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How Does Rural–Urban Migration Experience Affect Arable Land Use? Evidence from 2293 Farmers in China

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Abstract: Return migrants play an increasingly important role in agricultural production in China and other developing countries. However, the effect of rural–urban migration experience on farmers’ arable land use remains unclear. This study aims to fill this gap using data from a survey of 2293 farmers consisting of 586 return migrants and 1707 non-migrants in China. We employ the treatment effects model to account for the self-selectivity of rural–urban migration experience arising from observable and unobservable factors. The results show that after accounting for the self-selectivity bias, the rural–urban migration experience significantly increases farmers’ arable land use by 22%. Meanwhile, the positive effect of rural–urban migration experience on arable land use differs by farmers’ age group and region. While rural–urban migration experience increases arable land use for farmers aged below 65 years old by 29%, it shows no significant effect on arable land use for farmers aged 65 years old and above. In addition, there is a positive relationship between rural–urban migration experience and arable land use in Shaanxi, Shandong, and Zhejiang. However, there is no significant effect of rural–urban migration experience on arable land use. On such a basis, we discuss several important implications for policies related to arable land use in China.

Keywords: migration; land use; treatment effects model; self-selectivity; China

1. Introduction

Rural–urban migration has been playing an important role in economic development in China and many other developing countries worldwide [1,2]. Over the past four decades, the household responsibility system and progress in agricultural technology has greatly promoted the growth in agricultural productivity, which further leads to a sharp increase in surplus rural labour force in rural China [3–5]. Meanwhile, the impressive expansion of urban sectors has formed a huge labour demand, resulting in the migration of a large number of farmers to urban areas to participate in off-farm work with a relatively higher wage [2,6,7]. In 2018, there were more than 280 million farmers moving off farms in China [8]. Note that the massive migration of farmers from rural to urban areas aggravates the aging of the agricultural labour force, which raises the problem of who farms the land in the future [9–12].

The majority of farmers migrating to urban areas have to return to their hometown due to the rigid constraint of the dual household registration system (known as *hukou*) and other factors [2,13]. Many studies show that the presence of the dual household registration system constitutes a barrier to those farmers settling in urban areas [1,14,15]. After a period of off-farm work in urban areas, farmers migrating to urban areas have to return to their hometown as they get older or their health status becomes poorer.

Meanwhile, a considerable number of return migrants attempt to start their own business in their hometown upon return with the help of physical and human capital accumulated during the migration period [1,16,17]. For example, a survey conducted in 2009 found that 43% of 1019 return migrants in Hubei had a willingness to start a business in their hometown when they returned to their hometown in the future [18]. Similarly, about 65% of the 1145 return migrants surveyed between 2009 and 2010 in Jiangxi also had the willingness to start a business upon return [19]. Using data of the Chinese Household Income Project Survey (CHIPS), Zhou et al. [20] found that rural–urban migration experience increased return migrants’ likelihood of starting a business by 1.8%. However, Wang and Yang [21] conducted an econometric analysis using a survey dataset of 600 return migrants and 2561 non-migrants in China, and concluded that rural–urban migration experience exerted significantly positive effect on farmers’ participation in the wage-employed work, and was negatively associated with farmers’ self-employment.

A few studies analyse return migrants’ participation in agricultural production in recent years. A survey conducted in Sichuan found that nearly half of 309 return migrants aged above 40 years old had no option but to engage in agricultural production [22]. Using survey data from the Research Center for Rural Economy of the Ministry of Agriculture and Rural Affairs of China, a study indicated that about 31.4% of 799 migrant farmers born in 1980s and 1990s showed willingness to return to their hometown to engage in agricultural production [9]. Gong [23] also found that 28.6% of 1642 migrant farmers aged between 16 and 33 years old had the willingness to become occupational farmers upon return. Several studies further investigate the effect of the rural–urban migration experience on farmers’ agricultural production [19,24,25]. Using survey data of 1300 farmers in Hubei, for example, Shi and Wang [26] found that the accumulated time of rural–urban migration exerted a significantly positive effect on farmers’ adoption of new agricultural technologies upon return. Qian et al. [27] employed a Heckman selection model to account for the sample selection bias and pointed out that return migrants could provide financial and human capital to promote specialized agricultural production.

The small-scale farmers dominate agricultural production in China. For example, Huang and Ding [28] indicated that China has about 40% of the small-scale farmers in the world. Note that small-scale farming is closely associated with the overuse of agrochemicals [29], low productivity and efficiency [30], and poor risk-resistant capability [31]. In recent years, the land use policies implemented by the Chinese government aimed to increase the size of arable land managed by individual farmers in a moderate way and promote the appropriately large-scale arable land use [32]. For example, the government separated the ownership, contracting the right and management right of arable land to promote land transfer and appropriately large-scale land use. In such a context, which role do return migrants play in promoting the appropriately large-scale arable land use becomes a crucial issue that needs further study. In particular, it is of great importance to investigate whether rural–urban migration experience increases farmers’ arable land use. However, the relevant empirical evidence is rare.

