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Household Non-Farm Income: Any Influence on Agricultural Productivity in Rural Ghana?

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Abstract
This paper analyzes the effect of household non-farm income on agricultural productivity in rural Ghana using a nationwide household survey data. Key features of the analysis are the problem of endogeneity and selection bias which are addressed using the Heckman two-step procedure. The first stage probit regression revealed that the coefficients of availability of telecommunication infrastructure, availability of banks, availability of motorable roads, forest and savannah zones are significant in explaining non-farm income. The second stage OLS regression showed a significantly negative relationship between non-farm income and per-capita farm income given the other control variables.
Keywords: Non-farm income, Productivity, Ghana, Endogeneity and Probit

1. Introduction

The notion that rural households derive their livelihood only from agriculture is now changing. Different studies have suggested that rural households earn a significant amount of income from non-farm[1] sources (Ellis and Mdoe 2003). Recently Dimova and Sen (2010) assert that household income diversification has become a norm in rural societies and that specialization in a single activity is the exception. Through diversification, households have been able to generate extra income and are improving their welfare (Ellis and Mdoe 2003; Barrett et al. 2001).

The concept of non-farm income has generated enormous research interest, focusing to gain understanding over how and why households in rural areas diversify their income portfolio. Research efforts have concentrated on quantifying the share of non-farm income in total income, identification of factors driving households to diversify outside agriculture as well as examination of equity and food security implications. Theoretical explanation provides that, households diversify due to either push or pull factors (Ellis, 2000; Barrett et al., 2001).

Participation in non-farm income activities are also as a result of push and pull factors. This is because the actual participation of households in non-farm activities depends on the incentive and capacity to participate and the occurrence of entry barriers ((Reardon 1997). Two opposite forces will determine the household's motive to diversify its income sources. Push factors (or necessity) are the involuntary and sometimes desperate reasons to diversify; they include income risk management, coping mechanisms, diminishing or time-varying returns to productive assets, long-term constraints or smoothing household consumption (Ellis 2000; Barrett et al. 2001; Reardon et al. 2001). Pull factors on the other hand incentives that attract households to the non-farm sector when the non-farm activities offer higher returns compared to farming. Reardon et al. (2001) suggest that poor households will be attracted to low-risk Rural Non-Farm Employment in order to decrease income variability, even though they might have low returns. Wealthier households will be less diversified in their income sources because risk aversion motivation declines as wealth increases under perfect market conditions.

In many developing economies, unemployment and poverty are major issues confronting policy-makers. A major source of income for most rural households in developing countries is agriculture. Despite the fact that the agricultural sector in Ghana continues to be among the major contributors to the Gross Domestic Product (GDP), farmers in Ghana continue to be poor. The status of farmers could be attributed to the reasons that agriculture in Ghana continue to be rain-fed, rely on simple farm tools for cultivation; and most farmers are largely uneducated and therefore inefficient in applying new farm technologies and proper allocation of limited farm resources. The sector is also largely unbanked and uninsured because financial institutions and insurance companies find the sector to be highly risky due to exposure to severe droughts, bush fires and fluctuating output prices among others. These and other factors make them unproductive and thus giving them very low income after every production season.

According to Gordon and Craig (2001), it is impossible for agriculture alone to provide sufficient livelihood opportunities and thus non-farm income might also not be an option for everyone. This is because, although rural

[1] Any source of income not generated through agricultural activities and encompasses own account workers and working proprietors of unincorporated enterprises.

non-farm incomes are important as an off-season, part-time or home based income supplement for households whose main activity is farming, rural non-farm income in Africa tends to benefit more disproportionately the wealthier households implying significant entry barriers and market segmentation (Adams and HE 1995).
The GLSS5 (2008) report indicates that, the number of persons engaged in the non-farm sector in Ghana was about 5.4 million persons and represents 20 percent of the total population that own or operate non-farm enterprise in different capacities. Despite this importance of the sector in creating employment and supporting the livelihood of farm households, much is not known of how it affects agricultural productivity in Ghana. This study therefore tries to establish the impact of household non-farm income on agricultural productivity in rural Ghana by estimating the effect of non-farm income on farm income.

