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*ABSTRACT***:** This paper investigates how land acquisition during urbanization affects labor allocation decisions of farm households in China. We develop an agricultural household model by including land acquisition to examine its impacts on nonfarm labor participation and income. Two datasets (self-designed household surveys at Xingwen County in 2012 and the China Household Finance Survey (CHFS) data covering 29 provinces in 2013) are adopted for empirical analysis. The results find that land reduction has significantly positive effects on the probability and the share of family nonfarm labor allocation from both datasets. We also find that land acquisition increases the household income of the land acquisition group in CHFS data.

JEL classification: D13; J43; R23; R28

KEY WORDS: land acquisition; nonfarm labor allocation; household income; China

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1. Introduction

China has been experiencing rapid urbanization since the 1990s, with an urbanization rate rising from 26% in 1990 to 53% in 2013 (World Bank, 2014). Driven by increasing land demand for urban expansion, Chinese local governments massively acquire suburban rural land and transform them to urban land. As a result, more and more farmers have lost most of their land and have become a huge special group in China.[2] The total population of this group was estimated to be 40-50 million in 2010, with a growth rate of 3 million per year, and will reach 110 million by 2030 (Pan and Wei, 2011). Since land is the most important asset for Chinese farm households who do not qualify for essential welfare systems and lack of human capital, land acquisition may bring livelihood shocks to those affected households.[3] One important area of investigation is to examine the welfare effects of land acquisition on whether the affected households have sustainable livelihoods.

The purpose of this paper is to investigate how the affected farm households respond to land acquisition on nonfarm labor allocation decisions and the related income effects. The increasing nonfarm labor participation and income growth serve as indicators of welfare improvement, which is suggested by the literature on off-farm employment in rural China (Uchida et al., 2009). In addition, a sustainable livelihoods framework shows that livelihood behaviors are highly related to livelihood assets, and any change in household assets would bring behavior adjustments in the pursuit of sustainable livelihoods (Scoones, 1998). As

[2] According to China's land acquisition policy, this group statistically refers to those whose land size after land acquisition is below 0.3 mu (1 mu = 0.165 acre).
[3] See Yeh and Wu (1996), Ding (2007), and He et al. (2009).

land acquisition leads to the decrease of land assets and the gaining of monetary payments as compensation, it might induce households to reallocate labor endowments from farm to nonfarm sectors. This adjustment process is the key for family sustainable livelihoods since nonfarm activities contribute to rural income growth (Zhang et al., 2002; Yang, 2004), poverty reduction (Du et al., 2005), and welfare improvement (Uchida et al., 2009). Furthermore, from the perspective of economic efficiency, policy measures would be more effective when they begin with an understanding of household-level behaviors (Chambers and Conway, 1992). Hence, it is of significance to study the impact of land acquisition on nonfarm labor allocation decisions and income.

We extend the agricultural household model following Benjamin (1992) by including land acquisition. The model yields three main hypotheses: first, when compensation price is lower than a certain critical value, the shock of land reduction would increase family nonfarm labor participation; second, the higher the compensation price, the less the family labors allocating to nonfarm activities due to the income effect; third, land acquisition would increase family income when compensation price is greater than a critical value. Two datasets (self-designed household surveys at Xingwen County in 2012 and the China Household Finance Survey (CHFS) data covering 29 provinces in 2013) are adopted for empirical analysis. The results show that land reduction has significantly positive effects on the probability and the share of family nonfarm labor allocation. We do not find that land acquisition increases the income levels in Xingwen County, but do find the incomes are significantly higher in the households with land acquisition than those without land acquisition in CHFS data. We also find that the negative effect of compensation price on nonfarm labor input is not statistically significant in CHFS data. In addition, we find that human capital significantly contributes to both labor allocation and

income, suggesting that households with less human capital have bigger difficulties in labor adjustment and income growth. Hence, a special policy is needed to stimulate their nonfarm employment and help to accumulate essential livelihood assets.

Our study contributes to existing literature in three aspects. First, we investigate how farm households affected by land acquisition adjust their nonfarm labor allocation from the perspective of economic efficiency, which differs from other literature that either focus on China's ambiguous land property rights and inadequate compensation from the perspective of equity (Chan, 2003; Zou and Oskam, 2007; Po, 2011; Zhao and Webster, 2011) or focus on the outer shocks such as exchange rate and intra-industry trade on labor employment (Chang, 2010; Yang and Liou, 2013). Second, our study adds more evidence in examining the fundamental question of how public policies affect the nonfarm labor allocation of farm households in China. Existing literature focus on rural land arrangements (Yang, 1997; Zhao, 1999; Mullan et al., 2011) and rural-urban segmentation policy (Yang, 1999; Yang, 2004), but neglect the land acquisition policy, a new land arrangement arising during rapid urbanization in the past 20 years. Our work fills in this gap. Third, this study contributes to existing literature by examining the impact of government payments, as an important financial asset, on farm households' nonfarm labor supply. The existing literature study the government payment effect on the labor participation without decreasing their landholding (Aheran et al., 2006; El-Osta et al., 2008; Pandit et al., 2013; Uchida et al.; 2009). Differently we focus on the effects of compensation payments for the acquired landholding.

The rest of the paper is organized as follows. Section 2 provides an overview of the land acquisition policy in China's urbanization process. Section 3 develops an agricultural household model by including land acquisition and puts forward three main hypotheses. Section 4 conducts

empirical analysis based on the model and presents the empirical findings. Conclusion follows as the final section.

2. Urbanization and land acquisition policy in China

Since the 1990s, China has been experiencing rapid economic growth and urban expansion which has led to increasing land demand. To meet these demands, land acquisition is the primary solution used by Chinese local governments. Therefore, the process of China's urbanization is associated with the conversion of rural land to urban land (Yeh and Wu, 1996; Ghatak and Mookherjee, 2013).

