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Welfare Effects of Diversification on Farm Households in Cambodia

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Abstract

This paper analyzes the effects of diversifying into off-farm activities on farm household welfare in terms of household food consumption in rural Cambodia. An endogenous switching model is applied to data from the 2009 Cambodia Socio-Economic Survey to assess whether farm households make food consumption gains from participation in salary-paid employment and self-employment. This model accounts for selection bias arising from unobserved factors that potentially determine both off-farm participation and food consumption. It also controls for structural differences between participants and nonparticipants in off-farm activities that most previous studies do not account for. The results reveal that by participating in salary-paid employment, farm households make positive gains in food consumption per capita, then supporting the hypothesis that engagement in salary-paid employment has positive effects on farm households' welfare. However, per capita food consumption gains from participation in self-employment are negative, suggesting that the salary-paid employment has more important role in promoting household welfare in rural communities than does the self-employment.

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1. Introduction

Cambodia is an agrarian country, with approximately 80% of the population living in rural areas (NIS 2011). The agriculture employs over 70% of the labor force (ADB 2013), making the sector the most important in the economy. Rural households earn their living by farming for either subsistence or small-scale commercial purpose. Over the past two decades, the country has achieved remarkable economic growth, making tremendous contribution to poverty reduction from 50% in 2004 to 20% in 2011 (ADB 2013). Yet, income and food consumption inequality between rural and urban populations has increased, with rural households enjoying lower income and consumption levels. The nationwide undernourishment prevalence decreased from 37% in 2004 to 33% in 2009; however, rural undernourishment, especially among the poorest households, remained increased (NIS 2011), raising concern over rural household welfare issues. This result shows that more attention should be given to rural economic development. Although Cambodia has a higher potential for agriculture, off-farm activities can play a vital role in developing the rural economy, particularly in reducing poverty.

In addition to profits from farming, income diversification through engaging in off-farm activities such as self-employment and salary-paid employment contributes to farm households' level of income. The revenue from off-farm activities makes a substantial contribution to reducing poverty severity in rural Cambodia (Tong 2011). This reveals that agriculture per se cannot lift farm households out of the poverty trap in the rural communities. Cambodia's greater integration into international trade, the tourism boom and urban development have created employment for Cambodian farm households and stimulated off-farm sector. Furthermore, over the last few decades, the development of physical infrastructure has improved urban-rural road connectivity, thus facilitating farm households' participation in off-farm activities. Given the potential of off-farm activities to alleviate poverty in Cambodia, it is worth analyzing the effects of working off the farm on rural farm households' well-being in terms of food consumption.

There has been a growing belief that the income diversification through participating in off-farm activities is a pathway out of poverty in rural areas of developing countries (IFAD 2011). This has drawn research attention to economic effects of off-farm activities on farm households at the household level. Several studies evaluate the effects on farming practice, household expenditure or household income (see also Mishra and Sandretto 2001; McNally 2002; De Janvry and Sadoulet 2001; Goodwin and Mishra 2004; Chang and Mishra 2008; Owusu *et al.* 2011; Akaakohol and Aye 2014; Scharf and Rahut 2014). The findings suggest that off-farm activities play a crucial role in raising farm household incomes and improving farming practice. Then, farm households' engagement in off-farm activities would very likely increase and stabilize household food consumption over a prolonged period of time. Nevertheless, different types of off-farm activities may produce different economic effects on farm households, depending on returns from those activities. Therefore, salary-paid employment and self-employment would more likely contribute differently to household welfare improvement. However, to appropriately evaluate the potential for off-farm activities to improve rural household welfare in developing countries such as Cambodia, one needs an unbiased and consistent estimation of the effects of such activities.

Some studies evaluate the effects of off-farm employment on household income by using a propensity score matching (PSM) approach to control for selection bias (see also Owusu *et al.* 2011; Olugbire *et al.* 2011). Still, this approach cannot control for the unobserved factors that potentially affect both the treatment and outcome and, then, yields biased and inconsistent estimates of the effects. To address this issue, one can use standard treatment models that control for non-random sample selection (see also Chang and Mishra 2008). However, the models assume that the impacts are uniform across different subsamples; nevertheless, there may be inherent differences between off-farm participants and nonparticipants. This demonstrates that the structure of household income or consumption patterns would be very likely systematically different, especially if factors influencing the decisions of whether to engage or not engage in off-farm activities also affect the income or consumption level. The uniform effects assumption in this case conceals an inherent interaction between the decisions concerning off-farm activities and factors influencing the income or consumption level, more potentially bringing about implausible outcomes (Roa and Qaim 2011).

The attempt of the current paper is to quantify the effects of off-farm activities on rural farm household welfare in terms of food consumption by applying an endogenous switching model to data from the Cambodia Socio-Economic Survey (CSES) conducted in 2009. The model treats off-farm participation and nonparticipation as regimes to address potential endogeneity due to endogenous bias in the decisions regarding the regimes and inherent differences between participants and nonparticipants. Then, employing the model, the effects can be evaluated by controlling for both observed and unobserved factors that influence both the decisions and household food consumption. Moreover, the model controls for potential structural differences between the participants and nonparticipants in terms of consumption functions. The current paper contributes to the literature by disentangling the effects of off-farm activities by salary-paid employment and self-employment and addressing these econometric challenges using cross-sectional data. The salary-paid employment and the self-employment would more likely contribute differently to household food consumption due to their potentially different returns. The paper is also the first to assess the welfare effects of off-farm activities on farm households in terms of food consumption in rural Cambodia. The remainder of the paper is structured as follows. Section 2 reviews relevant literature, Section 3 describes empirical framework and data used for the analysis, Section 4 presents the results, and Section 5 concludes the study.

2. Literature Review

The role of income diversification through participating in off-farm activities in increasing household income is supported by many studies (see also Reardon *et al*. 1992; Mishra and Sandretto 2001; De Janvry and Sadoulet 2001; Goodwin and Mishra 2004; Chang and Mishra 2008; Owusu *et al*. 2011; Olugbire *et al*. 2011). Their findings show that by engaging in off-farm activities, farmers can augment their household earnings and reduce their vulnerability. Participation in off-farm activities is the farmers' strategy to diversify the household earnings portfolio that can sustain the household income and stabilize the household consumption over a prolonged period of time (Reardon *et al*. 1992). These effects make a tremendous contribution to poverty reduction in rural developing countries as identified by Lanjouw and Lanjouw (2001) and Lanjouw and Shariff (2004).