The motivation of this study is to investigate the effect of rural–urban migration experience on arable land use for Chinese farmers from both the theoretical and empirical perspectives. Compared with previous studies, the contributions of this study are twofold. First, previous studies have attached attention to the relationship between rural–urban migration experience and several aspects of agricultural production [19,24–27]. However, little is known about how rural–urban migration experience affects arable land use among farmers. This study fills this gap by investigating the effect of rural–urban migration experience on arable land use in China. Second, the self-selectivity issue of rural–urban migration experience has been ignored in previous studies, which would lead to a biased econometric estimation. In comparison, this study addresses this issue using the treatment effects model. Taking these two aspects into account, we use a random survey dataset covering 2293 farmers in seven Chinese provinces for analysis, and employ the treatment effects model to account for the potential self-selectivity of rural–urban migration experience. In fact, rural–urban migration and return migration are not unique phenomena in China; they are also popular worldwide, especially in many

developing countries [33–37]. It should be noted that when the advantages of physical strength and ability to participate in off-farm work gradually vanish as they become older, return migrants in rural areas would have to return to agriculture accordingly. While this study is conducted in the context of China, it also has important academic and policy implications for farmers' rural–urban migration and return migration as well as their effects on land use in other developing countries.

We organize the remainder of this study as follows. Section 2 discusses the mechanism by which rural–urban migration experience affects farmers' arable land use. Section 3 introduces the econometric technique for empirical analysis. In Section 4, we introduce the procedure of sampling, variable and data description. Section 5 reports the empirical results with robustness tests. The final section concludes the study with important implications for policies related to land use in China.

2. Theoretical Analysis

This part analyses the mechanism by which rural–urban migration experience affects farmers' arable land use. Rural–urban migration experience would affect farmers' arable land use through reducing capital constraint, improving entrepreneurship, and altering technology endowment [38–41].

First, rural–urban migration experience would increase arable land use through softening farmers' capital constraint. In China and many other developing countries, the undeveloped rural financial system forms a rigid capital constraint for farmers who are willing to manage arable land. Previous evidence demonstrates that the rural–urban migration experience could effectively raise the household income of farmers migrating to urban areas [42–44]. In China, for example, off-farm wage was the largest source of the growth of per capita rural income during the period 2014–2018, accounting for more than 40% of the growth [45]. In this context, the rural–urban migration experience may be conducive to increasing the likelihood that farmers manage larger arable land from this perspective.

Second, rural–urban migration experience could promote the development of farmers' entrepreneurial consciousness, which may also increase their likelihood of increasing arable land use. On the one hand, previous studies point out that the rural–urban migration experience results in the accumulation of human and social capital in addition to the increase in physical capital [1,46]. On the other hand, return migrants may be more likely to obtain a modern business and management philosophy [47]. Both these effects of rural–urban migration could help farmers to develop their entrepreneurial consciousness [1,46]. It is reasonable to assume that enhanced entrepreneurial consciousness would lead farmers to invest more in agriculture, such as increasing the size of arable land.

Third, the rural–urban migration experience would alter farmers' technology endowment with regard to agricultural production, which would further affect their decisions on arable land use. Overall, the rural–urban migration experience may exert both positive and negative effects on farmers' technology endowment with regard to agricultural production. First, due to a long-term absence from agricultural production, return migrants may lack farming experience and knowledge of traditional technologies to some extent [24,25]. Second, however, previous evidence also shows that the rural–urban migration experience could lead farmers to adopt new technologies with regard to agricultural production [26]. In such a context, whether rural–urban migration experience exerts a positive or negative effect on farmers' technology level is not explicit, and thus, the effect of rural–urban migration experience on farmers' arable land use remains ambiguous, altering their technology endowment.

Note that the effect of the rural–urban migration experience on arable land use may differ by farmers' age group and location. On the one hand, rural–urban migration experience would exert largely different effects on arable land use through affecting the aforementioned three factors for farmers in different age groups. For the aging and young farmers with rural–urban migration experience, the former would have stronger entrepreneurial consciousness [17]. Moreover, young farmers may be more likely to adopt new technologies in contrast to aging farmers when both have rural–urban migration experience [48,49]. On the other hand, there are obvious differences in geographical

characteristics and cropping structures in different regions. In contrast to producing grain crops, for example, the profit margin of producing cash crops is much larger, which would provide more incentive for farmers to increase arable land use.

3. Materials and Methods

3.1. Model Specification

In addition to farmers' rural–urban migration experience, other factors may also affect their arable land use. To examine the effect of rural–urban migration experience on farmers' arable land use, we develop a benchmark multivariate model to account for the other covariates. The model specification is as follows

$$\ln Y_i = \alpha D_i + X_i' \beta + u_i \quad (1)$$

where the subscript i denotes the i -th farmer. Y_i denotes arable land use measured by the size of arable land managed by the i -th farmer; D_i denotes a dummy variable indicating whether a farmer has rural–urban migration experience; X_i denotes a vector of covariates; α and β are the coefficients to be estimated; and u_i is the random error term.

3.2. Self-Selectivity Issue

We can employ two strategies to estimate the coefficients of Equation (1). The ordinary least squares (OLS) estimation of Equation (1) can produce unbiased and consistent results when both rural–urban migration experience and other covariates are exogenous. However, farmers' rural–urban migration experience is an outcome of self-selectivity [50], which is a type of endogeneity for dummy variables. For example, farmers with less interest or ability in agricultural production may be more likely to migrate to urban areas to seek for off-farm work. Meanwhile, farmers' interest and ability in agricultural production would in turn influence their arable land use. More importantly, the self-selectivity of rural–urban migration experience may arise from both observable and unobservable factors [49,51]. A failure to account for the self-selectivity would over-estimate or under-estimate the effect of rural–urban migration experience on arable land use.

Previous studies have employed several methods to account for the self-selectivity issue, such as propensity score matching, inverse probability of treatment weighting, and endogenous switching regression model [52]. However, the propensity score matching and inverse probability of treatment weighting could only account for the self-selectivity arising from observable factors [52]. In comparison, the endogenous switching regression model could account for the self-selectivity arising from both observable and unobservable factors, and calculate the average treatment effect [53]. However, it could not estimate the direct effect of endogenous dummy variables.

