepancy in possibilities with respect to education between children in rural and urban areas is unique in China and public educational facilities are, on average, better in urban areas, children from rural areas are usually not able to attend them due to the difficulty of becoming officially registered in the respective urban district (de Brauw and Giles 2008). This difficulty is rooted in the relatively high financial burden that temporarily enrolled children put on municipalities and the reason migrating parents usually leave their children in the source region.[3] While this is surely not ideal in itself, it mitigates concerns of selection that would be apparent if children of migrants could easily migrate with their

[3] Note that split migration, that is, the household head migrating to an urban area and leaving the rest of the family behind in the rural area, is also common in Kenya, for example (Agesa and Kim 2001).

parents. If such a family was exceptionally able, for example, and the children of this household would have done relatively well and stayed in education relatively long also in the rural area, this form of selection would have led to a downward bias in our estimate of the effect of migration on educational attainment.

As we are interested in the effect of exposure to migration on the (post-compulsory) education choices of young adults who stay in the rural area, we restrict our sample to individuals aged between 18 and 25 living in a rural area, which yields a sample size of 1,962 individuals with 2,463 observations from 147 rural villages. The lower cutoff relates to the age at which individuals graduate from high school if they decide to complete secondary education, which means that we investigate a sample that has most likely finished their educational career in secondary education and the associated decisions are not being made anymore, which would falsify our approach and findings.[4]

As shown in Table 1, the mean years of education is just above nine years; Table A1 in the appendix presents a detailed picture of the distribution of years of schooling in our sample. It is obvious that very few individuals have less than complete primary education and that almost three quarters of individuals in the sample have at least the compulsory nine years of education, which is also the median level of schooling. It follows that considering the effect of migration on post-compulsory education exclusively is sensible as this is where variation in decisions related to human capital investment exists.

2.3 Control variables

As shown in Table 1, 77% of the villages from which we have data have a primary school, 29% have a middle school, and 14% have a high school, which may impact on the likelihood of children attending further education, in particular in rural areas where public transportation is often problematic. Twenty-seven percent are classified as rural towns rather than villages and about a third of the rural communities in the sample are close to special trade areas that provide relatively good employment opportunities.[5] The mean population size of villages is just over 3,200, the labor share in agriculture takes a mean

[4] While we are in accordance with the existing literature (e.g. de Brauw and Giles 2008, Chiquiar and Hanson 2005, Hanson and Woodruff 2003, McKenzie and Rapoport 2006) in restricting our sample by age and assuming that age is a good predictor of the amount of schooling, the measure may be inaccurate due to delayed enrollment or shorter primary schooling in some regions, grades being skipped or repeated. Unfortunately, we are unable to infer more specific information from our data but believe that the mentioned reasons for inaccuracy relate to unusual cases and should not influence our findings.

[5] The relevant question yielding the latter variable is: “Is there an open trade area, an open city, or a special economic zone near this village/neighborhood (within two hours by bus)?” (Question O40 in the community questionnaires 1997 to 2009).

value of 45%, the one in enterprises takes a mean value of 22%, all taken from the community questionnaire of this survey.[6]

A little less than half of the sample is composed of women, the mean age is 21.7 years. The education of the household head's spouse takes an average value of just over six years, while household heads have received approximately two years more on average. Households have a mean size of almost 5 members and individuals an average of two siblings, which is not unusual, even considering the Chinese 'one child-policy', which has been applied in a less strict fashion in rural areas. Average real annual household income is equal to 24,579 Yuan, median urban household income within the province takes a value of 21,707 Yuan on average.[7] It is surprising that mean income is higher in rural areas. This may be driven by large income disparities in urban areas or by outliers in rural household income as indicated by the large maximum value relative to the mean and median.[8]

Remittances may be one of the key channels through which migration influences decisions related to education as mentioned above. Unfortunately, our data show severe shortcomings in terms of missing data and likely misreporting so we are unable to account for this factor. However, remittances are a consequence of migration and the two concepts, therefore, inevitably intertwined (McKenzie and Sasin 2007) so we are in accordance with a lot of the literature that does not explicitly consider the effect of remittances when studying the comprehensive impact of migration (de Brauw and Giles 2008, McKenzie and Rapoport 2007).

Finally, it should be noted that attrition with respect to entire villages or households is not a serious concern in our study. To be specific, 37 % of villages are included in our sample in all rounds and 35% are included in four rounds. This means that over two thirds of the villages are represented in at least four of the five rounds. Households, however, are not as continuously represented in our data due to the restrictions imposed according to the age of the individuals being studied and them "growing out" of our sample. Looking at the whole survey, over one third of households are surveyed in all five periods, and

[6] Note that data on the labor share in local enterprises are not available for all villages. This is unproblematic for the estimation, however, as this variable is solely used for illustrative statistics, not as part of the estimation.