However, the extent to which off-farm activities contributes to the farm households' well-being improvement may depend on different types of such activities. Furthermore, they may also produce effects on the distribution of household incomes because they are farm households' strategy for diversifying household earnings. For instance, Scharf and Rahut (2014) examined the distributional and welfare effects of working off the farm on farm households in the rural

Himalayas by estimating a structural-equations system and controlling for the heterogeneity of the decisions of whether to participate or not participate in off-farm employment. The findings reveal that low-return off-farm employment is correlated with lower income inequality, while high-return off-farm employment has a disequalizing impact on household income distribution. Also, by participating in high-return off-farm activities, participants enjoy better economic welfare. Furthermore, the authors found that poor farmers tend to depend on the low-return off-farm employment that does little to improve household welfare. By using an OLS regression to analyze the effects of off-farm employment on household expenditure in Nigeria, Akaakohol and Aye (2014) found that off-farm employment, household head's age and education level, and access to credit exert significant and positive effects on the expenditure.

The analysis of the economic effects of off-farm activities on farm households is a tough assignment, especially once using cross-sectional data at the household level, due to some econometric challenges such as self-selection bias and endogeneity problems. Owusu *et al.* (2011) attempted to reduce such issues when evaluating the effects of off-farm employment on farm households' revenue and food security by using data from the 2007 household survey in the rural Ghana. They adopted a propensity score matching (PSM) approach that allows them to compare income and food security of the participants in off-farm employment and those of the nonparticipants. They found that participation in off-farm employment has a significant positive effect on household income and food security. The authors also drew a general conclusion that off-farm revenue is the key to poverty alleviation in rural communities of developing countries. To analyze the effects of off-farm self-employment and wage-paid employment on farm households' revenue and poverty in Nigeria, Olugbire *et al.* (2011) also adopted the PSM method to control for the selection issue. They found that off-farm wage-paid employment households' revenue is significantly higher than self-employment households' revenue. These results suggest that the effect of wage-paid employment engagement is greater than that of self-employment engagement. But, the haves reap more benefits from wage-paid employment than do the have-nots. The PSM approach has a limitation because the evaluation of the impacts is carried out only with observed factors. That is, it cannot control for unobserved factors that affect both the treatment and outcome and, then, may produce biased and inconsistent estimates of the effects.

One can address this issue by adopting standard treatment models that control for non-random sample selection. For instance, Chang and Mishra (2008) employed a two-stage approach to investigate the effects of off-farm employment decisions by operator and spouse on household food expenditure and accounted for potential sample selection bias. They found that the spouse's decision regarding off-farm employment is significantly interrelated with that of the operator. However, the former has a negative correlation with food expenditure, while the latter is positively correlated with food expenditure. Nonetheless, the models fail to account for inherent differences between the off-farm participants and nonparticipants. That is, the structure of household consumption patterns would be more likely systematically different, in particular if factors affecting the decision of whether to work off the farm equally influence the expenditure. Therefore, this equal effect would conceal an inherent interaction between the decisions regarding off-farm activities and factors influencing the expenditure, thus bringing bout biased and inconsistent estimates of the effects (Roa and Qaim 2011).

There are few empirical studies that analyze the impacts of off-farm activities disaggregated into salary-paid employment and self-employment on household welfare by addressing endogeneity arising from the endogenous bias of the decisions concerning off-farm participation and inherent differences between the participants and the nonparticipants using cross-sectional data. To properly analyze the potential for salary-paid employment and self-employment to improve the farm households' welfare in rural Cambodia, an unbiased and consistent estimation of the effects of such an employment is necessarily needed. From the econometric viewpoints, this paper attempts to reduce the bias and inconsistent estimation by accounting for unobserved characteristics across farm households and systematic differences between participants and nonparticipants.

3. Methodology and Data

This section starts with an overview of econometric approaches to the analysis and ends with a brief description of the source of data used in this paper. A rigorous approach is used to identify determining factors of the farm households' decision to diversify into off-farm activities and to assess the effects of such activities on household welfare in terms of per capita food consumption.

3.1. Econometric Approaches

(a) Determinants of Off-farm Employment Participation

According to the conventional framework of household choice, a farmer decides to diversify into off-farm employment if off-farm wage/income is higher than the reservation wage/income from on-farm employment and leisure. This shows that the likelihood of diversifying into off-farm employment is determined by both household characteristics and farm characteristics. To capture the correlation between these characteristics and farm households' decision to participate in off-farm employment, a probit model is used.[1] Similar to Chang and Mishra (2008) and Ahearn *et al.* (2006), the probit model describing the decision can be written as follows:

$$I = \alpha Z + v \quad (1)$$

$$I^* = \begin{cases} 1, \text{if off} - \text{farm participation} \\ 0, \text{otherwise} \end{cases} \quad (2)$$

where I is the probability that a farm household diversifies into off-farm work in addition to primary farm activities (also known as the latent variable). It equals 1 for a farm household that participates in at least one salary-paid employment/self-employment and zero otherwise. α is the vector of parameters to be estimated, and v is the error term under the assumption that $v \sim N(0,1)$. Z includes household characteristics, farm characteristics, agro-ecological risks and public transportation condition, which are expected to determine the likelihood of participating in off-farm activities.

(b) Modeling Welfare Effects of Off-farm Employment Participation

In accordance with the standard agricultural household model, a farm household allocates labor and consumption levels by maximizing the utility subject to cash and production technology

[1] Following previous studies, the probit model has been employed to empirically analyze the decisions regarding off-farm labor supply (see also Huffman and Lange 1989; Lim-Applegate *et al.* 2002; Ahearn *et al.* 2006; Chang and Mishra 2008; Démurger *et al.* 2010).

constraints. Because it generates additional income, the engagement in off-farm employment is more likely to determine household food consumption. The study hypothesizes that participation in off-farm activities has positive effects on household welfare through increasing household food consumption. To quantify the effects, a commonly used model in the empirical literature on effect evaluation is written as follows:

$$Y = \beta X + \gamma I + \varepsilon \tag{3}$$

where *Y* is the farm household's food consumption expenditure per capita. *X* is the vector of household and farm characteristics and other factors, which are expected to affect the expenditure. *I* is a dummy for participation in salary-paid employment/self-employment, and then γ is the coefficient capturing the effects of off-farm employment participation on the expenditure. Nevertheless, this coefficient may be biased and inconsistent because the farm households may self-select to be or not to be in the off-farm participant group. If, for example, the farm households' off-farm skills and motivation for diversifying household earnings can affect their decisions concerning off-farm activities, potentially influencing both the decisions and household food consumption levels. Furthermore, if participants are wealthier or live in an area with a high cost of living, their food expenditure is higher, regardless of whether they engage in off-farm activities. The coefficient γ would, in this case, also include the effects of these unobserved factors and, then, creates an over-estimate of the effects of off-farm employment participation. In econometrics, once unobserved effects are correlated with both the regressed (food consumption per capita) and a regressor (off-farm employment participation), the coefficient on the latter is biased and inconsistent.

