The Local Effects of Education on Rural-Urban Migration in China: the Role of TVEs and Migrant Networks

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Abstract: This paper explores the local effects of education on rural-urban migration in China. Using data from China Household Income Project Survey 2002 (CHIPS 2002), we find that the community-level education has a positive impact on rural-urban migration. Further investigations find two mechanisms behind this impact: the development of the Township and Village Enterprises (TVE) and the intensity of migrant networks. More specifically, the magnitude of local effect is decreasing in the employment share of TVE and increasing in the intensity of migrant networks. The results of instrumental variable estimation also support our findings.

Keywords: Externality of Education; Rural-Urban Migration; Township and Village Enterprise; Social Network

JEL Classification: J24 O15 O18

1. Introduction

In recent decades, most developing countries, especially those with rapid industrialization, have experienced sizable labor migration from rural to urban areas. A large number of literatures have shown that rural-urban labor migration improves the efficiency of an economy (Lewis, 1954; Harris and Todaro, 1970; Lucas, 2004; Brandt and Zhu, 2010). For example, China, who has a rapid economic growth since the late 1970s, has also witnessed an explosive growth of labor migration during the same period. According to the estimation made by Sheng (2008), the number of rural residents temporarily working in urban areas has exceeded 130 million in 2007. The

reallocation of the labor force from agricultural sectors to industrial and service sectors promotes the total factor productivity, and in turn contributes to economic growth. Young (2003) argues that during the reform period about one-ninth of the 7.8% annual GDP growth of China can be explained by the rising labor participation, most of which is attributable to the transfer of labor out of agriculture. Similarly, according to Brandt and Zhu (2010), the rural-urban transfer of labor has increased annual GDP growth rate by at least one percent point. Therefore, understanding the determinants of China's rural-urban migration is important for understanding the emergence of China's economic miracle.

Then, what motivated millions of the rural labor force to migrate into cities and towns? Many previous studies have tried to address this research question (Todaro, 1969; Zhao, 1999a, b; Fu and Gabriel, 2011). However, very few literatures consider the role of community-level education in labor migration, even though human capital is found to have external effects on return of labor (Katz and Murphy, 1992). One exception is Liu (2008), which examines the externality of education on rural-urban migration and finds a negative effect. However, he doesn't move further on investigating the mechanisms behind.

Using the China Household Income Project Survey 2002 (CHIPS 2002), this paper analyzes the local effects of community-level education on migration behaviors of rural workers. Especially, we include the development of Township and Village Enterprise (TVE) and the intensity of migration networks into our analysis to understand how local effects of education work. Different from Liu (2008), our results show a positive externality of education on rural-urban migration. More specifically, an increase of one year in average educational attainment will increase the possibility of migration out of agriculture by one percent point. Considering the possibility of endogeneity problems, we use the distance from the village to the nearest middle school as the instrument of community-level education. The results of 2SLS also support our findings.

Doms et al., (2010) finds that, entrepreneurship is more active in regions with higher education. It implies that community-level education can promote the

development of local business, which will increase the availability of local non-agricultural jobs. Therefore, the local effects of education on rural-urban migration could be negative, especially in regions with vigorous local business. To consider such a channel of externality, we add the interaction term of the local TVE employment share and community-level education into our regressions. The results of the Multinomial Logit model show that, the interaction term has a negative effect on out-migration for work, and a positive effect on locally off-farm employment.

After controlling the share of TVE, the impact of average community-level education on migration is found to be positive. So we further investigate what are the determinants of this positive effect. It is noted that the social network plays an important role in rural-urban migration in China (Zhao, 2003). In addition, rural migrants living in the city show the cluster phenomenon (Xiang, 1996). On one hand, individuals with higher education in a network usually have more resources, such as higher income to provide temporary accommodation and lending or higher ability of collecting job information. Following Zhao (2003), we measure the intensity of a migrant's network with the number of existing migrant workers in his/her village. By adding the interaction term of migrant network and community-level education, we examine the role of social network in determining the local effects of education. The empirical results show that, in places with more intense migrant's networks, the positive effect of average education on migration will be stronger. With the consideration of potential endogeneity problem, we use the distance to the middle school as the instrument of community-level education. The results of 2SLS support our findings.

The paper proceeds as follows. Section 2 provides a simple review of literature on the related topics, such as determinants of rural-urban migration. Section 3 provides the background of rural-urban migration of China. The data description and empirical setup are introduced in section 4. Section 5 reports the regression results. The robustness check like instrumental variable methods is the subject of section 6. Section 7 concludes and discusses.

2. Literature Review

Our paper contributes to the branch of literatures about the determinants of rural-urban migration. Lall et al. (2006) give a long list of factors affecting individuals' decision-making on migration, such as urban-rural income gap, physical and cultural distance, worker characteristics and family characteristics. A number of studies focus on the specific case of China and investigate what are the factors promoting China's radical growth of rural-urban migration (Zhao, 1997, 1999a,b, 2003;Liu, 2008). Zhao (1997, 1999a,b) finds that the educational attainment has an encouraging effect on labor migration from rural to urban areas. However, these studies pay very little attention to the role of community-level educational attainment. To the best of our knowledge, Liu (2008) is the only paper that takes the externality of education into account. Using CHIPS 1995, he finds that the increase of average education of a village will reduce the migration to urban areas, but it will increase the probability of becoming a local off-farm worker. However, he does not investigate how these effects work further. Another concern is that, his conclusions may only hold in the 1990s, a special period of China's market reform. During 1980-1995, Chinese Township and Village owned Enterprises (TVEs) have enjoyed rapid growth and absorbed a huge amount of rural labor. Since 1995, the growth of TVEs has slowed down and the private enterprises in city rise rapidly (Putterman, 1997; Kung and Lin, 2007).

Our research also stays in lines with studies about how social networks affect migration. Regardless of the economies (developed or less developed), the social network is found to play an important role in labor migration (Banerjee, 1983; Massey, 1987). The effects of social network include: (1) lowering the psychological costs of migration; (2) lessening the credit constraints related to the migration; (3) providing job information and increasing the employment chance (Schwartz, 1973). Evidences from China (Meng, 2000; Zhao, 2000; Zhao, 2003) also confirm the importance of social networks in rural-urban migration. However, most previous studies mainly focus the quantity dimension of social networks, while our work also pays attention to the quality dimension. We hypothesize that higher community-level education will enhance the quality of social network and in turn have a stronger

encouraging effect.