[7] Values for annual household income are inflated to 2009. For reasons of comparison, one US-dollar corresponded to 6.831 Yuan in 2009 according to official exchange rates available from China's Statistical Yearbook 2012.

[8] Note that the main results are robust to excluding individuals who live in households that report incomes in the top or bottom fifth percentile.

about 60% are included in at least four out of the five survey rounds, which is not unusual in surveys covering such a long time frame.

3 Empirical approach

In this section we outline the empirical strategy with which we investigate the impact of out-migration on the accumulation of human capital in the source region. We discuss the difficulties inherent in estimating this causal relationship and discuss the validity of the instrumental variable used here: the availability of a local train station.

To begin with, we outline a reduced form equation for the impact of the exposure to migration on educational attainment:

$$years\ of\ schooling_{ihjpt} = \beta_1 share\ of\ migrants_{jpt} + \boldsymbol{Z'_{ihjpt}\beta_2} + \boldsymbol{X'_{hjpt}\beta_3} + \boldsymbol{V'_{jpt}\beta_4} + \beta_5 \ln\left(I^u_{pt}\right) + D_{jp} + v_t + e_{ihjpt}\,, \qquad (2)$$

where the dependent variable is the years of schooling of individual i from household h in village j and province p at time t. The ratio of migrants to the total number of members in the surveyed households in a village is the key variable of interest measuring the exposure to migration, median urban household income I^u within the province acts as a measure of expected income if migrating. $\boldsymbol{Z}$ is a vector of individual characteristics such as age and gender, while $\boldsymbol{X}$ represents household level control variables like the education of the household head and his spouse, the number of siblings, the logarithmic value of household income, and household size. Furthermore, we control for whether the village an individual resides in has a middle or high school, whether it is near a special trade area, and for the share of employment in the village being in agriculture. Survey round indicators are included with the help of v, e is a stochastic error term. Controlling for unobserved heterogeneity across villages is crucial as we aim to see the effect of migration within villages over time rather than seeing the average effect across villages. Village fixed effects (FE) are included with the help of D and equation (2) is estimated with heteroskedasticity-robust standard errors.

As briefly touched upon above, the difficulty in estimating the causal effect of migration on education lies in the fact that there may be reverse causality between the two, and a simultaneity or omitted variable bias, all of these implying endogeneity in the presence of which OLS produces biased estimates (Greene 2003). To be specific, it is also likely that a relatively high level of education is beneficial for migration due to higher expected incomes in the destination and lower costs of migration due to easier access to

employment, for example (Huffman 1980, Rong et al. 2012, Wu and Yao 2003, Zhao 1999), and, thus, that causality does not exclusively run from migration to education. Alternatively, it may be that a factor that is not included in equation (2) drives both the decisions to migrate and how much time to invest in education. Think of motivation or ambition on part of the parents, for example, that could lead to both part of the family migrating and children being urged to stay in education for a relatively long time.

3.1 The instrument

Like many other studies in this field, we adopt an instrumental variables technique to estimate the causal effect of migration on educational attainment in order to circumvent the problems outlined above (e.g. Antman 2011, Greene 2003, Hanson and Woodruff 2003, Hu 2012, McKenzie and Rapoport 2011). A relatively large number of instruments for this specific question have been proposed that can be broadly categorized as either relating to migrant networks that facilitate the migratory process and have been the topic of a large body of research themselves (e.g. de Brauw and Giles 2008, Dolfin and Genicot 2010, Giulietti et al. 2013, Rozelle et al. 1999, Zhang and Zhao 2015, Zhao et al. 2014) or to directly lowering the costs associated with migration. As examples of the first category, Acosta (2006), Hanson and Woodruff (2003), Hildebrandt et al. (2005), and McKenzie and Rapoport (2007, 2011) use historical migration rates to instrument for current migration. With respect to instruments related to a change in migration costs, the distance to urban areas (McKenzie and Rapoport 2011, McKenzie and Sasin 2007) and the occurrence of natural (Munshi 2003) or economic shocks (Yang 2008) have been applied. In addition, the study by de Brauw and Giles (2008) is related to our paper and empirical approach. They investigate how the opportunity to migrate influences high school enrollment in rural China between 1986 and 2003 based on data from four provinces, two of them also being investigated here. The authors use the time of the initial distribution of national identity cards in villages as their instrument for migration and argue that ID cards reduce the costs associated with migration and that the time since distribution increases the network of local migrants in the destination. They find a negative relationship between the opportunity to migrate and high school enrollment (de Brauw and Giles 2008).

We propose a novel instrument, the availability of a local train station, grounded on a different mechanism. On the one hand, railroads facilitate migration through the reduction of migration costs. To be specific, travelling by train is cheaper than other modes of transportation for longer distances in China, thus, highly demanded by migrants

when planning to return to their village of origin for important holidays, for example.[9] Furthermore, a local train station may be associated with a strong network of migrants from the "home region" in the destination, which lowers the costs associated with migration.