A Heckman sample selection model or standard treatment effect model can be utilized to account for the potential endogeneity due to the above-mentioned selection bias. Still, these approaches cannot account for the potential structural differences between the participant and nonparticipant groups due to the assumption that the consumption functions differ between the participants and nonparticipants by only a constant term (Rao and Qaim 2011). Owusu *et al.* (2011) and Olugbire *et al.* (2011) used the PSM method that can control for the structural differences in observed characteristics. The method may still produce biased and inconsistent estimates because it fails to account for unobserved confounders that influence both the decision of whether to participate in off-farm activities and the consumption.

The endogenous switching model is used to address these econometric challenges. The model treats participation in salary-paid employment/self-employment and nonparticipation as regimes and is specified as follows:

$$I = \alpha Z + v \tag{4}$$

$$y_1 = \beta_1 X_1 + u_1 \quad \text{if } I^* = 1 \tag{5}$$

$$y_0 = \beta_0 X_0 + u_0 \quad \text{if } I^* = 0 \tag{6}$$

where y_1 and y_0 are household food consumption expenditure per capita for off-farm participants and nonparticipants, respectively; *I* is a latent variable as defined in Equation (1); and α, β_1 and β_0 are vectors of parameters to be estimated. While the sets of variables *Z* and *X* can overlap, at least one variable in *Z* is required not to appear in *X* to properly indentify the outcome equations. v, u_1 and u_0 are error terms that are contemporaneously correlated and assumed to have a joint normal distribution with a zero mean vector and the following covariance matrix:

$$cov(v, u_1, u_0) = \begin{bmatrix} \sigma_{u_1}^2 & \sigma_{u_1u_0} & \sigma_{u_1v} \\ \sigma_{u_1u_0} & \sigma_{u_0}^2 & \sigma_{u_0v} \\ \sigma_{u_1v} & \sigma_{u_0v} & \sigma_v^2 \end{bmatrix} \quad (7)$$

where $var(v) = \sigma_v^2$, $var(u_0) = \sigma_{u_0}^2, var(u_1) = \sigma_{u_1}^2$, $cov(u_1, u_0) = \sigma_{u_1u_0}$, $cov(u_1, v) = \sigma_{u_1v}$, and $cov(u_0, v) = \sigma_{u_0v}$. The covariance σ_v^2 is assumed to equal 1, as α can be only estimated up to a scale factor (Maddala 1986; Greene 2008; Rao and Qaim 2011). Moreover, the covariance $\sigma_{u_1u_0}$ is equal to zero because y_1 and y_0 are not observed together. Note that in a cross-sectional sample, y_1 and y_0 are only partially observed, with the former being only observed for the subsample of off-farm participants and the latter being only observed for the subsample of nonparticipants.

If there are unobserved effects, the error term v of the selection equation is correlated with the error terms u_1 and u_0 of the outcome equations. That is, the expected values of u_1 and u_0 conditional on regime selection would be non-zero. Thus, endogeneity can be tested with estimates of the covariance terms σ_{u_1v} and σ_{u_0v}. If $\sigma_{u_1v} = \sigma_{u_0v} = 0$, the model shows exogenous switching; if either σ_{u_1v} or σ_{u_0v} is non-zero, the model exhibits endogenous switching (Maddala 1986). In this case, one needs to test for significant coefficients of the correlation between u_1 and v ($\rho_{u_1v} = \sigma_{u_1v}/\sigma_{u_1}\sigma_v$) and between u_0 and v ($\rho_{u_0v} = \sigma_{u_0v}/\sigma_{u_0}\sigma_v$) (Lokshin and Sajaia 2004). Using these correlations, the expected values of u_1 and u_0 conditional on regime selection can be written as follows:

$$E(u_1|I = 1, X_1) = E(u_1|v > -\alpha Z) = \sigma_{u_1v}\frac{\phi(Z\alpha)}{\Phi(Z\alpha)} = \sigma_{u_1v}\lambda_1 \quad (8)$$

$$E(u_0|I = 0, X_0) = E(u_0|v \leq -\alpha Z) = \sigma_{u_0v}\frac{-\phi(Z\alpha)}{1-\Phi(Z\alpha)} = \sigma_{u_0v}\lambda_0 \quad (9)$$

where ϕ is the probability density function; and Φ is the cumulative distribution function of standard normal distribution. λ_1 and λ_0 are the Inverse Mills Ratios (IMRs) estimated at $Z\alpha$ for participants and nonparticipants, respectively (Greene 2008).

In addition to the endogeneity test, ρ_{u_1v} and ρ_{u_0v} give economic interpretations based on their signs. If ρ_{u_1v} and ρ_{u_0v} have opposite signs, farmers decide whether to engage in salary-paid employment/self-employment based on the comparative advantage (Maddala 1983; Fuglie and Bosch 1995). That is, participants enjoy above-average consumption levels when they engage in off-farm employment if $\rho_{u_1v} < 0$, whereas nonparticipants enjoy above-average consumption levels once they do not participate if $\rho_{u_0v} > 0$ (Rao and Qaim 2011). Alternately, if the coefficients have the same signs, "hierarchical sorting" is evidenced (Fuglie and Bosch 1995), indicating that the participants consume above-average levels irrespective of whether they participate in off-farm employment but they are better off participating than not participating. Similarly, the nonparticipants consume below-average levels in either case but they are better off choosing not to participate. Moreover, the coefficients ρ_{u_1v} and ρ_{u_0v} can show model consistency under the condition $\rho_{u_1v} < \rho_{u_0v}$ (Trost 1981). This condition implies that the off-farm participants enjoy consumption levels above what they otherwise would be if they did not participate in off-farm employment.