Finally, this paper is also related to the question of how the externality of human capital works. Apparently, education is one of the main sources of human capital. In the previous studies, the externality of human capital appears in the following ways: (1) If the high-skilled labor and low-skilled labor are complementary to each other to some extent, more high-skilled labor will increase the marginal output of low-skilled labor (Katz and Murphy 1992; Moretti 2004a; Ciccone and Peri 2006). (2) More high-skilled labor can also promote the productivity of low-skilled labor through spillover effects (Lucas, 1988). There is another form of spillover effects that a larger share of high-educated population will create a more civilized working environment (Lochner and Moretti, 2004). (3) Doms et al. (2010) observes more entrepreneurship activities in regions with higher average education. That is, the high educated are more likely to involve in entrepreneurship activities, and in turn provide employment opportunities to local low-educated workers. In this paper, we connect the externality of education with rural-urban migration.

3. Background

After the launch of market reform in 1978, more and more rural labors have been engaging in non-agricultural sector. TVEs absorbed most of the off-farm rural workers before the mid 1990s. In most cases, TVEs are defined as the firms located in a town or a village. During the period from 1980s to the mid of 1990s, TVEs enjoyed very fast growth (See Figure 1). As shown in Figure 1, from 1978 to 2005, the employment of TVEs grew from 28 million to 135 million and the outputs of TVEs grew from 4.9 billion yuans to 1600 billion yuans.

[Insert Figure 1 Here]

After the mid 1990s, private sectors in the city grew faster than TVEs. And the sectors in city gradually became a more important source, absorbing rural workers.[1] Figure 2 shows that the number of migrants gradually caught up with the employment of TVEs. In other words, since 1995, a new off-farm labor forces

[1]The dynamics of TVEs in China has been discussedd by Kung and Lin(2007).

migrated into cities rather than staying and working in TVEs locally.

[Insert Figure 2]

Besides the growth of the private economy in cities, lessen of the constraints of the Hukou system also has a significant impact on rural-urban migration. According to the Hukou system, every person will be granted an urban or rural Hukou following the parents when he/she is born. A package of subsidies is exclusively given to people with the urban Hukou. The people who want to legally migrate to the other place must obtain the permission from the governments of both sending region and receiving region. China had lessened the Hukou system gradually. For example, rural worker can work and live in the city with the temporary permit of residence in the destination since 1984. However, migrant workers and their families still can't enjoy some important welfares such as: (1) an access to the public education system; (2) health insurance; (3) equal treatment in recruitment. Besides the regulatory constraints on migrant families, migrant worker also face discrimination in labor markets (Meng and Zhang, 2001) and psychological impacts associated with identity conflicts (Fu et al, 2007).

A social network of rural migrants provides support to new migrants for mitigating formal and informal constraints (Wang and Tong, 2004). Especially, the migrant network plays an important role in helping new migrant workers find job positions. As shown by Zhao (2000), more than 75% percent of migrants get their first job in the city with the help of friends and relatives. Meng (2000) also obtains a similar conclusion: more than 70% of migrant workers have job offers before moving to the cities. With CHIPS 2002, we show that around 37% of the migrant workers obtain their job offers with the help from friends or relatives (See Figure 3). On the other hand, the presence of homophily is a significant feature of China's migrant networks (Wang and Tong, 2004). Using the "Zhejiang village" in Beijing as an example, Xiang (1996) shows that migrants from the same hometown tend to live together. He also argues that the migrant network partially supplants the functions of state and market.

[Insert Figure 3 Here]

4. Data, hypothesis and empirical specifications

4.1 Data

The data used for our research purpose is the rural sample of China Household Income Project Income Survey (CHIPS) 2002, which is a widely used micro-level dataset. This dataset covers 18 provinces and 2 municipalities[2]. The questionnaire of CHIPS contains two parts: the first part includes information about the respondent's demographics and socio-economic statuses. In this part, the questionnaire has a question asking whether the respondent has earned money from employment outside of the village in the past year. The second part of the rural sample contains information on household characteristics and community characteristics. In this study, we limit our sample to16-60 year old rural residents with complete information about schooling, age, gender, and employment. Following Liu (2008), we exclude following observations from the sample: retired, full-time student, disabled or with other disease. Finally, we have 21549 observations distributed in 109 counties.

One key step of our study is identifying the migrant workers. The questionnaire of CHIPS2002 didn't directly ask respondents about working outside the community for at least one month or not. Instead, CHIPS2002 asked whether the respondent had earned salary by working outside of his/her community. Therefore, we define the respondents who have earned a salary outside their communities as migrant workers. Accordingly, we define the individuals who have no wage outside of their communities as non-migrant workers. Within the group of non-migrant workers, we categorize individuals earning money from off-farm jobs in their communities as local off-farm workers. Table 1 summarized the variables used in our analysis.

［Insert Table 1］

4.2 Hypotheses

We introduce a simple theoretical framework to obtain our empirical setting. Our framework is an extension of the migration model of Zhao (1997). In this extended

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[2] They are Liaoning, Hebei, Jilin, and Shanxi in the north, Shandong, Jiangsu, Zhejiang, and Guangdong as eastern coastal provinces, Anhui, Henan, Hubei, Jiangxi and Hunan from the interior, Gansu, Guizhou, Shananxi, Sichuan, Guangxi, Chongqing and Yunnanin the west, and Beijing.

model, we take community-level education, TVE ratio and migrant network into account. Following Zhao (1997), we assume that the urban-rural income gap motivates migrations. The income gap is defined as:

$$Incgap = \text{prob} * urbaninc - ruralinc$$

Here, $Incgap$ represents income gap, $urbaninc$ represents the wage rate in urban areas and $prob$ is the probability for a rural labor to be employed in urban areas (Todaro, 1969). The $ruralinc$ means reserve wage in rural areas, which is a weighted average wage of farming and local off-farm job. Moreover, the migrant workers have to pay some costs associated with migration. The migration costs include economic costs, psychological costs and others. We also define a function of migration costs as:

$$\text{cost} = f(x)$$

Whether migrating for a rural labor depends on the net gain which is:

$$netgain = incgap - \cos t = prob * urbaninc - ruralinc - \cos t$$

If $netgain$ is bigger than zero, the rural labor force will migrate out; otherwise they will stay and work in local rural areas.