On the other hand, train stations also lead to a reduction in trade costs and increases in trade and real income levels as found by Donaldson (forthcoming) in the case of colonial India. Thus, train stations enhance economic integration, possibly making migration for the purpose of finding employment superfluous due to better employment opportunities in the village or the possibility of commuting to work. The effect of physical infrastructure on the economic development, growth, and industrialization has been the topic of further recent studies: Banerjee et al. (2012) find moderate positive effects of access to the Chinese transportation system on economic development and argue the limited effect to be grounded on low factor mobility, and Hornung (2015) finds railroad access to positively affect urban population growth in Prussia in the 19th century. Turning back to China, Faber (2014) provides evidence on the effect of being connected to the highway system. To be specific, he finds that connected peripheral counties on the way between targeted destinations are negatively affected through a decrease in industrial output growth and lower transportation costs between metropolitan and targeted peripheral regions. These findings do not conflict with ours, however, as, due to its relatively rarer occurrence, a village with a train station is more comparable to a destination targeted by the highway system than to a non-targeted region that is "accidentally" connected to the highway system. On the other hand, it appears plausible that villages "coincidentally" receive a train station without the village being the target node of a railway line if it is located between two larger cities, whose connection is the aim of a newly-built railway line, which supports the validity of the chosen instrument.[10] All of these papers take measures to address the potential problem of the network connection points not being randomly assigned but that cities/villages may have been purposefully connected to the network because of their favorable economic outlook, thereby leading to biased estimates. We return to why this is not a reason for concern in this study below.

[9] Another mode of transport is provided by buses. Bus stations, however, may not be used as an instrument as the exclusion restriction does not hold. To be specific, the local government that strongly influences whether bus stations are being erected is also the one making decisions related to educational facilities so there may be a relationship between bus stations and educational attainment of stayers other than through migration flows. Note, furthermore, that approximately 63% of the villages in our sample have a bus station and that we do not find any apparent relationship between the availability of bus and train stations in villages; the correlation coefficient is only 0.21.

[10] We return to this issue in the robustness checks (Table 7).

Even though the dataset does not contain the exact date a train station was built or opened, a question in the commune questionnaire is: "Is this village near a train station?"[11] in each round so there are nine possibilities for when a local train station was built: before 1989, between 1989 and 1991, between 1991 and 1993, between 1993 and 1997, between 1997 and 2000, between 2000 and 2004, between 2004 and 2006, between 2006 and 2009, and no train station until 2009. We generate a binary variable taking a value of one if a train station is available in a period, and zero otherwise, which automatically introduces a time lag into the specification without incorporating it explicitly. The distribution of new train stations being available is presented in Table 2: almost 60% of villages state that a local train station was not yet available as of data collection in 2009, while a large number of over 12% of villages received a local train station between 1989 and 1991, for example.

Table 2: Local train station openings for villages over time

Railway station	Number of Villages	Percent	Cumulative
None yet	88	59.86	59.86
Until 1989	7	4.76	64.63
1989-1991	18	12.24	76.87
1991-1993	3	2.04	78.91
1993-1997	9	6.12	85.03
1997-2000	3	2.04	87.07
2000-2004	11	7.48	94.56
2004-2006	7	4.76	99.32
2006-2009	1	0.68	100
Total	147	100	

While a relationship between the availability of a local train station and migration flows is relatively straightforward, we now outline why the former is a valid instrument for the latter in this setting, that is, why there is no relationship between the availability of a local train station and educational attainment of young adults in the region other than through its effect on migration flows. A possibility for the exclusion restriction to be invalid were present if both the instrument and the dependent variable were driven by wealth of a village, i.e. if richer villages were able to build local train stations earlier and to provide

[11] This question is number 13 (O35) and can be found on page 12 in section 9 (Other Facilities and Services) of the 2009 community questionnaire, for example.

better educational facilities, which is similar to the concerns of Banerjee et al. (2012), Donaldson (forthcoming), and Hornung (2015). In our particular setting this is not of concern, however, as decisions to build new schools or an additional train station are taken by different levels of government. To be specific, while local government generally decides on investments related to education, it is the central and provincial governments that decide on and provide the financing for additional train stations (Li 2013). As local layers of government are unlikely to have an influence on decision processes within the central or provincial governments, the opening of a local train station can be understood as an exogenous shock leading to a change in migration rates, thereby satisfying the criteria that need to be fulfilled for instruments to be valid (Angrist 2001). We return to this issue with evidence from the data when the results are discussed.