(c) Estimation Method

When either σ_{u_1v} or σ_{u_0v} takes non-zero value, a two-stage procedure can be used to estimate the model. In the first stage, a probit model of regime choice is estimated, giving the estimates of α, on which λ_1 and λ_0 can be predicted according to Equations (8) and (9).[2] In the second stage, the outcome equations are estimated by including the predicted IMRs as regressors, and the coefficients of IMRs give the estimates of σ_{u_1v} and σ_{u_0v}. Nevertheless, due to the estimation of the IMRs, the residuals u_1 and u_0 cannot be used to calculate the standard errors of estimates in the second stage (Maddala 1983; Fuglie and Bosch 1995). Simultaneously estimating the selection and outcome equations with the full information maximum likelihood (FIML) method is more efficient for the endogenous switching regression (Lokshin and Sajaia 2004; Greene, 2008). It should be noted that the coefficients β_1 and β_0 in Equations (5) and (6) measure the marginal effects of independent variables on household food consumption unconditional on households' actual regime choice, i.e. the effects of X on y of the respective subsample.

To properly identify the model, it is necessary to use variables that directly influence the decision to participate in off-farm activities but not the outcomes as selection instruments. The study uses a dummy for availability public transportation in the village as the identification restriction. Then, the study hypothesizes that the availability of public transportation in the village would increase the probability of participating in off-farm activities. The hypothesis is built on the fact that the availability of public transportation in the village can facilitate the ability to travel back and forth between home and workplaces. Following Di Falco *et al*. (2011), a simple falsification test is performed to establish the admissibility of the instruments: if a selection instrument is valid, it will affect the participation decision but not the nonparticipants' food consumption per capita. Tables A1 and A2 in the appendix indicate that the dummy for availability of public transportation can be considered as a valid instrument because it has a statistically significant effect on the decision of whether to participate in off-farm activities but not on the nonparticipants' food consumption per capita.

(d) Estimation of Welfare Effects of Off-farm Employment Participation

The particular interest of the current study is to evaluate the effects of off-farm activities on farm households' welfare in terms of food consumption per capita. To do this, one needs to compare the participants' conditional expected consumption derived from the endogenous switching regression model with the counterfactual case that the same participants have chosen not to participate. For a farm household with characteristics X and Z that engages in off-farm activities, the conditional expected value of food consumption is derived as follows (Maddala 1983):

$$E(y_1|I = 1) = \beta_1 X_1 + \sigma_{u_1v}\lambda_1 \quad (10)$$

where $\sigma_{u_1v}\lambda_1$ accounts for sample selection arising from the fact that a farm household engaging in off-farm activities differs from other households with characteristics X and Z due to

[2] Because the endogenous switching model resembles a sample selection model, the selection in the first stage is responsible for the selection bias resulting from unobserved factors such as wealth, skills and motivation that potentially influence both the farm households' decision to participate in off-farm activities and food consumption levels. Generally, in the selection model, the probit model is estimated because of the assumption that the error term v is normally distributed with a zero mean and variance σ_v^2 normalized to 1 (see also Heckman 2001).

unobserved characteristics (Fuglie and Bosch 1995). The conditional expected value of food consumption that the same farm household would enjoy without participation is derived as follows (Maddala 1983):

$$E(y_0|I = 1) = \beta_0 X_1 + \sigma_{u_0 v}\lambda_1 \tag{11}$$

The difference in per capita food consumption due to off-farm employment participation can then be estimated as follows (Maddala 1983; Fuglie and Bosch 1995):

$$E(y_1|I = 1) - E(y_0|I = 1) = (\beta_1 - \beta_0)X_1 + (\sigma_{u_1 v} - \sigma_{u_0 v})\lambda_1 \tag{12}$$

In the literature on impact evaluation, this consumption gain from off-farm engagement is called the average treatment effect on the treated (ATT), which controls for all factors potentially causing consumption differences. The treatment effect on the treated is a result of the differences in the coefficients in Equations (10) and (11). If a farm household self-selects to engage or not engage in off-farm activities based on the comparative advantage, $\sigma_{u_1 v} - \sigma_{u_0 v}$ would be positive, and the engagement would produce higher returns under self-selection than under random sample (Maddala 1983; Rao and Qaim 2011). In this case, a simple comparison between mean consumption in the participant group $E(y_1|I = 1)$ and that in the nonparticipant group $E(y_0|I = 0)$ would lead to a bias of the treatment effect that is accounted for in Equation (12).

3.2. Variables

The dependent variables in the selection equations include a dummy for off-farm salary-paid employment and a dummy for off-farm self-employment. It equals 1 for a farm household that participate in at least one off-farm salary-paid employment/self-employment and 0 otherwise. The dependent variable in the outcome equations is household food consumption expenditure per capita within 7 days. The explanatory variables consist of household characteristics, farm characteristics, availability of irrigation infrastructure in the village, availability of public transportation in the village, and agro-ecological risks. The variables are summarized in Table 1.

Household characteristics include household head's age, gender, education level; household members over the age of 64 years; and household members under the age of 15 years. Age is used to capture life cycle effects. After reaching a certain age, a person would gradually start losing job opportunities and consuming less food. Education level measures human capital; those with high education level would have more opportunity for jobs. Moreover, well-educated head would have easier access to a large amount of information and be able to have better networks in the community (Azam *et al.* 2012). Then, education level would stimulate the farmers' participation in off-farm activities as found by Lanjouw and Shariff (2004). Household members over the age of 64 years or under the age of 15 years capture the effects of dependents on the likelihood of participate in off-farm activities and household food consumption. The number of dependents can have mixed effects on the farm households' off-farm participation (Shi *et al.* 2007). On the one hand, with more dependents in a farm household, high household incomes are needed to satisfy food consumption and other necessary expenditures, stimulating household earnings diversification. On the other hand, the farm households with more dependents need to spend more time taking care of these dependents, reducing the time available for off-farm activities. However, older members may help care for children, possibly allowing the parents to engage in either on-farm or off-farm employment. Yet, more dependents in a household would reduce household food consumption per capita if the household enjoyed low household earnings.