2. Literature Review

The role played by non-farm economic activities to household agricultural income in most developing countries especially sub-Saharan Africa is substantial. The old fact that the rural sectors of developing economies are purely agricultural is beginning to change. According to Chang and Boisvert (2006) the reliance on income from the non-farm sources by farm households has continued to narrow the gap between incomes obtained from farm households and incomes obtained from non-farm households.
According to Gordon and Craig (2001), the percentage of the poor in rural areas exceeds the ability of agriculture to provide sustainable job opportunities. Furthermore, whiles there is the possibility of migrating out of these areas to the urban areas, it is unlikely that the urban areas are able to provide enough job opportunities for people who move out because they are not able to make a living in the farming or agricultural sector (Marsland, et al. 2000). According to Gordon and Craig (2001), non-farm economic activities may take up extra labour in rural areas, aid farm households spread their risks, offer better remunerative jobs to supplement farm income, provide income possibility in times of off-farm seasons and offer alternative means to cope when farming fails.
Haggblade, Hazell, and Reardon (2005) found that local non-farm income constituted between 30 to 45 percent of rural household incomes in developing countries. Reardon et al. (1997) estimated it at 42 percent for sub-Saharan Africa and 32 percent for Asia and 40 percent for Latin America. Ellis (1998) gives higher numbers from case studies in sub-Saharan Africa in a range of 30 to 50 percent.
Farm/non-farm linkages are mostly used to study the relationship between the farm and non-farm sectors (see Reardon et al., 1997). Linkages are financial transactions between the two sectors which occur over time. There is a distinction between production and expenditure linkages. Production linkages can be further divided into upwards and downwards production linkages. Upward production linkages are found in the non-farm sector when agricultural output is used as input[1]. (see Woldenhanna, 2000). Any growth that occurs in farming stimulates agricultural productivity and hence the capacity to supply inputs and services to the non-farm sector.
Downward production linkages on the other hand refer to non-farm activities that provide inputs to agricultural production, such as agrochemicals, water pumps or fertilizers. The non-farm sector is encouraged to invest in supply capacity of agro-processing and distribution services (Reardon et al., 1997; Davies et al., 2003). Whether the production linkages will be upward or downward depends on the characteristics of the local agriculture (Reardon et al., 1997).
Expenditure linkages occur when households finance spending in one sector by the money earned from another sector. Farmers can for example purchase non-farm products with income generated from farm activities. On the contrary, people that have access to non-farm activities buy food and other agricultural output with the income derived from that non-farm activity. When these expenditures are related to household consumption, consumption linkages are established. Farm income raises or increases the demand for basic goods and services and results in diversification of consumption (Woldenhanna, 2000).
Investment linkages include expenditures used to finance non-farm or farm activities, which are mainly important within households. Returns from non-farm activities can be used to make investments in farm activities and thereby enhance agricultural productivity (Davies et al., 2003). The profitability of these expenditure linkages depends on the level and distribution of the income. Poor households will spend more on local goods and services from the non-farm activities, while richer households are more likely to invest in goods from the modern and urban manufacturing sectors or in imports.
The structure of the agricultural sector and the type of growth determines the type of linkage that will occur. Davies et al. (2003) illustrates this with several examples. If significant external inputs are needed for agricultural production, it is expected that backward production linkages will occur. Agricultural output that requires processing before selling induces forward production linkages. If growth in the agricultural sector is capable of inducing rural income growth, consumption and potential investments will be enhanced by

[1] Raw agricultural outputs are processed and distributed by non-farm enterprises

expenditure linkages.
Ellis (1998) finds that possible adverse (competition for labour and credit) and beneficial (reinvestments and insurance) impacts of non-farm income on household level are suggested in the literature. The net impact of non-farm activities is however highly specific in time and space.
The non-farm income affects agricultural production in a direct and indirect way when credit and liquidity market imperfections occur. The direct effect of non-farm income is the relaxation of household budget constraints and the increase of the purchase of normal goods. The indirect effects of non-farm income are more complex: non-farm activities provide households capital, security and liquidity to invest in technology or farm inputs.
Competing linkages occur if households' decisions about non-farm and farm activities are made jointly and households face limited resources and inputs such as capital and labour (Reardon et al. 1994). Participation in non-farm activities requires reallocation of those limited resources and this results in an inevitable withdrawal of critical resources from the farm. If non-farm activities have a higher return and agricultural investments are risky, investments in land conservation and technology could be impeded (Reardon et al. 2001). According to Reardon et al. (2001), the high productivity and higher returns of non-farm activities lead to concentration of resources on rural non-farm activities. As a consequence, participation by households in non-farm activities can hamper their own farm productivity (Ellis and Freeman 2004). This phenomenon decreases agricultural production and hence farm income will decrease and thereby hampers agricultural commercialization or modernization (Ruben and van den Berg 2001). The amount of non-farm activities performed and the importance of each activity depends on the relative returns to farm versus non-farm activities and their input requirements.
In sum, several factors appear to be involved in decisions by rural households to participate in rural non-farm economic activities. Some might be attracted by the incentives offered and labour availability whereas others might be pushed into the non-farm sector due to lack of opportunities on the farm. Also the characteristics of farm households also contribute to the participation in non-farm economic activity. Involvement in non-farm activities, as a livelihood strategy among poor rural households, play a vital role in promoting growth and welfare and offers a pathway out of poverty if non-farm opportunities can be seized by the rural poor. It was revealed in the literature that non-farm income could either increase agricultural productivity or decrease it or non-farm income could affect agricultural productivity either positively or negatively. Positively in the sense that non-farm income could contribute to investment in the farm sector to increase productivity and also, negatively in the sense that income from the farm sector could be invested in the non-farm sector more than it would be invested back into agriculture.

3. Data

The study used data from the Ghana Living Standards Survey (GLSS5) a nationally representative multipurpose household survey conducted in 2005/2006 by the Ghana Statistical Service. The survey captured comprehensive information related to household agricultural and non-agricultural activities as well as income generated. In addition to that, issues related to private income transfer or remittances were adequately covered. Structure of data collection instrument (questionnaire) suggests that key variables for the proposed study were adequately covered.
The GLSS5 is a nationally representative sample of 8687 households in 580 enumeration areas (EA), containing 37128 household members. Of the 8687 households surveyed, 5069 were in rural areas. This study focuses on farm households who owned or operated some farm land and also engage in rural non-farm activities of which there were a total of 4056 in the survey after the author's own computation. The households considered in the dataset undertake both farm and non-farm income activities.