If the assignment of a local train station really was exogenous and not related to characteristics of the village such as wealth, we should not be able to detect any differences between the characteristics of villages that have and those that do not possess a local train station. Table 3 presents basic summary statistics and mean comparison tests for the average value of the share of migrants, average years of education in the village, population size, classification as a rural town, proximity to a special trade area, the percentage of the labor force working in agriculture, median urban income within the province, household income and indicators of whether the village has a middle or high school. It is reassuring to see that most differences are not statistically significant.

Rural communities with a train station are statistically significantly more likely to be classified as a rural town, however. The share of migrants is slightly lower in villages with a railway station and average education higher, both of these differences being statistically significant. Interestingly, villages with a train station have a higher share of labor in local enterprises and a lower one in agriculture, which suggests that economic integration induced by being connected to the railway network does play a role. Average household income is higher in villages with a train station, which are also more likely to have a middle school but not a high school. None of these latter differences are statistically significant, however, which supports our choice of instrument.

Table 3: Characteristics of villages with and without train stations

	with station			without station			with station – without station
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	
share of migrants	59	0.08	0.06	88	0.10	0.07	-0.02**
average years of education	59	7.42	1.53	88	6.68	1.19	0.74***
size of the population	57	4,175.40	6,108.92	84	3,232.25	3,332.00	943.15
labor share in agriculture	59	37.29	32.97	88	44.10	27.04	-6.81
labor share in local enterprises	57	26.04	27.59	85	18.72	23.49	7.32
median urban HH income	59	30,485.31	8,007.49	88	31,052.75	9,933.04	-567.44
household income	59	22,913.81	9,993.85	88	22,324.55	11,201.07	589.26
primary school	59	0.64	0.48	88	0.61	0.49	0.03
middle school	59	0.29	0.46	88	0.30	0.46	-0.01
high school	59	0.12	0.33	88	0.10	0.30	0.02
rural town	59	0.35	0.48	88	0.20	0.41	0.15**
near trade Area	59	0.36	0.48	88	0.30	0.46	0.06

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Two-sample t-tests for unpaired data with unequal variances in all cases. Latest available round of data used for each village.

In addition, it may be that a newly built train station has an influence on characteristics of villages, which in turn also affect educational attainment, e.g. households and villages may become richer with a train station due to better possibilities of trade or economic integration as suggested by Banerjee et al. (2012), Donaldson (forthcoming), and Hornung (2015). We divide the sample of villages almost equally by separating those that received the train station before the survey round of 1997, and those that have received a new train station in and after the survey round of 1997 and display basic summary statistics and mean comparison tests of the latest available round of data in Table A2 in the appendix. First of all, the absence of a statistically significant difference in migration rates is surprising at first but may be rooted in longer histories of railroad transportation being associated with a higher ratio of migrants, and of local employment or commuting acting as a substitute for migration and the two outweighing each other. Furthermore, household income is slightly higher in villages that received a train station early, which are also less likely to be classified as a rural town, less likely to be close to a special trade area, and to have a middle school. Only the latter difference is statistically significant, which is not a source of big concern as middle school is compulsory and we investigate the effect of exposure to migration on post-compulsory education decisions. It is, thus, reassuring that the difference in high schools is not statistically significant.

4 Evidence on the relationship between migration and education

In this section we present the empirical results. We start by discussing the first stage, that is, the relationship between a village having a train station and migration flows, and move on to discussing the results of the instrumental variables approach for the effect of migration on educational attainment. Finally, we present robustness and sensitivity checks.

4.1 The first stage: train stations and migration

Table 4 presents the key estimation results of the first stage, i.e. where migration is the dependent variable and the instrument, the binary variable for the existence of a local train station, is the key explanatory variable. We use our main measure of migration, the share of migrants in the village, in column (1) and the ratio of migrants above age 25 in relation to the total number of individuals inside survey households in the village in column (2). In column (3), migration is simply measured as the number of migrants as not only the relative, but also the absolute size of migration may be important. We find statistically significant associations of the existence of a train station in all columns and achieve values of the F-statistic for weak identification well above the conventional threshold of 10. The sign of the relationship is negative, that is, a train station is negatively associated with migration, which indicates that the effects of enhanced economic integration are larger than those of the facilitation of migration.

As touched upon above, train services could enhance migration by reducing migration costs but may also reduce it by facilitating local employment through economic integration or commuting, thereby reducing migration for the purpose of finding employment. In this setting, both of these mechanisms are likely to be at play in the first stage. We split the sample into rural communities that are close to a special trade area (defined as within two hours of reach by bus) and those that are not and we find evidence in support of the explanation being mainly driven by economic integration. As shown in Table A3, the effect persists only in villages that are not close to special trade areas, that is, those for which train stations are likely to facilitate economic integration through trade but not commuting, when the main explanatory variable, the share of migrants is investigated.[12] This is also supported by the fact that villages with a train station have a lower share of the labor force being active in agriculture and a higher share in local

[12] Looking at the share of migrants above age 25 and the absolute number of migrants, the effects are almost identical in villages that are close and not close to a special trade area in Table A3.

enterprises as presented in Table 3, even if these differences are not statistically significant.