3.3. Treatment Effects Model

The treatment effects model is also suitable to account for the self-selectivity arising from both observable and unobservable factors. More importantly, it could also provide both the average treatment effects and the direct effect of endogenous dummy variables [54]. The treatment effects model contains two equations. The first is a treatment equation in which the endogenous dummy variable is regressed on the instrumental variable and other covariates. The second one is an outcome equation described by Equation (1), in which the outcome variable is regressed on the endogenous dummy variable and other covariates. We can estimate the following treatment equation

$$D_i^* = \gamma I_i + X_i' \delta + v_i \quad (2)$$

$$D_i = \begin{cases} 1, & D_i^* > 0 \\ 0, & D_i^* \leq 0 \end{cases} \quad (3)$$

where D_i^* denotes the latent variable of the endogenous dummy variable. In this study, it measures the likelihood that the i -th farmer has rural–urban migration experience. Note that D_i is equal to one when the farmer has rural–urban migration experience, and zero otherwise. I_i denotes the instrumental variable. γ and δ are the coefficients to be estimated. v_i is the random error term.

As for the treatment effects model, we assume the random error terms of Equations (1) and (2) to be normally distributed with zero means, and have a bivariate normal distribution with covariance matrix as

$$\text{cov}(v_i, u_i) = \begin{pmatrix} \sigma_u^2 & \rho\sigma_u \\ \rho\sigma_u & 1 \end{pmatrix} \quad (4)$$

where the variance of v_i (σ_v^2) is normalized to one. σ_u^2 , σ_u , and ρ denote the variance of u_i , standard deviation of u_i , and correlation coefficient between u_i and v_i , respectively. When the estimated ρ is not equal to zero, it suggests the presence of self-selectivity of farmers' rural–urban migration experience.

We calculate the conditional expectation of the size of arable land managed by farmers with rural–urban migration experience and without rural–urban migration experience as

$$E(\ln Y_i | D_i = 1) = \alpha + \mathbf{X}_i' \boldsymbol{\beta} + E(u_i | D_i = 1) \quad (5)$$

$$E(\ln Y_i | D_i = 0) = \mathbf{X}_i' \boldsymbol{\beta} + E(u_i | D_i = 0) \quad (6)$$

Based on Equation (2), we can further specify Equations (5) and (6) as

$$E(\ln Y_i | D_i = 1) = \alpha + \mathbf{X}_i' \boldsymbol{\beta} + \rho\sigma_u \lambda(-\gamma I_i - \mathbf{X}_i' \boldsymbol{\delta}) \quad (7)$$

$$E(u_i | D_i = 0) = \rho\sigma_u \lambda(\gamma I_i + \mathbf{X}_i' \boldsymbol{\delta}) \quad (8)$$

In Equations (7) and (8), $\lambda(\cdot) = \varphi(\cdot) / [1 - \Phi(\cdot)]$ denotes the inverse Mills ratio. Note that $\varphi(\cdot)$ and $\Phi(\cdot)$ denote the standard normal density function and cumulative distribution function, respectively. We can calculate the difference in the conditional expectation between return migrants and non-migrants as

$$E(\ln Y_i | D_i = 1) - E(\ln Y_i | D_i = 0) = \alpha + \rho\sigma_u [\lambda(-\gamma I_i - \mathbf{X}_i' \boldsymbol{\delta}) + \lambda(\gamma I_i + \mathbf{X}_i' \boldsymbol{\delta})] \quad (9)$$

Hence, the effect of rural–urban migration experience on arable land use contains two parts. The first part is captured by the coefficient α , and the second part is captured by $\rho\sigma_u [\lambda(-\gamma I_i - \mathbf{X}_i' \boldsymbol{\delta}) + \lambda(\gamma I_i + \mathbf{X}_i' \boldsymbol{\delta})]$. It becomes apparent that the OLS estimation of Equation (1) ignores $\rho\sigma_u [\lambda(-\gamma I_i - \mathbf{X}_i' \boldsymbol{\delta}) + \lambda(\gamma I_i + \mathbf{X}_i' \boldsymbol{\delta})]$, which would produce a biased and inconsistent result when ρ is not equal to zero. We re-range the inverse Mills ratio for each farmer as

$$\lambda_i = \begin{cases} \lambda(-\gamma I_i - \mathbf{X}_i' \boldsymbol{\delta}), & D_i = 1 \\ -\lambda(\gamma I_i + \mathbf{X}_i' \boldsymbol{\delta}), & D_i = 0 \end{cases} \quad (10)$$

Using Equations (7) and (8), we can write Equation (1) as

$$E(\ln Y_i) = \alpha D_i + \mathbf{X}_i' \boldsymbol{\beta} + \rho\sigma_u \lambda_i \quad (11)$$

4. Data and Variables

4.1. Sampling Procedure

The data used in this study were from a cross-sectional survey of 2293 Chinese farmers between October and November 2016. We conducted the survey in seven provinces, including Guangdong, Guizhou, Hubei, Jiangsu, Shaanxi, Shandong, and Zhejiang. In China, important agricultural provinces in China are located in the northeastern areas, Yellow River Basin, Yangtze River Basin, and Pearl

River Basin. Meanwhile, massive rural–urban migration and return have also been occurring in these areas except for the northeastern areas. To make the sample in this study representative, all the seven provinces were selected in the Yellow River Basin, Yangtze River Basin, and Pearl River Basin. Specifically, Shaanxi, and Shandong are located in the Yellow River Basin; Guizhou, Hubei, Jiangsu, and Zhejiang are located in the Yangtze River Basin; and Guangdong is located in the Pearl River Basin. We selected the surveyed farmers through a multistage random sampling procedure. First, we sorted all the counties in each province according to their per capita rural income and used a systematic sampling method to select four counties (Figure 1). Second, we used a similar approach to select two or three townships in each selected county, and then two villages in each selected township. Third, we randomly selected about 20 farmers according to a household list provided by village leaders in each village. The final sample used in this study contains 2293 farmers. Table 1 presents the distribution of the surveyed farmers.

