Assessing Off-farm Employment Decisions of Rural Households in China

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Abstract:

This paper investigates the off-farm employment decisions of farm households in China. A rigorous theoretical framework which incorporates agricultural risks is constructed and comparative statistics are derived and assessed. Associated empirical models are developed to quantify households' decisions on supplying off-farm labor using a sample of household finance survey in 2010. Our empirical results show that farm income variability significantly impacts off-farm labor supply by farm households and individual farmers, which implies off-farm employment is a risk adaption behavior among Chinese farmers.

I.   Introduction

Nearly four decades of economic reform has led to dramatic changes in the economic landscape of China. The nation has received a remarkable success in economic growth and poverty reduction. The expansion of the rural economy has driven a large part of this success. Rural incomes have risen significantly and hundreds of millions of people have escaped poverty during this time (World Bank 2001). From 1978 to 2014, the rural income per capita increased from 133.6 Yuan to 9,892 Yuan, and the rural poverty percentage fell from 76% to 7.2% (National Bureau of Statistic of China, NBSC, 2015). Much of the credit goes to a series of agricultural and rural industrial reforms implemented since 1978. The reforms provided new opportunities for farmers, allowing them to freely respond to market signals rather than to follow government commands. Agricultural production shifted from production-team system to the household responsibility system (HRS). Not only did production efficiency increase as farmers responded to the new incentives such as HRS and the adjustment in state procurement prices (Lin, 1992), but also farming families had much greater flexibility of allocating labor between on and off farm opportunities. Led by the rapid growth of township and village enterprises (TVEs) and urban labor markets, many farmers and their family members began to engage in economic activities off their lands. As a result, rural non-farming employment rose from 67 million to 217.8 million (about 52.6% of rural workforce) between 1985 and 2010 (NBSC, 2011). The booming non-farming economy in rural China has led to a great increase in economic well-being, contributing significantly to both employment expansion and rural income growth (Goh, Luo, and Zhu, 2008; Walder, 2002; Yang, 2004). Off-farm earnings rose to 47% of rural household incomes in 2012 (NBSC, 2013).

Rural economy of China has earned a lot of research interest due to its importance in the size of its rural labor force and the increased reliance on off-farm income by Chinese farm households. Previous literature found that young and well-educated generations are better prepared for the off-farm labor market. Using the Probit model, de Javry, Sadoulet and Zhu (2005) found that higher educations and more social network connections increase the likelihood of a rural Chinese household to allocate their labor towards the off-farm activities. Similar results are presented in Chen, Huffman, and Rozelle (2004) where education, household size and social networks were

found crucial in in deciding the locations of employments by rural households in China. Zhang, Huang, and Rozelle (2002) concluded that rural workers have been increasingly rewarded for their education through both better off-farm job access and higher wages. Their results suggest that investments in rural education are desperately needed to improve agricultural productivity and facilitate the demographic and economic transition of the rural areas. Restructuring the rural education system might enhance the rural human capital accumulation and economic development. Zhang, De Brauw, and Rozelle (2004) concluded that there has been an overall increase in off-farm participation and young migrants have driven a large part of this increase. Gender difference has also been emphasized. A number of studies demonstrated that the determinants of off-farm labor supply participation vary significantly by gender (Zhang, De Brauw, and Rozelle, 2004; Willmore, Cao, and Xin, 2011; Hare 1994).

The existing literature on off-farm labor supply in China centers on applying appropriate econometric methodologies to identify the impacts of various factors. However, we found a significant gap in the literature that agricultural production risks are rarely considered as a driving factor of farmers' labor allocation in China. Even in a global context, the only studies that we found have considered this factor are Mishra and Goodwin (1997) and Mishra and Holthausen (2002) that analyzed the impacts of risks of farming and off-farm incomes on the US farmers. Given the increasing importance of risk management in China's agricultural industries, such an overlook of production risks in the study of off-farm labor supply suggests a further investigation. In addition, we found few literature considered the regional heterogeneity when studying the off-farm employment decision in rural China. Our study strives to fill these information gaps. Thus, the following research questions arise: (1) How do households allocate their labor time between farm and off-farm jobs? (2) What are the driving forces behind a farm household's time allocation? (3) Does this labor allocation decision response to agricultural production risks? (4) Does this labor allocation decision differ across the regions? The overall goal of this paper is to contribute to the assessment of agricultural households' decision-making on labor allocation in China.

Different previous models (Mishra and Goodwin 1997; Mishra and Holthausen 2002) in which risks are only implicitly included, we construct a theoretical framework explicitly modeling agricultural production risk and evaluating its impact. Further, we validate our theoretical results by empirically analyzing a sample of China's rural households' labor supply decisions. As such a

problem concerning Chinese farmers is never studied before, our paper will provide important economic insights and policy implications for both academic and public audiences.

In the theoretical part, we consider a typical agricultural household as an integrated identity of consumer of consumable goods and leisure, producer of agricultural products and potential supplier of off-farm labor. A stochastic function is used to model the risks. Based upon this framework, we obtained the functional forms of both interior and corner solutions of farm labor supply. In addition, comparative statistics of off-farm labor supply in response to the change of an exogenous variable (i.e. wage rate, age and education) are derived and assessed.

Our empirical analysis uses a survey of Chinese households conducted by CHFS[1] in summer 2011. We focus on the households of which at least one member engaged in farming activities in 2010. Our data include 2352 rural households from 21 provinces. A binary logit model is adopted when the dependent variable is defined as whether a household participated in any form of off-farm income generating activity that requires their own labor input. The set of explanatory variables include the expectations and risks of farming and off-farm incomes, household demographics (i.e. age and household size) and other relevant repressors. Further, for the purpose of comparison, we also evaluate labor supply decisions at the individual level. In general, the results are consistent with the predictions of our theoretical model. In particular, the risks of agricultural production are found to be a significant factor for Chinese farmers to decide their labor allocations.

In conclusion, the contributions of our study are in four folds. First, our paper fills the gap in the existing literature that production risks were never considered as an important factor in determining the Chinese rural households' labor supply. Second, we construct a rigorous theoretical framework to explicitly address this issue. Third, our study is one of the first to recognize and identify regional heterogeneity among rural households' off-farm labor supply decisions. Last not the least, our empirical analysis provides evidence to verify our hypothesis that agricultural risks are a crucial determinant, and hence policy suggestions are discussed.

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[1] The China Household Financial Survey (CHFS) was carried out by the survey and research center for China Household Finance, a non-profit institute for academic inquiry based at Southwestern University of Finance and Economics (SWUFE).

The rest of the paper is organized as follows. Next section presents the theoretical framework. In section 3, we introduce the data that are used for the analysis. Section 4 describes the empirical analysis and Section 5 presents the results to explain the determinants of employment decision at both household and individual level. The final section concludes.

II. Theoretical framework

Our theoretical framework is based on a number of assumptions:

A1. Following the approach of Goodwin and Mishra (1997), we assume that income-generating options exist for each rural household member in agriculture (supplying F hours of labor to farming) and through off-farm employment (supplying H hours of labor to the off-farm market).

A2. Under conditions of perfect information, utility (U) is a function of total household consumption (C), a vector of household member's leisure (L) and a vector of factors exogenous to current household consumption decisions (k). We assume household utility function is in the form of Cobb-Douglas which is specified as equation (1).

(1) $U = U(C, L; k) = C^a L^b, (U_C > 0, U_L > 0, \ 0 < a, b < 1)$

A3. It is well known that farm income is quite unstable. Both unpredictable weather and the biological risks inherent in agricultural production contribute to price volatility in agricultural commodity markets. Given the riskiness of the farming business, agricultural production function is assumed to be in the stochastic Cobb-Douglas form defined by equation (2). The disturbance ε of the production function representing factors such as whether, unpredicted variations in labor or facility performance, etc., is normally distributed with variance σ^2.