Our study focuses on the role of community-level education in the migration process. The local education can affect rural-urban migration in two opposite ways. On one hand, higher local education induces more entrepreneurship activities, which can be a force deferring migration, because it means more job opportunities available locally (Doms et al., 2010). This negative effect on migration will be especially significant in the regions with flourishing TVEs. On the other hand, high community-level education also means that its previous migrant workers have higher educational attainments on average. These educated migrant workers tend to be more capable of providing support to new migrants from their hometowns. First, high-educated workers tend to have more economic resources to help new migrant workers from their hometown. Second, high-educated workers also tend to be more capable of searching and diffusing information related to the job vacancies. In other words, an increase of community-level education can improve the quality of migrant network, and in turn, encourage new migration. Therefore, the local effect of education on rural-urban migration is a combination of two opposite forces. Considering the relative stagnation of TVE development since the mid 1990s, we can

reasonably hypothesize that the positive effects from migrant network side would dominate the possibly negative effects from TVE side. Therefore, we propose the following hypotheses to be examined in our paper:

Hypothesis1: *The community-level education has a positive local effect on rural-urban migration in China.*

Hypothesis 2: *In regions with high TVE employment share, the local effect of community-level education will be less positive or even become negative.*

Hypothesis 3: *The local effect of community-level education will be more positive in regions with a larger migrant network.*

4.3 Empirical strategy

Following Zhao (1999b) and Liu (2008), we also use the logistic model for our estimation. As shown in our theoretical framework, the representative labor makes a decision about whether or not going out for utility maximization. We denote the expected utility from migration with y^* and we have:

$$y^* = B'X + u$$

Here, X includes the variables affecting the expected utility, and u follows the logistics distribution and an average value is 0 and the variance is 1. However, the net present value is not directly observable. We can only observe the decision y: migrate (y=1) or not (y=0). That is, if $y^* > 0, y = 1$ otherwise $y = 0$.

The logit model of migration decision is:

$$\text{Prob}(y = 1) = \frac{e^{B'X}}{1 + e^{B'X}}$$

The key independent variable of this paper is the average educational attainment of rural residents at county level. In the other scenario, we consider the representative rural labor facing three choices: migrating out, doing farming locally, and doing off-farm work locally. Therefore, we have a multinomial logit model as follow:

$$\text{Prob}(M = 1) = \frac{e^{B_j'X}}{\sum_{k=0}^{2} e^{B_k'X}}$$

Here, M=1 represents emigrating, M=2 represents working on off-farm activities, and

M=0 presents working on the farm.

The variable of our interests are community-level education and its interaction terms with TVE share and migrant network size. To avoid potential omitted variable problems, we control a number of community characteristics, such as variables depicting the local economic structure. We also employ the instrument-variable estimation to address potential endogeneity and check the robustness of our findings.

5. Results

5.1 Basic results

We report the results of Logit regressions in Table 2. In regression (1), we only control the individual characteristics and average educational attainment on county level. We add variables of family characteristics in regression, (2) and add variables of community characteristics in regression (3). As shown in Table 2, young and unmarried males are more likely to migrate. Educational attainment on individual level is positively associated with the likelihood of migration. Compared with the illiterate, individuals with more education have higher odds to work outside of their hometown.[3] Family size promotes rural-urban migration, while both the size of the land and financial wealth owned by the family hinder the migration behaviors. The community characteristics are also found to have influences. Rural resident living close to the urban areas are more likely to be migrant workers. And, those living in plain regions are less likely to be migrants. These findings are generally consistent with previous studies (Zhao, 1999 a, b; De Brauw et al., 2002; Liu, 2008). To reduce the potential omitted variable problem, we add variables representing the economic structure of the county, including employment share of the agricultural sector and employment share of TVEs. Table 2 also shows that, in counties with high employment share of the agricultural sector, individuals are less likely to work outside.

The coefficients of average educational attainment are positive in all regressions, and are significantly positive in (2) and (3) .It supports our first hypothesis that individuals from high-educated counties are more likely to be migrant workers.

[3]The vocation or college education attainment is not significant.

We then consider a scenario in which the representative rural labor faces three choices: local on-farm job, local off-farm job, and migrating out for job opportunities. We conduct analysis with multinomial logit model and present results in Table 3.

[Insert Table 3 Here]

For migration, the results are similar to those from the binomial logit regressions. In addition, the coefficients of average educational attainment are all significantly positive in the multinomial logistic regressions. In general, individual-level education also raises the likelihood of involving in local off-farm activities. Similarly, the size of the land and financial wealth owned by the household hinder rural labor from being engaged in local off-farm activities. Individuals living in the community near the urban areas are more likely to do local off-farm activities. The local economic structure also matters. The employment share of agricultural discourages rural residents from local off-farm jobs, while the employment share of TVEs encourages. Especially, the Table 3 shows that the average education at county level is found to have a positive effect on local off-farm activities regression (1) and (2). After adding the variable of TVE employment share, such a positive effect becomes insignificant. It implies that, the employment share of TVEs matters much on the occupational choice of rural resident.

5.2 The interaction effect of share of TVEs and average education on migration

Doms et al. (2010) find that, there are more entrepreneurship activities in high-educated regions. This finding implies the interaction between the education and development of TVEs may matter. In this section, we examine the hypothesis 2: In regions with high TVE employment share, the local effect of community-level education will be less positive or even become negative. We add the interaction term of TVE share and average education into our regressions, and report the new results in Table 4 and Table 5.

[Insert Table 4 Here]

[Insert Table 5 Here]

All regressions in Table 4 show that, the coefficients of average educational attainment are positive, while the coefficients of the interaction terms between TVE and average education are significantly negative. It means that, in regions with high

TVE employment share, the effect of average education on migration will be less positive or even negative.[4]The results of Table 5 are very close to those of Table 4. In all regressions of Table 5, for migration, the coefficients of the interaction term are also negative, but only significant negative in regression (3). While for local off-farm activities, all the coefficients of interaction term are significantly positive. In general, we find supporting evidence for hypothesis 2.

5.3 The interaction between migrant's networks and average education on migration

We pay attention to how the migrant network affects the magnitude of the externality of education on rural-urban migration. With the data used for this paper, we find that about 37% of migrant workers obtain their jobs with the help from friends and relatives. Similarly, Zhao (2003) finds that the migrant networks significantly increase the probability of rural-urban migration. Based on these work, we develop hypothesis 3 -- the local effect of community-level education will be more positive in regions with a larger migrant network. We examine this hypothesis by adding the interaction term between migrant's networks and average education into our regressions.