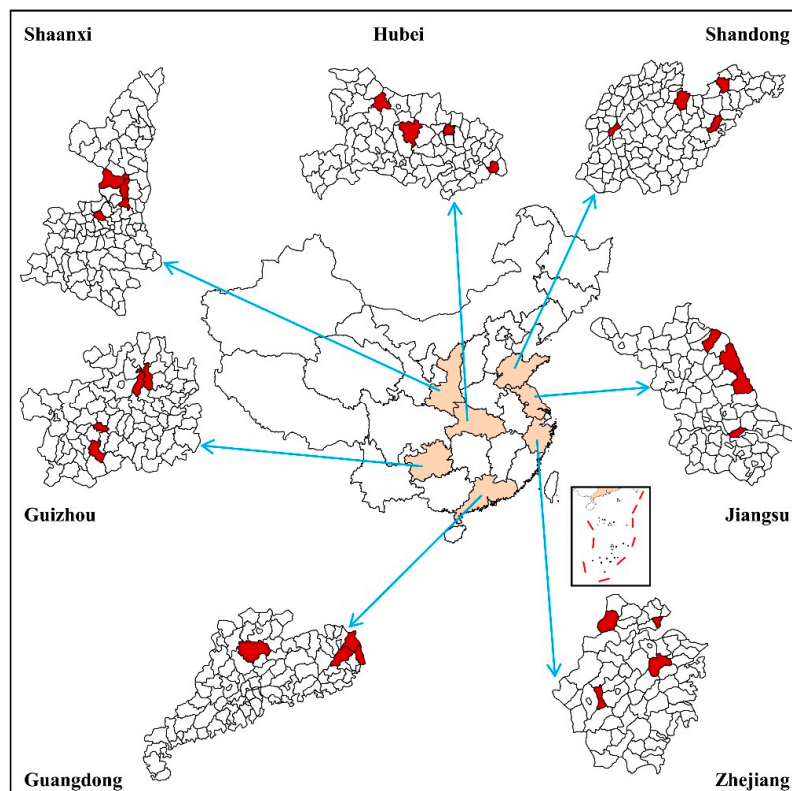


Figure 1. Location of the sample provinces and counties.

Table 1. Number of return migrants and non-migrants by province.

Province	Return Migrants		Non-Migrants		Total
	Number	Percentage (%)	Number	Percentage (%)	
Guangdong	111	36.8	191	63.2	302
Guizhou	111	30.7	251	69.3	362
Hubei	82	26.3	239	73.7	321
Jiangsu	72	21.8	259	78.2	331
Shaanxi	59	18.1	267	81.9	326
Shandong	87	26.3	244	73.7	331
Zhejiang	64	20.0	256	80.0	320
Total	586	25.6	1707	74.4	2293

Note: Data come from the authors' survey.

4.2. Variable and Data Description

A questionnaire interview was conducted to collect a wide range of information, including farmers' socioeconomic characteristics, arable land use, access to agricultural extension service, technology adoption, and agricultural knowledge. To address the issue in this study, we constructed the following variables from the survey dataset. First, arable land use was measured by the aggregate size of arable land managed by the surveyed farmers. Second, rural–urban migration experience refers to a farmer that had previously migrated to urban areas to engage in a fulltime off-farm work before the survey and returned to their hometown to engage in agricultural production when the survey was conducted. Hence, we accordingly divided all the surveyed farmers into two groups, including (1) return migrants rural–urban migration experience, or (2) non-migrants without rural–urban migration experience. Third, several other variables were also drawn from the dataset, including (1) farmers' gender, age, education, and health perception; (2) access to agricultural extension service; (3) number of members engaging in agricultural production and off-farm work, and locational landform; (4) dummy variables for crops produced by farmers and the counties.

For each surveyed farmer, we used the share of return migrants in the same village as an instrumental variable of rural–urban migration experience to account for the self-selectivity. In this study, we selected the instrumental variable based on many previous studies [1,20,49,50,55]. As previously discussed, farmers' migration to urban areas and return to their hometown would be affected by their social network [1,55]. The likelihood that a farmer had rural–urban migration experience may be larger when there were more farmers with rural–urban migration experience in the same village [49,50].

Table 2 summarizes the definition and descriptive statistics of key variables.

Table 2. Definition and descriptive summary of key variables.

Variable	Definition	Mean (SD)
(1) Dependent variable		
Arable land use	Aggregate size of arable land (hectare)	2.24 (17.23)
(2) Independent variables		
Migration experience	1 = return migrant; 0 otherwise	0.26 (0.44)
Male	1 = male; 0 otherwise	0.92 (0.27)
Age	Age in 2016 (years)	53.92 (9.82)
Education	Years of formal schooling (years)	7.22 (3.15)
Health	1 = better self-evaluated health status; 0 = otherwise	0.39 (0.49)
Extension service	1 = access to extension service; 0 = otherwise	0.29 (0.45)
Labour	Number of household labourers	2.91 (1.21)
Plain	1 = home located in plain area; 0 = otherwise	0.56 (0.50)
Rice	1 = producing rice; 0 = otherwise	0.53 (0.50)
Apple	1 = producing greenhouse vegetables; 0 = otherwise	0.20 (0.40)
Vegetable	1 = producing apple; 0 = otherwise	0.09 (0.29)
Tea	1 = producing tea; 0 = otherwise	0.26 (0.44)
(3) Instrumental variable		
Share of return migrants	Percentage of return migrants in the village (%)	25.56 (12.12)

Note: SD refer to standard deviations. Data come from the authors' survey.