It is generally thought that the compensation for the lost land is low. According to China's Land Administration Law, farm land is collectively owned and local governments have the extensive power to acquire farm land compulsorily; farm households have the right to use the land allocated to them for agriculture use but have no property rights over the land. Therefore, when land is acquired, governments only compensate households based on the farm output value of the land instead of its market price. According to compensation forms, Chinese land acquisition policy history can be divided into two stages.

The first stage is 1990-1998. Following the 1986 version of the Land Administration Law, governments compensated farmers with a policy package that contained four main components: compensation for the land, resettlement subsidies for farm labor, compensation for crops and attachments on the land, and labor resettlement. In monetary compensation, the sum of land compensation and labor resettlement subsidies should not have exceeded 20 times the average annual output value of the land in the preceding three years before land acquisition (Ding, 2007). This compensation level was not high and thus governments provided job offers and urban residency certificates (*hukou*) to the affected farmers. Under unequal urban-rural welfare system,

the job offers in enterprises established on the acquired land and urban residency certificates made the affected farmers eligible for urban social welfare services, so these intangible benefits were appealing to farmers. Meanwhile, since the scale of land acquisition for urban use was relatively small and the appreciation of farm land was limited, there were seldom conflicts resulting from land acquisition at that time.

Rapid economic growth and urbanization prompted China to revise its Land Administration Law in 1998, which brought the land acquisition policy into its second stage. According to the 1998 version, the total amount of land compensation and labor resettlement subsidies increased to the level that should not be greater than 30 times the average annual output value of the land in the preceding three years before land acquisition. However, governments typically did not provide job offers for the affected laborers. Since the new land compensation level could not cover the loss of employment opportunities and social security provided by farm land, and the rapid urban expansion raised the market price of the land acquired, social tensions caused by land acquisition became higher. For example, according to our survey data from Xingwen County in southwestern China, the compensation standard per unit land size (*mu*) was 45,000 *yuan* in 2010, 30 times the derived land productivity; but the market price of adjacent land converted from farm land to commercial land was 290,000 *yuan*. The discrepancy between urban land value and compensation for the acquired farm land has become one of the economic roots of increasing rural unrest (Ding and Lichtenberg, 2011).

To solve these problems, Chinese central government made policies to emphasize employment support and social security system construction for land-lost farm households in 2004, including paying unemployment insurance benefits to laborers and pensions to the elderly. However, these measures were only implemented in some provinces. Currently, the central government highly

emphasizes a compensation principle of maintaining constant living standard for affected farmers, but there are still no detailed and effective implementation measures.

3 Theoretical models

3.1 Preferences, constraints and optimal values

Following Benjamin (1992), we develop an agricultural household model by including parameters of land acquisition. The agricultural household model is actually a time allocation model that depicts how the household allocates his time endowment. The farm household is assumed to have preferences not only over the services provided by consumption goods and leisure time, but also over the livelihood security provided by wealth that is related to land assets. The representative household maximizes the following utility function:

$$U(C, L_l; W) = U(C, L_l) + W \tag{1}$$

where C, L_l, and W are consumption good, leisure, and wealth, respectively. The utility of wealth is treated as exogenous. Following Mankiw (1988), the household maximizes a Cobb-Douglas utility function over current consumption of the single purchased good (C) and leisure (L_l):

$$U(C, L_l) = \alpha \log C + (1-\alpha) \log L_l \tag{2}$$

where $0 < \alpha < 1$. Utility is maximized subject to a budget constraint:

$$pC = y = p_a Q_a + wL_w + (\bar{y}_a A')i \tag{3}$$

where p is the price of goods consumed; y is the total income including farm income, nonfarm labor income, and the income from compensation payment. Here y equals consumption expenditure when there are no savings. In detail, farm income is determined by the quantity and price of farm output. By setting farm output price (p_a) equal to 1, farm income only depends on farm output Q_a . Nonfarm labor income may come from wage employment and self-employment. For simplicity, we only introduce wage earnings depending on market wage rate (w) and

nonfarm labor input (L_w). Compensation payment ($\bar{y}_a A'$) is the product of compensation price per unit land size ($\bar{y}_a$) times land area acquired (A'). i is the annual rate of return on the investment of such compensation, $0 < i < 1$. Parameters ($p, w, \bar{y}_a, A'$) are greater than zero.

The household also faces a time constraint. Time endowment (T) includes farm labor input (L_a), nonfarm labor input (L_w), and leisure (L_l):

$$T = L_a + L_w + L_l \tag{4}$$

where $T > 0$ and $L_a, L_w, L_l \geq 0$. Besides, the household also faces an agricultural production technology constraint that describes the relationship between farm inputs and outputs. More population and less land in China result in that most farm households operate the farm by self-employment, so we assume that the representative household does not hire nonfamily workers. Hence, the farm production function is:

$$Q_a = L_a^r (A - A')^{1-r} \qquad (A > A') \tag{5}$$

where A is the land size before land acquisition, $A > 0$; $A - A'$ is the remaining land size; r is the elasticity coefficient of factor input, $0 < r < 1$. Both functions, U and Q_a, are assumed to be increasing and concave. Q_a equals to zero if $A = A'$, meaning that all the family land is acquired.

Substituting Eq. (4)-(5) into (3), we obtain a single constraint:

$$pC + wL_l = \left[L_a^r (A - A')^{1-r} - wL_a\right] + wT + (\bar{y}_a A')i = M \tag{6}$$

where consumption of goods and leisure equals full income M, which is composed of farm profits, value of time endowment, and the income from the compensation payment. According to Mankiw (1988), the Cobb-Douglas utility function implies that the constant share of M, α, is devoted to consumption, and α is the marginal propensity to consume. Hence, we obtain the relationship of full income, consumption and leisure:

$$pC = y = \alpha M \tag{7}$$

$$L_l = \frac{1-\alpha}{w} M \tag{8}$$

Besides consumption and leisure, wealth (*W*) is an important component in utility function for providing household security and economic and political power (Hill, 2000), and can be accumulated through savings, inheritance, or appreciation of household assets (Mishra et al., 2002). In China, land is the most important asset to farm households and is also a valuable asset in the long run (Zhao, 1999). Since suburban farm land has a huge appreciation potential due to its scarcity during urban expansion, family wealth depends to a large extent on the owned land asset. Assume *W* is exogenously determined by land appreciation in the future:

$$W = \bar{V}_a (A - A') \tag{9}$$

where $\bar{V}_a$ is land appreciation per unit area, which is the difference between the market price and farm output value of the land taken, $\bar{V}_a > 0$; $A - A'$ is the remaining land size.