Following Zhao (2003), we measure the social network of migrant with the numbers of migrant in a village. The more migrant worker a village has, it has the larger migrant's network. However, the strength of a migrant network is not only determined by its size, but also determined by its quality. Here, average education also serves as a proxy of migrant network quality. Table 6 shows that the coefficients of the interaction term between migrant network and average education are significantly positive. It means that, in regions with large migrant network, the positive effect of average education will be stronger. On the other side, the interaction terms between TVE and average education keep significantly negative for migration. We report estimates of multinomial logit in Table 7. Table 7 shows that for migration, the coefficients of the interaction term between networks and average education are positive, while the coefficients of the interaction term between TVE and average

[4] As Liu (2008) has found the increase of average education can hinder the individuals to be migrant.

education keep negative, though not significant. The interaction term between networks and average education doesn't have significant effects on off-farm work.[5]

[Insert Table 6 Here]

[Insert Table 7 Here]

5.4 The nonlinear effect of average education on migration

Considering the potential non-linearity of education, we employ share of population with education above certain levels as the alternative measures of average education. We conduct analyses by using the share of college graduates and above, the share of vocation graduates and above, and the share of high school graduates and above, as indicator of community-level education respectively. Table 8 reports the results. We find: (1) no matter which measure we choose to use, the coefficients of interaction terms between the community-level education and TVE are always significantly negative, while the coefficients of the interaction term between the average education and network are significantly positive. These findings are consistent with the results when we use the education years as the measure of the local average education endowment; (2) the results confirm the non-linearity nature of educational externality. The coefficients of interactions with college share are much bigger than those of interactions with high school share.

[Insert Table 8 Here]

5.5 The local effect of education on groups of different education

The local effects of average education may be different in magnitude for rural residents with different educational attainments. To address the heterogeneity of educational externality, we divide the sample into two groups according to the respondent's education attainment. In particular, we categorize those with high school education and above into high-educated subsample, and categorize the others into low-educated subsample. The results of estimation are shown in Table 9. We find that the local effect of education is stronger for individuals with less education. Although both the

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[5] After adding the interaction term between network and average education, we still find the positive effect of education on migration. So there could exist other channels through which the average education affect the migration positively.

coefficients of average education in a high-educated subsample (see regression (1)) and low-educated subsample (see regression (3)) are positive but only the coefficient for low-educated group is statistically significant. We also include the interaction terms for further examination. The results for high-educated subsample are reported in (2) and for low-educated subsample in regression (4). In general, the local effects of education in both ways are stronger for low-educated individuals.

[Insert Table 9 Here]

6. Robustness check

6.1 TVE, migration and average education

This paper discusses the local effect of education on migration of rural labor, whose direction can ambiguous. On one hand, the rise of average education will increase the probability of migration through improving the quality of migrant network. On the other, it can also increase the return of local off-farm activities by promoting the development of TVEs, which in turn can hinder the migration. We find that, in general, the positive effect from migrant side dominates the negative effect from TVE side. In other words, the aggregated local effect of education is positive. This finding is different from the work by Liu (2008), which finds a negative local effect. To reconcile the conflicts between our paper and Liu (2008), we argue that, due to the relative stagnation of TVEs and the flourishing of private sectors in cities since the mid 1990s, the return of education from migration work increases, while the return of education from off-harm activities decreases. Therefore, high-educated individuals moved to the urban areas during this period. The outflow of high-educated peers weakens the effects of local entrepreneurship, but strengthens the effects of migrant network. Therefore, we examine the returns of education from migration work (off-farm work) with CHIPS 1995 and CHIPS 2002, separately.

With dataset from CHIPS 1995 and CHIPS 2002, we find that both the returns of education from migration and from local off-farm activities are positive (see Table 10). However, there is not a significant difference in return of education from migration and from working locally. While in 2002, the difference is apparent: the return of education from migration is significantly larger than that from working in the TVEs.

[Insert Table 10 Here]

Figure 4 shows that the average education of migrant workers is higher than the average education of local TVE worker in 2002. It supports our argument that a sizable number of high-educated rural labors moved from rural areas to urban areas during this period.

[Insert Figure 4 Here]

6.2 Instrumental variable method

To avoid the potential omitted-variable problems, we have added many community-level controls. However, the problem of omitted variables or endogeneity problem can still exist to extent. Here, we employ the instrumental variable method to deal with these problems.

The key of IV estimation is to find a variable highly correlated with average education and meanwhile uncorrelated or slightly correlated with the employment choice of rural labor. Now we use the distance to the junior middle school (measured in kilometer) as the instrument of average education. Intuitively, if a village is closer to the middle school, it is cheaper for the children to go to the school. Therefore, in general, there will be more individuals completing junior middle school and above. So the closer the village is to the junior middle school, the higher of the average education the village has.[6]

Table 11 reports the two stage estimates of instrumental variables (2SLS). To save space, we just show the estimates of average education. Regression (1) and (2) are respectively the estimates of logit and Mlogit regressions without interaction term, the results are similar to our previous findings: average education has a positive local effect on rural-urban migration. (3) and (4) are respectively estimates of logit and Mlogit regressions with interaction terms; the results are still consistent with the findings we have found.

[Insert Table 11 Here]

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[6]The first stage regression of OLS, thet value of estimates of distance is 10.06, while for migrant, the z value is 1.74. It shows the distance is highly related to average education and less related to the migration choice.

7.Concluding Remarks

This paper investigates the external effect of local average education on rural-urban migration with a rural sample of CHIPS 2002. We find that the rise of community-education has an encouraging effect on rural-urban migration. We then explore two channels affecting the externality of education: TVE and social network. By adding the interaction term of employment share of TVE and average education, we find that the positive effect of community-level education on migration would be smaller or even become negative in regions with high ratio of TVEs. On the other side, we also add the interaction term of migrant's network and average education into the regressions. The results show that the higher educated the migrant network is, the larger encouraging effects on migration will be. Finally, we employ the instrumental variable method to deal with the potential endogeneity problem and the results of IV estimation still support our hypotheses. Further, we divide the sample into two groups according to individual-level education and then repeat the regressions. We find that the local effects of education are stronger for individuals with less education.

This paper provides a new perspective to understand the rural-urban migration in China. One puzzle about rural-urban migration of China is the coexistence of shortage of rural migrant workers in urban sectors and the surplus of the labor force in rural areas (Knight et al., 2011). We highlight the interactions among TVEs, migrant networks and community-level education. Our results have some policy implications about increasing the incomes of rural households and promoting economic efficiency through labor force reallocation.

