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IS NON-FARM INCOME RELAXING FARM INVESTMENT LIQUIDITY CONSTRAINTS FOR MARGINAL FARMS? AN INSTRUMENTAL VARIABLE APPROACH

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Abstract

This paper tests the hypothesis that off-farm income relaxes the liquidity constraints of farm households using survey data derived from 734 households from eight villages, drawn from the three agro-climatic zones of northern Ethiopia. The results of the econometric models show that off-farm income positively affects agricultural input expenditure but negatively affects livestock investment. This may be explained by the higher per capita land holdings of households who invest in improved agricultural inputs compared to those who invest in livestock. Our results show the complementarities between off-farm activities and productivity enhancing investment for agricultural inputs. However, off-farm activities may be competing for labor resources for landless and near landless households (those who invest in livestock).

Key words: *off-farm-farm linkage* IVTobit **

JEL Classification: E22; L38; L39

1. Introduction

The literature on off-farm activities revolves around the questions of what drives participation in off-farm work and how off-farm income contributes to farm activities. Regarding the importance of non-farm income for total household welfare various percentage contributions to total household income have been evidenced by Reardon (1997:1173) and de Janvry and Sadoulet (2001:468). The role of off-farm income in terms of poverty reduction or income inequality and the drivers of diversification is also documented by several previous studies (Lanjouw and Lanjouw, 2001:8; Haggblade et al., 1989:1177). However, the literature on nonfarm-farm linkages is still evolving. A central question is whether additional income earned outside agriculture is spent on farm-related investment or whether it is invested outside agriculture or negative relationship (Maertens, 2009:225).

A number of previous studies have examined the interactions between farm and nonfarm income. Evans and Ngau (1991:521) examined the role of non-farm income in raising smallholder's agricultural productivity and output using a case study of Kutus, Kenya. Similarly Savadogo et al. (1994:610) concluded that non-farm earnings positively influence animal traction adoption. In contrast to the above findings, according to Holden et al. (2004:371) access to rural non-farm activities leads to increased soil erosion and land degradation suggesting a drop in agricultural total factor productivity, for Ethiopia. A negative relationship between non-farm income and household calorie consumption was also reported by Pfeiffer et al. (2009:133) for Mexico.

While the above studies and many more have made substantial contributions to the understanding of off-farm and farm relationships, almost all studies focused on off-farm income contribution towards agricultural inputs and farm capital investment. Little is known how off-farm income and the livestock sector interact. Specifically, we did not come across any empirical study on the relationship between off-farm work and livestock investment. However, it is important to understand this relationship, as keeping livestock takes on a prominent role in Ethiopian agriculture. If off-farm income is invested in productivity enhancing inputs or asset creation, it could drive self-reinforcing growth and build households' resilience to future shocks. On the other hand, if the off-farm income is used for consumption and other non-productive expenditures its contribution to growth and poverty reduction will be limited. The above observations raise the following research questions. First, what type of relationships exist between households' participation in off-farm activities and farm investment decisions? Second, given the above stated conditions (if there is any farm investment at all), what would be the preferred investment type: farm inputs or livestock investment?

2. Data and methodology

The dataset is generated from a household survey conducted in 2009, that consists of 676 farm households drawn from 10 Districts and 168 Sub-Districts using stratified random sampling. The research site is located in the less favored area of northern Ethiopia. In view of the censored nature of our dependent variables, we have employed an Instrumental variable Tobit (IVTobit) approach to estimate the coefficient of interest (impact of nonfarm activities on the two outcome variables). We introduce two instruments that are relevant to our variable of interest.