Substituting budget constraint (3) and production constraint (5) into direct utility function (1) yields an indirect utility function that depicts the time allocation decision of the farm household:

$$V(L_a, L_w, L_l; W) = V(L_a, L_w, L_l) + W \tag{10}$$

This indirect utility function is maximized only subject to time constraint (4). Hence, the household's optimization problem can be summarized as follows:

$$\max_{L_a, L_w, L_l} V(L_a, L_w, L_l) + W = \max_{L_a, L_w, L_l} \left[\alpha \log \frac{L_a^r (A - A')^{1-r} + w L_w + (\bar{y}_a A') i}{p} + (1-\alpha) \log L_l + W \right] \tag{11}$$

subject to $T = L_a + L_w + L_l$.

To solve this constrained optimization, we set up a Lagrangian function:

$$Z(L_a, L_w, L_l, \lambda) = V(L_a, L_w, L_l; W) + \lambda (T - L_a - L_w - L_l) \tag{12}$$

where λ is the Lagrangian multiplier. The first-order conditions are:

$$\frac{\partial Z}{\partial L_a} = \frac{\partial Z}{\partial L_w} = \frac{\partial Z}{\partial L_l} = 0, \quad \frac{\partial Z}{\partial \lambda} = 0 \tag{13}$$

By solving Eq. (13), we derive the optimal family time allocation:

$$L_a^* = (A - A')(r/w)^{1/(1-r)} \tag{14}$$

$$L_l^* = \frac{1-\alpha}{w} \cdot \left[(A - A')(1-r)(r/w)^{r/(1-r)} + wT + (\bar{y}_a A')i\right] \tag{15}$$

$$L_w^* = T - (A - A')(r/w)^{1/(1-r)} - \frac{1-\alpha}{w} \cdot \left[(A - A')(1-r)(r/w)^{r/(1-r)} + wT + (\bar{y}_a A')i\right] \tag{16}$$

Substituting Eq. (15) into (8), we obtain the optimal full income M^* composed of maximized farm profits, value of time endowment, and the income from the compensation payment:

$$M^* = (A - A')(1-r)(r/w)^{r/(1-r)} + wT + (\bar{y}_a A')i \tag{17}$$

Substituting optimal time input equations (14)-(16) into income function (3) and utility function (1), we derive the optimal values of total income $y^*(L_a^*, L_w^*)$ and utility $V^*(L_a^*, L_w^*, L_l^*; W)$ of the representative household:

$$y^*(L_a^*, L_w^*) = \alpha M^* = \alpha\left[wT + (1-r)(A - A')(r/w)^{r/(1-r)} + (\bar{y}_a A')i\right] \tag{18}$$

$$V^*(L_a^*, L_w^*, L_l^*; W) = \left[\alpha \log \frac{y_a^*(L_a^*) + y_w^*(L_w^*) + (\bar{y}_a A')i}{p} + (1-\alpha)\log L_l^* + W\right] \tag{19}$$

3.2 Comparative static analysis

We conduct the comparative static analyses to find out how land area acquired A' and compensation price $\bar{y}_a$ affect the nonfarm labor allocation and income in this section.

3.2.1 Effects of land acquisition on household labor reallocation decisions

First, by taking partial derivatives with respect to A' in Eq. (14)-(16), we derive the effects of land reduction on household time distribution decisions:

$$\frac{\partial L_a^*}{\partial A'} = -(r/w)^{1/(1-r)} \tag{20}$$

$$\frac{\partial L_l^*}{\partial A'} = \frac{1-\alpha}{w}\left[\bar{y}_a i - (1-r)(r/w)^{r/(1-r)}\right] \tag{21}$$

$$\frac{\partial L_w^*}{\partial A'} = (r/w)^{1/(1-r)} + \frac{1-\alpha}{w}\left[(1-r)(r/w)^{r/(1-r)} - \bar{y}_a i\right] \tag{22}$$

In Eq. (20), $\frac{\partial L_a^*}{\partial A'} < 0$, showing that land reduction ($A' > 0$) would decrease farm labor input which is determined by farm production technology. Given household time endowment, the total time of other two activities ($\frac{\partial L_l^*}{\partial A'} + \frac{\partial L_w^*}{\partial A'}$) would rise, but the respective effects of land acquisition on them are uncertain which depends on the value of related parameters ($r, w, \alpha, \bar{y}_a, i$). We focus on the value of compensation price ($\bar{y}_a$).

According to Eq. (22), $\frac{\partial L_w^*}{\partial A'}$ is determined by two items: the former is the change of farm production time and the latter is the change of leisure time. We can easily calculate:

$$\frac{\partial L_w^*}{\partial A'} > 0 \text{, when } \bar{y}_a < \frac{1}{i}\left[(1-r)(r/w)^{r/(1-r)} + \frac{w}{1-\alpha}(r/w)^{1/(1-r)}\right] \tag{23}$$

which indicates that land reduction would increase family nonfarm labor input when the compensation price set by the government ($\bar{y}_a$) is lower than a critical value, which is the

product of a multiplier (1/*i*) with the summation of the reduced farm profit [4] $(1-r)(r/w)^{r/(1-r)}$ and the required full income payment $\frac{w}{1-\alpha}(r/w)^{1/(1-r)}$. For the latter, according to the relationship between full income and leisure in Eq. (8), it corresponds to the possible newly added leisure time $(r/w)^{1/(1-r)}$ that comes from the reduced farm production time. On the contrary, when the compensation price ($\bar{y}_a$) is higher than this critical value, land reduction would lead to a decrease in nonfarm employment. This explains the phenomena that some farmers leave labor market after land acquisition in eastern China where compensation prices are very high.