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Table 1 Definition of key variables

Key dependent variables	**Definition**	**Mean**	**standard deviation**
Migrant	=1 if household get wage from working outside, =0 for all others	0.170	0.376
Migrant_2	=1 if household get wage from working outside,=2 if household engaged primarily in local non-farming activities ,=0 for all others	0.534	0.783
Cedyr	Average level of education in years in a county based on the sample	7.23	0.860
Chss	Graduates at least completing highschool as a share of county labor force based on the sample (%)	0.160	0.073
Cvss	Graduates at least completing vocation as a share of county labor force based on the sample (%)	0.047	0.037
Colsh	Graduates at least completing college as a share of county labor force based on the sample (%)	0.002	0.004
Individual characteristics			
College	=1 for college graduates, =0 for all others	0.22	0.047
Vacation school	=1 for vocational school graduates, =0 for all others	4.4	0.206
High school	=1 for high school graduates, =0 for all others	11.3	0.317
Middle school	=1 for middle school graduates, =0 for all others	50.7	0.500
Primary school	=1 for primary school graduates, =0 for all others	30.7	0.461
Illiterate	=1 for individual with education less three years,=0 for all others	9.14	0.158
Age	Age in years	37.11	11.97
Male	=1 for males, =0 for females	0.550	0.498
Married	=1 for married people, =0 for all others	0.777	0.417
workdays	The number of days working in nonagricultural work for a year (day)	187.8	108.64
Family characteristics			
Family size	Number of household members	4.48	1.37
Family land	Land under the household control (mu)	2.69	3.88
Family labor force	Number of household members in the labor force	3.09	1.20
Family wealth	Total value of all financial asset at the end of 2002 (10,000 yuan)	0.745	1.21
Community			

characteristics			
Suburb of a city	=1 if the village is a suburb of middle or large sized city, =0 otherwise	0.078	0.268
Flatland	Type of terrain: =1 for flat land, =0 for hilly or mountainous land	0.469	0.499
Telephone	=1 if telephone service is available, =0 otherwise	0.951	0.216
Share of TVE	Share of the county labor force working in town and village enterprises (%)	0.053	0.093
Share of agriculture sector	Share of the county labor force working primarily in the agricultural sector (%)	0.533	0.155
Network	The number of individual with migrating experience in a village in 2002	4.10	4.65

Table 2 The external effect of average education on migration: Logit regressions

	(1)	(2)	(3)
Variables	migrant	migrant	migrant
Cedyr	0.0505	0.0644*	0.101***
	(0.0365)	(0.0372)	(0.0389)
Gender	0.904***	0.915***	0.914***
	(0.0434)	(0.0436)	(0.0438)
Married	-0.656***	-0.690***	-0.675***
	(0.0662)	(0.0701)	(0.0705)
Age	0.0698***	0.0705***	0.0710***
	(0.0158)	(0.0165)	(0.0166)
age_square	-0.00185***	-0.00184***	-0.00186***
	(0.000213)	(0.000221)	(0.000222)
College	0.332	0.378	0.505
	(0.438)	(0.439)	(0.439)
vocation_school	0.272	0.325	0.368
	(0.241)	(0.242)	(0.242)
high_school	0.552**	0.560**	0.570**
	(0.231)	(0.232)	(0.232)
middle_school	0.589***	0.602***	0.610***
	(0.225)	(0.226)	(0.226)
primary_school	0.429*	0.437*	0.448**
	(0.225)	(0.226)	(0.226)
family_land		-0.00985	-0.0135**
		(0.00634)	(0.00639)
family_size		0.106***	0.102***
		(0.0222)	(0.0223)
family_wealth		-0.0912***	-0.0560***
		(0.0209)	(0.0213)
labor_force		-0.0405*	-0.0328

		(0.0234)	(0.0234)
Suburb			-0.336***
			(0.104)
flatland			-0.239***
			(0.0532)
telephone			-0.174*
			(0.0998)
labor_share_agri			-1.120***
			(0.227)
share_TVE			-2.813***
			(0.370)
Province dummy	Yes	Yes	Yes
Constant	-4.228***	-4.719***	-3.537***
	(0.417)	(0.455)	(0.521)
R_squared	0.180	0.183	0.189
Observations	21,549	21,549	21,549

Note:age_square is the quartic term of age, standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 3 The external effect on migration: Mlogit regressions

	(1)		(2)		(3)	
Variables	migrant	Local_offfarm	migrant	Local_offfarm	migrant	Local_offfarm
Cedyr	0.0840**	0.142***	0.0805**	0.0760**	0.0909**	-0.0160
	(0.0376)	(0.0358)	(0.0383)	(0.0370)	(0.0400)	(0.0402)
Gender	1.148***	1.183***	1.156***	1.174***	1.151***	1.209***
	(0.0444)	(0.0446)	(0.0446)	(0.0449)	(0.0447)	(0.0461)
Married	-0.635***	0.0371	-0.666***	0.0494	-0.656***	0.00193
	(0.0689)	(0.0824)	(0.0728)	(0.0868)	(0.0730)	(0.0882)
Age	0.0960***	0.137***	0.0863***	0.0871***	0.0864***	0.0876***
	(0.0162)	(0.0160)	(0.0168)	(0.0168)	(0.0169)	(0.0171)
age_square	-0.00218***	-0.00171***	-0.00204***	-0.00109***	-0.00205***	-0.00107***
	(0.000217)	(0.000195)	(0.000225)	(0.000205)	(0.000226)	(0.000209)
College	0.491	1.212***	0.528	1.128**	0.606	0.907**
	(0.456)	(0.445)	(0.457)	(0.453)	(0.456)	(0.460)
vocation_school	0.807***	2.240***	0.843***	2.137***	0.873***	2.062***
	(0.245)	(0.223)	(0.246)	(0.224)	(0.246)	(0.225)
high_school	0.800***	1.447***	0.798***	1.367***	0.811***	1.327***
	(0.233)	(0.213)	(0.234)	(0.214)	(0.234)	(0.215)
middle_school	0.698***	1.032***	0.703***	0.951***	0.711***	0.901***
	(0.226)	(0.209)	(0.227)	(0.209)	(0.228)	(0.210)
primary_school	0.464**	0.584***	0.470**	0.529**	0.470**	0.400*
	(0.226)	(0.209)	(0.227)	(0.209)	(0.228)	(0.210)
family_land			-0.0131**	-0.0181***	-0.0160**	-0.0156**
			(0.00646)	(0.00645)	(0.00650)	(0.00647)
family_size			0.123***	0.0381*	0.120***	0.0462**
			(0.0228)	(0.0228)	(0.0229)	(0.0232)
family_wealth			-0.0512**	0.115***	-0.0419*	0.0457***
			(0.0220)	(0.0154)	(0.0221)	(0.0167)
labor_force			-0.0981***	-0.240***	-0.0901***	-0.259***

			(0.0241)	(0.0244)	(0.0241)	(0.0250)
Suburb					-0.237**	0.344***
					(0.107)	(0.0848)
Flatland					-0.234***	-0.0142
					(0.0548)	(0.0502)
Telephone					-0.156	0.174
					(0.102)	(0.129)
labor_share_agri					-1.268***	-0.739***
					(0.233)	(0.226)
share_TVE					-0.820**	4.274***
					(0.391)	(0.255)
Province dummy	Yes		Yes		Yes	
Constant	-5.153***	-8.639***	-5.252***	-6.742***	-3.783***	-5.577***
	(0.426)	(0.446)	(0.464)	(0.482)	(0.530)	(0.564)
R_squared	0.181		0.187		0.202	
Observations	21,549	21,549	21,549	21,549	21,549	21,549

Note: In Table, regression (1) just is with the individual controls. Regression (2) controls the family characteristics; (3) regression (3) controls the community characteristics.