Table 1. Summary definition of variables

Variables	Definition
Dependent	
- Food consumption per capita	Natural log of household food consumption expenditure per household member
- Salary-paid employment	=1 if the farm household participates in at least one off-farm salary-paid work activity
- Self-employment	=1 if the farm household engages in at least one off-farm self-employment
Independent	
- Head's gender	=1 if the household is male-headed
- Head's age	Natural log of household head age
- Head's age squared	Natural log of household head age squared
- Head's education level	Natural log of head schooling years (formal education)
- Household members > 64	Total family members over the age of 64 years
- Household members < 15	Total family members under the age of 15 years
- Landholding	Natural log of land area in ha owned by farm household in hectare
- Availability of irrigation	=1 if the farm household's land is located near irrigation infrastructure in the village
- Yield damage	=1 if yield damage caused by over-rainfall and/or flood, drought, rot, eaten by birds/other insets and rodents
- Availability of public transportation	=1 if the farm household lives in the village where there is public transportation such as taxi, bus, and motorbike taxi.

Landholding in hectares is employed to capture farm characteristics. The landholding variable is used in lieu of a cultivated land size variable because the latter has a potential for endigeneity, although land markets in rural Cambodia are inactive as asserted by Azam *et al.* (2012). Labor employed on larger farms is less flexible, thus lowering the likelihood of engaging in off-farm employment (Benjamin 1994; Mishra and Goodwin 1997). The landholding would therefore have negative effects on off-farm participation. Nonetheless, it is difficult to hypothesize about the potential effects on household food consumption due to the potentially mixed effects, more possibly depending on how efficiently farmers can use their land in combination with other inputs.

In Cambodia, there are only two seasons: 6 months for dry season and 6 months for wet season for farming per year. Farmers tend to experience the shortcoming of water for the dry season farming due to limited irrigation infrastructure development. Thus, the availability of irrigation infrastructure in the village, especially in dry seasons, is likely to encourage farmers to undertake more on-farm investments without diversifying into off-farm activities. Due to the unavailability of information on rainfall levels, the study constructs a dummy for yield damage caused by over-rainfall and/or flood, drought, rot, eaten by birds/other insets and rodents to capture the agro-ecological risks, with the value equal to 1 if a farmer suffered post-harvest damage caused by the above factors and 0 if the farmer did not suffer such damage. The dummy negatively affect agricultural returns and, thus, would affect the farm households' decision concerning on-farm and off-farm activities and household welfare in terms of food consumption (Kaur *et al.* 2011). As already mentioned in Section 3, the dummy for availability of public transportation in the village is used as the identification instrument in the model. The public transportation availability can facilitate the ability to travel back and forth between home and workplaces, creating off-farm employment opportunities for farm households.

3.3. Data

The data from the 2009 CSES conducted by the National Institute of Statistics are used for the empirical analysis in the current study because the data represent the nationwide sample of the household surveys. The 2009 CSES was sampled based on the preliminary data from the General Population Census conducted in 2008, with three-stage cluster procedure. Villages and enumeration areas were selected in the first and second stage, respectively; and households were selected in the last. 12 000 households within 24 provinces (all provinces in Cambodia) were selected as the sample, which is the largest sample size among the CSESs. Nevertheless, 29 households were dropped due to their absence at the time of the enumerators' visit, and then the remaining households were 11 971. Because the study interest is in rural communities, Phnom Penh city (the Capital of Cambodia) and other provincial capital cities are excluded from the observations. After excluding the cities and deleting some missing observations, 5762 households are counted in the final sample for the analysis.

4. Results and Discussion

This section starts with a description of summary statistics of main variables used in the analysis and a descriptive statistical analysis of the differences between farmers who diversify into off-farm activities and those who do not. The section ends by presenting the results of the econometric analysis.

4.1. Descriptive Statistical Analysis

Table 2 shows that on average approximately 22% and 60% of the farm households engage in salary-paid employment and self-employment, respectively; and approximately 87% of the households are male-headed. Moreover, only approximately 16% of the households have access to irrigation infrastructure in the wet season because of the availability of infrastructure in the village; and approximately 52% of the households live in the village where there is public transportation available.

Table 2. Summary statistics of variables used in regression

Variables	Obs.	Mean	Std. Dev.	Min	Max
Head's gender	5762	0.872	0.334	0	1
Head's age	5762	3.745	0.312	2.708	4.466
Head's age squared	5762	14.122	2.321	7.334	19.944
Head's education level	5762	1.596	0.536	0	2.944
Household Members > 64	5762	0.203	0.487	0	3
Household Members < 15	5762	1.607	1.256	0	8
Landholding	5762	-0.062	1.118	-6.502	5.709
Availability of irrigation	5762	0.158	0.364	0	1
Yield damage	5762	0.720	0.449	0	1
Availability of public transportation	5762	0.516	0.500	0	1
Salary-paid employment participation	5762	0.219	0.414	0	1
Self-employment participation	5762	0.601	0.490	0	1
Food consumption per capita	5762	10.159	0.539	7.567	12.789

Source: Author's computation from the 2009 CSES data-set

Tables 3 and 4 report general differences between the off-farm participants and nonparticipants. The summary statistics in the tables show some remarkable differences between the participants and nonparticipants, which are confirmed by simple statistical tests of differences in means. There is significant difference between the farm households that engage in off-farm activities and those that do not in terms of the head's gender. On average approximately 76% of the salary-paid participant households and approximately 82% of the self-employment participant households are man-headed, while approximately 79% of the salary-paid nonparticipant households and 79% of the self-employment nonparticipant households are male-headed. The heads of participant households complete, on average, a 7-year formal education for the salary-paid employment and a 6-year formal education for the self-employment, while the heads of nonparticipant households complete, on average, a 6-year formal education for the salary-paid employment and a 5-year formal education for the self-employment. This result reveals that households headed by a better-educated person are more likely to engage in off-farm activities.

There is also a significant difference related to availability of village public transportation between the farm households that participate in off-farm activities and those that do not participate for both the salary-paid participant households and self-employment participant households. The majority of participants, on average approximately 58% of the participants for the salary-paid employment and approximately 65% of the participants for the self-employment, live in a village where public transportation is available. These results indicate that public transportation availability in the village is more likely to promote off-farm activities, both salary-paid employment and self-employment.