Table 4: The first stage – Train stations and migration

	share of migrants	share of migrants (age>25)	number of migrants
	(1)	(2)	(3)
train station	-0.019***	-0.021***	-2.91 ***
	(0.005)	(0.003)	(0.486)
Individual controls	Yes	Yes	Yes
Household controls	Yes	Yes	Yes
Village controls	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes
Number of observations	2,463	2,463	2,463
F test of excluded instruments	16.15	47.08	35.90
R-squared	0.19	0.18	0.23

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses. Individual, household and village controls include all those discussed in relation to equation (2). The dependent variable is the ratio of migrants in a village in relation to the total number of individuals inside survey households in the village in columns (1), the ratio of migrants above age 25 in relation to the total number of individuals inside survey households in the village in column (2) and the number of migrants in column (3).

4.2 The main results

Also when applying the instrumental variables approach we focus on differences within villages over time and employ a fixed effects instrumental variables estimator for panel data (IV-FE). Tables 5 and A4 present the main results with the results of the standard fixed effects specification (FE) presented in column (1), the ones for instrumental variables with village fixed effects in columns (2) through (4). While we use the share of migrants in the first two columns, we use the ratio of migrants above age 25 in relation to the total number of individuals listed as members of surveyed households in the village in column (3) to ensure that our findings are not simply the result of a mechanical effect which would occur, for example, if mostly educated individuals left, if these individuals were in the same age span as the remaining individuals under investigation, and if the average level of education in the remaining population sank (with migration). In such a case, the effect of migration on education would be negative by construction, which we want to ensure is not the case here. In column (4) we do not use the share of migrants

but simply the number of migrants originating from a village. For reasons of space, the main results are split with the results for the key explanatory variables presented in Table 5 and the remainder in Table A4 in the appendix.

Table 5: The impact of migration on educational attainment

	years of schooling			
	(1)	(2)	(3)	(4)
	FE	IV-FE	IV-FE	IV-FE
share of migrants	0.203	51.79**		
	(1.216)	(19.44)		
share of migrants (age>25)			46.74**	
			(14.83)	
number of migrants				0.335**
				(0.110)
median urban HH income	0.561	1.904*	2.027**	1.448*
	(0.474)	(0.809)	(0.709)	(0.623)
household income	0.195***	0.245***	0.217***	0.248***
	(0.0486)	(0.0675)	(0.0553)	(0.0591)
female	-0.0711	-0.0764	-0.0583	-0.0989
	(0.0893)	(0.119)	(0.101)	(0.104)
age	-0.00329	-0.0500	-0.0178	-0.0315
	(0.0195)	(0.0314)	(0.0225)	(0.0245)
education of the head	0.0264	0.108***	0.124***	0.109***
	(0.0151)	(0.0255)	(0.0206)	(0.0221)
education of the head's spouse	0.128***	0.0163	0.0194	0.0169
	(0.0183)	(0.0205)	(0.0172)	(0.0178)
middle school	0.139	0.256	0.371	0.423*
	(0.163)	(0.222)	(0.198)	(0.211)
high school	-0.752**	-1.005**	-1.327***	-1.354***
	(0.248)	(0.345)	(0.335)	(0.350)
Village fixed effects	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes
Number of observations	2,463	2,463	2,463	2,463
R-squared	0.155			
Wald Chi-squared		25,267.25	35,375.74	33,316.49

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses.

With respect to our coefficient of interest, the effect of migration is consistently statistically significant and positive across the different measures of migration if instrumental variables estimation is used (columns (2) through (4)). To be specific, the main results in column (2) indicate that an increase in the ratio of migrants in the village by one percent is associated with an increase in the years of education by 0.52 years, which is a large, but not unrealistic effect.

Seeing these results in conjunction with the first stage ameliorates concerns of the instrument being invalid for reasons related to the studies by Banerjee et al. (2012), Donaldson (forthcoming), and Hornung (2015): train stations are negatively associated with migration, which is in turn found to be positively associated with education. In support of this, the relationship between train stations and education is negative in a reduced form equation with village fixed effects.[13] Were non-random placement of train stations determined by wealth of a village an issue by leading to more educational facilities as well as train stations, we would expect to see a positive relationship in the reduced form. This not being the case supports the validity of the chosen instrument.

When investigating the control variables, we find that both household and median urban incomes within the province are positively associated with educational attainment. Parental education, especially of the head of household, is positively associated with years of schooling. Having a middle school in the village yields one statistically significant positive coefficient, while those for having a high school in the village are statistically significant and negative, which is surprising.