4. Theoretical Framework

The model employed in this study is essentially the one suggested by Huffman (1991), where farm households allocate their time to individual activities including non-farm work. It is based on the agricultural household model that combines agricultural production, the households' consumption, and non-farm work decision by the household in a single framework. The study considers a household with two activities, the household farm work and non-farm work. A farm household is assumed to maximize a utility function defined over consumption of goods, Q and leisure, H , i.e.,

$$U = U(Q, H).$$

Utility is maximized subject to time, budget, production, and non-negativity constraints. The time constraint is:

$$T = L_1 + L_2 + H$$

Where T is total time endowment; L_1 and L_2 are respectively time allocated to farm work; and non-farm work

and H is leisure as defined above.
The budget constraint on household cash income can be expressed as:

$$PQ = p_1 y_1 - w_1 L_1 + w_2 L_2 + R \quad (1)$$

Where P is the price for the consumption good purchased in the market; w_1 and w_2 denote returns to labour from farm work and non-farm work respectively; y_1 and p_1 are annual quantity of farm output produced and sold and price for farm output respectively; R represent non-labour income.
The first order condition for optimal time allocation for farm work, non-farm work and leisure is given as:

$$\frac{\delta U}{\delta L_i} = w_i \frac{\delta U}{\delta Q} - \frac{\delta U}{\delta L} = 0 .$$

This first order condition can be rearranged to obtain the returns to labour from farm work and non-farm work:

$$w_i = \frac{(\partial U / \partial L)}{(\partial U / \partial Q)} .$$

When farm households allocate their time to the three activities, the labour supply functions for farm work and non-farm work can be derived as

$$L_1 = L_1(w_1, w_2, p_1, p_2; Z) \quad (2)$$

$$L_2 = L_2(w_1, w_2, p_1, p_2, R; Z) \quad (3)$$

As noted by Huffman (1991), a positive number of non-farm hours will be observed for household i, if the potential market wage (w_i^m) is greater than the reservation wage (w_i^r).

Thus, $L_i = 1$ if $w_i^m > w_i^r$ and $L_i = 0$ if $w_i^m \le w_i^r$
However, these differential wages are not observable. What is observed is the decision to earn, or not to earn non-farm income. This decision can be specified as an index function, with unobserved variable,

$$L_i^* = \beta Z_i^{'} + \mu_i \quad (4)$$
$$L_i = 1 \quad \text{if } L_i^* > 0$$
$$L_i = 0 \quad \text{if } L_i^* \le 0$$

Where $Z_i^{'}$ denotes a vector of variables such as household and location characteristics that influence the household's reservation and non-farm income; μ_i is the random disturbance term.
To analyze the impact of non-farm income on farm income, we start from the linear function

$$Y_i = \lambda_i + \alpha_i X_i^{'} + \delta_i L_i + \varepsilon_i \quad (5)$$

where Y_i is household farm income, L is a variable representing one, if the household earns non-farm income and zero otherwise; $X_i^{'}$, is a vector of personal and household characteristics and assets, and location characteristics, λ_i is a vector of unknown parameters, and ε_i is a random error term.

5. Empirical Estimation Method

The impact of non-farm income participation on agricultural outcome can be estimated by using per-capita income from agricultural households engaged in agricultural production as a proxy for agricultural productivity while controlling for a set of other factors. This methodology assumes that the systematic differences between households engaged in agricultural production is captured through the inclusion of a set of observable characteristics at the household and community levels.
Heckman (1979) two-step procedure was specified for estimation. A decision model will be specified to estimate the participation decision of farm households in non-farm work. This will be the first stage regression. The second stage will be to specify a model that will capture the impact of non-farm income on per-capita farm income.
Probit regression method is used for the selection equation. For the probability of being a non-farm income recipient household for observation i; thus, $y_i = 1$ if household receives non-farm income; $y_i = 0$ if not. We estimate the probability that the event occurs as a function of the explanatory $Z_i^{'}$. The probit model uses the

normal cumulative density function (c.d.f.) for F:

$$\Pr ob(y_i = 1) = \phi(\beta Z_i^{'}). \quad (6)$$

Where ϕ =standard normal cumulative density function; β is the vector of unknown parameters to be estimated.

As a cumulative density function, it has the desired property of always falling between 0 and 1. Following the index function and writing it out explicitly:

$$\phi(\beta Z_i^{'}) = \int_{-\infty}^{\beta Z_i^{'}} \phi(\varepsilon) d\varepsilon . \quad (7)$$

The study therefore estimate β using the maximum likelihood.

The empirical model for the probit model for recipient of non-farm income recipients' households to be estimated is specified as follows:

$$y_i = \beta_0 + \beta_1 \text{agehd} + \beta_2 \text{agesq} + \beta_3 \text{educhd}_j + \beta_4 \text{hhsize} + \beta_5 \text{ach} + \beta_6 \text{tel} + \beta_7 \text{mkt} + \beta_8 \text{bnk} + \beta_9 tr + \beta_{10} ptrans + \beta_{11} elec + \beta_{12} ezones_i + \varepsilon_i \quad (8)$$

Where j = primary, JSS and secondary/tertiary, $agehd$ is age of household head; $agehd^2$ represents the squared age of household head; $educhd$ depicts education levels of household head; $hhsize$ represent the household size; ach is access to credit; tel is availability of telecommunication facilities; mkt is availability of market, bnk is availability of bank; tr is access to motorable road, $ptrans$ is availability of public transportation, $elec$ is availability of electricity, $ezones_i$ represent ecological zones (i = forest, savannah and coastal) and finally, ε_i is the random error term.