Table 3. Characteristics of salary-paid participants and nonparticipants

	Participants (22%)		Nonparticipants (78%)		Difference
Variables	Mean	SD	Mean	SD	in Means
Food consumption per capita	32 068.030	20 919.080	29 138.470	19 212.040	2 929.556***
Head's gender	0.763	0.425	0.795	0.404	-0.032***
Head's age	46.732	12.998	44.890	14.557	1.842***
Head's education level	7.109	3.820	5.731	2.772	1.379***
Household members > 64	0.181	0.449	0.228	0.511	-0.047***
Household members < 15	1.449	1.276	1.570	1.292	-0.121***
Landholding	1.716	8.809	1.761	6.978	-0.045
Availability of irrigation	0.138	0.345	0.146	0.353	-0.008
Yield damage	0.700	0.459	0.728	0.445	-0.028**
Availability of public transportation	0.583	0.493	0.494	0.500	0.089***

Note: ** and *** are statistically significant different at 5% and 1% level, respectively.
Source: Author's computation from the 2009 CSES data-set

With average food consumption expenditure per capita of 32 068.030 riels (US$ 8) per week, the per capita expenditure by the salary-paid employment participants is significantly higher than the expenditure by the nonparticipants, with an average of 29 138.470 riels (US$ 7.28).[3] This result suggests that the salary-paid participants are more likely to enjoy greater food consumption per capita more than the nonparticipants. However, the difference in per capita food consumption between the self-employment participants and the nonparticipants is not statistically significant.

[3] The amount is converted into US dollar at the exchange rate of 1 USD = 4000 riels.

Table 4. Characteristics of self-employment participants and nonparticipants

Variables	Participants Mean	Participants SD	Nonparticipants Mean	Nonparticipants SD	Difference in Means
Food consumption per capita	26 217.71	16 032.31	26 256.53	15 602.60	-38.818
Head's gender	0.819	0.385	0.788	0.409	0.031***
Head's age	45.684	13.942	45.147	14.193	0.537*
Head's education level	5.701	2.693	5.444	2.682	0.256***
Household members > 64	0.216	0.492	0.232	0.513	0.016
Household members < 15	1.537	1.268	1.650	1.310	0.113***
Landholding	0.747	0.435	0.753	0.431	0.006
Availability of irrigation	0.181	0.385	0.098	0.297	0.083***
Yield damage	0.712	0.453	0.736	0.441	-0.024**
Availability of public transportation	0.65	0.477	0.381	0.486	0.270***

Note: ** and *** are statistically significant different at 5% and 1% level, respectively.
Source: Author's computation from the CSES 2009 data-set

4.2. Econometric Analysis

The descriptive analysis reveals significant differences in household food consumption per capita only between the salary-paid participants and the nonparticipants but not significant differences between the self-employment participants and the nonparticipants. Nonetheless, to properly evaluate the welfare effects on farm households in terms of household food consumption per capita, as outlined in Section 3, an endogenous switching regression model is adopted to estimate the effects.

(a) Determinants of Off-farm Employment Participation

The first column of Table 5 reports the estimated results of the probit model for salary-paid employment participation, while the second column presents the results of the probit model for self-employment engagement. The probit models are jointly estimated with the consumption equations by using the FIML method. Participation in salary-paid employment is significantly dependent on the farm household head's education level and age, while engagement in self-employment is significantly dependent only on the head's education. This result shows that farm households with better-educated heads are very likely to engage in off-farm activities. The result is consistent with the above descriptive statistical analysis and the findings by Lanjouw and Shariff (2004), and Akaakohol and Aye (2014). This is plausible because education can help farm households to better adjust to off-farm labor market requirements. Generally, better educated farmers are more innovative and entrepreneurial (Rao and Qaim 2011), and then more likely to be active in generating incomes not only from on-farm activities but also from off-farm activities.

Also, older farmers are very probably to engage in salary-paid employment, which may have something to do with experiences. However, the coefficient of age squared term is significantly negative, revealing that as the head grows older, s/he has gained more experience with growing job opportunities but starts to gradually lose the opportunities after turning a certain age. The coefficient of household members over the age of 64 years is significantly negative, suggesting that the farm households with older members (over the age of 64 years) are more likely discouraged from engaging in salary-paid work. This is because farmers may face a shortage of labor force when family members get aging and, then, are more likely to loss salary-paid employment opportunities.

Table 5. Determinants of off-farm employment participation (jointly estimated probit[a])

Variables	Salary-paid employment			Self-employment		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Head's gender	-0.067	0.058	0.247	-0.013	0.052	0.805
Head's age	9.562***	1.659	0.000	-0.325	1.278	0.799
Head's age squared	-1.137***	0.223	0.000	0.033	0.174	0.848
Head's education level	0.330***	0.037	0.000	0.122***	0.032	0.000
Household members > 64	-0.147***	0.047	0.002	-0.032	0.041	0.437
Household members < 15	-0.021	0.017	0.204	-0.054***	0.015	0.000
Landholding	-0.112***	0.017	0.000	0.343***	0.016	0.000
Availability of irrigation	-0.051	0.052	0.327	0.451***	0.049	0.000
Yield damage	-0.034	0.043	0.428	-0.176***	0.039	0.000
Availability of public transport	0.140***	0.038	0.000	0.099***	0.028	0.000
Constant	-21.049***	3.079	0.000	0.965	2.335	0.679
Observation			5762			5762
Prob. > Chi-squared			0.000			0.000

Note: [a] Probit model is jointly estimated with the consumption regime equations by using the FIML procedure reported in Table 6 for the salary-paid employment and Table 7 for the self-employment. *** is statistically significant at 1% level.

Landholding has a significantly negative correlation with the participation in salary-paid work, revealing that the farm households owning larger land are more likely to prefer on-farm work to diversifying into salary-paid employment. Labor employed on larger farms is not flexible, then lowering the likelihood of engaging in salary-paid work (Benjamin 1994; Mishra and Goodwin 1997). Yet, the probability of engaging in self-employment is very likely to be positively determined by landholding. The availability of public transportation in the village has significantly positive correlation with the participation in off-farm activities. It can help facilitate the ability to travel back and forth between home and workplaces, more likely motivating farm households to engage in off-farm employment.