4.3. Differences between Return Migrants and Non-Migrants

Table 3 presents the differences of key variables between return migrants and non-migrants. Overall, most of the variables show significant differences between the two groups. On average, the size of arable land managed by return migrants was 4.49 hectare (ha), which was about 3.02 ha larger than that managed by non-migrants. Male farmers were more likely to have rural–urban migration experience. In addition, return migrants were significantly younger and better educated than non-migrants were. The percentage of return migrants with access to agricultural extension services was 7% higher than that of non-migrants. Moreover, return migrants were less likely to live in

plain areas. It should be noted that the significant difference in these variables confirm the presence of self-selectivity of rural–urban migration experience.

Table 3. Mean differences of key variables between return migrants and non-migrants.

Variable	Return Migrants (1)	Non-Migrants (2)	Difference = (1) – (2)
Arable land use	4.49 (30.95)	1.47 (8.25)	3.02 ***
Male	0.94 (0.23)	0.91 (0.29)	0.03 ***
Age	50.63 (10.26)	55.05 (9.40)	−4.42 ***
Education	8.00 (2.77)	6.95 (3.23)	1.04 ***
Health	0.40 (0.49)	0.39 (0.49)	0.01
Extension service	0.34 (0.48)	0.27 (0.44)	0.07 ***
Labour	2.85 (1.21)	2.93 (1.21)	−0.08
Plain	0.52 (0.50)	0.57 (0.50)	−0.05 **
Rice	0.51 (0.50)	0.54 (0.50)	−0.04
Apple	0.15 (0.36)	0.21 (0.41)	−0.06 ***
Vegetable	0.10 (0.30)	0.09 (0.28)	0.01
Tea	0.35 (0.48)	0.23 (0.42)	0.11 ***
Share of return migrants	31.30 (11.63)	23.58 (11.65)	7.72 ***
No. of observations	586	1707	

Note: Standard deviations presented in parentheses. ** and *** denote the statistical significance at 5% and 1% levels, respectively. Data come from the authors' survey.

5. Results and Discussion

5.1. Main Results

Table 4 reports the results estimated using the treatment effects model and OLS method with robust standard errors. We estimated the treatment effects model using the maximum likelihood method. The estimated ρ (the correlation coefficient between u_i and v_i) is significant at the 10% level, which rejects the null hypothesis that the outcome and treatment equations are independent. This suggests that there is a self-selectivity issue of farmers' rural–urban migration experience arising from both observable unobservable factors. The value of ρ is equal to -0.08 , indicating a negative self-selectivity bias. This means that farmers whose size of arable land is larger than the average level are more likely to be a return migrant. In this context, the OLS method would under-estimate the effect of rural–urban migration experience on arable land use.

Table 4. The effects of rural–urban migration experience on arable land use.

Variable	Treatment Effects Model		OLS
	Treatment Equation	Outcome Equation	
Migration experience		0.22 (0.10) **	0.08 (0.06)
Male	0.33 (0.13) ***	0.23 (0.08) ***	0.24 (0.08) ***
Ln(Age)	−1.41 (0.18) ***	−1.11 (0.15) ***	−1.17 (0.15) ***
Ln(Education)	0.05 (0.02) ***	0.01 (0.01)	0.01 (0.01) *
Health	−0.15 (0.06) **	0.17 (0.05) ***	0.17 (0.05) ***
Extension service	0.13 (0.07) *	0.15 (0.05) ***	0.15 (0.05) ***
Labour	−0.02 (0.03)	0.08 (0.02) ***	0.08 (0.02) ***
Plain	0.19 (0.10) *	0.21 (0.07) ***	0.22 (0.07) ***
Rice	0.26 (0.14) *	−0.31 (0.10) ***	−0.30 (0.11) ***
Apple	0.11 (0.30)	0.35 (0.22)	0.35 (0.22)
Vegetable	−0.10 (0.38)	0.26 (0.24)	0.25 (0.24)
Tea	0.36 (0.19) *	0.63 (0.15) ***	0.63 (0.15) ***
County dummy variables	Yes	Yes	Yes
Share of return migrants	0.03 (0.00) ***		
Constant	3.49 (0.76) ***	3.32 (0.66) ***	3.60 (0.65) ***
Independent equations (ρ)	−0.08 (0.05) *		

Table 4. Cont.

Variable	Treatment Effects Model		OLS
	Treatment Equation	Outcome Equation	
Weak instrument			
F statistic	88.24 ***		
Minimum eigenvalue statistic	82.68 [16.38]		
Adjusted R ²			0.21
No. of observations	2293	2293	2293

Note: Robust standard errors presented in parentheses. The critical value of the minimum eigenvalue statistics for a Wald test at the 5% level with a rejection rate of no more than 10% presented in bracket [56]. *, **, and *** denote the statistical significance at 10%, 5%, and 1% levels, respectively.