The findings of the main specification are in contrast to other empirical research which suggests that low returns to high school education are a likely explanation for a negative relationship between exposure to migration and educational attainment (de Brauw et al. 2002, Cai et al. 2008, Chi et al. 2012, Zhang et al. 2002). It should be noted, however, that most existing research uses cross-sectional data or panel data without the possibility of controlling for unobserved heterogeneity. Doing exactly this and addressing the endogeneity in the relationship by employing an instrumental variables approach, we obtain results that contradict those of many existing studies: controlling for the unobserved heterogeneity across villages, we find a positive effect of migration on the investment in human capital, which may be grounded on relatively high returns to post-primary education among migrants in China as suggested by de Brauw and Rozelle (2008)

[13] The results of this reduced form are not presented but available from the authors upon request.

and is in line with the literature on the "brain gain" (e.g. Batista et al. 2012, Beine et al. 2001, 2008, 2011, Stark 2005, Stark et al. 1997, 1998).

4.3 Robustness Checks

This section presents a series of sensitivity and robustness checks to support and complement the main findings.

4.3.1 Type of migration

As shown in Figure 2, there are both highly and less educated migrants in China and it is possible that the effect of migration on education depends on the level of education of migrants. In the results reported in Table 6 we look at the effects of migration of both highly and less educated migrants on the education of individuals in the source region. To be specific, we replicate the main results but only looking at migrants that have not received more than compulsory education, that is, nine years or less, in columns (1) through (3) of Table 6. The respective effects of migration of highly educated individuals, that is, of those with more than compulsory education, are presented in columns (4) through (6) of Table 6.

It is interesting to see that the effect is found in all columns but stronger for the migration of highly educated individuals: the effect of these types of migrants is almost three times the size of the effect found in the main results. While this may suggest that highly educated migrants act as an example to stayers and induce them to invest in their education, it should be noted that also the share of less educated migrants in relation to the total number of household members in the survey households in column (1) yields a statistically significant and positive impact on the education of stayers.

Furthermore, while we specifically investigate the effect of an exposure to migration for the purposes of finding employment in the main results, we now investigate whether the effect depends on migration being for this specific reason or whether it is driven by migration in general. To be specific, we investigate the effect of the relative and absolute numbers of migrants that migrated specifically for the purpose of higher education and those that left for any type of migration, irrespective of their motivation. The results are presented in Table A5.

Table 6: Robustness check with different types of migrants

	years of schooling					
	(1)	(2)	(3)	(4)	(5)	(6)
share of less educated migrants	81.31*					
	(34.66)					
share of less educated migrants (age>25)		62.59**				
		(19.97)				
number of less educated migrants			0.469**			
			(0.158)			
share of highly educated migrants				142.6*		
				(57.03)		
share of highly educated migrants (age>25)					184.6*	
					(73.55)	
number of highly educated migrants						1.173**
						(0.439)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Village controls	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2,463	2,463	2,463	2,463	2,463	2,463
Wald Chi-squared	19,586	34,961	31,403	22,253	22,425	25,380

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses. "Less educated" denotes compulsory education or less, i.e. nine years or less, "highly educated" denotes more than nine years of schooling. Individual, household and village controls include all those discussed in relation to equation (2). Instrumental variables estimation with village fixed effects in all columns.

Interestingly, migration for the purpose of higher education does not yield comparable results (columns (1) through (3) of Table A5) to the main results in which we investigate the effect of migration for the purpose of finding employment (Table 5). If a statistically significant effect is found here, it is *negative*, suggesting that the mechanism for the positive effect of migration on education is not driven by migrants receiving their education elsewhere acting as examples and yielding an incentive to invest in the formation of human capital. Migration for all purposes, on the other hand, yields a statistically significant and positive coefficient (columns (4) through (6) of Table A5) but it is weaker than in the main results. This suggests that it is mainly migration for employment that induces human capital formation in the source region.

4.3.2 Identification conditional on the existence of a train station in 2009

It is apparent from the summary statistics that the majority of villages does not have a train station by 2009, which is when our data end. For this reason, we verify the main results in the sub-sample of villages that have a train station by 2009, i.e. identifying the effect on the basis of the time a train station became available, rather than on the basis of their mere existence. The results are presented in column (1) of Table 7 and support our main findings, also with respect to the magnitude of the effect.

4.3.3 Proximity to a special trade area

As the effect of the existence of a train station impacts on migration flows differently depending on whether a village is close to a special trade area or not as discussed above and presented in Table A3, we also replicate the main specification in these sub-samples. The results for villages close to a special trade area are displayed in column (2) of Table 7 and in column (3) of the same table for villages where this is not the case. Interestingly, migration does not yield a statistically significant coefficient in villages that are close to a special trade area, although it should be kept in mind that the sample size is diminished. The main results are supported in villages that are not close to a special trade area, however.