To further explain the labor adjustment affected by land acquisition, we analyze the impact of land reduction on household welfare by taking a partial derivative with respect to A' in Eq. (19).

$$\frac{\partial V^*}{\partial A'} = \frac{\alpha}{y^*}\frac{\partial y^*}{\partial A'} + \frac{1-\alpha}{L_l^*}\frac{\partial L_l^*}{\partial A'} - \bar{V}_a = \frac{1}{M^*}\left[\bar{y}_a i - (1-r)(r/w)^{r/(1-r)} - \bar{V}_a M^*\right] \tag{24}$$

Eq. (24) shows that the welfare effect of land acquisition is composed of three items: the first tw o items are the effects of land acquisition on income and leisure, respectively; and the third item $(-\bar{V}_a)$ is the loss of land appreciation. We can easily calculate:

$$\frac{\partial V^*}{\partial A'} < 0 \text{ , when } \bar{y}_a < \frac{1}{i}\left[(1-r)(r/w)^{r/(1-r)} + \bar{V}_a M^*\right] \tag{25}$$

where $\bar{V}_a M^*$ is the product of value appreciation per unit land area times optimal full income. Eq. (25) indicates that land reduction would decrease household welfare if the compensation price cannot cover the value that is the product of a multiplier (1/*i*) with the summation of the reduced farm profit and the value appreciation of the acquired land. In practice, compensation prices set by Chinese local governments are only based on farm output value, not considering land

[4] The first term in Eq. (17), $(A-A')(1-r)(r/w)^{r/(1-r)}$, is farm profit function. By taking partial derivative with

appreciation which is much higher than the compensation standard. Obviously such compensation level may decrease household welfare and thus provide an explanation to the increasing nonfarm labor input after land acquisition.

Second, by taking the partial derivative with respect to $\bar{y}_a$ in Eq. (16), we derive the effect of the compensation price set by local government on household nonfarm employment:

$$\frac{\partial L_w^*}{\partial \bar{y}_a} = -\frac{1-\alpha}{w} A' i \tag{26}$$

In Eq. (26), $\frac{\partial L_w^*}{\partial \bar{y}_a}$ is negative, showing that compensation price is inversely related to nonfarm lab or input. Given other parameters, the effect of compensation price on labor reallocation depends on the land area acquired. The larger the land area acquired, the stronger the effect of compensati on price on nonfarm labor reallocation.

3.2.2 Effect of land acquisition on household income

First, by taking partial derivatives with respect to A' in Eq. (18), we derive the effect of land reduction on household income:

$$\frac{\partial y^*}{\partial A'} = \alpha\left[\bar{y}_a i - (1-r)(r/w)^{r/(1-r)}\right] \tag{27}$$

Eq. (27) shows that the effect of land acquisition on current income is determined by the relationship between the average investment return of compensation payment ($\bar{y}_a i$) and the reduced farm profit $(1-r)(r/w)^{r/(1-r)}$. This effect would be positive ($\frac{\partial y^*}{\partial A'} > 0$) if the former is higher than the latter. On one hand, according to China's Land Administration Law, the compensation price for land use, $\bar{y}_a$, should be 10-30 times the average annual output value of

respective to A', we derive that the change of farm profit is $-(1-r)(r/w)^{r/(1-r)}$.

acquired land in the preceding three years. Under this institutional arrangement and given other parameters, the higher the compensation price, the stronger the effect of land acquisition on income. On the other hand, the rate of return on the investment of compensation (i) depends on household's choices after land acquisition. According to the CHFS data in 2013, most Chinese rural households invest assets in risk-free assets such as deposits and treasury bills; the ratio of investment in risk assets for rural households and the households with land acquisition are only 1.45% and 1.86%, respectively. Hence we could assume the parameter i is constant. Under this condition, we can easily calculate:

$$\frac{\partial y^*}{\partial A'} > 0 \text{ , when } \bar{y}_a > \frac{1}{i}(1-r)(r/w)^{r/(1-r)} \tag{28}$$

which shows that the effect of land acquisition on income would be positive when compensation price $\bar{y}_a$ is higher than a critical value, which is the multiplier of the reduced farm profit.

Second, by taking a partial derivative with respect to $\bar{y}_a$ in Eq. (18), we derive the effect of compensation price on household current income:

$$\frac{\partial y^*}{\partial \bar{y}_a} = \alpha A' i \tag{29}$$

which shows that compensation price is positively related with family income. This is determined by the definition of Eq. (18) in which the income from compensation payment is a component of total income. It is an obvious fact and thus would not be tested in our regression.

In summary, the main hypotheses concerning the effects of land acquisition on nonfarm labor allocation and income can be stated as follows: (1) land reduction would increase family nonfarm labor supply when compensation price is below a certain critical value (the product of a multiplier with the summation of the reduced farm profit and the required full income payment);

(2) compensation price would be negatively related with nonfarm labor input; and (3) land acquisition would increase family income when compensation price is higher than a critical value (the multiplier of the reduced farm profit). The following section will use two survey data to test these hypotheses.

4. Empirical analysis

4.1 Econometric specification

To estimate the nonfarm labor allocation function of farm households affected by land acquisition, as in Eq. (16), we use the following specification:

$$L_w = \alpha_0 + \alpha_1(LAND\ ACQUISITION) + \alpha_2 X_1 + \alpha_3 X_2 + \alpha_4 X_3 + \varepsilon \tag{30}$$

where L_w is nonfarm labor input; *LAND ACQUISITION* characterizes variables of land reduction and compensation. X_1 (land size), X_2 (human capital), and X_3 (household composition) are control variables measuring household characteristics. The parameters to be estimated are α_0, α_1, α_2, α_3, and α_4. ε is the stochastic error term.