(2) $y = F^\alpha X^\beta e^\varepsilon, (\ 0 < \alpha, \beta < 1, \ \alpha + \beta > 1)$

A4. We assume the production function has increasing returns to scale. Given the small scale of farm size, China exhibits a relatively low capital labor ratio in agriculture, which implies a high return to capital. Therefore, productivity will be enhanced if more capital were utilized.

A5. The prices (p, P, w) are assumed to be known with certainty.

A6. We also assume that wage rate (w) is determined by a set of exogenous factors, such as age, education, etc., and the marginal effect of these factors is diminishing.

A7. The expected farm income will be assumed to increase as farming experience increases.

Labor supply decisions of farm household members are viewed as the result of household utility maximization subject to income and time constraints (equation 3 and 4, respectively).

$$(3)\ C = E(R) - PX + wH + A$$

$$(4)\ T = F + H + L,\ (F > 0, H \geq 0, L \geq 0)$$

Where:

$$(5)\ E(R) = p * E(y)$$

Substituting (2) and (5) into (3):

$$(6)\ C = p * E\left(F^\alpha X^\beta e^\varepsilon\right) - PX + wH + A = pF^\alpha X^\beta e^{\frac{\sigma^2}{2}} - PX + wH + A$$

In equations above, $E(R)$ represents the expected farm income, F and H represent farm and off-farm hours supplied respectively, p represents a price vector of yield y, P represents a price vector of other inputs X, w represents the off-farm wage rate, and A represents other income.

In this study, we define rural households as those engaging in agricultural activities who have a positive amount of labor supply to on-farm employment. Whenever the production process is not instantaneous, the effect of the disturbance on yield cannot be known until after the preselected quantities of inputs have been employed in production. Any given level of inputs will result in an uncertain quantity of yield and, consequently, in an uncertain of farm income. Therefore, the mathematical expectation of farm income will be used to maximize household utility.

Maximizing the utility function subject to the income and time constraints, the Lagrangian function is:

(7) $\mathcal{L} = C^a L^b + \lambda(pF^\alpha X^\beta e^{\frac{\sigma^2}{2}} - PX + wH + A - C) + \delta(T - F - H - L)$

where λ and δ represent Lagrange multipliers for the household's income and time allocation.

Solving for the first-order conditions yields:

(8) $\frac{\partial E(R)}{\partial F} = p\alpha F^{\alpha-1} X^\beta e^{\frac{\sigma^2}{2}} = w$

(9) $H = \frac{a}{a+b}T - \frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)F - \frac{b}{a+b}\frac{A}{w}$

(10) $F^* = (p\alpha^{1-\beta}\beta^\beta P^{-\beta}w^{\beta-1}e^{\frac{\sigma^2}{2}})^{\frac{1}{1-(\alpha+\beta)}}$,

(11) $H^* = \frac{a}{a+b}T - \frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)(p\alpha^{1-\beta}\beta^\beta P^{-\beta}w^{\beta-1}e^{\frac{\sigma^2}{2}})^{\frac{1}{1-(\alpha+\beta)}} - \frac{b}{a+b}\frac{A}{w}$

Equation (8) implies that the marginal farm income with respect to farm labor is equal to the off-farm wage rate. Equation (9) shows the relationship between farm hours and off-farm hours supplied. Equations (10) and (11) are solutions for F and H (F^* and H^*, respectively), which is a function of some or all exogenous variables of the model.

Based on our assumptions, the sign of F^* is positive, but the sign of H^* is indeterminate.

Case 1: If H^* is positive, then we can solve for interior solutions. Sufficient conditions for constrained maximization in optimization problems require determining the sign of the second total differential. And the sign of the second total differential of the Lagrangian function depends on the sign of the determinant of the bordered Hessian as follows:

$$(12)\ H = \begin{bmatrix} \mathcal{L}_{\lambda\lambda} & \mathcal{L}_{\lambda\delta} & \mathcal{L}_{\lambda C} & \mathcal{L}_{\lambda L} & \mathcal{L}_{\lambda F} & \mathcal{L}_{\lambda H} & \mathcal{L}_{\lambda X} \\ \mathcal{L}_{\lambda\delta} & \mathcal{L}_{\delta\delta} & \mathcal{L}_{\delta C} & \mathcal{L}_{\delta L} & \mathcal{L}_{\delta F} & \mathcal{L}_{\delta H} & \mathcal{L}_{\delta X} \\ \mathcal{L}_{\lambda C} & \mathcal{L}_{\delta C} & \mathcal{L}_{CC} & \mathcal{L}_{CL} & \mathcal{L}_{CF} & \mathcal{L}_{CH} & \mathcal{L}_{CX} \\ \mathcal{L}_{\lambda L} & \mathcal{L}_{\delta L} & \mathcal{L}_{CL} & \mathcal{L}_{LL} & \mathcal{L}_{LF} & \mathcal{L}_{LH} & \mathcal{L}_{LX} \\ \mathcal{L}_{\lambda F} & \mathcal{L}_{\delta F} & \mathcal{L}_{CF} & \mathcal{L}_{LF} & \mathcal{L}_{FF} & \mathcal{L}_{FH} & \mathcal{L}_{FX} \\ \mathcal{L}_{\lambda H} & \mathcal{L}_{\delta H} & \mathcal{L}_{CH} & \mathcal{L}_{LH} & \mathcal{L}_{FH} & \mathcal{L}_{HH} & \mathcal{L}_{HX} \\ \mathcal{L}_{\lambda X} & \mathcal{L}_{\delta X} & \mathcal{L}_{CX} & \mathcal{L}_{LX} & \mathcal{L}_{FX} & \mathcal{L}_{HX} & \mathcal{L}_{XX} \end{bmatrix} =$$

$$\begin{bmatrix} 0 & 0 & -1 & 0 & p\alpha F^{\alpha-1}X^{\beta}e^{\frac{\sigma^2}{2}} & w & p\beta F^{\alpha}X^{\beta-1}e^{\frac{\sigma^2}{2}}-P \\ 0 & 0 & 0 & -1 & -1 & -1 & 0 \\ -1 & 0 & a(a-1)C^{a-2}L^{b} & abC^{a-1}L^{b-1} & 0 & 0 & 0 \\ 0 & -1 & abC^{a-1}L^{b-1} & b(b-1)C^{a}L^{b-2} & 0 & 0 & 0 \\ p\alpha F^{\alpha-1}X^{\beta}e^{\frac{\sigma^2}{2}} & -1 & 0 & 0 & \lambda p\alpha(\alpha-1)F^{\alpha-2}X^{\beta}e^{\frac{\sigma^2}{2}} & 0 & \lambda p\alpha\beta F^{\alpha-1}X^{\beta-1}e^{\frac{\sigma^2}{2}} \\ w & -1 & 0 & 0 & 0 & 0 & 0 \\ p\beta F^{\alpha}X^{\beta-1}e^{\frac{\sigma^2}{2}}-P & 0 & 0 & 0 & \lambda p\alpha\beta F^{\alpha-1}X^{\beta-1}e^{\frac{\sigma^2}{2}} & 0 & p\beta(\beta-1)F^{\alpha}X^{\beta-2}e^{\frac{\sigma^2}{2}} \end{bmatrix}$$

Lemma 1: Given assumptions A1-A7, if the bordered Hessian matrix H is negative semi-definite, then household will spend H on off-farm employment, as expressed in equation (11).