In using equation (8), sample selection issues may arise. Sample selection bias therefore refers to problems where the dependent variable is only observed for a restricted, non-random sample. That is, selection into non-farm participation may not be random and as such there could be selection bias and hence the inverse mills ratio would be estimated to deal with this potential problem. Thus equation (8) is used to generate this selectivity term also known as the Inverse Mills ratio (Lambda), which is added to the second stage outcome equation or per-capita farm income equation in equation (9) below. This will provide evidence for the presence of self-selection and hence justify the use of Heckman's two-step procedure.

5.1. Solving the Problem of Potential Endogeneity

Endogeneity refers to the fact that an independent variable included in the model is potentially a choice variable, correlated with unobservables relegated to the error term. The dependent variable, however, is observed for all observations in the data. In analyzing the effect of non-farm income on farm income, there is the possibility of the problem of endogeneity, in that non-farm income could be invested into agricultural production and farm income could also be invested into non-farm economic activities. In other words, there could be a bi-directional effect between the two. In order to solve this problem of potential endogeneity, equation (9) below was estimated where y was treated as a continuous variable to get the predicted values of non-farm income which was then plucked into the selection equation, thus per-capita income equation for the second stage OLS regression.

$$y = \beta_0 + \beta_1 \text{agehd} + \beta_2 \text{agesq} + \beta_3 \text{educhd}_j + \beta_4 \text{hhsize} + \beta_5 \text{ach} + \beta_6 \text{tel} + \beta_7 \text{mkt} + \beta_8 \text{bnk} + \beta_9 tr + \beta_{10} ptrans + \beta_{11} elec + \beta_{12} ezones_i + \varepsilon_i \quad (9)$$

5.2. Heckman Sample Selection Estimation

The impact of non-farm income on farm income is estimated within a linear regression framework by placing the predicted values for households that receive non-farm income as part of the independent variables. This will be the second stage. This linear regression equation is shown below in equation (10):

$$pay_i = \lambda_0 + \lambda_1 educhd_i + \lambda_2 hhsize + \lambda_3 fsize + \lambda_4 vfinv + \lambda_5 fbo + \lambda_6 ezones_j + \lambda_7 prdnfe + \lambda_8 invmills + \mu_i \quad (10)$$

Where i = household; pay_i is household per-capita agricultural income, $educhd_i$ is educational levels, $hhsize$ represents the household size, $fsize$ is farm size, $vfinv$ value of farm investment, fbo depicts household head is a member of a farmer-based organization, $prdnfe$ thus is the predicted value of non-farm income which was calculated from equation (9) above when y was treated as a continuous variable, λ_i are

coefficients of the parameters to be estimated, *invmills* is the inverse mills ratio (IMR) generated after the first stage probit regression and finally, μ is a random disturbance term assumed to be normally distributed. The impact of non-farm income on household per-capita agricultural income is measured by the estimate of the parameter λ_9. The inverse mills ratio is self-selection which is a term that explains the fact that individuals self-select (make their own choice) into certain programmes or behaviours which make participation in such programmes or behaviours not randomly determined (Wooldridge, 2005). Wooldridge (2005) further explained that the term is mostly used when a binary indicator of participation might be systematically correlated with unobserved factors. Thus, this makes the self-selection problem another way an explanatory variable can also be described as endogenous.

In this case, a farmer self-selects whether to be a non-farm income recipient household or not depending on the perceived marginal benefit. But a farmer who makes a choice to be a non-farm income recipient household will likely have relatively high income even if he does not participate. Since *y* cannot be treated as an exogenous variable, estimating equation (10) by the Ordinary Least Squares (OLS) method will yield inconsistent result and biased estimates.

To obtain a consistent result, the process of correcting for self-selection bias using the Heckman Sample Selection Model (also known as the Heckman Two-step procedure) proposed by Heckman (1979) and Maddala (1983) is followed. An equation explaining the sample selection is included into the equation to be estimated. The equation in this case is the participation equation represented by equation (11) below as already explained above.

Thus;

$$y_i^* = \beta Z_i^{'} + \mu_i, \qquad y^* = 1 \quad if \quad y^* > 0, \quad 0 \quad otherwise \tag{11}$$

Where y^* represent the decision to participate in non-farm income activities; $Z_i^{'}$ is a vector of household and community level characteristics taken to influence the probability that a household participate in the non-farm sector or simply a vector of explanatory variables; β is the vector of unknown parameters to be estimated and; u is an error term assumed to be distributed as $\mu(0, \sigma^2)$.

Equation (11) is the probit model, in which we first, estimate the participation equal to 1 if the household receives non-farm income and 0 otherwise, is regressed on the independent variables. This specification in equation (11) treats non-farm income as an exogenous variable on the premise that non-farm income recipient households increase their farm income or improve their food security status.

6. Empirical Results and Discussion

This section provides an interpretation of the regression results from the probit and the ordinary least squares (OLS) regression models for both non-farm income and per-capita agricultural income respectively. The probit regression model is estimated to determine the probability of a household being a non-farm income recipient one, while the OLS regression model is estimated to assess the impact of non-farm income on agricultural income. Table 3 and Table 4 present the results from the probit estimation and the Heckman selection model for non-farm income recipients and per-capita agricultural productivity respectively.

Inclusion of all exogenous variables in both the decision (reduced form) and agricultural income equation will result in multi-collinearity problems in the second stage of the estimation procedure (Nakosteen and Zimmer 1980). Thus, access to credit, access to bank, access to telecommunication, availability of electricity, access to motorable roads and availability of public transportion are included as regressors in the non-farm income decision equation, but excluded from the agricultural income equation.