Table 4 The interaction between TVEs and average education on migration：logit regression

	(1)	(2)	(3)
Variables	Migrant	migrant	migrant
Cedyr	0.0943**	0.101***	0.117***
	(0.0370)	(0.0377)	(0.0389)
c.cedyr#c.share_TVE	-0.346***	-0.326***	-0.348***
	(0.0436)	(0.0442)	(0.0486)
Individual controls	Yes	Yes	Yes
Family controls	No	Yes	Yes
Community controls	No	No	Yes
Province dummy	Yes	Yes	Yes
R_squared	0.184	0.186	0.189
Observations	21,549	21,549	21,549

Note: Regression (1) is only with individual controls, regression (2) is with individual and family controls, regression(3) is with individual, family and community controls. c.cedyr#c.share_TVE is the interaction term of share_TVE and cedyr.

Table 5 The interaction between TVEs and average education on migration：logit regression：Mlogit regressions

	(1)		(2)		(3)	
Variables	migrant	Local offfarm	migrant	Local offfarm	migrant	Local offfarm
Cedyr	0.0952**	0.0596	0.0918**	0.0109	0.0951**	-0.0596
	(0.0381)	(0.0367)	(0.0388)	(0.0377)	(0.0400)	(0.0401)
c.cedyr#c.share_TVE	-0.0638	0.618***	-0.0539	0.607***	-0.0888*	0.551***
Individual controls	Yes		Yes		Yes	
Family controls	No		Yes		Yes	
Community controls	No		No		Yes	
Province dummy	Yes		Yes		Yes	
R_squared	0.194		0.199		0.202	
Observations	21,549	21,549	21,549	21,549	21,549	21,549

Note: : Regression (1) is only with individual controls, regression(2) is with individual and family controls, regression(3) is with individual, family and community controls. c.cedyr#c.share_TVE is the interaction term of share_TVE and cedyr.

Table 6 The interaction between network and average education on migration：logit regressions

	(1)	(2)	(3)
Variables	migrant	migrant	migrant
cedyr	0.0708*	0.0752**	0.0797**
	(0.0372)	(0.0379)	(0.0392)
c.cedyr#c.share_TVE	-0.300***	-0.280***	-0.329***
	(0.0436)	(0.0443)	(0.0485)
c.cedyr#c.network	0.00664***	0.00656***	0.00637***
	(0.000617)	(0.000621)	(0.000631)
Individual controls	Yes	Yes	Yes
Family controls	No	Yes	Yes
Community controls	No	No	Yes
Province dummy	Yes	Yes	Yes
R_squared	0.190	0.191	0.194
Observations	21,549	21,549	21,549

Note: c.cedyr#c.share_TVE is the interaction term between cedyr and share_TVE，c.cedyr#c.network is the interaction between cedyr and network。Regression (1) is with the individual controls. Regression (2) is added with the family controls, and regression (3) is added with the community controls.

Table 7 The interaction between network and average education on migration：Mlogit regressions

	(1)		(2)		(3)	
Variables	Migrant	localofffarm	Migrant	localofffarm	Migrant	localofffarm
Cedyr	0.0719*	0.0569	0.0653*	0.00809	0.0579	-0.0606
	(0.0383)	(0.0368)	(0.0390)	(0.0378)	(0.0403)	(0.0402)
c.cedyr#c.share_TVE	-0.0177	0.612***	-0.00703	0.604***	-0.0681	0.551***
	(0.0464)	(0.0298)	(0.0471)	(0.0306)	(0.0511)	(0.0334)
c.cedyr#c.network	0.00627***	-0.00192**	0.00634***	-0.00112	0.00626***	-0.000603
	(0.000636)	(0.000773)	(0.000640)	(0.000780)	(0.000650)	(0.000792)
Individual control	Yes		Yes		Yes	
Family control	No		Yes		Yes	
Community control	No		No		Yes	
Province control	Yes		Yes		Yes	
R_squared	0.197		0.202		0.204	
Observations	21,549	21,549	21,549	21,549	21,549	21,549

Note: c.cedyr#c.share_TVE is the interaction term between cedyr and share_TVE，c.cedyr#c.network is the interaction between cedyr and network。Regression (1) is with the individual controls. Regression (2) is added with the family controls and regression (3) is added with the community controls.

Table 8 The nonlinear effect of average education on migration

	(1)	(2)	(3)
variables	migrant	migrant	migrant
c.chss#c.share_TVE	-11.55***		
	(1.797)		
c.chss#c.network	0.286***		
	(0.0306)		
c.cvss#c.share_TVE		-28.52***	
		(4.406)	
c.cvss#c.network		0.624***	
		(0.0875)	
c.colsh#c.share_TVE			-237.5***
			(42.66)
c.colsh#c.network			2.615***
			(0.999)
Province dummy	Yes	Yes	Yes
R_squared	0.194	0.192	0.189
Observations	21,549	21,549	21,549

Note：The three regressions are logit regressions. The key variables are respectively:chss,cvss and colsh, other controls are the same as the Table 3.To save space, we just report the estimates of our interest.

Table 9 The external effect of education by education groups

	(1)	(2)	(3)	(4)
Variables	migrant	migrant	migrant	migrant
Cedyr	0.0533	0.0537	0.0974**	0.0709
	(0.0937)	(0.0936)	(0.0436)	(0.0440)
c.cedyr#c.share_TVE		-0.149		-0.417***
		(0.0918)		(0.0589)
c.cedyr#c.network		0.00489***		0.00676***
		(0.00161)		(0.000689)
Individual controls	Yes	Yes	Yes	Yes
Family controls	Yes	Yes	Yes	Yes
Community controls	Yes	Yes	Yes	Yes
Province dummy	Yes	Yes	Yes	Yes
R_squared	0.158	0.160	0.199	0.204
Observations	3,447	3,447	18,102	18,102

Note：the other controls is the same as correspondence controls in the Table 3.