Case 2: If H^* is negative, and $H = \frac{a}{a+b}T - \frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)F - \frac{b}{a+b}\frac{A}{w} = \frac{a}{a+b}\left(aT - aF - \frac{b(1-\beta)}{\alpha}F - b\frac{A}{w}\right)$, which gives $aT - aF - \frac{b(1-\beta)}{\alpha}F - b\frac{A}{w} < 0$, we can show: $\frac{\partial \mathcal{L}}{\partial H}|_{H=0} = \lambda w - \delta = aC^{a-1}L^{b}w - bC^{a}L^{b-1} = C^{a-1}L^{b-1}(aLw - bC) = C^{a-1}L^{b-1}\left\{w\left(aT - aF - \frac{b(1-\beta)}{\alpha}F - b\frac{A}{w}\right)\right\} < 0$

Lemma 2: Given assumptions A1-A7, if $\frac{\partial \mathcal{L}}{\partial H}|_{H=0}$ is negative, we got the corner solution, H=0. In this case, household will not allocate any labor on off-farm employment.

Since we have a third type of time-allocation choice, L, we also need to check the sign of L to make sure it is nonnegative in both cases.

According to (9), we can get:

$$(13)\ F = \frac{a\alpha}{a\alpha+b(1-\beta)}T - \frac{b\alpha}{a\alpha+b(1-\beta)}\frac{A}{w} - \frac{(a+b)\alpha}{a\alpha+b(1-\beta)}H$$

Substituting into $T = F + H + L$, yielding

$$(14)\ T = \frac{a\alpha}{a\alpha+b(1-\beta)}T - \frac{b\alpha}{a\alpha+b(1-\beta)}\frac{A}{w} - \frac{(a+b)\alpha}{a\alpha+b(1-\beta)}H + H + L$$

Rearranging equation (14), we can get the expression for L:

$$(15) \ L = \frac{b(1-\beta)}{a\alpha+b(1-\beta)}T + \frac{b\alpha}{a\alpha+b(1-\beta)}\frac{A}{w} - \frac{b[1-(\alpha+\beta)]}{a\alpha+b(1-\beta)}H$$

Based on our assumption $\alpha + \beta > 1$, if H* is the interior solution, then L* is positive. If H* is the corner solution, meaning H equals zero, $L^* = \frac{b(1-\beta)}{a\alpha+b(1-\beta)}T + \frac{b\alpha}{a\alpha+b(1-\beta)}\frac{A}{w}$ is also positive. This result confirms our two solutions.

Furthermore, in order to better develop our hypotheses in the empirical analysis on off-farm participation, comparative statistics are derived for the interior solution H^*.

Lemma 3: Given assumptions A1-A7, an increase in the variation of farm output (and therefore farm income) leads to an increase in the amount of time spent working off farm by the farm operator, as shown in equation (16).

$$(16) \ \frac{\partial H^*}{\partial \sigma^2} = -\frac{1}{2}\frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)\frac{1}{1-(\alpha+\beta)}(p\alpha^{1-\beta}\beta^\beta P^{-\beta}w^{\beta-1}e^{\frac{\sigma^2}{2}})^{\frac{1}{1-(\alpha+\beta)}} > 0$$

Farmers also care about the level of expected farm income when they make employment decisions.

Lemma 4: Given assumptions A1-A7, the expected farm income has a negative impact on off-farm employment, as demonstrated in equation (18).

In order to derive the effect of off-farm time spending in response to a given change in expected agricultural income, we rearrange H^* yielding:

$$(17) \ H^* = \frac{a}{a+b}T - \frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)\{p^{-1}\left(\frac{\alpha P}{\beta w}\right)^\beta e^{-\frac{\sigma^2}{2}}E(R)\}^{\frac{1}{\alpha+\beta}} - \frac{b}{a+b}\frac{A}{w}$$

Then we can show:

$$(18) \ \frac{\partial H^*}{\partial E(R)} = -\frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)\frac{1}{\alpha+\beta}(p^{-1}\left(\frac{\alpha P}{\beta w}\right)^\beta e^{-\frac{\sigma^2}{2}}E(R))^{\frac{1}{\alpha+\beta}-1}(p^{-1}\left(\frac{\alpha P}{\beta w}\right)^\beta e^{-\frac{\sigma^2}{2}}) =$$

$$-\frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)\frac{1}{\alpha+\beta}(p^{-1}\left(\frac{\alpha P}{\beta w}\right)^\beta e^{-\frac{\sigma^2}{2}})^{\frac{1}{\alpha+\beta}}(E(R)^{\frac{1}{\alpha+\beta}-1}) < 0,$$

Lemma 5: Given assumptions A1-A7, off-farm wage rate has a positive effect on off-farm labor supply which is conditional on wage rate is less than a certain value, as shown in equation (19).

The interpretation for this might be that as wage rate goes up to a certain point, farmers will spend more time on leisure rather than work.

$$(19)\ \frac{\partial H^*}{\partial w} = -\frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right) *$$

$$\frac{1}{1-(\alpha+\beta)}\left(p\alpha^{1-\beta}\beta^\beta P^{-\beta}w^{\beta-1}e^{\frac{\sigma^2}{2}}\right)^{\frac{1}{1-(\alpha+\beta)}-1}\left(p\alpha^{1-\beta}\beta^\beta P^{-\beta}e^{\frac{\sigma^2}{2}}\right)(\beta-1)w^{\beta-2} + \frac{bA}{a+b}\frac{1}{w^2}$$

$$\frac{\partial H^*}{\partial w} > 0, \text{ when } w < \left(\frac{bA(\alpha+\beta-1)}{a(1-\beta)\left(1+\frac{b(1-\beta)}{a\alpha}\right)}\left(p\alpha^{1-\beta}\beta^\beta P^{-\beta}e^{\frac{\sigma^2}{2}}\right)^{\frac{1}{\alpha+\beta-1}}\right)^{\frac{\alpha+\beta-1}{\alpha}}.$$

Lemma 6: Given assumptions A1-A7, off-farm labor will increase as total time of household increase as shown in equation (20).

$$(20)\ \frac{\partial H^*}{\partial T} = \frac{a}{a+b} > 0$$

Lemma 7: Given assumptions A1-A7, an increase in other farm input (i.e. farmland, fertilizer, facility, etc.,) will result in a decrease in off-farm labor, as shown in equation (21).

$$(21)\ \frac{\partial H^*}{\partial X} = -\frac{a}{a+b}\left(1 + \frac{b(1-\beta)}{a\alpha}\right)\frac{\alpha P}{\beta\omega} < 0$$

Lemma 8: Given assumptions A1-A7, the amount of time spent working off farm by farmers will increase as age increases up to a certain point, and thereafter declines as age increases, as shown in equations (22) and (23).

Since we already know off-farm wage rate is positively correlated with off-farm employment plus the assumption made on wage rate with respect to age, the relationship between age and off-farm employment can be derived.

$$(22)\ \frac{\partial H^*}{\partial age} = \frac{\partial H^*}{\partial w} * \frac{\partial \omega}{\partial age} > 0, \text{ and}$$

$$(23)\ \frac{\partial^2 H^*}{\partial age^2} = \frac{\partial\left(\frac{\partial H^*}{\partial age}\right)}{\partial age} = \frac{\partial\left(\frac{\partial H^*}{\partial w}*\frac{\partial\omega}{\partial age}\right)}{\partial age} = \frac{\partial^2 H^*}{\partial w\,\partial age} * \frac{\partial\omega}{\partial age} + \frac{\partial H^*}{\partial w} * \frac{\partial^2\omega}{\partial age^2} < 0,$$

where $\frac{\partial^2 H^*}{\partial w\,\partial age} = 0, \frac{\partial\omega}{\partial age} > 0, \frac{\partial H^*}{\partial w} > 0$, and $\frac{\partial^2\omega}{\partial age^2} < 0.$

From equations (22) and (23), the amount of time spent working off farm by farmers will increase as age increases up to a certain point, and thereafter declines as age increases.