The literature on off-farm-farm interaction identifies two major types of linkages: production and expenditure. Production linkages can be further divided into backward and forward linkages, sometimes called "up-stream" and "down-stream" linkages. The expenditure linkage, which is the focus of our study, intends to examine how the incomes generated from non-farm activities are used (if at all) to finance farm activities (Stampine and Davis, 2009:185). According to the agricultural household model, given the resource constraints, the farm household tries to allocate lifetime income derived from farm and non-farm sources, so as to maximize lifetime utility (Singh et al., 1986:17); Adesina and Zinnah, 1993:300). Following Adesina and Zinnah, the utility maximization problem can be specified as follows. Consider two decisions: the decision to participate in non-farm activities and the decision to invest in farm activities. Define participation in nonfarm activities by j=1 and j=0 for nonparticipation. Similarly, conditional on participation, the decision to use non-farm income for farm investment can be depicted I=1 and I=0 otherwise. Thus, the utility derived from the first step decision can be depicted as;

$$U_{ji=1} = F(F,H)+\varepsilon_1 \qquad j = 0,1; i = 1, \dots\dots . n$$

$$U_{ji=0} = F(F,H) + \varepsilon_0 \tag{1}$$

for participants and non-participants respectively, where F and H are farm and household characteristics of the households explaining their status. The second step is, conditional on participation in off-farm, households' decision to participate in farm investment. The utility function can be written as,

$$U_{Ii=1} = F(P_{1,}F, H) + \mu_1 \qquad I = 0, 1; i = 1, \dots \dots . n$$
$$U_{Ii=0} = F(P_{0,}F, H) + \mu_0 \qquad (2)$$

As the two step decisions and their respective utility functions are random, i^{th} farmer will select the alternative $j = 1 \; if \; U_{ji=1} > U_{ji=0}$ and conditional on the first decision if or if the non-observable (latent) random variables $\mathbf{Y_j^*} = \mathbf{U_{ji=1}} - \mathbf{U_{ji=0}} > \mathbf{0}$ **and** $\mathbf{Y_I^*} = \mathbf{U_{Ii=1}} - \mathbf{U_{Ii=0}} > \mathbf{0}$. The probability that the farmer participates and show positive investment in agricultural activities (Y_j^* and Y_I^* >0), is a function of the independent variables (simultaneity of decision to invest and amount of investment is assumed).

$$P_j = \Pr\,(Y_{j1} = 1) = \Pr\,(U_{ji=1} > U_{ji=0}) \quad for\ participation\ equation$$
$$= Pr(F(F, H) \; + \varepsilon_1 \; > \; F(F, H) + \varepsilon_0 \qquad (3)$$
$$= F(X_i\beta, Z_i\alpha_{i,_i})$$

$$P_{I1} = \Pr\,(Y_{I1} = 1) = \Pr\,(U_{Ii=1} > U_{Ii=0}\,) \quad for\ investment\ \ equation$$
$$= Pr[F(P_{1,}F, H) \; + \mu_1 \; > \; F(P_{0,}F, H) + \mu_0] \qquad (4)$$
$$= F\,(P_{i,}\, X_i\beta)$$

where $\mathbf{X\,and\,Z\,are\;n*k}$ and $\mathbf{n*m\;matrices}$ of the explanatory and instrumental variables and β and α are $\mathbf{k*1\;and\;m*1}$ vectors of parameters to be estimated. $\mathbf{Pr(.)}$ is the probability function, ε and μ are random error terms, and $\mathbf{F[(X]_i\beta)}$ and) are the cumulative distribution function for ε and μ evaluated at $\mathbf{X_i\beta}$, and $Z_i\alpha$. Equation (3) and (4) can be estimated by employing the Instrumental variables Tobit (IVTobit) model with maximum likelihood, where ε and μ are assumed to be independently and identically distributed.

$$Y_i^* = \theta P_{i,} + X_i\beta_i + \varepsilon_i \qquad (5)$$
$$P_{i,} = Z_i\alpha_{i,} + X_i\alpha + \mu_i \qquad (6)$$

where $i = 1, \dots N,$ P is an endogenous explanatory variable of interest (off-farm participation), X is a vector of exogenous variables, Z is a vector of instrumental variables, β, θ and α are vectors of structural parameters. In this set up, we do not observe Y_i^*; instead we observe Y_i=0 for Y_i^*<0; and $Y_i = Y_i^*$ for

$Y_i^*>0$. Following the decomposition technique proposed by McDonald and Moffitt (1980:318), the model permits the investigation of the decision of whether or not to participate, and the conditional level of expenditure. The list of all the variables used for estimation, and their definitions, are presented in Table 1[1].