6.1. Estimates of the Probit Model

From the estimations in Table 3, the probability of being a non-farm income recipient household is significantly dependent on the availability of telecommunication infrastructure, availability of bank and the availability of motorable roads. In addition, the negative coefficient of availability of telecommunication infrastructure variable indicates that the probability of engaging in non-farm income decreases with telecommunication access. In the same vein, the same can be said about the availability of bank since it is also significantly negative. Even though this is counter intuitive, it could also mean that rural households concentrate much of their efforts on the farm since there are now opportunities for them to get easy access to their customers in the urban centres to purchase their produce.

The banks could also show interest in making credit available to the farm households rather than the non-farm sector and hence the negative relationship with the non-farm sector. This contrasts the findings of Babatunde and Qaim (2010) that household members with little or no education and no access to infrastructure such as

communication, roads and markets etc were constrained in their ability to participate in a well-paying non-farm economic activity.

Motorable road dummy shows that the probability of participation in the non-farm sector increases with the availability of motorable roads. Roads are seen as significant agents of development and hence anywhere that roads are constructed, businesses or non-farm sector activities strive.

With regards to the ecological zones, the reference category is coastal zone. The coefficients of forest zone and savannah zone dummies are significantly positive. It is worth noting from the result that: in comparison with farm households in the coastal zone, the probability of farm households to be in the forest zone are expected to reduce non-farm income by GH¢0.16 whiles farm households in the savannah zone are expected to reduce non-farm income by GH¢0.22. This result does not confirm the assertion by Newman and Canagarajah (2000) that farm households in savannah zone would participate more in non-farm income activities. Their findings show that farm households in forest and coastal zones would participate more in non-farm activities. Meanwhile the results above also show that farm households in the forest zone would also be less likely to participate in non-farm income activities.

The first stage of Heckman's two stage model is non-farm income participation equation that captures the factors determining participation by employing a binary probit equation as shown in Table 3 above. This equation, that is, the participation equation was used to generate a selectivity term known as the Inverse Mi lls Ratio (Lambda), which is added to the second stage outcome equation or per-capita farm income as shown in Table 4 below.

6.2. Effect of Non-farm Income on Agricultural Productivity

The results of the regression on the effect of non-farm income on agricultural productivity are contained in Table 4**.** Literature reveals that income generated from non-farm sources could either increase agricultural income or reduce it. It is expected from this study that income generated from non-farm recipient households would reduce agricultural income levels of farm households who participate in non-farm economic activities. This is because, women dominate the petty trade industry in Ghana according to the GLSS5 report. Since most women cannot sustain their farms, they eventually leave that sector for non-farm activities and hence increasing the income accruing to this sector at the neglect of agriculture. Meanwhile, this is not to say that men are not into the petty trade industry. In solving the problem of endogeneity of non-farm income, an OLS regression was estimated and the predicted values were employed in the Heckman selection model as an exogenous variable. The result of this regression is shown in Table A1 of the Appendix.

The results in Table 4 show that per-capita non-farm income is significantly negative at 10 percent level of significance. This indicates that an increase in per-capita non-farm income by GH¢1 reduces per-capita farm income by GH¢0.02. This finding lends support to the argument by Godwin and Mishra (2004) that much involvement in non-farm work decreased efficiency on the farm and hence reduced agricultural productivity. Similarly, this result confirms the findings by Pfeiffer, Lopez-Feldman and Taylor (2008) who studied empirically the effect of non-farm income on some activities in agricultural production in Mexico. Their results show that non-farm income has a significantly negative effect on agricultural output and also reduced the supply of family labour to the farm.

The second stage of Heckman's procedure also referred to as the outcome or selection equation uses Ordinary Least Squares (OLS) for establishing the effect of non-farm income on household per-capita farm income. The coefficient of the selectivity variable is statistically significant and negative. This finding calls for a couple of comments. First of all, the statistical significance of the coefficient lends support to our choice of the Heckman selectivity-adjusted model. Secondly, the negative sign of the coefficient suggests the presence of unobserved variable(s) which exert contrasting effects on non-farm income participation decision and farm income earned.

The estimated coefficient for age of the household head is significant in explaining why it is an important determinant in the farm sector. It is significant at 10 percent level and has a positive effect. The positive coefficient for head of household implies that for each additional increase in the age of the household head per-capita farm income increases by GH¢0.01. The negative and significant coefficient of age squared implies that there is a nonlinear relationship between age and per-capita farm income and this relationship is convex. This implies that at younger ages farm household heads leave the non-farm sector and, as they increase in age, they retire from the farm work and participate in the non-farm work because they are expected to be weak and for that matter cannot do hard work. This result is inconsistent with previous studies (e.g. Sumner 1982; Abdulai and Delgado 1999; Man and Sadiya, 2009). They found that as young farm household members increase in age, they tend to participate more in off-farm work but at older ages, they work more on-farm.

With regards to the educational variables, no education was used as the reference category. The results show that compared to no education, per-capita farm income reduces by GH¢0.12 for all farm household heads with secondary education. This means that farm household heads with no education would increase per-capita farm income compared to farm household head with secondary education. There is a negative effect on per-capita farm income for each farm household head who acquire secondary education. This can be explained that as

households attain secondary education, it slightly increases their chances of getting a non-farm income work and hence reduce their involvement in farm work. This is consistent with the work of Lanjouw (1999) who explain that people are employed in high paying sectors of the economy as their education levels rise and this will have a great and positive impact on their income and has an eventual negative effect on agricultural productivity. In a related development, there is a consistent and contrasting view by Islam (1997) who suggests that primary education improve the productivity of labour whiles secondary education stimulates entrepreneurial activity thereby raising agricultural income levels of farm households.