Similarly, we can show:

$$(24)\frac{\partial H^*}{\partial edu} = \frac{\partial H^*}{\partial w} * \frac{\partial \omega}{\partial edu} > 0, \text{ and}$$

$$(25)\frac{\partial^2 H^*}{\partial edu^2} < 0, \text{ since } \frac{\partial^2 \omega}{\partial edu^2} < 0$$

Lemma 9: Given assumptions A1-A7, farmers with higher education level are more likely to participate in the off-farm activity. However, the marginal effect of education on off-farm employment is diminishing, as shown in equations (24) and (25).

Farming experience is also a crucial factor which potentially impacts the farm operator's employment decision.

Lemma 10: Given assumptions A1-A7, the farm operators will spend less time on off-farm job as their farming experience increases, as shown in equation (26).

$$(26) \frac{\partial H^*}{\partial exp} = \frac{\partial H^*}{\partial E(R)} * \frac{\partial E(R)}{\partial exp} < 0$$

III.   Data

The data used in this study focus on the rural households which were involved in agricultural activity in the sample year 2010. The survey contained 3244 rural households from different provinces of China. Among the 3244 rural households, 1526 had both farm and off-farm sources of income; 829 had income exclusively derived from farm activities; and the remaining 889 had off-farm activities as their exclusive means of income. This study excludes those rural families that do not engage in farm activities. The focus is on the sample that (1) households that have total income from farm activities and (2) those that have mixed income from farm and off-farm

activities. The off-farm sources of income defined in this study are: (1) income earned by self-employment in non-farm activities such as industrial and/or commercial activities; (2) income earned from formal or informal wage, including salary, allowance, bonus, dividend, and other sorts of remuneration; and (3) property income such as rental income, compensation and investment income. Off-farm activity is defined as either individual workers among those farm households work locally or migrate. The reason for not distinguishing these two types of off-farm activity is that we cannot find the relevant job information regarding the locality for each labor force. There are only three rural households in shanghai. To avoid a biased representation of farm households, we rule out shanghai in our study area to ensure a random selection. In short, the sample is composed of 2352 households with farm income which are from 21 provinces of China. Starting from the Eleventh Five-Year Plan of China, the division of Chinese economic regions defined by the central government is: (1) Western region, (2) Northeast region, (3) Central region, and (4) Eastern region. Figure 1 depicts the study area of this paper with regional division.

Figure 1. Study Area
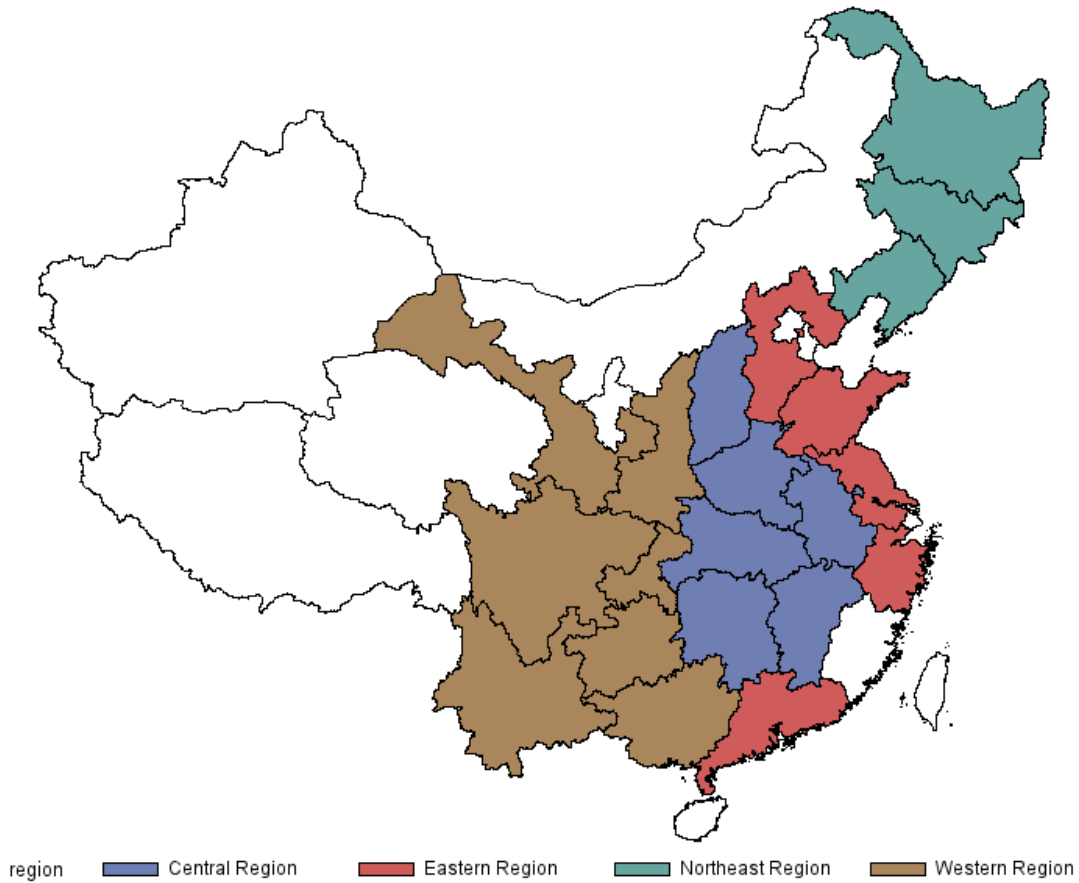
Based on our assumption of Cobb-Douglas production function in the theoretical framework, it is assumed that the logarithmic transformation of farm income per acre is normally distributed. In order to confirm this assumption, we checked the distribution of per acre farm income in the sample year using the survey data and the distribution of per acre farm income using the preceding 5-year data from National Bureau of Statistics of China (NBSC). Consistent with our assumption in the theoretical framework, the distribution of farm income per acre as a proxy of agricultural productivity seems to be log-normal distributed as illustrated in figure 2.

Figure 2

(a) Distributions of farm income per acre and its logarithm in 2010
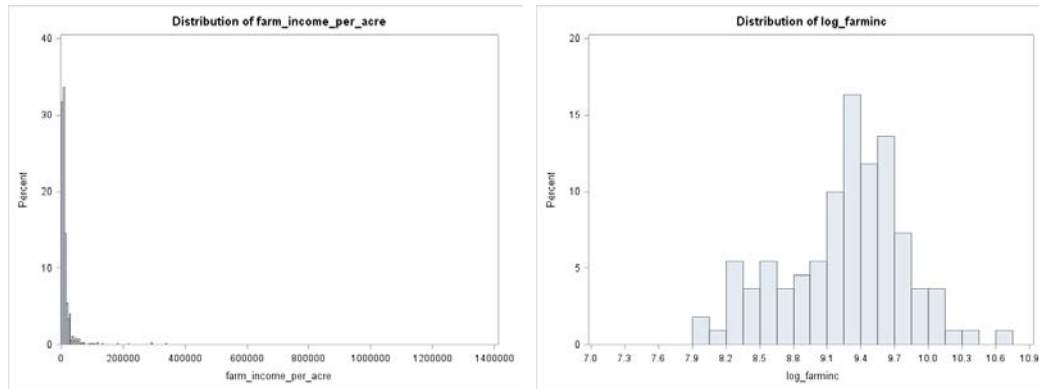
Source: CHFS survey.