The fact that the results are only supported in villages that are not close to a special trade area may, on the one hand, be related to commuting to a special trade area for employment being more difficult in the absence of a special trade area, thereby leading to migration being a more necessary step to finding employment and to migration having a larger impact on the investment in human capital in these types of villages. On the other hand, it should be kept in mind that the negative relationship between a village having a train station and out-migration found in the first stage is driven, again, by villages that are not close to a special trade area. It may, thus, be that the results found here are grounded in the instrument being stronger in this part of the sample due to the positive effect of a train station on the economic integration of a village being more important in more remote villages.

Table 7: Robustness checks by characteristics of the village

	train station by 2009	close to a special trade area	not close to a special trade area	classified as rural town	not classified as rural town
	(1)	(2)	(3)	(4)	(5)
share of migrants	47.48**	-101.3	41.23**	32.42	53.01**
	(21.34)	(102.8)	(17.00)	(29.26)	(23.49)
Individual controls	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes
Village controls	Yes	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes
Number of observations	1,062	840	1,623	493	1,970
Wald Chi-squared	12,802.01	7,867.20	20,810.74	9,520.11	17,945.23

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses. The dependent variable is years of schooling in all columns and individual, household and village controls include all those discussed in relation to equation (2). Instrumental variables estimation with village fixed effects in all columns.

4.3.4 Classification as a rural town

As discussed above, one worry about the instrument is that villages may have been purposefully selected to receive a train station, which would render the instrument invalid if the characteristics leading to the receipt of a train station were also correlated with educational facilities (and thereby educational attainment). Factors driving this may be wealth of the village, political or geographical importance as discussed above. As this would be most likely for villages that have been classified as rural towns, it is reassuring to see that the main results are supported only in villages that have not been classified as a rural town (column (5) of Table 7), not in villages that have been classified as rural towns (column (4) of Table 7).[14] These findings, again, suggest that migration may be more necessary and influential for education when villages are small and less industrial.

4.3.5 Demographic characteristics

With respect to demographic characteristics, we first split the sample into sub-samples according to age and replicate the main results reported in column (3) of Table 5. The key results for the sub-sample of individuals aged 18-21 are reported in column (1) of Table

[14] Note that the data also do not yield evidence for this concern: middle and high schools are not mostly found in rural towns in the data used here.

8, while those for the subsample of individuals aged 22 to 25 are presented in column (2) of the same table. The coefficient on the ratio of migrants in the village is statistically significant and positive only in column (1), which indicates that the effect is driven by younger individuals and that our choice of the upper cutoff of age 25 for the sample used in the central part of the paper is not critical for the main results.

Table 8: Sub-samples by age and gender

	Age 18-21	Age 22-25	male stayers	female stayers
	(1)	(2)	(3)	(4)
share of migrants	49.58**	47.49	41.81**	47.26
	(22.43)	(29.54)	(21.32)	(31.61)
Individual controls	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes
Village controls	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes
Number of observations	1,143	1,320	1,309	1,154
Wald Chi-squared	12,215.08	14,811.81	16,567.30	12,603.12

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses. The dependent variable is years of schooling in all columns and individual, household and village controls include all those discussed in relation to equation (2). Instrumental variables estimation with village fixed effects in all columns.

It may be that gender plays a role as well so we again split the sample: male stayers are investigated in column (3) of Table 7, while the results for female ones are reported in column (4) of the same table. It is interesting to see that the effect is exclusively apparent for male individuals in the rural community and absent for female ones, which is interesting considering that gender did not yield a statistically significant coefficient in the main results.

5 Conclusions

Our study investigates the relationship between migration and educational attainment, which is the heart of a large body of literature due to its relevance, particularly in developing economies, and due to the difficulty of clearly estimating the causal effect empirically. To be specific, estimating the effect of migration on education is difficult due to reverse causality, that is, the prospect of migration may influence the investment in human capital, but different levels of education may also impact on the likelihood of migrating.

Like many other studies in this field, we employ an instrumental variables approach and, furthermore, take advantage of the fact that rural communities in China have not been connected to the railroad system at a uniform point in time. This allows us to propose a novel instrument for migration: the availability of a local train station. While it is relatively straightforward to see that the possibility of using railway services impacts on migration positively, the relationship may also work in the other direction through the facilitation of local employment or commuting, thereby making migration superfluous. We find evidence for the latter outweighing the former as the existence of a train station is negatively associated with out-migration in our data. Furthermore, we argue at length that there is no direct link between a village having a train station and the educational attainment of young adults in that village, a critical criterion for the validity of an instrumental variable.

We use the ratio of migrants to the size of the survey population in a village as the main measure of the exposure to migration. Investigating changes within villages over time rather than across villages in the instrumental variables approach, we find a positive effect of migration on educational attainment among the stayers that is robust to using different definitions of the exposure to migration and in additional sensitivity checks.