The household size has a negative impact on per-capita agricultural income since the p-value of household size is less than 1 percent. The result shows that an increase in the household size by 1 person causes per-capita agricultural income to reduce by GH¢0.13. This revelation could be attributed to the fact that larger households could be made up of the elderly and minors who will not be very active to participate in farm work and hence lower values of agricultural output per capita. In another vein, the negative effect of the household size on per-capita farm income could be that most of the members of the farm household are younger and of school going age and therefore do not work to bring income. It could also be because of the goal of poor married farmers to have more children as old age security and household labour (Jensen, 1990). Also the majority of farm households being children requires more time to be allocated towards taking care of them and therefore reduces the options to generate additional per-capita farm income and this could also put a strain on the little income of the household restricting further reinvestment.

Large farm size gives opportunity for diversification of crops cultivated so as to have both perennial and short period yielding crops. This helps in cushioning the farm household at all times. Therefore a farm household with a large farm size is expected to have a higher per-capita agricultural income holding all other factors constant. From Table 5.4 the log of farm size is significant at 1 percent level of significance and has a positive impact on household per-capita agricultural income. This implies that an increase in the farm size by one acre increases household per-capita agricultural income by GH¢0.36. This implies that farm households with large farm size are productive in the use of farm lands which therefore generates higher per-capita agricultural income. This finding emphasizes the fact that land is a primary input in agriculture.

The coefficient of the variable, log of value of farm investment is significantly positive at 1 percent level of significance implying that for each unit increase in the log of value of farm investment, per-capita farm income increase by GH¢0.27. This means that as more investments are made in the farm, it brings about more productivity and hence increases per-capita farm income. This contrasts the findings of Keith et el. (2007) who found out that as more investment goes into the farm sector, it brings about a reduction in per-capita farm income.

The forest and savannah zones have positive coefficients but that of savannah zone is not significant. The implication of the significantly positive coefficient of forest zone is that in comparison with farm households in the coastal zone, farm households in the forest zone are able to increase their per-capita farm income by GH¢0.12. This finding confirms the different climatic and topographical conditions in the various zones which may be favourable or unfavourable to agricultural production (Seini, 2002).

7. Policy Implications

Rural non-farm activities are an important driving force for sustained income growth and economic development in rural Ghana. However the development of non-farm activities compromise agricultural production and threaten food security. Using a cross-sectional data from Ghana, this study has examined the extent to which non-farm activities reduce agricultural productivity in rural Ghana.

Government of Ghana recognizes the need to increase agricultural productivity sustainably in particular on small farms in Ghana. However, it requires a long-term nature of engagement to meet future demand for food and other agricultural products. The study recommends therefore investment in sustainable approaches to productivity growth in the agricultural sector, with particular attention to smallholder farmers, both women and men, according to their role in the overall agricultural and food security systems, fostering structural transformation and sustainable agricultural growth.

Again, since households see agriculture as a risky venture, and prefer to invest in non-farm activities which are less risky; thus suggesting a competition between the two sectors. This study therefore recommends that policies must target agriculture directly. For instance, credit institution which supports agricultural production[1] and ensures that farming becomes self-sustaining can be established.

The coefficients[2] of the educational levels were found to be negative implying a negative effect on per-capita farm income as compared to no education. These coefficients therefore suggest the need to strengthen and re-

[1] Credit scheme aimed at supporting only agricultural production.
[2] Even though not all the coefficient were statistically significant

emphasize the importance of agriculture as taught subject in school. Thus, students should be encouraged to pursue agriculture related subjects at higher levels of education. The Ministry of Education and the Ghana Education Service should make agricultural science an integral part of basic education and encourage farm households to attend school to learn about new technologies and strategies to improve agricultural production in the long run. More agricultural colleges must also be established and well-resourced to equip students of such institutions to apply modern technology in agriculture.

In conclusion, as non-farm income is gaining grounds in Ghana, it should not be promoted at the peril of agriculture since the two are not seen to complement each other because the engagement in non-farm activities rather decrease farm income in rural Ghana.

References

Abdulai, A., and Delgado, C. L. (1999), Determinants of Non-farm Earnings of Farm Based Husbands and Wives in Northern Ghana. *American Journal of Agricultural Economics*, 81(1), 117-130.

Adams, R. H. and HE, J. J (1995), Sources of income inequality and poverty in rural Pakistan. *International Food Policy Research Institute. Research Report, No. 102. Washington DC*

Barrett, C.B. et.al. (2001), Non- farm Income Diversification and Household Livelihood Strategies in Rural Africa Concepts, Dynamics and Policy Implications.

Chang, H. and Boisvert, R. N. (2009) The Conservation Reserve Program, Off-farm Work, and Farm Household Technical Efficiencies. *(Working paper 2009-33). Ithaca, New York, USA: Cornell University, Department of Applied Economics and Management*.

Davis, J. R. (2003), The Rural Non-farm Economy, Livelihoods, and their Diversification: Issues and Options. *(NRI report No: 2753). Chatham, Kent, UK: Natural Resources Institute*.

Dimova, Ralitza, and Kunal Sen. (2010) Is household income diversification a means of survival or a means of accumulation? Panel data evidence from Tanzania. *BWPI Working Paper 122*

Ellis F. (2000) Rural Livelihood and Diversity in Developing Countries. *New York; Oxford University Press*.