(b) Distributions of farm income per acre and its logarithm from 2005 to 2009
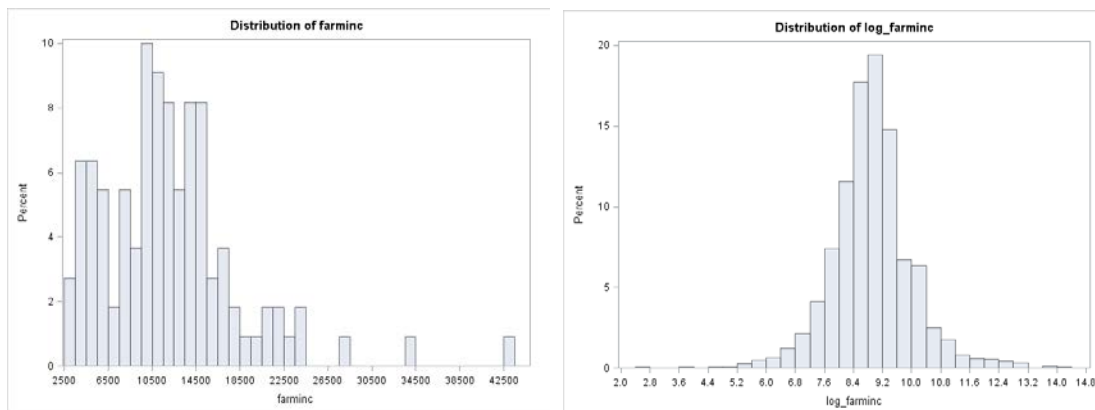
Source: National Bureau of Statistics of China.

Table 1 summarizes farm household statistics in two household categories. Category one is households that participate in both farming and off-farm activities, and category two is households that exclusively participate in farming activities. As described from these data, on average, households that have both sources of income have a lager household size, younger family members, higher education level, less farming experience, smaller farmland size and slightly closer distance to the county center as compared to those that specialized in farming.

Table 1. Household Characteristics in two household categories

	Overall	Category	
		(1)	(2)
Household size	4.07	4.62	3.24
Average age	40.68	36.44	47.00
Average education	6.94	7.63	5.89
Average farming experience among work force	32.08	27.61	38.92
Farmland size (acre)	1.05	0.98	1.15
Proximity (km)	35.43	34.60	36.69
N	2355	1410	945

Among these 2352 farm households, the individual household members are classified into five types: (1) pure farmers who only engaged in the farming activities; (2) off-farmers who primarily engaged in the farming work but also had an off-farm job; (3) non-farmers who exclusively worked outside the farm; (4) dependents who were under 16 years old; and (5) other unemployed adult individuals who did not have any job information. Table 2 describes individual statistics for the first three categories which indicate the labor force of the rural sector in our sample. Among working age individuals, off-farm worker are more likely to be single young male with higher education level as well as smaller farmland holdings.

Table 2. Individual Characteristics among the labor force

	Pure farmer	**Off-farmer**	**Non-farmer**
Male	46.48%	79.35%	63.73%

Marital status	*92.23%*	*95.88%*	*63.74%*
Average age	*50.23*	*45.28*	*31.69*
Average education	*6.00*	*7.96*	*9.30*
Farmland size per capita (acre)	*0.30*	*0.24*	*0.20*
N	*4062*	*368*	*2046*

IV.   Empirical analysis

3.1 Decision-making determinants at the household level

To address the heterogeneity across regions, a binary logit model with region effect control is applied to identify the determinants of household-level participation in off-farm activities. The binary respondent variable is defined as whether a household had any type of off-farm income sources or exclusively had income from farming activities. Employment decisions are made upon available information, such as own characteristics and prior information.

$$P_i^* = R_i\gamma + X_i\beta + \varepsilon_i, \quad P_i = 1\ (P_i^* > 0)$$

Where P_i^* is a non-observed continuous latent variable and P_i is an observed binary variable. P_i =1 if the household participates in the off-farm activity, and P_i =0 otherwise. R_i is a vector of historical income information. X_i is a vector of own characteristics. γ and β are parameters associated with R_i and X_i, respectively. ε_i is a random disturbance term following a standard logistic distribution.

The explanatory variables of key interest in this study are (1) the variation of farm income measured as the riskiness of agricultural production; (2) the expected farm income which reflects the relative return of agricultural production; and (3) the expected off-farm income which predicts the return of off-farm activities. Therefore, based on the theoretical framework, we adopted three historical income variables as proxies which are calculated over the preceding several years' income: (1) standard error of farm income per household; (2) average farm income per household; and (3) average wage income per household. In order to better investigate the role of agricultural income risks, three time periods – three-year, five-year, and ten-year – which represent shot-term,

mid-term and long-term respectively, are considered in this analysis. All income variables are at the province level and adjusted by provincial CPI with 2010 as the base year. Data source is NBSC.

Other explanatory variables represent own characteristics. Household size is the number of family members which determines the labor supply. Male is the number of male members in the household. This variable controls for possible differences for the productivity between male and female. Proximity to the downtown is included to capture the convenience of the farmers to the local markets. Farmland size is assumed to positively affect the relative return of agricultural production. That is, as farmland size increases, the farm income increases. Dependents are defined as individuals who are under 16 years old. Households with dependents need spend extra time on child care, which leads to a decline in total work and leisure time. Average age per household controls for the possible differences in work time allocation. Younger households have less opportunity cost to search an off-farm job. Therefore, they are more likely to work off the farm. Age squared is included to capture the possibility that the depreciation of human capital after a certain age offsets the accumulated experience. Average education per household is the factor which determines the quality of labor supply, in other words, the capacity to participate in the off-farm activities. Similarly, education squared is to capture the marginal return of formal education of off-farm employment choice. Average farm experience is considered to affect the relative return of agricultural production. Households with more experience tend to be more productive.

A number of dummy variables are assigned to four regions: Western region, Northeast region, Central region, and Eastern region respectively. To avoid the dummy variable trap, Northeast region was dropped from the estimation procedure and chosen as the reference category.

Table 3(a) provides summary statistics for all the variables used in the household level participation equation.

Table 3 (a). Definition and Statistics of Variables in the household level equation

Variable	Definition	Mean	Std.
Off farm Dummy	1 if the household had any type of off-farm	0.65	0.48
Household size	Number of household members	4.07	1.70
Male	Number of male household members	2.12	1.02
Proximity (km)	The distance between the household's residence	0.04	0.03
Farmland size (acre)	The area of farmland per household	1.05	1.94
Dependent	Number of dependents under 16 years old per	0.70	0.90
Age	Average age of household members	40.67	13.42
Age squared	The square term of average age	1834.	1260.
Education	Average years of formal education of household	6.94	2.82
Education squared	The square term of average education	55.53	36.76
Farming experience	Average years of farming experience among the	32.08	11.51
Western Dummy	1, if the household belongs to Western region, 0	0.28	0.45
Northeast Dummy	1, if the household belongs to Northeast region,	0.08	0.27
Central Dummy	1, if the household belongs to Central region, 0	0.44	0.50
Eastern Dummy	1, if the household belongs to Eastern region, 0	0.20	0.40
Short-term (Three-year:			
Farm income variation	Average annual farm income in each province	0.06	0.04
Average Farm income	Average annual farm income in each province	1.41	0.32
Average Wage income	Average annual wage income in each province	0.74	0.37
Mid-term (Five-year:			
Farm income variation	Average annual farm income in each province	0.11	0.05
Average Farm income	Average annual farm income in each province	1.33	0.29
Average Wage income	Average annual wage income in each province	0.67	0.34
Long-term (Ten-year:			
Farm income variation	Average annual farm income in each province	0.20	0.08
Average Farm income	Average annual farm income in each province	1.15	0.24
Average Wage income	Average annual wage income in each province	0.54	0.28

3.2 Decision-making determinants at the individual level

This section provides the empirical evidence by assessing the off-farm employment decision among pure farmers, off-farmers and non-farmers (type 1, 2 and 3) within the sample households that constitute the labor force in this study. The dependent variable is defined as whether the individual worker took any off-farm job or stayed as a pure farmer. The structure of this analysis is similar with that of the household level analysis. Income variables are all in real, per capita term. West region was dropped from the estimation procedure and chosen as the reference category. Table 3(b) provides summary statistics for all the variables used in the individual level analysis.

