

Factors Affecting Rural Households' Income Diversification: Case of Zoba Maekel, Eritrea

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Abstract

This paper examines the effects of internal and external factors on total household's income through OLS method and the determinants of incomes earned from various income generating activities with the help of Tobit models, based on household level survey data from 4 villages in Zoba Maekel, Eritrea. The study revealed that ownership of irrigated and rain-fed area and livestock units; human capital; social capital; off-farm income and unearned income, have positive effect on total household income. Regarding activities income, income from any kind of wage-employment and non-agricultural wage-employment are negatively related with livestock possession. Probability of being male headed household has positive effect on income from non-agricultural wage-employment and any kind of wage-employment, while it has a negative effect on income from non-agricultural self-employment. The positive effects of: years of schooling of head of household on income from off-farm; adult members on income from non-agricultural self-employment and crop production; number of dependents on income from non-agricultural self-employment and off-farm employment; risk on income from all agricultural and non-agricultural wage-employments are documented. Furthermore, negative effects of distance to the nearest market on income from any kind of wage-employment and non-agricultural wage-employment are found. The results of the analyses are used to draw policy recommendations with respect to activity diversification and rural development which would assist in alleviating rural poverty.

Keywords

Rural Non-farm, Off-Farm, Livelihood Diversification, Total Income, Activity Income, Eritrea, Zoba Maekel

1. Introduction

The traditional image of farm households in developing countries has focused, almost exclusively, on farming with little attention to rural non-farm (RNF) activities. This image persists and is widespread. Policy debate still tends to equate farm incomes with rural incomes, and rural/urban relations with farm/non-farm relations [10]. Thus, policy makers view state efforts to combat rural poverty as policies taken to enhance farm productivity. Most official reports produced by governments and multilateral institutions such as the World Bank, as well as others, who have shaped the agricultural policy agenda, have focused almost exclusively on agricultural development as the way to reduce rural poverty and achieve sustainable economic growth in rural areas [9].

In real life, there is a great degree of heterogeneity in asset possessions and in income generating activities among rural households. As part of their survival strategies, rural households engage in a wide variety of activities: they cultivate crops on their fields, work as wage laborers on other farms, or operate a small shop and other manufacturing and service activities. Thus, RNF activities are important sources of income for rural families. Early studies have shown that the relative importance of RNF activities in the rural economy which comprises 20 to 60% of rural income and the proportion increases with their levels of economic development.

The prevalence of RNF activities in rural areas dates back centuries, however, studies undertaken over the past three

decades have highlighted the increasing importance of non-agricultural sources of income to rural dwellers. The focus on livelihood diversification necessarily implies the process of broadening of income and livelihood strategies away from purely crop and livestock production towards both farm and non-farm activities that are undertaken to generate additional income via the production of other agricultural and non-agricultural goods and services, the sale of waged labor or self-employment in small enterprises and remittance from urban areas and from abroad [19]. This is especially true in rural areas of low-income countries, where high transactions costs induce many residents to self-provision in several goods and services, where increasing population pressures often result in landholdings too small to absorb all of a household's labor supply, and where limited risk-bearing capacity and weak financial institutions create strong incentives to select a portfolio of activities in order to stabilize income flows so as to stabilize consumption and minimize the risk of entitlements' failure. The result of each of these mechanisms is diversified employment and income patterns [3].

In this paper we examine the factors that determine total household incomes and incomes from various agricultural and non-agricultural activities, in one of the six administrative regions of Eritrea. The analysis is based on OLS method in examining the determinants of total household incomes and Tobit models are used in estimating the determinants of activities income. The rest of the paper is organized as follows: after the introductory part, theoretical explanation of livelihood diversification and its determinants is provided in section 2. Section 3 presents the background of the study area and data sources. The empirical models and results are discussed in section 4 of the paper. Finally, conclusion and policy implications are drawn in section 5.

2. Livelihood Diversification

In recent years, there has been increasing emphasis within the rural development literature on 'rural livelihoods and livelihood diversification'. A key feature of the concept of livelihoods is the link between assets, activities and incomes. According to [21], the livelihoods approach has played an important role in highlighting the multiple activities undertaken by rural households, the importance of assets in determining the capacity to undertake activities, the dynamic nature of actions of rural households and the link between the diversification of assets and activities. Evidence from developing countries indicates that rural households rely on a number of assets and are engaged in multiple activities to generate incomes. In particular, there has been strong evidence indicating the importance of RNF activities. Based on a set of studies from Latin America and Africa, RNF activities account for 30-45% of household incomes where the highest is obtained in Africa and lowest in Latin America.

For the purposes of our study, we adopted the definition of rural livelihood diversification developed by [7] as the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to

improve their standard of living.

What is distinctive about livelihood diversification in many of the developing countries is its pervasive and enduring character. It is pervasive in the sense that it is not just an isolated or scattered phenomenon corresponding to particular types of farm families in particular locations. Livelihood diversification is widespread and is found in all locations, as well as across farm sizes and across ranges of income and wealth. It is enduring in the sense that it is not just a transient phenomenon, caused by lags in the otherwise smooth adjustment of resource use between equilibrium states, so that it will quickly disappear with further economic growth and changes [8].