The empirical analysis of nonfarm labor allocation is conducted on the household level without recognizing the head of the household. For household laborers, farm and nonfarm employment are classified by their major activities (Zhang and Li, 2003; Yang, 2004). For instance, a person engaged primarily in a wage job and secondarily in farm production is classified as nonfarm labor. Following Goodwin and Holt (2002), we measure labor allocation decisions by both the binary farm/nonfarm work decision and the degree of nonfarm labor participation. The latter is measured by the share of laborers in nonfarm activities.

The land acquisition is a dummy variable (being 1 if the land is acquired, 0 otherwise). If the land is acquired, we further look at how much land area is acquired, the related compensation price and total payments. The total amount of compensation includes three items in China:

compensation for farm land, resettlement subsidies for the affected laborers, and compensation for crops and attachments on the land. Compensation amount is introduced to estimate the impact of government payments, as financial capital, on labor participation decisions.

Since natural capital, human capital, and household composition are important determinants of nonfarm labor allocation (Zhao 1999; Zhang and Li 2003; Yang 2004; Liang et al. 2012), we include them in specification (30) to control the effects of household characteristics. In detail, human capital (X_2) is measured with family labor endowment (the number of laborers aged 16-60 in the family), average education (the average years of schooling for all family laborers) and average age for all family laborers. Household composition (X_3) is measured using two dummy variables: first, if the household has elderly over the age of 60; second, if the household has children under the age of 16. The elderly and children defined here do not belong to the labor force in our study, but they play an important role in family nonfarm labor allocation since they may affect the household time endowment (T) in Eq. (16). For example, in rural China, the elderly usually provide family support to their children by doing farm work and caring for the grandchildren, which may help to relax the constraints on nonfarm labor supply (Pang et al. 2004). On the other hand, the presence of children would increase the home time of laborers and decrease their nonfarm working time (Zhao 1999; Liang et al. 2012).

To estimate the household income function in Eq. (18), we use the following empirical form:

$$Y = \beta_0 + \beta_1(LAND\ ACQUISITION) + \beta_2 X_1 + \beta_3 X_2 + \beta_4 H + \varepsilon \tag{31}$$

where Y is household income. *LAND ACQUISTIION* is defined the same as the above. X_1 is land size; X_2 is family human capital vector including laborer endowment, education, and age; H is housing area. The literature (Zhang and Li 2003; Yang 2004; Liang et al. 2012) has documented natural capital and human capital as important factors affecting farm household income. The

housing area is included as physical capital because urbanization makes the livelihoods of suburban households rely on housing as an economic resource. Housing provides not only space for production, access to income-earning opportunities, but also an income-generating asset in the form of rooms that can be rented out (Satterthwaite and Tacoli 2002).

4.2 Data

We use two data sets for our analysis. The first one is the survey data that we designed and implemented at five villages of Xingwen County in 2012. The data include 192 farm households whose lands were acquired with the detailed household-level information before and after land acquisition. The data have desirable features even though this before-after data set is specific and relatively small. First, Xingwen County is located in southwestern China and is a typically underdeveloped and agricultural county. According to the Population Census of China, the urbanization rate of Xingwen County in 2010 was 22.7%, 27 percent lower than the national level (NBS, 2012). Currently, its process of urbanization is accelerating, leading to the rapid increase of land acquisition. Second, the farm households affected by land acquisition in Xingwen County, compared to those in developed regions, are paid with lower compensation price under the budget constraints of local government. They also have a lower base of livelihood assets and nonfarm employment environment. Hence examining the determinants of nonfarm labor allocation and income in this type of households has more important policy implications. Finally, we study the same group person before and after land acquisition, which yields a good within-group analysis. Also, the data within a County have a more homogeneous nature from the macro shock. However, the limitation of this survey data is the lack of control group so it may cause potential bias due to sample selection problem. We, therefore, adopt another extensive data set covering national-level household data.

The second data set is from the China Household Finance Survey (CHFS) conducted by the Survey and Research Center for China Household Finance at Southwestern University of Finance and Economics. The CHFS started the first survey in 2011 and revised their results in 2013. We use the most recent representative 2013 data set as the land acquisition is a one-time event. And most importantly, compared to the data collected in 2011, the sample size in 2013 has more than tripled, with about 28,000 households in 272 counties in 29 provinces (Tibet, Xinjiang, Macau and Hong Kong are not included) and are randomly selected. Therefore, the data in 2013 are more representative in terms of economic development and geographic location at the province level and city level. In particular, this large sample includes the households with land acquisition and the control group without land acquisition, which serves as a good foundation for our empirical analysis.

Table 1 presents the mean characteristics of surveyed households in Xingwen County. After eliminating observations with missing data, the sample contains 164 households and 328 observations. Since the time of land acquisition is 2010, the data before and after land acquisition are in 2009 and 2011, respectively. The land size in general is proportional to the family size by the land reform policy in Mao era. The compensation price is the same at Xingwen County, and thus the difference in compensation payments comes from the land area acquired and compensation for crops and attachments on the land. During the urbanization process, the number of surveyed households participating in nonfarm activities increases from 118 before land acquisition to 143 after land acquisition, rising by 21.2%. As we can see from Table 1, both land size and nonfarm labor allocations have statistically significant differences before and after land acquisition. The average land size decreases from 3.08 *mu* to 1.16 *mu*, with a reduction of 62.3%. These households reallocate more laborers to nonfarm sectors and both the average

number and share of nonfarm laborers have an overall growth after land acquisition. On average, about 64 percent of family laborers are allocated to nonfarm activities after land acquisition.

There are no significant changes in the other variables before and after land acquisition in Table 1. The average housing area, education and age do not change significantly. The average income level rises a little and remains at the same level, between 10,000-20,000 *yuan*. In detail, the changes in household income level are different. After land acquisition, 12 percent of households have declining income, 43 percent of them keep income unchanged, and 45 percent of them have increasing income.