Table 3(b). Definition and Statistics of Variables in the individual level equation

Variable	Definition	Mean	Std.
Off farm Dummy	1 if the working age individual took any off-farm	0.37	0.48
Male Dummy	1 male, 0 female	0.54	0.50
Marital Status Dummy	1 married, 0 otherwise	0.83	0.37
Age	Age of the individual in the sample year 2010	44.09	15.09
Age squared	The square term of age	2171.9	1379.8
Education	Years of formal education	7.16	3.74
Household size	Number of household members	4.57	1.78
Farmland size (acre)	The area of farmland per capita	0.27	0.54
Proximity (km)	The distance between the household's residence	0.04	0.03
Dependent	Number of dependents under 16 years old per	0.77	0.94
Western Dummy	1, if the household belongs to Western region, 0	0.28	0.45
Northeast Dummy	1, if the household belongs to Northeast region,	0.07	0.26
Central Dummy	1, if the household belongs to Central region, 0	0.46	0.50
Eastern Dummy	1, if the household belongs to Eastern region, 0	0.19	0.39
Short-term (Three-year:			
Farm income variation	Average annual farm income per capita in each	0.02	0.01
Average Farm income	Average annual farm income per capita in each	0.35	0.10
Average Wage income	Average annual wage income per capita in each	0.18	0.09
Mid-term (Five-year:			
Farm income variation	Average annual farm income per capita in each	0.03	0.02
Average Farm income	Average annual farm income per capita in each	0.33	0.09
Average Wage income	Average annual wage income per capita in each	0.17	0.09
Long-term (Ten-year:			
Farm income variation	Average annual farm income per capita in each	0.05	0.02
Average Farm income	Average annual farm income per capita in each	0.28	0.07
Average Wage income	Average annual wage income per capita in each	0.13	0.07

V. Results

Table 4 (a). Estimates and statistics of household level participation equation

	(1)	*(2)*		
		(a) Three-year	*(b) Five-year*	*(c)Ten-year*
Intercept	-2.0382***	-2.0819**	-1.8098*	-1.7867*
	(0.7887)	(1.0490)	(1.0449)	(1.0496)
Farm income standard error (10000 Yuan)		7.8027***	7.1981***	4.1443***
		(2.4139)	(1.9384)	(1.5522)
Farm income (10000 Yuan)		-0.6470**	-1.1137***	-1.2674***
		(0.2957)	(0.3510)	(0.4227)
Wage income (10000 Yuan)		0.4544**	0.6190***	1.0354***
		(0.2059)	(0.2164)	(0.2787)
Household size	0.4334***	0.4312***	0.4301***	0.4372***
	(0.0718)	(0.0722)	(0.0721)	(0.0722)
Number of Male Members	0.0904	0.0987	0.1053	0.0900
	(0.0906)	(0.0914)	(0.0916)	(0.0915)
Proximity (100km)	-0.6026	-0.3887	-0.3024	0.3764
	(1.9436)	(1.9606)	(1.9588)	(1.9725)
Farmland size (acre)	-0.0833**	-0.0679*	-0.0607	-0.0634
	(0.0420)	(0.0410)	(0.0401)	(0.0404)
Number of Dependents	-0.3042**	-0.3070**	-0.2985**	-0.3133**
	(0.1219)	(0.1222)	(0.1223)	(0.1223)
Average age of household members	0.0950***	0.0955***	0.0968***	0.0945***
	(0.0328)	(0.0328)	(0.0328)	(0.0328)
Age squared	-0.0008**	-0.0008**	-0.0008**	-0.0008**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Average Education of household members	0.1516**	0.1423*	0.1458**	0.1425*
	(0.0733)	(0.0734)	(0.0737)	(0.0737)
Education squared	-0.0068	-0.0063	-0.0065	-0.0067
	(0.0055)	(0.0055)	(0.0056)	(0.0056)
Farming experience among labor force	-0.0802***	-0.0847***	-0.0847***	-0.0825***
	(0.0098)	(0.0100)	(0.0100)	(0.0100)
East	1.1066***	1.1901***	0.9791***	0.6023*
	(0.2498)	(0.4135)	(0.3777)	(0.3551)
Middle	0.6962***	1.0194***	0.8585**	0.7512**
	(0.2347)	(0.3904)	(0.3559)	(0.3542)
West	0.6632***	0.9636**	0.8111**	0.6153*
	(0.2405)	(0.3895)	(0.3612)	(0.3492)
-2 Log L	2086.708	2064.739	2059.618	2064.932
Likelihood Ratio	694.4228***	616.7519***	621.5139***	616.1986***
F test		21.0581***	24.7491***	20.2483***
N		*2085*		

*Note: *, **, and *** represent significance at the 10%, 5% and 1% levels, respectively.*

Table 4 (b). Estimates and statistics of individual level participation equation

	(3)	(a) Three-year	(b) Five-year	(c) Ten-year
			(4)	
Intercept	1.1199***	0.4997	0.3576	0.1243
	(0.4067)	(0.5047)	(0.5097)	(0.5025)
Farm income per capita standard error (10000 Yuan)		17.2390***	7.7201*	2.4995
		(6.1317)	(4.6070)	(3.0535)
Farm income per capita (10000 Yuan)		-0.9417	-0.6484	0.3469
		(0.8934)	(1.0966)	(1.1441)
Wage income per capita (10000 Yuan)		5.3468***	6.7730***	9.0438***
		(0.8153)	(0.7808)	(0.8793)
Male Dummy	1.0390***	1.0789***	1.0795***	1.0813***
	(0.0738)	(0.0750)	(0.0750)	(0.0751)
Marital Status Dummy	-0.6075***	-0.5932***	-0.5892***	-0.5871***
	(0.1239)	(0.1252)	(0.1252)	(0.1252)
Age	-0.0478**	-0.0512***	-0.0524***	-0.0532***
	(0.0191)	(0.0191)	(0.0191)	(0.0191)
Age squared	-0.0004*	-0.0004*	-0.0004*	-0.0004*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Education	0.1409***	0.1414***	0.1405***	0.1400***
	(0.0128)	(0.0130)	(0.0130)	(0.0130)
Household size	0.1051***	0.1272***	0.1263***	0.1263***
	(0.0276)	(0.0284)	(0.0285)	(0.0285)
Farmland size per capita	-0.8814***	-0.5481***	-0.5367***	-0.5315***
	(0.1683)	(0.1625)	(0.1632)	(0.1635)
Proximity (100km)	-3.8476***	-3.5876***	-3.4228***	-3.4415***
	(1.2970)	(1.3129)	(1.3183)	(1.3244)
Number of dependent	-0.1682***	-0.1946***	-0.1925***	-0.1918***
	(0.0483)	(0.0491)	(0.0491)	(0.0492)
Northeast	-0.5146***	--1.1081***	-0.9756***	-1.0237***
	(0.1824)	(0.3274)	(0.3200)	(0.3232)
East	0.1100	-0.9894***	-1.1881***	-1.3578***
	(0.1047)	(0.2127)	(0.2015)	(0.1906)
Middle	-0.0412	-0.3338***	-0.3655***	-0.3759***
	(0.0844)	(0.1062)	(0.1042)	(0.1022)
-2 Log L	5160.449	5045.255	5048.010	5045.468
Likelihood Ratio	2479.1868***	2594.3802***	2591.6256***	2594.1675***
F test		110.3417***	107.8613***	110.4402***
N			5772	

Note: *, **, and *** represent significance at the 10%, 5% and 1% levels, respectively.