The results also suggest that the share of return migrants in the same village is a valid instrument variable for rural–urban migration experience (Table 4). The F statistic estimated using the two-stage least squares (2SLS) method is equal to 88.24 and significant at the 1% level (Table 4). Moreover, the minimum eigenvalue statistic for the Wald test at the 5% level with a rejection rate of no more than 10% is equal to 82.68, largely exceeding its critical value of 16.38 proposed by Cragg and Donald [56]. The estimated F and minimum eigenvalue statistics are sufficient to reject the null hypothesis of weak instrument. The coefficient of the share of return migrants in the same village is significant and positive, which illustrates that the likelihood of farmers’ rural–urban migration experience is positively associated with the share of return migrants in the same village. This is consistent with the aforementioned analysis and previous studies [1,20,49,50,55].

Farmers’ rural–urban migration experience is also associated with several factors (Table 4). Male and better-educated farmers are more likely to have rural–urban migration experience since both coefficients are significant and positive. Farmers’ rural–urban migration experience also has a negative relationship with their age. In addition to the fact that farmers migrating to urban areas are relatively younger [23], many farmers withdraw from agricultural production when they are aged 80 years old and above [23]. By contrast, those migrating to urban areas often retire from off-farm work at a much younger age [23]. There is a negative association between farmers’ self-evaluated health status and rural–urban migration experience. Although previous evidence for this finding is lacking, it remains reasonable. Note that farmers migrating to urban areas would not retire unless their health status becomes unqualified for off-farm work. In addition, farmers with better access to an agricultural extension service and living in plain areas are more likely to have rural–urban migration experience.

The finding of interest in this study is that farmers’ rural–urban migration experience exerts a significant and positive effect on their arable land use (Table 4). According to the results of the treatment effects model, the coefficient of rural–urban migration experience is equal to 0.22 and significant at the 5% level. This suggests that rural–urban migration experience would increase farmers’ arable land use by 22%, accounting for the self-selectivity bias. Farmers’ behavior and performance during their rural–urban migration process have been well documented in previous studies [27,51,57–60], but little attention is paid to the relationship between rural–urban migration experience and farmers’ behavior after their return to hometown. Hence, this study can help improve the understanding of the role of farmers’ rural–urban migration experience in China.

In addition to rural–urban migration experience, we also found that several other factors exert a significant effect on farmers’ arable land use (Table 4). For example, the coefficient of the male dummy variable is equal to 0.23 and significant at the 1% level, which illustrates that male farmers manage 23% more arable land than female farmers with other factors held constant. In fact, several previous studies have indicated that male farmers would not be inclined to transfer their arable land to others [61], or leave arable land idle [62]. There is a significantly negative relationship between farmers’ age and arable land use. The coefficient shows that each 1% increase in farmers’ age would lead to a 1.11% decrease in arable land use. In other words, as farmers’ age increases by 10 years, the size of arable land they manage would accordingly decline by 0.46 ha. This is consistent with several previous studies in

which the older farmers are perceived to be more likely to abandon and transfer arable land [61,63], and thus, managed a smaller-scale of arable land [64]. Moreover, farmers with better self-evaluated health status are more likely to manage 17% more arable land.

Farmers' arable land use was also positively associated with their access to agricultural extension service and number of household labourers (Table 4). An interesting finding shows that access to agricultural extension service has a significant positive effect on farmers' arable land use. In contrast to farmers without access to agricultural extension service, those with access to agricultural extension service manage about 15% more arable land. With other factors held constant, each one increase in the number of household labourers results in about an 8% increase in farmers' arable land use. This finding is reasonable because more household labourers could meet the demand for the labour input of a larger farm size. In addition, farmers' arable land use is also associated with locational landform and cropping structure. For example, farmers living in plain areas and producing tea are inclined to increase the size of arable land, while those producing rice are more likely to manage less arable land.

This study further investigates the effects of rural–urban migration experience on arable land use across farmers' age groups. For this purpose, we divide all the surveyed farmers into two groups. The first group include farmers aged below 65 years old, while the second group include those aged 65 years old and above. We separately estimate the econometric models for these two groups of farmers. Table 5 reports the estimation results. The coefficient of rural–urban migration experience for farmers aged below 65 years old is significant and positive. With other factors held constant, this means that rural–urban migration experience would increase arable land use by 29% for farmers aged below 65 years old. In comparison to those relatively young farmers, there is no positive relationship between farmers' rural–urban migration experience and arable land use for farmers aged 65 years old and above. Note that these results are highly consistent with the aforementioned theoretical analysis. Moreover, the coefficients of other variables are also consistent with the results reported in Table 4.

Table 5. The effects of rural–urban migration experience on arable land use by age group.

Variable	Age < 65 Years Old	Age ≥ 65 Years Old
(1) Outcome equation		
Migration experience	0.29 (0.12) **	0.00 (0.12)
Male	0.21 (0.09) **	0.08 (0.14)
Ln(Age)	−0.75 (0.18) ***	−1.91 (0.79) **
Ln(Education)	0.01 (0.01)	−0.01 (0.01)
Health	0.17 (0.05) ***	0.18 (0.09) **
Extension service	0.16 (0.06) ***	0.09 (0.10)
Labour	0.07 (0.02) ***	0.12 (0.03) ***
Plain	0.20 (0.08) ***	0.26 (0.22)
Crop dummy variables	Yes	Yes
County dummy variables	Yes	Yes
Constant	2.15 (0.76) ***	5.83 (3.29) *
(2) Treatment equation		
Share of return migrants	0.04 (0.00) ***	
Other variables	Yes	
Constant	4.19 (0.90) ***	
Independent equations (ρ)	−0.11 (0.06) *	
Weak instrument		
F statistic	81.55 ***	
Minimum eigenvalue statistic	76.20 [16.38]	
Adjusted R^2		0.37
No. of observations	1959	334

Note: Robust standard errors presented in parentheses. The critical value of the minimum eigenvalue statistics for a Wald test at the 5% level with a rejection rate of no more than 10% presented in bracket [56]. *, **, and *** denote the statistical significance at 10%, 5%, and 1% levels, respectively. The results of treatment effects model are reported for farmers aged below 65 years old since the estimated ρ is significant, while the results of the ordinary least squares (OLS) method are reported for farmers aged 65 years old and above since the estimated ρ is not significant.