(b) Determinants of Farm Household Welfare

The off-farm participant households' and the nonparticipant households' household welfare is, as outlined in Section 3, explained based on household food consumption per capita with the endogenous switching model. The estimates for the consumption equations of the model are presented in Table 6 for salary-paid employment and Table 7 for self-employment. The likelihood ratio test for joint independence of the three equations and the significance of the ρ covariance coefficients showing a self-selection (Lokshin and Sajaia 2004) are reported at the bottom of Tables 6 and 7. The likelihood ratio test results suggest that the three equations are jointly dependent for both the salary-paid employment and self-employment, giving evidence of endogeneity that needs to be controlled for in the model specification of consumption equations. Table 6 indicates that $\rho_{u_1 v}$ and $\rho_{u_0 v}$ have alternative signs with the former being statistically significant and negative but the latter being statistically nonsignificant and positive. Table 7 also shows that $\rho_{u_1 v}$ and $\rho_{u_0 v}$ have alternative signs with the former being significantly positive and the latter being significantly negative. These results confirm that the endogenous switching model is an appropriate model for accounting for selection bias and structural differences between the participants and the nonparticipants. For the salary-paid work, the significantly negative sign of $\rho_{u_1 v}$ indicates that participants enjoy above-average per capita food consumption levels when they participate in salary-paid work. Nevertheless, for the self-employment, the significantly positive sign of ρ_{u_1v} suggests that participants are very likely to enjoy below-average per capita food consumption levels once they engage in self-employment.

Table 6. Determinants of farm household food consumption (salary-paid employment)

Variables	Participants (n = 1262)			Nonparticipants (n = 4500)		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Head's gender	-0.035	0.040	0.392	-0.043**	0.021	0.039
Head's age	0.650	1.429	0.649	0.490	0.507	0.334
Head's age squared	-0.125	0.185	0.499	-0.070	0.069	0.310
Head's education level	0.106***	0.036	0.003	0.096***	0.014	0.000
Household members > 64	0.021	0.034	0.536	-0.050***	0.017	0.003
Household members < 15	-0.117***	0.012	0.000	-0.126***	0.006	0.000
Landholding	0.024*	0.014	0.092	-0.013**	0.007	0.046
Availability of irrigation	-0.033	0.037	0.380	0.018	0.018	0.319
Yield damage	-0.024	0.030	0.430	0.009	0.015	0.542
Constant	9.772***	2.850	0.001	9.332***	0.932	0.000
$\ln \sigma_{u_1v}$	-0.688***	0.067	0.000			
ρ_{u_1v}	-0.462**	0.206	0.025			
$\ln \sigma_{u_0v}$				-0.814***	0.012	0.000
ρ_{u_0v}				0.136	0.108	0.205
LR test of indep. eqns.						0.0427**
Log likelihood						-6361.84

Note: These outcome equations are jointly estimated with the selection equation reported in Table 5 by using the FIML. ** and *** are statistically significant at 5% and 1% level, respectively.

The estimated results also demonstrate that there are systematic differences across the two regimes for both the salary-paid employment and self-employment. For example, Tables 6 and 7 demonstrate that the household heads' education level has significant and positive correlation with the consumption for both regimes, but the coefficient is higher for the off-farm participants than that for the nonparticipants. These results suggest that the effects of education are greater among the participants. This is because better-educated participants may be more productive in farming than their counterparts in the nonparticipant group. The results confirm the important role of education and/or technical training in contributing to the improvement in farm household well-being. Of note, because the coefficients measure unconditional effects, the differences are not due to the engagement in off-farm activities. Additionally, the findings indicate that education jointly determines the likelihood of off-farm participation and household food consumption.

The number of household members under the age of 15 years has significantly negative correlation with the consumption for both regimes, while the number of family members over the age of 64 years is significantly and negatively correlated with the consumption only for the nonparticipants. This can somehow explain the fact that inactive members do little to contribute to household income portfolio, largely relying on active members. The results in Tables 6 and 7 also show that landholding has a significantly positive correlation with consumption for the participants and a significantly negative correlation for the nonparticipants. These results suggest that the participants can use their own land for farming in a more productive way than the nonparticipants, more possibly because of better-human capital and the ability to use more fertilizers. As noted in the descriptive statistics analysis, the heads of participant households are better educated than those of nonparticipant households. Moreover, the inverse relationship between the landholding and household food consumption for the nonparticipants somehow can reflect the inverse relationship between land size and productivity. Because for the nonparticipants labor remains in the farm sector, the possibility of disguised unemployment cannot be ruled out (Seng 2015). According to the Lewis model, the presence of disguised labor in agriculture reduces farm output below its potential, thus affecting food consumption levels.

Table 7. Determinants of farm household food consumption (self-employment)

Variables	Participants (n = 3464)			Nonparticipants (n = 2298)		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Head's gender	-0.056**	0.027	0.038	-0.017	0.030	0.585
Head's age	0.236	0.651	0.718	1.065	0.762	0.162
Head's age squared	-0.045	0.088	0.610	-0.147	0.104	0.156
Head's education level	0.135***	0.016	0.000	0.063***	0.019	0.001
Household members > 64	-0.028	0.020	0.172	-0.034***	0.025	0.171
Household members < 15	-0.131***	0.008	0.000	-0.111***	0.009	0.000
Landholding	0.080***	0.009	0.000	-0.112***	0.014	0.000
Availability of irrigation	0.130***	0.023	0.000	-0.200***	0.035	0.000
Yield damage	-0.053***	0.019	0.006	0.071	0.024	0.300
Constant	9.640***	1.191	0.000	7.831***	1.391	0.000
$\ln \sigma_{u_1 v}$	-0.633***	0.024	0.000			
$\rho_{u_1 v}$	0.890***	0.073	0.000			
$\ln \sigma_{u_0 v}$				-0.601***	0.038	0.000
$\rho_{u_0 v}$				-0.982***	0.097	0.000
LR test of indep. eqns.						0.000
Log likelihood						-7081.718

Note: These outcome equations are jointly estimated with the selection equation reported in Table 5 by using the FIML. ** and *** are statistically significant at 5% and 1% level, respectively.

(c) Effects of Off-farm Employment Participation on Household Welfare

To assess the welfare effects of off-farm employment participation, the conditional expected food consumption by the participant households $E(y_1|I = 1)$ are compared with what they would have enjoyed if they did not engage in off-farm activities $E(y_0|I = 1)$. The difference in food consumption conditional on off-farm participation is calculated following Equation (12) and presented in Table 8.

Table 8. Effects of off-farm participation on household food consumption

	Obs.	Mean	Std. Dev.
Salary-paid employment			
$E(y_1 \vert I = 1)$	1262	24 542.98	4031.425
$E(y_0 \vert I = 1)$	4500	23 817.71	3695.085
ATT		725.263***	
Self-employment			
$E(y_1 \vert I = 1)$	3464	23 853.21	3649.535
$E(y_0 \vert I = 1)$	2298	24 186.45	3892.079
ATT		-333.240***	

Note: The expected values for individual households are transformed from log terms. *** is statistically significant at 1% level.