Table 2 presents the mean characteristics of surveyed households using 2013 CHFS data. We start with 28,143 households, of which 9,428 households come from rural areas. We further reduce the data from 9,428 to 6,493 observations after removing missing numbers and outliers. Among them, there are 493 households with land acquisition and 6000 households without land acquisition. Column (1) and (2) list the summarized statistics of these two types of households. Similar to Xingwen County data presented at Table 1, the means in column (2) of Table 2 for households with land acquisition are close but slightly larger. Likewise, land size and nonfarm laborers are significantly different between the two types of households, showing that urbanization may increase the nonfarm labors. As it shows, the average compensation price is 17.7 thousand yuan per mu, but the compensation prices are different at different County. Therefore, the difference in compensation amount comes from the compensation price, the land area acquired, and compensation for crops and attachments on the land. Finally, the housing values are significantly higher for households with land acquisition. This may be due to the fact that urbanization makes the house more valuable by being close to the city.

4.3 Estimation results

This section further examines how land acquisition affects nonfarm labor allocation and income of the households. We first look at the land acquisition impact on nonfarm labor allocation using the same households before and after land acquisition in Xingwen County. We repeat the same exercise in the larger dataset across households with CHFS 2013 survey data. Then we look at the land acquisition impact on income in Xingwen County and in the national CHFS survey data.

Table 3 reports regression results for nonfarm labor allocation based on Eq. (30) using survey data from Xingwen County before and after land acquisition. The first three columns examine if land acquisition affects the binary farm/nonfarm employment decision using a Logit model while the last three columns estimate the effects of land acquisition on the share of nonfarm labor input using a Tobit model.[5] As we can see in columns (1) and (4), where the independent variable is "if the land is acquired", the results show that land acquisition significantly increases the probability and the share of nonfarm labor allocation for those households after land acquisition. This finding is consistent with our hypothesis (1) that the land acquisition event significantly affects the nonfarm labor input. However, when we replace the "if the land is acquired" with the "actual land area acquired" in columns (2) and (5), we find that more land acquisition increases neither the probability nor the share of nonfarm labor allocation. Similarly, in columns (3) and (6), the compensation payments have no significant impact on the probability and the share of nonfarm labor participation. One explanation is that the lands acquired and the compensations do not vary

[5] We conduct other regression using panel data and find consistent results, the paper reports the pooled data regression given only two years of data. We also repeat the same regression using the number of nonfarm laborers. The results are available upon request.

significantly across households. Our findings also indicate that compensations in Xingwen County are close to or lower than the critical value indicated in Eq. (23).[6]

There are other control variables in Table 3 having significant impacts on the probability and the share of nonfarm labor allocation. Land size has a significantly negative impact on the household nonfarm employment choices, consistent with existing literature (Zhao, 1999; Yang, 2004). The households with more laborers have a higher probability of pursuing nonfarm activities, even though the shares of nonfarm laborers are not necessarily higher. The average education significantly increases the shares of nonfarm employment. The households with younger laborers are more likely to increase nonfarm laborers, and the shares of nonfarm laborers are also significantly higher. These findings are consistent with existing literature (Zhang and Li, 2003; Yang, 2004; Liang et al., 2012). Finally, having children does not affect the labor allocation. We find that the households having elderly over the age of 60 are more likely to have nonfarm laborers, which fits with the Chinese culture that the elders help with much of the house work to free younger laborers to work outside the home.

Table 4 reports similar regression results for nonfarm labor allocation using CHFS 2013 data. The first four columns examine if land acquisition affects the binary farm/nonfarm employment decision using a Logit model while the last four columns estimate the effects of land acquisition on the share of nonfarm laborers using a Tobit model. As we can see in columns (1) and (5), where the independent variable is "if the land is acquired", the results show that the households with land acquisition are more likely to have nonfarm work and that the share of nonfarm laborers are significantly higher than those households without land acquisition. This is

[6] The survey data show that differences exist in compensation payments among households. The average compensation payment for land loss is over 10 thousand *yuan*. The largest share of respondent households is compensated below 50 thousand yuan (42%). The second and third shares of respondent households are

consistent with our hypothesis (1). However, among the households with land acquisition, we find that the land area acquired and compensation amount have no statistically significant effects on nonfarm labor allocation. Furthermore, we find that compensation price has negative impacts on the probability and the share of nonfarm labor allocation, but the effects are not statistically significant, which do not provide strong support for hypothesis (2).

The control variables are also similar to what we found in Table 3. Namely, land size has a significantly negative impact on household nonfarm employment choices. The households with more laborers, higher education and younger laborers are more likely to pursue nonfarm activities and, thus, have higher shares of nonfarm laborers. Finally, the households having more children are less likely to have nonfarm laborers and also have fewer shares of nonfarm laborers. Households having elderly over the age of 60 have significantly higher shares of nonfarm laborers. This is consistent with the observations in rural China that the presence of children would increase the home time of laborers and decrease their nonfarm working time (Zhao 1999; Liang et al. 2012) and that the elderly usually provide family support to their children by doing farm work and caring for the grandchildren (Pang et al. 2004).

Table 5 presents the estimation results for the household income function in Eq. (31) using survey data from Xingwen County. Since the income level is an ordinal dependent variable from 1 to 6, we use an ordered Probit model to estimate. As can be seen, the households with more laborers, higher average education, younger laborers and larger housing areas have significantly higher income, which is consistent with existing literature (Satterthwaite and Tacoli 2002; Zhang and Li 2003; Yang 2004; Liang et al. 2012). The land acquisition, land areas acquired, and compensations are with expected signs but not significant on the short run income, which do not

compensated 50-100 thousand *yuan* (24%) and 100-200 thousand *yuan* (20%), respectively. Only 14 percent of households are compensated over 200 thousand *yuan*.

provide strong support for hypothesis (3). One conjecture is that the compensation price may be close to the critical value. Another explanation is that the income variables are not continuous variables and are at 1-6 levels, so they may neglect the fact that income may increase but not high enough to the higher level.