Table 1. Descriptive statistics of the dependent and explanatory variables

	Description
Dependent Variables	
Off-farm	1 if the household participate in any of the off-farm income generating activities (wage employment and business)
lnModeminputs	Log transformed household expenditure on total modern inputs(fertilizer+ improved seed) in Birr
lnliveinv	Log transformed household expenditure on livestock investment in Birr
Householdheadage	Age of the household head (years)
Malehhh	=1 if Sex of the head of the household is male, 0 otherwise
Adultlabforce	Working age group members of the household (> 14 years and <60 years)
Headschooling	Educational level of the head of the household
LandPercapita	land per capita, in Tsemad (1tsemad=.25 ha)
TLU Before	Log lagged livestock asset holding
Edirmembership	= 1If a member the household is a member of social network called edir, 0 otherwise
DistanceCapital city	Sub-district distance to Capital city market in Kms
DistanceDistrict	Sub-district distance to District market in kms
Instrumental variables	
Migperyear	Number of household members migrated in terms of years
Woreda unemply	Unemployment rate at district level

3. Results and Discussion

3.1 Robustness check

For IV regressions to work, each instrument must comply to two conditions, i.e., instrumental relevance and instrumental exogeneity. In our case both conditions are satisfied (the variation in the instrument is related to the variation in the instrumented variable and the Sargan N*R-sq statistic for over-identification).

The two instruments are migrant person year and district level of unemployment. The first instrument aims to capture two things, whether a household had a migrant member and if yes the number of people who migrated and the duration of days migrant members stayed outside their village during the year. Hence, households who have some migrant members are expected to get more information and network and thereby are more likely to participate in off-farm activities. The second instrument, the unemployment rate in each of the 4 districts, is expected to be negatively associated with the participation in nonfarm activities. The unemployment level, except through its negative influence on non-farm participation and access to non-farm income, is unlikely to be related to outcome variables (agricultural input expenditure and livestock investment).

We checked the exogeneity of off-farm activities and in fact the Wald tests clearly rejected (p=0.04) and (p=0.00) exogeneity for the livestock investment and agricultural input equations respectively; indicating off-farm variable is indeed endogenous. We also found a higher and significant coefficient for off-farm activities in the two instrumental models (IVTobit and 2SLS[1] compared to smaller and insignificant coefficient in the Tobit[1]. This shows that when the potential factors that could make off-farm activities endogenous are removed, the effect of off-farm participation in the two outcome variables becomes greater. Thus our preference for IV based estimation was based on a strong reason. For reasons explained above, our analysis will be based on IVTobit results.

3.2 Regression results

Using rural household survey data from northern Ethiopia, we found that first, almost 61% of all households sampled in our research have at least some source of off-farm income. Second, on average off-farm income accounts for nearly 26% of the total income of those who engage in off-farm activities. Third, the share of off-farm income is positively correlated with wealth proxies: land size and livestock asset. This result negates the widespread notion that shrinking per capita land availability and non-availability of other assets are the main driving force for the growing importance of off-farm activities[1]. Table 2 reports the results for total log transformed expenditure on modern agricultural inputs. The results of the IVTobit specification suggest that the impact of off-farm participation (non-farm income) is positive and significant at the 1% level of significance. Households' participation in off-farm activity increases the probability of the household's expenditure in modern agricultural inputs by 62.9%. Furthermore, off-farm participation will have a marginal effect of 2.2% and 6% expenditure among the whole sample and among users respectively. Our finding is consistent with the conclusion of earlier studies who documented a positive relationship between off-farm participation and agricultural investment (Evans and Ngau, 1991:521). However, it contradicts the findings of Kilic et al. (2009:151) in Albania, and Holden et al (2004) for Ethiopia, who both found a negative relationship between off-farm participation and farm investment level.

In addition to the variable of main interest (participation in off-farm activities) the model includes land per capita, lagged tropical livestock unit (TLUbefore), distance to main market and local market, gender of the household head and adult labor force, as variables that are statistically significantly affecting the outcome variable. As expected, land per capita has a positive and significant influence on the amount of expenditure on modern agricultural inputs. This supports the findings by Tiwari et al (2008:217) who reported a positive relationship between farmers' landholding new technology adoption. However, it contradicts Adesina and Zinnah (1993:303) findings which underscored the importance of farmers' perception of the technology as opposed to resource endowment in the adoption process.