Table 10 The estimates of education return using CHIPS1995 and CHIPS2002

	1995	1995	2002	2002
Variables	lnwage(TVE)	lnwage(migration)	Lnwage(TVE）	lnwage(migration)
years_edu	0.110***	0.115***	0.0321***	0.0508***
	(0.0165)	(0.0177)	(0.00569)	(0.00627)
Age	0.157***	0.0539	0.0371***	0.0446***
	(0.0359)	(0.0362)	(0.0115)	(0.0108)
age_square	-0.00184***	-0.000570	-0.000451***	-0.000491***
	(0.000451)	(0.000499)	(0.000140)	(0.000147)
days_work_perweek	0.354***	0.0861***		
	(0.0185)	(0.0163)		
Gender	0.191*	0.256**	0.0790**	0.0617*
	(0.103)	(0.101)	(0.0326)	(0.0319)
married	-0.513***	-0.175	0.107*	0.0735*
	(0.178)	(0.139)	(0.0606)	(0.0432)
workdays			0.00746***	0.00572***
			(0.000137)	(0.000150)
Constant	-2.978***	-1.749***	2.830***	2.789***
	(0.603)	(0.599)	(0.201)	(0.172)
Observations	3,209	2,175	3,772	3,586
R-squared	0.155	0.034	0.463	0.318

Note：lnwage is the log year wage.

Table 11 The estimates of average education based on 2SLS

	(1)	(2)		(3)	(4)	
Variables	migrant	1	2	migrant	1	2
cedyr_hat	0.642***	0.749***	0.250	0.669***	0.752***	0.149
c.cedyr_hat#c.share_TVE				-0.343***	-0.0813	0.532***
				(0.0553)	(0.0578)	(0.0403)
c.cedyr_hat#c.network				0.00643***	0.00629***	-0.000655
				(0.000636)	(0.000656)	(0.000793)
Constant	-7.453***	-8.563***	-7.593***	-7.399***	-8.355***	-6.923***
	(1.434)	(1.491)	(1.354)	(1.424)	(1.481)	(1.338)
Province dummy	Yes	Yes		Yes	Yes	
R_squred	0.190	0.203		0.196	0.205	
Observations	21,549	21,549	21,549	21,549	21,549	21,549

Note:cedyr_hat is the predicted value of cedyr from first stage of OLS. c.cedyr_hat#c.share_TVE is the interaction terms of share_TVE and cedyr,c.cedyr_hat#c.network is the interaction term between cedyr and network.The other controls is the same as the controls in Table 3.

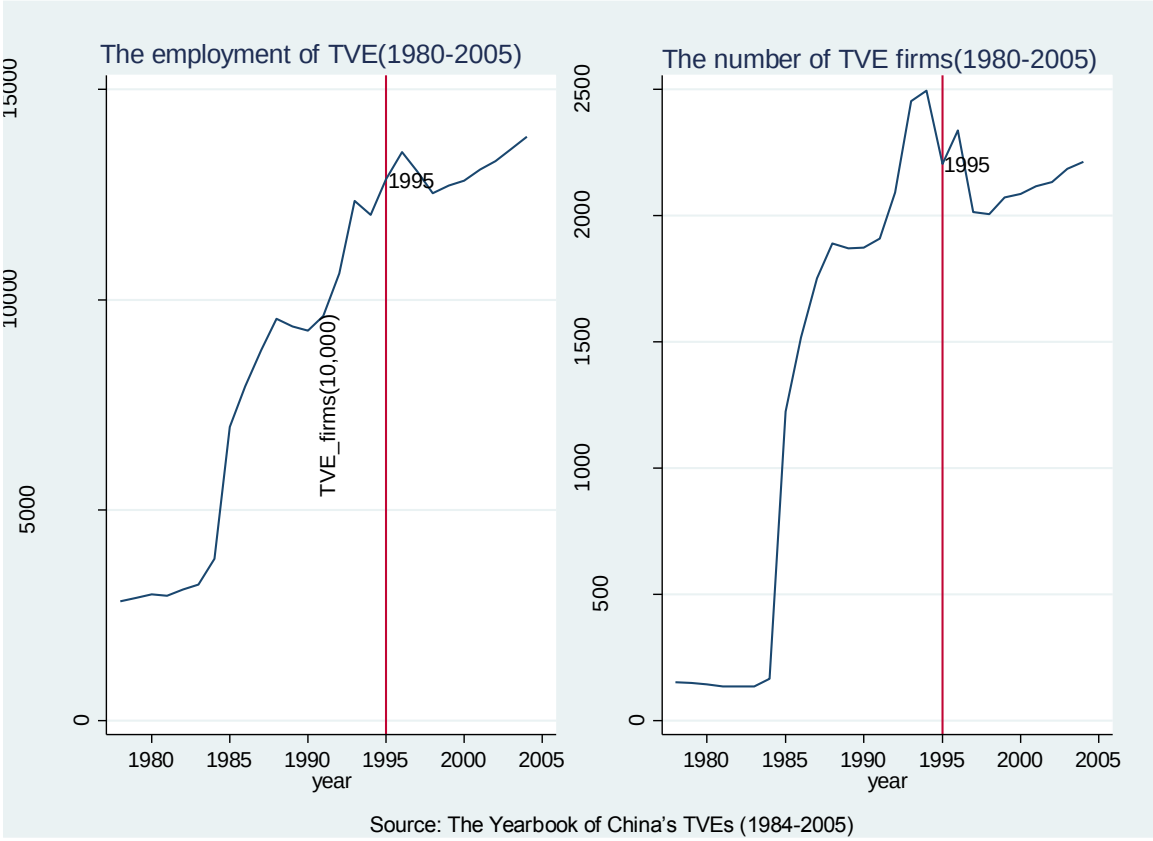
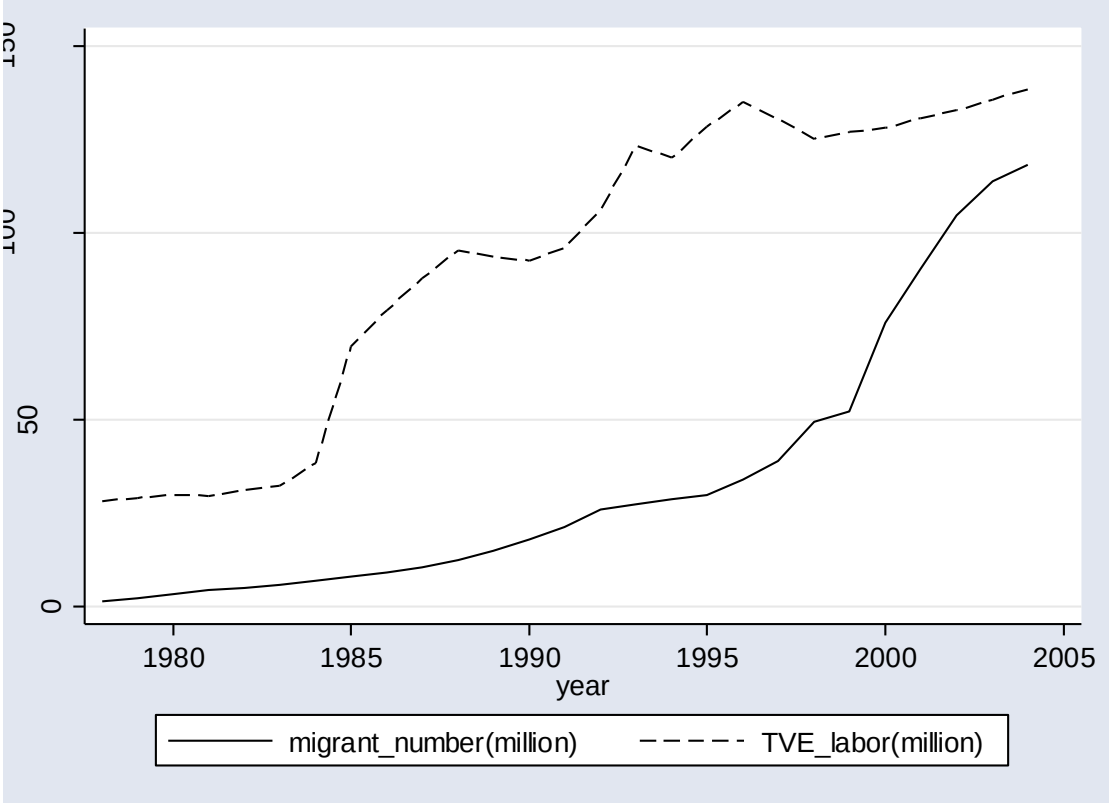