Ellis, F. (1998) Household strategies and rural livelihood diversification. *Journal of Development Studies*, 35: 1-38.

Ellis, F. and Freeman, H.A. (2004) Rural livelihoods and poverty reduction strategies in four African countries. *Journal of Development Studies*, 40: 1-30.

Ellis, F. and Mdoe, N. (2003) Livelihoods and Rural Poverty Reduction in Tanzania. *World Development Report* Vol 31(8):1367-1384.

Ghana Statistical Service (GSS, 2008) Ghana Living Standards Survey Round V 2005/6

Ghana Statistical Service (GSS, 2012), Revised Gross Domestic Product 2011

Gordon, A., and Craig, C. (2001), Rural Non-farm Activities and Poverty Alleviation in Sub-Saharan Africa. *Natural Resources Institute, Social and Economic Development Department Policy Series* 14. *Chatham, UK:*

Haggblade, S., et. al. (2005), The Rural Non-Agricultural Economy: Pathway out of Poverty or Pathway in? *Paper Presented at the Meeting of the International Food Policy Research Institute on the Future of Small-Farms, Washington D.C.*

Heckman, J.J. (1979), Sample Selection Bias as a Specification Error. *Econometrica* 47(1), 153-161

Huffman, W. E. (1991), Agricultural household models: Survey and critique. *In M. C. Hallberg, J. L. Findeis, and D. A.Lass (Eds.), Multiple job-holding among farm families* (pp. 79-111). Ames, IA: Iowa State University Press.

Islam, N. (1997), The Non-farm Sector and Rural Development. *Food, Agriculture and Environment Discussion Paper* No. 22.

Lanjouw, P. (1999) Rural Non-Agricultural Employment and Poverty in Ecuador, Economic Development and Cultural Change. 48(1) October

Maddala, G. S. (1983), Limited-Dependent and Qualitative Variables in Economics, New York: Cambridge University Press, pp. 257-91

Man, N., and Sadiya, S. I. (2009), Off-farm Employment Participation among Paddy Farmers in the Muda Agricultural Development Authority and Kemasin Semerak Granary areas of Malaysia. *Asia-Pacific Development Journal*, 16(2), 142-157.

Marsland, N. et. al. (2000), Policy and Research on the Rural Non-farm Economy: A review of Conceptual, Methodological and Practical Issues. *Chatham, UK: Natural Resources Institute.*

Reardon, T. (1997), Using Evidence of Household Income Diversification to Inform. A Study of the Rural Non-Farm Labour Market in Africa. *World Development*, 25(5), 735–747.

Reardon, T. (2001), Rural Non-farm Employment and Incomes in Latin America: Overview and Policy Implications. *World Development*, 29(3), 395-409.

Reardon, T., et.al.(1994), Links between Non-farm Income and Farm Investments in Africa Households: Adding

the Capital Market Perspective. *American Journal of Agricultural Economics,* 76(5), 1172-1176.
Ruben, R. and van den Berg, M. (2001), Non-farm employment and poverty alleviation of rural farm households in Honduras. *World Development*, 26: 549-560.
Seini, A. W. (2002), Agricultural Growth and Competitiveness under Policy Reforms in Ghana. *Technical Publication No. 61). Legon: Univerity of Ghana, Institute of Statistical, Social and Economic Research (ISSER).*
Senadza, B. (2011) "Non-farm Income Diversification in Rural Ghana: Determinants and Implications for Income Distribution and Welfare", VDM Verlag Dr. Mueller
Sumner, D. A. (1982) The Off-farm Supply of Farmers. *American Journal of Agricultural Economics,* 64(3), 499-509.
Woldehanna T. (2000) Economic Analysis and Policy Implications of Farm and Off-farm Employment, A Case Study in Tigray Region of Ethiopia. *Unpublished Master's Thesis, Wageningen University, Wageningen, the Netherlands*.

Appendix

Table A1: OLS Regression of Non-farm Income and other Explanatory Variables

Variable	Coefficient	Standard Error	t-stat	p-value
Age of Head of Household	0.0178	0.0109	1.64	0.102
Age Squared	-0.0001	0.0001	-1.26	0.206
No Education (Ref. Group)				
Basic Education	-0.0818	0.1064	-0.77	0.442
Secondary Education	0.0375	0.0927	0.4	0.686
Higher Education	-0.5465	0.0973	-5.62	0.000***
Household Size	-0.0926	0.0112	-8.3	0.000***
Access to Credit	0.6071	0.0683	8.89	0.000***
Availability of Telecom	0.1607	0.1575	1.02	0.308
Availability of Market	0.0833	0.1006	0.83	0.408
Availability of Bank	0.0368	0.1337	0.28	0.783
Availability of Motorable Road	0.0165	0.0985	0.17	0.867
Availability of Public Transport	0.4046	0.0849	4.76	0.000***
Availability of Electricity	-0.0561	0.1579	-0.36	0.722
Coastal Zone (Ref. Group)				
Forest Zone	0.1012	0.0910	1.11	0.266
Savannah Zone	-0.0532	0.0914	-0.58	0.561
Constant	12.1941	0.2737	44.55	0.000***
Number of Obs	4056			
F(15, 4040)	24.01			
Prob > F	0.000			
R-squared	0.0818			
Adj R-squared	0.0784			

*****significant at 1%** ****significant at 5%** ***significant at 10%**

Source: Computed from GLSS5 by authors

Table 1: Descriptive Statistics of Independent Continuous Variables for Econometric Analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
Age of Household Head	4056	42.1987	16.1342	16	99
Age Squared	4056	2040.979	1578.7940	256	9801
Household Size	4056	5.0483	3.0343	1	29
Log of Non-farm Income	4056	12.3335	2.1227	0	18.2886
Log of Agric Income	4056	13.7914	1.4036	6.2729	18.1425
Log of Farm Size	4056	1.6185	0.8071	0.1823	8.9227
Log of Val of Farm Invest	4056	12.3927	1.4286	7.6009	19.1727

Source: Computed from GLSS 5 data by authors.