Table 2 log amount expenditure on modern agricultural inputs : IVTobit estimate

	β	SE	Δ in probability	Total Δ	Δ among users
Off-farm	13.244***	4.910	.629	2.206	5.976
landpercap~a	1.634***	.414	.080	.492	.803
TLU Before	.218***	.085	.010	.213	.107
Ln Distance Capital city	-2.579**	1.111	-.127	-2.941	-1.267
DistrictDistance	.077**	.035	.003	.263	.038
Malehhh	1.403*	.750	.071	.281	.672
Householdheadage	-.038	.149	-.001	-.456	-.018
Age sqr	.001	.001	.000	.364	.000
Headschooling	-.428	.273	-.021	-.103	-.210
Adultlabforce	.400*	.224	.019	.3009	.196
Edirmembership	.540	.717	.026	.0341	.268
_cons	1.259	4.782			

Sargan N*R-sq test 1.091 Chi-sq(1) P-value = 0.2963
Tests of endogeneity of: offfarm
H0: Regressor is exogenous
Wu-Hausman F test: 34.66506 F(1,711) P-value = 0.00000
Durbin-Wu-Hausman chi-sq test: 33.65787 Chi-sq(1) P-value = 0.00000

Table 3 reports results the impact of the off-farm variable and other covariates on livestock investment. The variables which were found to be statistically significant includes: the instrumented variable of interest off-farm, land per capita, lagged TLU asset, gender, age, and education of the household head and edir membership (social network). The effect of off-farm participation on livestock investment was found to be negative and significant. Households' participation in off-farm activity decreases the probability of the household's decision in livestock investment by 31%. Furthermore, off-farm participation will have a marginal negative effect of .9% and 4.7% expenditure among the whole sample and among users respectively. The negative relationship could probably indicate the labor competition between off-farm participation and livestock rearing; and the general decline in fodder production due to recurrent drought and land degradation.

Table 3 Log total investment on livestock: IVTobit estimate

			Marginal effects		
	β	SE	Δ in probability	Total Δ	Δ among users
Off-farm	-7.249*	4.048	-.311	-.9118	-4.740
landpercap~a	-.630**	.315	-.031	-.143	-.384
TLU Before	.104*	.063	.005	.077	.063
Ln Distance Capital city	-.683	.851	-.033	-.587	-.417
DistrictDistance	-.041	.026	-.002	-.105	-.025
Malehhh	2.093***	.569	.112	.316	1.220
Householdheadage	.307***	.115	.015	2.784	.188
Age sqr	-.003***	.001	-.000	-1.52	-.002
Headschooling	.508**	.210	.025	.092	.310
Adultlabforce	.101	.166	.005	.057	.062
Edirmembership	.993*	.529	.046	.047	.621
_cons	4.345	3.585			

Sargan N*R-sq test 2.636 Chi-sq(1) P-value = 0.1045
H0: Regressor is exogenous
Wu-Hausman F test: 4.25389 F(1,711) P-value = 0.03952
Durbin-Wu-Hausman chi-sq test: 4.30591 Chi-sq(1) P-value = 0.03798

4. Conclusions

Using rural household survey data from northern Ethiopia, we found that first, almost 61% of all households sampled in our research have at least some source of off-farm income. Second, on average off-farm income accounts for nearly 26% of the total income of those who engage in off-farm activities. Third, the share of off-farm income is positively correlated with wealth proxies: land size and livestock asset. This result negates the widespread notion that shrinking per capita land availability and non-availability of other assets are the main driving force for the growing importance of off-farm activities. Fourth, using household survey data estimates; we found that off-farm income has a mixed effect on farm production. While the effect on the amount of improved agricultural inputs was positive, the impact on the amount of livestock investment was negative.

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End notes:

[1] Descriptive statistics; 2SLS and Tabit model estimate Tables are not included to save space, but are available on request.