Table 6 presents the land acquisition effect on household income using the CHFS data where we have control group without land acquisition. In this regression, the income is a continuous variable instead of income level as an ordinal dependent variable in Xingwen County. As we can see in the first column, the household incomes are significantly higher for those households with land acquisition. This is consistent with hypothesis (3). However, within the treatment group of households with land acquisition, the amount of land acquired, compensation price and total compensations have no further impacts on household income. Consistent with findings in Xingwen County, the households with more laborers, higher education, younger laborers and higher housing values have significantly higher income.

In sum, the studies of both Xingwen County and CHFS data indicate that land acquisition in China increases the nonfarm labor allocation. we do not find household income improvement for Xingwen County after land acquisition while the CHFS national data analyses indicate that there is income improvement for the households with land acquisition when compared to the households without land acquisition. We also find that the negative effect of compensation price on nonfarm labor input is not statistically significant in CHFS data. In addition, our findings that human capital significantly contributes to both labor reallocation and income, suggesting that households with lower human capital have bigger difficulties in labor adjustment and income growth. Hence, a special policy is needed to stimulate their nonfarm employment and help to accumulate essential livelihood assets.

5. Conclusions

This paper investigates how land acquisition during urbanization affects labor allocation decisions of farm households in China. We develop an agricultural household model by including land acquisition to examine the effects on nonfarm labor participation and income. The model predicts that land acquisition would increase family nonfarm labor supply when compensation price is below a critical value. The compensation would contribute income improvement even though it could potentially reduce labor input due to income effect.

To verify the above prediction, we use two datasets to conduct empirical tests. Using both datasets from household surveys in Xingwen County in 2012 and the extensive CHFS data covering 29 provinces in 2013, we find that land reduction has a significantly positive effect on family nonfarm labor allocation. In terms of income effect, we do not find significant results of land acquisition on household income levels in Xingwen County. However, with the control group in CHFS data, we do find that land acquisition increases the household income of the land acquisition group. Finally, we find that among the land acquisition group, the amount of land acquisition, compensation amount and price have no impact on nonfarm labor allocation and income. Further research in welfare analysis is needed for more clear policy implication.

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Table 1 Mean Characteristics of Household Sample, 2012 Xingwen County Survey Data

Variable	(1) Before land acquisition (in 2009)	(2) After land acquisition (in 2011)
Land size (mu)	3.08 (1.79)	1.16 (1.07)***
Land area acquired (*mu*)	—	1.92 (1.39)
Compensation payments (10,000 *yuan*)	0.00 (0.00)	10.19 (9.61)***
Compensation price (10,000 *yuan*)	—	5.01 (1.29)
Number of labors	2.45 (0.81)	2.31 (0.80)
Number of nonfarm labors	1.02 (0.79)	1.45 (0.79)***
Share of nonfarm labors	0.41 (0.33)	0.64 (0.35)***
Average education (years)	7.72 (2.00)	7.87 (2.23)
Average age (years)	37.25 (7.38)	38.93 (8.79)*
If having children	0.37 (0.48)	0.36 (0.48)
If having the elderly	0.18 (0.38)	0.18 (0.38)
Housing area (square meter)	159.39 (92.98)	157.74 (70.86)
Income level	2.42 (0.95)	2.57 (1.03)
Observations	164	164

Notes: (1) The data are mean value at household level; figures in parentheses are standard deviations; asterisks (***, ** and *) denote that mean difference of relevant variables before and after land acquisition are statistically significant at 1%, 5%, and 10%, respectively. (2) *mu* = 0.165 acre. *yuan* = $0.16. (3) The labor force refers to population ages 16-60 that is economically active. (4) The income level is divided into six levels. It equals 1 for income below 10,000 *yuan* (not including 10,000 *yuan*), 2 for income between 10,000-20,000 *yuan*, 3 for income between 20,000-30,000 *yuan*, 4 for income between 30,000-40,000 *yuan*, 5 for income between 40,000-50,000 *yuan*, 6 for income over 50,000 *yuan*. (5) The figures of compensation amount and income level are in 2011 prices.

Table 2 Mean Characteristics of Household Sample, 2013 CHFS Survey Data

Variable	(1)Households without land acquisition (Control group)	(2)Households with land acquisition (Treatment group)
Land size (mu)	5.81 (23.67)	4.08 (9.45)**
Land area acquired (*mu*)	0.00 (0.00)	3.53 (6.20)***
Compensation payments (10,000 *yuan*)	0.00 (0.00)	4.97 (15.94)***
Compensation price (10,000 *yuan*)	0.00 (0.00)	1.77 (4.79)***
Number of labors	2.69 (1.15)	2.73 (1.11)
Number of nonfarm labors	1.13 (1.07)	1.32 (1.04)***
Share of nonfarm labors	0.41 (0.36)	0.48 (0.35)***
Average education (years)	7.53 (2.83)	8.07 (2.68)***
Average age (years)	39.52 (8.12)	39.38 (7.60)
Number of children	1.12 (0.99)	1.02 (0.94) **
Number of the elderly	0.33 (0.60)	0.32 (0.59)
Housing value (*yuan*)	168908.20 (497912.40)	343394.80 (740357.80)***
Annual income (*yuan*)	39585.49 (120934.6)	49065.82 (84548.44)**
Observations	6000	493

Notes: (1) The annual income is an absolute value, and the figures are in 2013 prices. (2) 2013 CHFS data only distinguish the household sample by the place of resident (rural or urban area), not by the place of domicile. So we could only use the household sample, living in rural area, in the analysis.