We run the participation regression considering four circumstances: (1) without income factors; (2) with short-term income effect (three-year); (3) with mid-term income effect (five-year); and (4) with long-term income effect (ten-year). ***Table 4 (a)*** provides the logistic regression results at the household level. In almost all respects, the multivariate regression analyses perform well. The estimation of the model as a whole in each circumstance is highly significant. The coefficients of all the explanatory variables in the models have the expected signs which are consistent with the predictions derived by our theoretical model, and most of them are highly significant.

For those three scenarios in which prior income effect are taken into account, similar results are shown on the income factors. In general, there is a significant overall impact of the income factors on the off-farm employment decision and this is confirmed by the F tests. In other words, all income variables are relevant and necessarily retained in the model. In particular, an important finding is that farm income variability, as represented by the coefficient of standard error on historical agricultural income has a positive and significant effect on the off-farm employment choice. On average, for every additional 10000 Yuan variation of agricultural income in the short run, the probability of the household holding off-farm jobs would increase by 126.7% 2. It shows the similar result in the mid-term (116.6%), however, in the long term, this figure is 67.3%. Likely, this trend is due to the farmers' desire to make consistent and predictable earnings. Rural households are more likely to take off-farm jobs when high riskiness of farm earnings is presented. Expected incomes based on prior years' earnings present significant impact in this study, indicating rural households take their past income into account when they make employment decisions. On average, as the average farm income increases 10000 Yuan the probability of seeking off-farm jobs decreases by 10.5%, 18.1%, and 20.7% in the three time period respectively, while an additional 10000 Yuan increase in the average wage income increase the probability of working outside the farm by 7.4% (short-term), 10.1% (mid-term) and 16.9% (long-term) respectively. These results indicate that households with higher average farm income are more likely to stay on the farm rather than leave to find a job, while those with higher wage income are less likely to do so.

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[2] Marginal effects are the average marginal effect of farm income variation on the probability of off-farm=1 meaning farm household had any types of off-farm income sources in 2010.

Confirming our predictions, the general findings on the non-income variables are pretty similar across different circumstances. The coefficient of *household size* is positive and statistically significant at the 1% level. Households with larger size tend to need more income to support the household, hence, greater incentive for a family worker to leave the farm to seek work. The presence of dependents has a significant negative effect on the off-farm employment. Dependents who are under 16 years old tend to need more time to be cared for, and thus the adult members have less opportunity to work outside of the home. The relationship between *age* and the decision to work off-farm is quadratic – there is an optimal age (for example, in model 4, 59 years old) that maximizes the probability that a farm household seeks an off-farm income source. One possible explanation is that productivity tends to rise with age, however, after a certain point, it declines as age increases. That is, the marginal return of age on off-farm participation decision is diminishing. Intuitively, the present value of the returns to invest in the search for off farm jobs will be much smaller for the old families, since the payoff period for such activities is shorter. The phenomenon is evident from the coefficient of age squared, which is negative and statistically significant at the 5% level. This result also presents the empirical evidence for the phenomenon that rural elderly are being left behind in the Chinese countryside. Years of schooling is positively associated with the off-farm employment. Schooling is generally expected to promote job mobility and migration. Formal education has strong effects for shifting from rural farm to off-farm work. *Average years of farming experience among labor force* is a significant determinant of the off-farm employment decision for rural households. More farming experience corresponds less likelihood of working off the farm. This likely reflects the fact that farming experience builds farming-specific human capital and thus raise farming's relative return. The only difference is that *Farmland size* is found to be significantly correlated with the off-farm employment decision in the short run. Households with smaller land holdings were more likely to send members into off-farm employment.

Finally, our results reveal that regions defined in this study are significantly different from each other. Moreover, the results for testing the joint significance of the region dummy variables (associated p-values are 0.039, 0.0778, and 0.0002 in model 2, 3 and 4 respectively) allow us to reject the null hypothesis of no regional effect on this decision-making process at the 10% significance level. Therefore, we can conclude that there exists heterogeneity across regions. Specifically, comparing to Northeast China, off farm employment is more attractive to farm households in the other three regions. In the short run, comparing to the Northeast region, farm

households in the East, West and Central region had approximately 19.4%, 15.7% and 16.6% higher probability to seek off-farm employment respectively. Similar results were obtained in the mid-term and long-term regression. Northeast China is considered to be China's granary, as it is situated on one of the world's few fertile black earth belts and has the highest endowment of farmland per capita in China. Diversified cultivation as well as vigorous development of agriculture in recent years make the northeast an attractive and competitive market. Therefore, farm households are more likely to stay on the farm. It is worth noting that there is an increasing employment access gap between regions over time, indicating that regional disparities are expanding.

Table 4 (b) provides the logistic regression results at the individual level. There is a significant overall impact of the income factors on the off-farm employment decision among individuals and this is confirmed by the F tests. In particular, individual workers who experienced greater farm income variability were significantly more likely to work off-farm in the short-term as well as mid-term. This finding confirms our hypothesis that farm income variation which represents the risks matters on the individual employment choice. Expected wage income is found to be a significant determinant on the employment decision among the labor force in all three time periods. Higher average wage income in the past results in higher probability of a family worker seeking an off-farm job in the current year. This trend is guided by the income maximization principle since the return on off-farm job is generally higher than the return on farming.

Own characteristics are found to be statistically significant in this study. The general findings are as follows: off-farm workers are more likely to be single young well-educated male workers from families with larger household size, less land per capita, easier access to the local market and fewer dependents. The intuition behind these results are: (1) male workers tend to receive higher return on off-farm work; (2) single workers have more freedom to allocate their labor; (3) the tendency for the returns from a job search to decline relative to the costs as age increases will therefore induce older farm operators to devote more of their time to household activities and less to off-farm work; (4) well-educated generation are better prepared to work outside agriculture since higher education develops the skills needed for non-agricultural activities; (5) large household are more likely to have one or more members working as off-farmers or non-farmers; (6) less land holding per capita is negatively associated with the off-farm employment choice since land is the
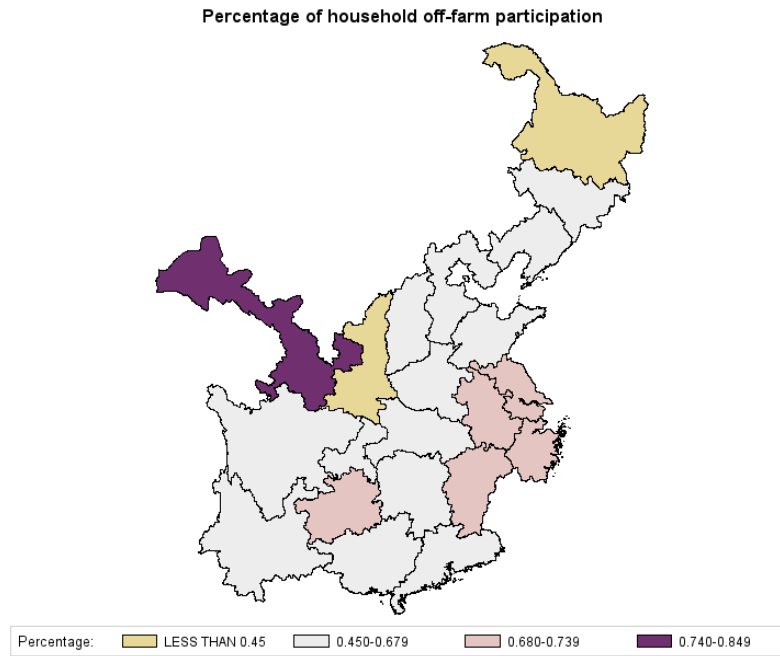
major source for agricultural income generation; (7) in rural China, downtown is the place where non-farm industries and markets are concentrated, making proximity easier for rural household members to find local off-farm jobs; and (8) having more children in the household indicate less opportunity for adult labor force to work outside the family farm.