Table 6 reports the results of the effects of rural–urban migration experience on arable land use for farmers in different provinces. Specifically, rural–urban migration experience would increase the size of arable land managed by farmers in Shaanxi, Shandong, and Zhejiang provinces by 40–70%. However, we fail to observe such positive effects for farmers in Guangdong, Guizhou, Hubei, and Jiangsu provinces. More importantly, the underlying reasons for the differentiated effects of rural–urban migration experience on arable land use across provinces remain unclear.

Table 6. The effects of rural–urban migration experience on arable land use by province.

Variable	Guangdong	Guizhou	Hubei	Jiangsu	Shaanxi	Shandong	Zhejiang
(1) Outcome equation							
Migration experience	0.13 (0.15)	0.20 (0.13)	−0.10 (0.15)	−0.08 (0.16)	0.48 (0.25) *	0.70 (0.17) ***	0.40 (0.23) *
Male	−0.17 (0.25)	0.06 (0.23)	0.77 (0.22) ***	0.41 (0.15) ***	−0.05 (0.10)	0.15 (0.15)	0.47 (0.26) *
Ln(Age)	−1.16 (0.42) ***	−0.72 (0.30) **	−2.69 (0.40) ***	−1.84 (0.54) ***	0.46 (0.18) **	−0.22 (0.25)	−2.09 (0.62) ***
Ln(Education)	0.03 (0.03)	−0.00 (0.02)	0.02 (0.02)	0.00 (0.02)	0.03 (0.02)	0.02 (0.02)	−0.02 (0.02)
Health	0.35 (0.13) ***	0.37 (0.10) ***	0.07 (0.13)	0.12 (0.14)	0.14 (0.08) *	−0.00 (0.07)	0.16 (0.16)
Extension service	0.12 (0.16)	0.37 (0.13) ***	0.14 (0.15)	0.02 (0.16)	−0.03 (0.06)	0.11 (0.07)	0.27 (0.25)
Labour	0.07 (0.05)	0.11 (0.04) ***	0.05 (0.05)	0.08 (0.05)	0.12 (0.03) ***	0.05 (0.04)	0.06 (0.07)
Plain	0.31 (0.35)	−0.61 (0.20) ***	0.24 (0.16)	0.31 (0.11) ***	−0.00 (0.06)	−0.23 (0.19)	0.47 (0.16) ***
Other variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.42 (1.66) **	0.96 (1.16)	8.89 (1.60) ***	6.22 (2.13) ***	−2.71 (0.69) ***	0.18 (1.04)	6.71 (2.50) ***
(2) Treatment equation							
Share of return migrants					0.04 (0.01) ***	0.03 (0.01) ***	
Other variables					Yes	Yes	
Constant					0.63 (1.93)	7.98 (2.32) ***	
Independent equations (ρ)					−0.57 (0.22) *	−0.75 (0.10) ***	
Weak instrument							
F statistic					9.71 ***	12.41 ***	
Minimum eigenvalue statistic					10.47 [8.96]	9.92 [8.96]	
Adjusted R^2	0.16	0.28	0.27	0.21			0.14
No. of observations	302	362	321	331	326	331	320

Notes: Robust standard errors presented in parentheses. The critical value of the minimum eigenvalue statistics for a Wald test at the 5% level with a rejection rate of no more than 10% presented in bracket [56]. *, **, and *** denote the statistical significance at 10%, 5%, and 1% levels, respectively. The results of treatment effects model are reported for Shaanxi and Shandong since the estimated ρ is significant, while the results of the OLS method are reported for the other five provinces since the estimated ρ is not significant.

5.2. Robustness Tests

We employ two strategies to further test the robustness. Note that a very short-term rural–urban migration may not exert a substantive effect upon farmers’ return to hometown, and thus, the effect of short-term rural–urban migration experience on arable land use may be trivial. Hence, the first strategy is to re-define rural–urban migration experience as farmers’ duration of rural–urban migration that lasts for at least five years. As the second strategy for the robustness test, we exclude the outliers of arable land use above 100 ha. Table 7 reports the results of the robustness tests.

Table 7. Robustness tests for the effects of rural–urban migration experience on arable land use.

Variable	Model (1)	Model (2)
(1) Outcome equation		
Migration experience	0.26 (0.10) ***	0.21 (0.10) **
Male	0.23 (0.08) ***	0.23 (0.07) ***
Ln(Age)	−1.15 (0.15) ***	−1.08 (0.15) ***
Ln(Education)	0.01 (0.01)	0.01 (0.01)
Health	0.17 (0.05) ***	0.15 (0.04) ***
Extension service	0.15 (0.05) ***	0.13 (0.05) ***
Labour	0.08 (0.02) ***	0.09 (0.02) ***
Plain	0.21 (0.07) ***	0.19 (0.07) ***
Other variables	Yes	Yes
Constant	3.48 (0.64) ***	3.13 (0.65) ***
(2) Treatment equation		
Share of return migrants	0.04 (0.00) ***	0.03 (0.00) ***
Other variables	Yes	Yes
Constant	1.33 (0.82)	3.42 (0.76) ***
Independent equations (ρ)	−0.06 (0.04) *	−0.10 (0.06) *
Weak instrument		
F statistic	85.20 ***	87.48 ***
Minimum eigenvalue statistic	88.04 [16.38]	81.91 [16.38]
No. of observations	2293	2287

Notes: Robust standard errors presented in parentheses. The critical value of the minimum eigenvalue statistics for a Wald test at the 5% level with a rejection rate of no more than 10% presented in bracket [56]. *, **, and *** denote the statistical significance at 10%, 5%, and 1% levels, respectively. In Model (1), migration experience was re-defined as farmers' duration of migration lasting for at least five years. In Model (2), farmers managing more than 100 ha of arable land were excluded.