Figure 1 The development of TVEs in China(1978-2005)



Data source: The employment of TVEs is from the Statistical Yearbook of China's TVEs (1984-2005); the number of migrant is from the estimates of Sheng (2008).

Figure 2 The number of migrants and employment of TVEs(1978-2004)

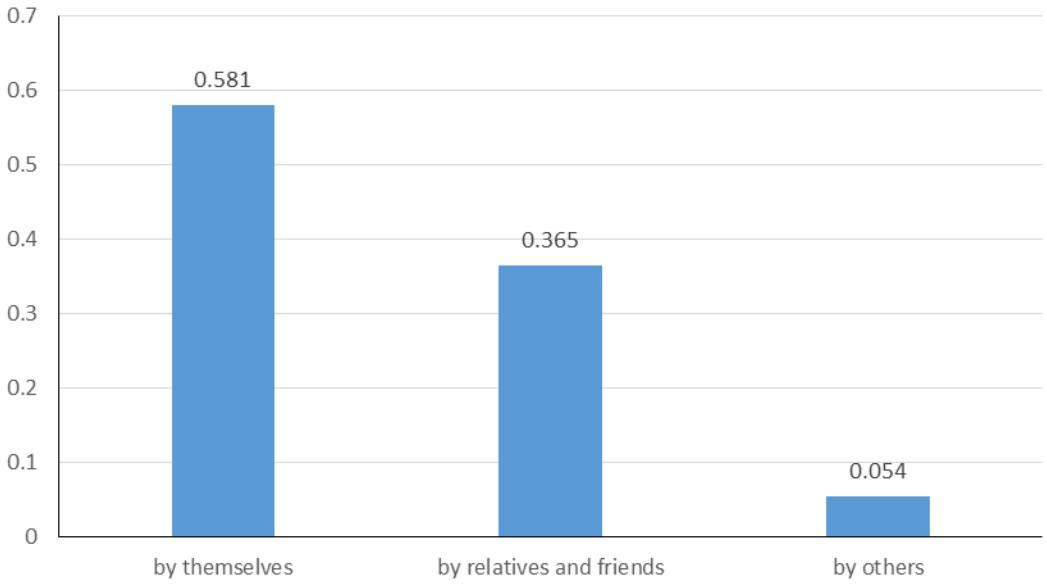


Figure 3 Ways of finding the job for migrants in CHIPS2002

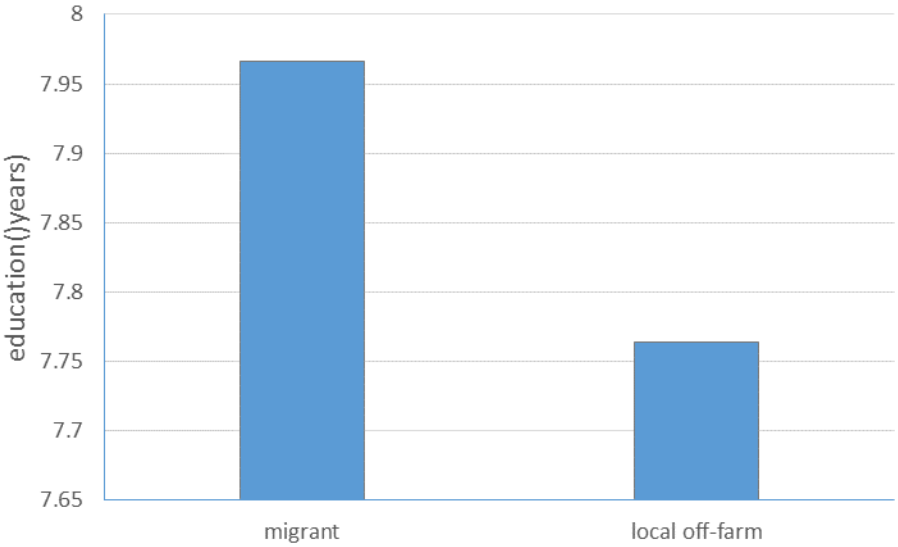


Figure 4 The average education level of labors working in TVEs and migrants (CHIPS2002)