The findings suggest that internal migration should not be discouraged when enhancing educational attainment is also a topic on the policy-making agenda, which is especially important and topical in the Chinese context. To be specific, the recent relaxation of barriers to rural-urban migration in mid-2014, a period our data do not cover, may have (unintended) positive effects on education in rural areas besides directly facilitating the attendance of urban schools for children originally from rural areas, and could play an important role in minimizing the discrepancies between the urban and rural regions of China.

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Appendix

Table A1: Distribution of the years of schooling

years of schooling	Frequency	Percent	Cumulative percentage
0	22	0.89	0.89
1	5	0.20	1.10
2	9	0.37	1.46
3	26	1.06	2.52
4	34	1.38	3.90
5	145	5.89	9.78
6	160	6.50	16.28
7	80	3.25	19.53
8	134	5.44	24.97
9	1,170	47.50	72.47
10	51	2.07	74.54
11	140	5.68	80.23
12	391	15.87	96.10
13	9	0.37	96.47
14	13	0.53	97.00
15	54	2.19	99.19
16	16	0.65	99.84
17	3	0.12	99.96
18	1	0.04	100.00
Total	2,463	100	

Table A2: Characteristics of villages with train stations until and after the 1997 survey

	Until 1997			After 1997			Until 1997 -
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	After 1997
share of migrants	31	0.08	0.07	28	0.08	0.05	0.00
average years of education	31	7.39	1.77	28	7.44	1.26	-0.05
size of the population	30	3,027.37	3,415.75	27	5,451	8,009.69	-2,423.63
labor share in agriculture	31	36.16	35.23	28	38.53	30.86	-2.37
labor share in local enterprises	30	29.03	30.77	27	22.70	23.71	6.33
median urban HH income	31	31,718.54	1,662.11	28	29,119.94	1,178.71	2,598.59
household income	31	23,210.56	10,175.20	28	22,585.27	9,964.90	625.29
primary school	31	0.58	0.50	28	0.71	0.46	-0.13
middle school	31	0.16	0.37	28	0.42	0.50	-0.26**
high school	31	0.06	0.25	28	0.18	0.39	-0.12
rural town	31	0.32	0.48	28	0.39	0.50	-0.07
near trade area	31	0.26	0.44	28	0.46	0.51	-0.2

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Two-sample t-tests for unpaired data with unequal variances in all cases. Latest available round of data used for each village.

Table A3: The first stage split by proximity to a special trade area

	Close to a special trade area			Not close to a special trade area		
	(1)	(2)	(3)	(4)	(5)	(6)
	share of migrants	share of migrants (age>25)	number of migrants	share of migrants	share of migrants (age>25)	number of migrants
train station	-0.01	-0.02***	-5.62***	-0.02***	-0.02***	-3.17***
	(0.01)	(0.07)	(1.16)	(0.01)	(0.04)	(0.55)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Village controls	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	840	840	840	1,623	1,623	1,623
R-squared	0.19	0.18	0.28	0.16	0.18	0.19

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses. Individual, household and village controls include all those discussed in relation to equation (2).

Table A4: The Impact of migration on educational attainment – Control variables

	years of schooling			
	(1)	(2)	(3)	(4)
	FE	IV-FE	IV-FE	IV-FE
number of siblings	-0.03	-0.06	-0.0485	-0.09
	(0.06)	(0.08)	(0.0637)	(0.07)
household size	-0.05	-0.10*	-0.0672*	-0.09*
	(0.03)	(0.04)	(0.0333)	(0.04)
near trade area	0.08	-0.301	0.0616	-0.39
	(0.13)	(0.23)	(0.149)	(0.22)
labor share in agriculture	-0.003	-0.006	-0.000328	0.001
	(0.003)	(0.004)	(0.00331)	(0.004)
Village fixed effects	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes
Number of observations	2,463	2,463	2,463	2,463
R-squared	0.155			
Wald Chi-squared		25,267.25	35,375.74	33,316.49

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses.

Table A5: Robustness check with different types of migration

	years of schooling					
	(1)	(2)	(3)	(4)	(5)	(6)
share of migrants for education	218.1					
	(163.20)					
share of migrants for education (age>25)		-426.6**				
		(162.1)				
number of migrants for education			1.552			
			(0.81)			
share of migrants for all purposes				39.85**		
				(14.92)		
share of migrants for all purposes (age>25)					52.67**	
					(16.97)	
number of migrants for all purposes						0.259**
						(0.08)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Village controls	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2,463	2,463	2,463	2,463	2,463	2,463
Wald Chi-squared	6,352.16	24,658.57	13,133.71	25,383.96	34,291.67	34,290.03

Note: *, **, and *** indicate statistical significance at 10%, 5%, and 1%. Robust standard errors are presented in parentheses. Individual, household and village controls include all those discussed in relation to equation (2). Instrumental variables estimation with village fixed effects in all columns.