Overall, the results again confirm the positive effects of rural–urban migration experience on arable land use. As shown in Table 7, both the coefficients of rural–urban migration experience in Models (1) and (2) are significant and positive, and their magnitude is consistent with the estimation results in Table 4. Specifically, rural–urban migration experience would increase farmers' arable land use by 21–26%, with other factors held constant. This illustrates that the positive effect of rural–urban migration experience on farmers' arable land use is robust. In addition, the sign, magnitude, and significance of other coefficients are also consistent with those in Tables 4–6.

5.3. Discussion

To address the problems of who farms the land and the low efficiency of small-scale farmers in China, the government have been making great efforts to foster new types of agricultural business entities and promote appropriately large-scale farming [32]. In this context, the findings in this study have several important implications for policies related to land use in China.

First, more efforts should be made to encourage return migrants to rent arable land. In 2009, the Chinese government started to determine, register and certify the rights to contracted use of arable land in rural areas, which was basically over in 2018 [61]. On this basis, the Chinese government further implemented policies to separate the ownership, contracting right and management right of contracted arable land [65]. The implementation of the above-mentioned policies laid a solid foundation for the orderly transfer of contracted land-use rights, and the promotion of appropriately large-scale farming. However, as an increasing number of return migrants engage in agricultural production, the transfer contracts of the management rights of arable land are often informal, or even signed orally [66]. The resulting risks from this situation are detrimental to the orderly transfer of arable land and appropriate large-scale farming for farmers, especially return migrants. This study shows that the size of arable land managed by return migrants is significantly larger than that managed by non-migrants, in which farmers' rural–urban migration experience plays an important role. Hence,

it becomes greatly important to take measures to ensure that the transfer contracts of management right of arable land are rule- and law-based.

Second, it is important to enhance credit support and subsidy policies to promote arable land use for return migrants. The results in this study, to some extent, may provide evidence that reduced capital constraints through rural–urban migration are conducive to increasing arable land use. However, it is important to give a greater priority to rural credit encouraging return migrants and other farmers to participate in off-farm entrepreneurship [67]. By contrast, rural credit support for return migrants' engagement in appropriately large-scale farming is far from enough [67]. Although return migrants may face relatively weaker capital constraints in contrast to non-migrants, to some extent, the lack of credit support to agriculture would hinder the appropriately large-scale management of arable land for farmers. In this context, it is important to attach much attention to the innovation of rural credit policy aiming to support return migrants and other farmers to engage in appropriately large-scale farming. For example, we can take effective measures to allow farmers (especially return migrants) mortgage management rights for their contracted arable land.

Third, more efforts should be made to improve social agricultural services to reinforce training in agricultural technology and skills for return migrants. Rural–urban migration experience would result in farmers' having a lack of traditional agricultural technology and skills, but it could also encourage farmers to adopt modern agricultural technologies [24–26]. However, the crux of the matter is that public agricultural extension service in China could hardly satisfy the technological needs of different types of farmers [68]. This greatly hinders return migrants from increasing their arable land use. In this context, it is crucial to enhance training in agricultural technology and skills. Meanwhile, social agricultural services are perceived to be a fundamental means of making up for the deficiency of public agricultural extension services [69,70].

Fourth, the implementation of land use policies aiming to promote appropriately large-scale farming should be suited to local conditions. The findings in this study reveal that the effect of rural–urban migration experience on arable land use greatly differs across provinces. Although the reasons for such findings remain unclear, it is important to create and implement site-specific policies in accordance with the regional characteristics.

In addition to the aforementioned aspects, it is also crucial for local governments to develop more advanced agricultural technologies to promote the productivity of arable land use. Given the large gap in return to labour between agriculture and non-agricultural work, rural–urban migration is inevitable in a certain sense. However, it is also reasonable to assume that the higher productivity of arable land use would decrease the need for farmers to migrate to urban areas from the outset, which would be useful to mitigate the shortage of agricultural labour force.

6. Conclusions

Return migrants have been playing an increasingly important role in agricultural production in China. This study explores the effect of the rural–urban migration experience on farmers' arable land use theoretically and empirically. Data used in this study come from a cross-section survey of 2293 Chinese farmers conducted in 2016. We employ the treatment effects model to account for the self-selectivity of rural–urban migration experience.

The results provide robust evidence that rural–urban migration experience significantly increases farmers' arable land use by more than 20%. While rural–urban migration experience exerts significantly positive effect on arable land use for farmers aged below 65 years old, it does not have a positive relationship with arable land use for farmers aged 65 years old and above. In addition, the effect of rural–urban migration experience on arable land use also differ across provinces.

Based on the aforementioned findings, we discuss several important implications for policies related to land use in China. To summarize, it is important to take measures to encourage return migrants to rent arable land, and enhance credit support and subsidy policies to promote arable land use for return migrants, improve social agricultural services to reinforce training in agricultural

technology and skills for return migrants, implement locally suitable land use policies aiming to promote appropriately large-scale farming, as well as develop advanced agricultural technologies to promote the productivity of arable land use.

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