2.1. Determinants of Diversification

Decisions made by rural households concerning the form and extent of their diversification of activities generally depend on two main factors: the incentive offered and the household's capacity to undertake such an activity.

2.2. Incentives to Diversify

The literature has long emphasized the relative importance of "pull" and "push" factors as incentives for farm households to turn to non-farm employment. Pull factors that would attract households to non-farm employment include: (i) higher income generated in non-farm wage and self-employments; (ii) potentially lower risks; and (iii) greater social status attributed to non-farm activities [5].

The push factors related to incentives are more complex. Households are "pushed to diversify their activities by factors which can be "idiosyncratic" (related to a single household or group of households) or "common" to all households in a zone or region [18]. The common push factors include market failures in credit, factor and output markets. Therefore, the goal of livelihood diversity likely varies among households, and can be as straight forward as raising income, or it might involve risk minimization and income stabilization or other goals [16].

2.3. Capacity to Diversify

Capacities refers to assets obtained at individual, household, and the community or regional levels, which are vectors of capital including human, physical, social, natural and financial capital (their quality and quantity) [12]. These capacities will place households in relatively better positions to respond to incentives. The capital can be public or private goods, and can be at the *meso* or regional level and thus generalized over an area of households, or "idiosyncratic" thus related to a household or a group of households [18]; [4] and [9]. Even if the incentives to diversify are high, whether the household will react to these incentives depends on its capacity to do so [10]. A household may have the incentive to participate in non-farm employment, say because of higher wage rates offered, but if the capacities are not in place (such as skills to qualify for the job), then even though the incentives are in place, the household will not be able to take advantage of them.

3. Study Area and Data Source

Eritrea is one of the poorest countries in Sub-Saharan Africa (SSA) where about 70% of its population is engaged in rural and agricultural-based economic activities. It has one of the lowest per capita incomes in the world and high incidence of absolute poverty [11]. The overall poverty estimate for the country is 66 percent, with 37 percent living in extreme poverty that is below the food poverty line [22]. Poverty is generally concentrated in rural areas with about 67% of the country's poor living in rural areas [2].

Rural area is not only the place where most of the poor lives, but also the place where livelihoods is no longer considered as being a synonym for farming activities. Instead, it has been acknowledged that people in rural Eritrea pursue multiple strategies to make a living and earn income from various sources, which is reflected in the combination of crops farmers grow as well as the diversification of their activities in non-farm activities.¹ A good understanding of the determinants of income derived from these diversified sources is essential for the design of policies to further promote diversification of activities and income and promoting rural development and alleviating rural poverty. For these reasons, the paper aimed to undertake a quantitative assessment of factors affecting total household income and income earned from various income sources using data which was collected from randomly selected 202 households in four villages of Zoba Maekel² in 2007. A standardized questionnaire was administered on the households³.

The dependent variables of the study measure both total household income and activity income. The dependent variables on activity income are categorized as income earned from agricultural self-employments (crop production and livestock production), agricultural wage-employment, non-agricultural wage-employment, any kind of wage-employment (total of agricultural wage-employment and non-agricultural wage-employment), non-agricultural self-employment and off-farm activities (both wage and self-employments). All these variables measure yearly income earned in terms of Nakfa (henceforth NKF)⁴ by a given household participating in an activity. In order to identify the underlying factors determining total household's income and activities incomes, two econometric models have been applied depending on the nature of the dependent variables. In both models a common set of explanatory variables have been used to enable comparisons of the influence of the variables across models, in addition to some variables which are included to avoid misspecification.

1 For factors that determine participation of households in various income generating activities, refer (Teame, 2015).

2 Eritrea is composed of six Administrative regions known as "Zobas", and Zoba Maekel refers to Central Region, where the capital city of Asmara is also to be found.

3 For details on the sampling design of the study refer to (Teame, 2015)

4 Nakfa (NKF) is name given to the local currency of Eritrea (1\$=15.75 NKF)

4. Research Findings

4.1. Income by Source

The selected households in the research area have earned a total income of around 2,584,906.75 NKF for the year with agricultural activities as the most important contributor. Their incomes can be divided broadly by activity sources into farm incomes, off-farm labor income and non-labor (unearned) incomes. From this total households income, farm incomes accounts for 44.90% with crop productions and livestock contributing 34.76% and 10.14% respectively. Off-farm labor incomes account for 32.17% which can be divided into wage-employment incomes accounting 21.08% and self-employment incomes contributing 11.09%. Non-labor incomes which includes remittances, martyrs survivors' benefit, pension, and gifts and inheritance from relatives accounts for 22.95% of the total incomes. This confirms with the findings of [17] and [10] reporting that about 30% to 40% of rural incomes in developing countries stem from off-farm activities.