The expected food consumption per capita by the salary-paid households $E(y_1|I = 1)$ is approximately 24 542.98 riels, while the expected food consumption per capita that the same participant households would have enjoyed without participation $E(y_0|I = 1)$ is approximately 23 817.71 riels. Therefore, when participating in salary-paid employment, on average, farm households can make food consumption gains of approximately 725.26 riels per household member. This result indicates that engagement in salary-paid employment can allow rural farm households to improve welfare through increasing household food consumption per capita. Because off-farm employment generates supplementary household incomes, it can provide the participants with additional capital for investments in agricultural technologies, enhancing farm productivity. In addition, it can reduce the possibility of disguised unemployment as a result of excessive labor force on the farm, increasing the farm's output level.

Surprisingly, the estimated result of the effects of self-employment show that when participating in self-employment, on average, farm households make negative food consumption gains of approximately 333.24 riels per household member. These results are similar to previous findings (see also Olugbire *et al*. 2011) that salary-paid households make larger gains in terms of household incomes from participation in such off-farm activities than do self-employment households. The results can be somewhat explained by the fact that the self-employment generates negative profits due to high costs of or/and inefficiency of self-employment, thus reducing the expenditure on household food consumption. Nonetheless, with revenue from self-employment, farm households may increase the expenditure on other necessary household consumption than food.

5. Conclusion

The paper evaluates the welfare effects of diversification through engaging in off-farm activities on rural farm households based on household food consumption gains by using data from the CSES conducted in 2009. The evolution is carried out with the endogenous switching model, which accounts for selection bias and systematic differences between participants in off-farm activities and nonparticipants. The results confirm that the off-farm participation decision and household food consumption are affected by unobserved characteristics of farm households. There is also the presence of structural differences between the participants and nonparticipants; for instance, landholding has positive effects on the participants' food consumption but negative influences on the nonparticipants' consumption.

By controlling for the self-selection bias and inherent differences between participants and nonparticipants, the per capita food consumption gains from the participation in salary-paid employment are still positive, while the gains from engagement in self-employment are negative. Then, through engaging in salary-paid employment as an income diversification strategy, rural farmers are more likely to increase food consumption, then improving household well-being. Increased and stable earnings can increase and stabilize rural farmers' food consumption. Households having more access to higher-return off-farm activities, enjoy higher levels of incomes and food security than those who do not (Chang and Mishra 2008).

At policy level, main attention should be focused on the development of rural off-farm sector, which integrates rural farmers into higher-return off-farm activities, especially salary-paid employment, that need input-intensive technologies enhancing not only productivity but also agricultural marketing. Policies to promote the development of rural off-farm sector should be formulated at three levels. At the national level, policies should focus on a friendly business environment, allowing well-paid employment. At the regional level, the focus should be on the provision of physical and social infrastructure that facilitates the connectivity of economic activities. Lastly, at the local level, the emphasis should be on training, migration facilitation and public transportation development, which motivate households to engage in off-farm activities.

Finally, the fact that self-employment participants gain negative benefits in terms of household food consumption per capita is worth being taken in consideration in future studies of participation in off-farm activities and farm household well-being. Those studies should obtain accurate data on different types of off-farm employment by the operator and spouse and analyze their effects on rural farm households' welfare. The effects, especially effects of the households' time allocated to off-farm activities, may differ by gender because farm couples play different roles in terms of labor allocation within the household.

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Appendix

Table A1: Test for admissibility of the selected instrument (salary-paid employment)

Variable	Per capita food consumption by nonparticipants (OLS)			Salary-paid participation (Probit)		
	Coef.	Std. Err.	*P*-value	Coef.	Std. Err.	*P*-value
Head's gender	-0.042**	0.021	0.046	-0.068	0.058	0.238
Head's age	0.370	0.494	0.455	9.504***	1.654	0.000
Head's age squared	-0.057	0.067	0.402	-1.130***	0.222	0.000
Head's education	0.089***	0.013	0.000	0.331***	0.038	0.000
Household members > 64	-0.046***	0.016	0.005	-0.145***	0.047	0.002
Household members < 15	-0.125***	0.006	0.000	-0.021	0.017	0.200
Landholding	-0.011*	0.006	0.091	-0.114***	0.017	0.000
Availability of irrigation	0.019	0.018	0.297	-0.052	0.052	0.319
Yield damage	0.011	0.015	0.476	-0.032	0.043	0.453
Availability of public transport	-0.018	0.013	0.187	0.122***	0.039	0.002
Constant	9.589***	0.901	0.000	-20.924***	3.071	0.000
Observation	4500			5762		
Adj *R*-squared	0.118					
Prob. > Chi-squared				0.000		
Pseudo R^2				0.065		
Log likelihood				-2831.2		

Note: *, ** and *** are statistically significant at 10%, 5% and 1% level, respectively.

Table A2: Test for admissibility of the selected instrument (self-employment)

Variable	Per capita food consumption by nonparticipants (OLS)			Self-employment participation (Probit)		
	Coef.	Std. Err.	*P*-value	Coef.	Std. Err.	*P*-value
Head's gender	-0.020	0.027	0.457	-0.009	0.053	0.870
Head's age	1.133*	0.683	0.097	-0.368	1.317	0.780
Head's age squared	-0.158*	0.093	0.089	0.038	0.179	0.830
Head's education	0.099***	0.017	0.000	0.112***	0.033	0.001
Household members > 64	-0.047**	0.023	0.040	-0.026	0.042	0.535
Household members < 15	-0.013***	0.008	0.000	-0.059***	0.015	0.000
Landholding	-0.021**	0.009	0.026	0.348***	0.017	0.000
Availability of irrigation	-0.071**	0.030	0.018	0.467***	0.050	0.000
Yield damage	0.023	0.021	0.279	-0.193***	0.039	0.000
Availability of public transport	0.012	0.018	0.521	0.123***	0.035	0.000
Constant	8.139***	1.248	0.000	1.068	2.407	0.657
Observation	2298			5762		
Adj *R*-squared	0.131					
Prob. > Chi-squared				0.000		
Pseudo R^2				0.077		
Log likelihood				-3577.426		

Note: *, ** and *** are statistically significant at 10%, 5% and 1% level, respectively.