In addition, our results confirm the heterogeneity across regions by investigating the individual level participation decision. Choosing West China as the base category, we found that individual workers in Northeast China and Middle China are less likely to leave the farm for an off-farm job while those in East China are more likely to do so. East China is well developed and the wealthiest region. Individuals from the rural sector have better access to off farm labor market and get well paid, therefore more incentive to seek off farm work. The second region with higher possibility of individuals working outside the farm is West China which is the less developed and the poorest region. This founding is in line with the results found in Du, Park, and Wang (2005) that the poor are more likely to migrate. Farming efficiency in this region is quite low due to limited access to inputs, financial services and markets plus heavy reliance on traditional farming techniques. Therefore, working individuals from the rural sector in this region depend heavily on off farm earning to improve their living standard.
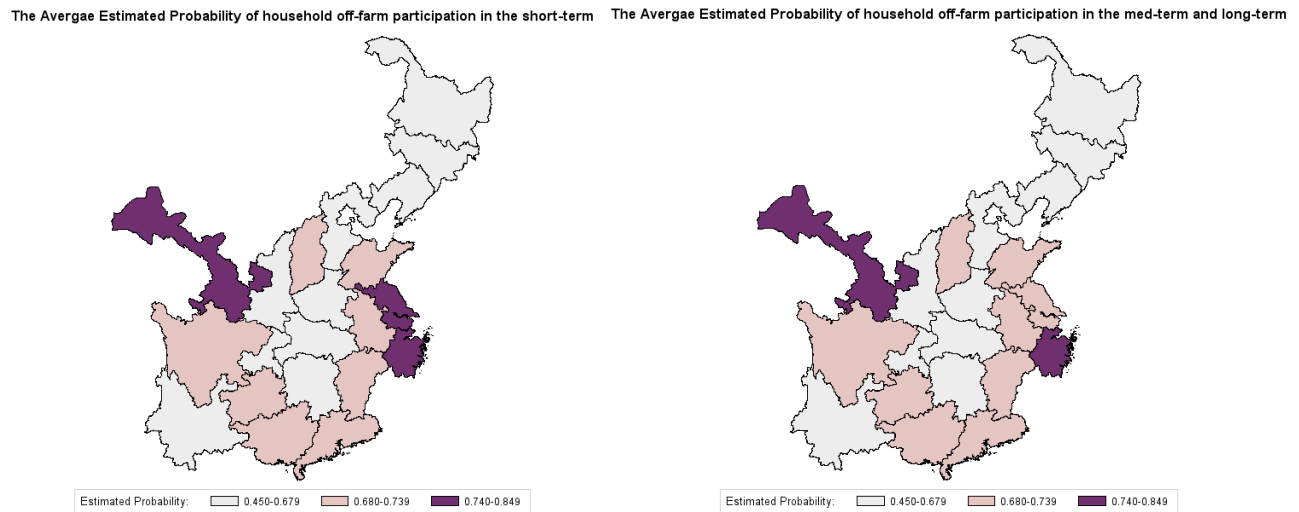
Comparing the average of estimated probability based on our empirical model with real percentage of working off-farm by households across provinces, results are close, as illustrated in figure 3.

Figure 3

(a) Real percentage of working off-farm by households across provinces

Percentage of household off-farm participation

| Percentage: | LESS THAN 0.45 | 0.450-0.679 | 0.680-0.739 | 0.740-0.849 |

(b) The average of estimated probability of working off-farm by households across provinces

The Avergae Estimated Probability of household off-farm participation in the short-term   The Avergae Estimated Probability of household off-farm participation in the med-term and long-term

| Estimated Probability: | 0.450-0.679 | 0.680-0.739 | 0.740-0.849 |

VI.   Conclusions and Discussions

Our empirical results show that there is a positive and significant relationship between farm income variability and off-farm work participation by farm households and their individual members, which implies off-farm employment is a risk adaption behavior among Chinese farmers. Second, the levels of expected income are important. Higher wage increases off-farm employment; while higher expected agricultural income lowers off-farm labor supply. Third, the impacts of household and demographic characteristics are consistent with our expectations at both levels: (1) off-farm labor supply increases as household size expands; (2) farmland size and the number of dependents play a negative role on the off-farm labor supply decision; (3) age is correlated with participation of off-farm activity; (4) higher education level leads to higher likelihood of off-farm activity participation; (5) farming experience among the labor force is negatively associated with the off-farm employment; (6) single young male is more likely to pursuing off-farm job. The differences are (1) farmland size is only significant in the short term at the household level, and (2) proximity to the nearest downtown is found to be negatively associated with the individual off-farm employment decision while it seems not have much effect on the household level labor supply decision. Finally, regional differences have been confirmed at both levels.

The contribution of this study is four-fold. First, this is one of the first attempts to account for agricultural risks on employment decision in rural China. Second, associated theoretical framework is explicitly constructed and comparative statistics are derived. Third, we have empirically tested the effects of the factors built in the theoretical model. Last but not least, regional difference is incorporated and confirmed in our empirical analysis. By shedding light on these theoretical and empirical results, policy managers are able to device better strategies for either improving farming productivity or encouraging off-farm labor supply.

Specifically, our analysis provides important suggestions to encourage pure farming and stabilize structure of rural society. For instance, to control the risks of agricultural production, the governments could apply subsidized risk management tool against farm output. Also, they could provide price support, which generally raises the average price of the target commodity as well as reduce the variability of price. These two strategies can be used to avoid income variations for farm households. Lowering the minimum nonfarm wage simply encourages farmers to stay on the farm. Technical and extension support is expected to increase the profits and will encourage the transition from traditional to modern agriculture. Farm land size is positively correlated with

farming productivity. Therefore, more farmland for each farm will result in more proportion of farm outputs. Furthermore, it is important to recognize the regional differences when formulating farm policy.

However, on the other hand, many agricultural workers would be squeezed out of agriculture by increasingly commercialized and capital intensive modes of farming. Thus, there is a need for the government to formulate policy to increase the availability of off-farm jobs. Our results may have important implications for this. The federal government could stimulate rural non-farm economy by increasing off-farm minimum wage; lessen population restriction which allows better access to the off farm labor supply; provide more education opportunities, better social security benefits which will increase the opportunity cost of raising dependents at home and also recognize the regional differences. The local government, on the other hand, could take steps to attract more private sectors to create income-generating activities in the rural areas and provide better transportation constructions. Training programs should be directed towards training farmers in skills that can be used in off-farm jobs.

Our next step is to relate off-farm decisions to income enhancement. The objective of future study is to investigate how off-farm employment affects the income level among farm households.

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Appendix

Variable	Marginal Effect		
	Three-year	**Five-year**	**Ten-year**
Farm income standard error (10000 Yuan)	*1.267*	*1.166*	*0.673*
Farm income (10000 Yuan)	*-0.105*	*-0.181*	*-0.207*
Wage income (10000 Yuan)	*0.074*	*0.101*	*0.168*
Household size	*0.070*	*0.070*	*0.071*
Number of Male Members	*0.016*	*0.017*	*0.015*
Proximity (100km)	*-0.063*	*-0.035*	*0.061*
Farmland size (acre)	*-0.011*	*-0.010*	*-0.010*
Number of Dependents	*-0.050*	*-0.049*	*-0.051*
Average age of household members	*0.016*	*0.016*	*0.015*
Age squared	*-0.000*	*-0.000*	*-0.000*
Average Education of household members	*0.023*	*0.024*	*0.023*
Education squared	*-0.001*	*-0.001*	*-0.001*
Farming experience among labor force	*-0.014*	*-0.014*	*-0.013*
East	*0.194*	*0.159*	*0.098*
Middle	*0.166*	*0.140*	*0.100*
West	*0.157*	*0.132*	*0.122*