Table 2: Descriptive Statistics of Independent Categorical Variables for Econometric Analysis

Variable	Frequency	Percent	Cumulative
Non-farm Income			
Participates	3,433	84.64	84.64
Do not Participate	623	15.36	100
No Education			
Yes	668	16.47	16.47
No	3,388	83.53	100
Basic Education			
Yes	819	20.19	20.19
No	3,237	79.81	100
Secondary Education			
Yes	594	14.64	14.64
No	3,462	85.36	100
Higher Education			
Yes	2,798	68.98	68.98
No	1,258	31.02	100
Farmer-Based Org.			
Member	635	15.66	15.66
Non-member	3,421	84.34	100
Availability of Bank			
Available	260	6.41	6.41
Not Available	3,796	93.59	93.59
Availability of Telecom			
Available	908	22.39	22.39
Not Available	3,148	77.61	100
Availability of Motorable Road			
Available	3,201	78.92	78.92
Not Available	855	21.08	21.08
Availability of Market			
Available	562	13.86	13.86
Not Available	3,494	86.14	100
Access to Credit			
Access	1,449	35.72	35.72
No Access	2,607	64.28	100
Available	2,424	59.76	59.76

Source: Computed from GLSS 5 data by authors.

Table 2: Descriptive Statistics of Independent Categorical Variables for Econometric Analysis (cont'd)

Variable	Frequency	Percent	Cumulative
Availability of Public Transport			
Not Available	1,632	40.24	100
Availability of Electricity			
Available	901	22.21	22.21
Not Available	3,155	77.79	100
Ecological Zones			
Coastal			
Yes	3329	82.08	82.08
No	727	17.92	100
Forest			
Yes	2341	57.72	57.72
No	1715	42.28	100
Savannah			
Yes	2442	60.21	60.21
No	1614	39.79	100

Source: Computed from GLSS 5 data by authors.

Table 3: Probit Estimates of Non-Farm Income Participation Decision Estimation

Variable	Coefficient	Standard Error	z-stat	p-value
Age of Head of Household	0.0031	0.0082	0.38	0.706
Age Squared	0.0000	0.0001	-0.21	0.831
No Education (Ref. Group)				
Basic Education	0.0924	0.0811	1.14	0.255
Secondary Education	0.0106	0.0696	0.15	0.879
Higher Education	0.0205	0.0734	0.28	0.78
Household Size	-0.0004	0.0083	-0.05	0.958
Access to Credit	0.0841	0.0519	1.62	0.105
Availability of Telecom	-0.2342	0.1204	-1.95	0.052*
Availability of Market	0.0979	0.0784	1.25	0.212
Availability of Bank	-0.2244	0.0944	-2.38	0.017**
Availability of Motorable Road	0.2305	0.0716	3.22	0.001***
Availability of Public Transport	0.0593	0.0649	0.91	0.361
Availability of Electricity	0.1417	0.1224	1.16	0.247
Coastal Zone (Ref. Group)				
Forest Zone	-0.1614	0.0714	-2.26	0.024**
Savannah Zone	-0.2182	0.0712	-3.06	0.002**
Constant	0.8382	0.2057	4.08	0.000***
Number of Obs	4056			
LR chi^2 (15)	48.13			
Prob > chi^2	0.000			
Pseudo R^2	0.0138			

*****significant at 1%** ****significant at 5%** ***significant at 10%**

Source: Computed from GLSS5 by authors

Table 4 Estimates of the OLS Model Variables (Heckman Selection Model)

Variable	Coefficient	Standard Error	t-stat	P-value
Non-Farm Income	-0.0194	0.0091	-1.95	0.052*
Age of Household Head	0.0126	0.0068	1.86	0.063*
Age Squared	-0.0001	0.0001	-1.82	0.070*
No Education (Ref. Group)				
Basic Education	-0.0246	0.0662	-0.37	0.710
Secondary Education	-0.1246	0.0574	-2.17	0.030**
Higher Education	-0.0780	0.0595	-1.31	0.190
Household Size	-0.1282	0.0071	-18.09	0.000***
Log of Farm Size	0.3644	0.0264	13.81	0.000***
Log of Value of Farm Invest	0.2658	0.0151	17.61	0.000***
Coastal Zone (Ref. Group)				
Forest Zone	0.1167	0.0563	2.07	0.038**
Savannah Zone	0.0799	0.0569	1.41	0.160
Availability of Farmer-based Org.	0.0222	0.0551	0.40	0.688
Inverse Mills Ratio	-0.0265	0.0449	-0.59	0.055*
Constant	10.2851	0.2402	42.83	0.000***
Number of Obs	4056			
F(13, 4042)	71.37			
Prob > F	0.000			
R-squared	0.1867			
Adj R-squared	0.1841			

*****significant at 1%** ****significant at 5%** ***significant at 10%**

Source: Computed from GLSS5 by authors

Note: the dependent variable is log of per-capita farm income