Table 3 Effects of Land Acquisition on Household Nonfarm Labor Allocation Decisions, 2012 Xingwen County Survey Data

Explanatory variable	Dependent variable					
	Household participating in nonfarm work = 1, Logit model			Share of nonfarm labors, Tobit model		
	(1)	(2)	(3)	(4)	(5)	(6)
If land is acquired	0.127***			0.273***		
	(0.046)			(0.078)		
ln (land area acquired)		0.031			0.049	
		(0.028)			(0.058)	
ln (compensation payment)			0.029			0.030
			(0.028)			(0.054)
ln (land size)	-0.067**	-0.058**	-0.059**	-0.132***	-0.132***	-0.131***
	(0.027)	(0.027)	(0.027)	(0.038)	(0.047)	(0.047)
Number of labors	0.223***	0.121***	0.122***	0.016	0.147**	0.146**
	(0.033)	(0.042)	(0.042)	(0.043)	(0.065)	(0.065)
Average education	0.012	0.031***	0.031***	0.070***	0.136***	0.135***
	(0.009)	(0.009)	(0.009)	(0.017)	(0.026)	(0.026)
Average age	-0.010***	-0.007***	-0.007***	-0.020***	-0.016**	-0.016**
	(0.002)	(0.002)	(0.002)	(0.005)	(0.006)	(0.006)
If having children	0.011	-0.001	-0.001	0.068	0.015	0.017
	(0.039)	(0.048)	(0.048)	(0.071)	(0.108)	(0.108)
If having the elderly	0.176***	0.039	0.041	0.252***	0.080	0.088
	(0.053)	(0.058)	(0.058)	(0.090)	(0.134)	(0.135)
Pseudo R^2	0.334	0.434	0.432	0.181	0.218	0.217
No. of observations	328	164	164	328	164	164

Note: (1) standard errors are in parentheses. ***, ** and * mean statistically significant at 1%, 5%, and 10%, respectively. (2) All reported results are marginal effects. The marginal effect for a dummy variable is the difference in probability of nonfarm employment relative to the period before land acquisition; for continuous variables, the effect is evaluated at the mean.

Table 4 Effects of Land Acquisition on Household Nonfarm Labor Allocation Decisions, 2013 CHFS Survey Data

Explanatory variable	Dependent variable							
	Household participating in nonfarm work = 1, Logit model				Share of nonfarm labors, Tobit model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
If land is acquired	0.044**				0.047**			
	(0.020)				(0.022)			
ln (land area acquired)		0.012				0.016		
		(0.023)				(0.029)		
ln (compensation payment)			-0.003				-0.013	
			(0.018)				(0.020)	
ln (compensation price)				-0.023				-0.028
				(0.024)				(0.028)
ln (land size)	-0.005***	-0.003	-0.003	-0.003	-0.006***	-0.004	-0.003	-0.004
	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Number of labors	0.097***	0.094***	0.094***	0.095***	0.023***	0.008	0.010	0.010
	(0.005)	(0.018)	(0.018)	(0.017)	(0.005)	(0.018)	(0.017)	(0.017)
Average education	0.029***	0.030***	0.030***	0.031***	0.042***	0.044***	0.046***	0.045***
	(0.002)	(0.007)	(0.007)	(0.007)	(0.003)	(0.009)	(0.009)	(0.009)
Average age	-0.011***	-0.009***	-0.009***	-0.009***	-0.017***	-0.010***	-0.010***	-0.010***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)
Number of Children	-0.020***	-0.026	-0.025	-0.025	-0.020***	-0.016	-0.015	-0.015
	(0.006)	(0.019)	(0.019)	(0.019)	(0.007)	(0.023)	(0.023)	(0.023)
Nunber of the elderly	0.007	-0.039	-0.039	-0.040	0.041***	-0.023	-0.025	-0.025
	(0.009)	(0.027)	(0.027)	(0.027)	(0.011)	(0.036)	(0.036)	(0.036)
Pseudo R^2	0.215	0.279	0.279	0.280	0.153	0.186	0.186	0.187
No. of observations	6493	489	489	489	6493	493	493	493

Note: (1) Standard errors are in parentheses. ***, ** and * mean statistically significant at 1%, 5%, and 10%, respectively. (2) The sample in the regressions from column (2) to (4) is 489 because four observations are dropped for multicollinearity.

Table 5 Effects of Land Acquisition on Household Income Level, 2012 Xingwen County Survey Data

Explanation variable	Dependent variable: household income level (ordered probit model)		
	(1)	(2)	(3)
If land is acquired	0.204 (0.153)	—	—
ln (land area acquired)	—	0.139 (0.108)	—
ln (compensation payment)	—	—	0.100 (0.100)
ln (land size)	-0.074 (0.070)	-0.125 (0.083)	-0.121 (0.083)
Number of labors	0.592*** (0.089)	0.630*** (0.127)	0.627*** (0.128)
Average education	0.133*** (0.034)	0.176*** (0.044)	0.174*** (0.044)
Average age	-0.039*** (0.009)	-0.026** (0.010)	-0.027** (0.011)
ln (housing area)	0.569*** (0.145)	0.628*** (0.243)	0.640*** (0.246)
Pseudo R^2	0.161	0.171	0.169
No. of observations	328	164	164

Note: Standard errors are in parentheses. ***, ** and * mean statistically significant at 1%, 5%, and 10%, respectively.

Table 6 Effects of Land Acquisition on Household Income, 2013 CHFS Survey Data

Explanation variable	Dependent variable: household income (OLS)			
	(1)	(2)	(3)	(4)
If land is acquired	0.164**			
	(0.073)			
ln (land area acquired)		0.035		
		(0.116)		
ln (compensation payment)			0.115	
			(0.077)	
ln (compensation price)				0.097
				(0.117)
ln (land size)	0.003	-0.007	-0.006	-0.006
	(0.003)	(0.015)	(0.014)	(0.014)
Number of labors	0.254***	0.385***	0.375***	0.381***
	(0.018)	(0.066)	(0.067)	(0.067)
Average education	0.119***	0.111***	0.104***	0.109***
	(0.008)	(0.032)	(0.031)	(0.031)
Average age	-0.005*	0.007	0.006	0.007
	(0.003)	(0.009)	(0.009)	(0.009)
ln (housing value)	0.050***	0.028	0.026	0.026
	(0.007)	(0.022)	(0.022)	(0.022)
adj. R^2	0.140	0.161	0.166	0.162
No. of observations	6360	478	478	478

Note: Standard errors are in parentheses. ***, ** and * mean statistically significant at 1%, 5%, and 10%, respectively.