4.2. Total Household Income

To determine the influence of internal factors (physical, human and social capital) and external factors (institutions, financial markets, agricultural input and output markets, prices and wages and infrastructure) on total household's income, which is a continuous variable, a standard Ordinary Least Square (OLS) model is followed. Similar models on total household's income have been widely used in the literature, for example in [4] and [6]. The OLS specification model for total income is:

$$\ln y_i = \beta_0 + \beta_1 x_i + u_i$$

Where Y_i denotes the total household's income, X_i is a vector of exogenous explanatory variables influencing income, β_0 is the constant and β_1 is the vector of coefficients which will be estimated and U_i is the unobservable random disturbance or error term.

Usually cross-sectional data are plagued with the problem of heteroscedasticity which was confirmed in our data using White's general heteroscedasticity Test. There is also an evidence of multicollinearity for two variables using VIF and TOL. Similarly Breusch-Godfrey Serial Correlation LM Test was utilized and confirmed the existence of autocorrelation. Therefore, HAC Consistent Covariances (Newey-West) was used to account for heteroscedasticity and autocorrelation which is able to produce valid standard errors, t-statistics and F-statistics. To correct the problem of multicollinearity, the principles of 'do-nothing school of thought' was followed, because dropping explanatory variables may lead to problems of model specification.

Since all households obtain an income, the total household income equation is estimated by OLS method (Table 1). The estimated coefficients represent percentage change in the dependent variable for a unit change in the explanatory variable, holding the effect of other variables constant.

Table 1. Ordinary Least Square (OLS) Regression result for total income

| Variable | Coeffi. | Std. Error | t-Statistic | Prob. |
|----------------------------------|-----------|-----------------------|-------------|--------|
| Constant | 7.800516 | 0.480503 | 16.23407* | 0.0000 |
| Sex of HoH (1= male headed) | 0.202132 | 0.066317 | 3.047973* | 0.0026 |
| Age of HoH | 0.016131 | 0.018090 | 0.891683 | 0.3737 |
| Age of HoH ² | -0.000113 | 0.000165 | -0.680949 | 0.4968 |
| Year of Schooling of HoH | 0.003418 | 0.007920 | 0.431552 | 0.6666 |
| Average education | 0.005082 | 0.017012 | 0.298766 | 0.7655 |
| Number of dependents | -0.017410 | 0.019851 | -0.877056 | 0.3816 |
| Adult members (≥15 & ≤65 of age) | 0.021969 | 0.026742 | 0.821496 | 0.4124 |
| Dependency Ratio | -0.006720 | 0.024148 | -0.278285 | 0.7811 |
| Distance to market | -0.000970 | 0.000683 | -1.419717 | 0.1574 |
| Rain-fed area | 0.086338 | 0.020206 | 4.272921* | 0.0000 |
| Irrigated area | 0.153619 | 0.088865 | 1.728680** | 0.0856 |
| Livestock units owned | 0.073400 | 0.018975 | 3.868159* | 0.0002 |
| Social capital index | 0.001020 | 0.000364 | 2.804768* | 0.0056 |
| Off-farm income | 3.01E-05 | 7.35E-06 | 4.093912* | 0.0001 |
| Unearned income | 6.10E-05 | 6.90E-06 | 8.838894* | 0.0000 |
| Access to formal Credit | -0.013090 | 0.066207 | -0.197720 | 0.8435 |
| R ² | 0.668033 | Mean dependent var | | 9.2791 |
| Adjusted R ² | 0.639008 | S.D. dependent var | | 0.5809 |
| S.E. of regression | 0.349026 | Akaike info criterion | | 0.8138 |
| Sum squared resid | 22.29290 | Schwarz criterion | | 1.0941 |
| Log likelihood | -64.38278 | F-statistic | | 23.016 |
| Durbin-Watson stat | 1.811040 | Prob(F-statistic) | | 0.0000 |

Note: *, ** indicate statistical significance at 1% and 10% levels, respectively

The physical capital endowment turned out to be an important determinant of total household income. An additional *tsmdi*⁵ of rain-fed land owned, an additional *tsmdi* of irrigated area owned and a marginal livestock unit raises total household income by 8.63%, 15.63% and 7.34% respectively which are statistically significant.

Turning to household characteristics, eight different empirical proxies that can measure the influence of human capital have been used. These are: gender of head household (probability of being male headed household), age of head of household, age of head of household squared, year of schooling of head of household, average education of household members, dependency ratio (number of dependents to working members), number of dependents, and adult members (≥15 & ≤65 years of age). The gender of head of household has statistically significant positive influence. This means that the expected total income for male headed households is 20.21% higher than that of female headed households.

Social capital index has positive and significant effect on total household income. A unit increase in the index increases household income by 0.10%. Finally, the effect of off-farm income and unearned income in total household income shows positive and statistically significant effect. This implies that

off-farm income and unearned income have important shares in total household income.

Finally, the overall fit of the model is satisfactory in terms of R² (0.668033) is quite reasonable compared to models on total household income in the literature from surveys conducted in some Latin American and African countries for nearly the same set of explanatory variables. Applying F-test which is used to test the significance of R², which is also the same as testing the overall significance of the regression model, the null hypothesis of no linear relationship between the dependent variable and the regressors is rejected. This implies the regressors jointly affect total household income.

4.3. Income by Activity

Seven different activities as sources of income were identified: crop production, livestock production, agricultural wage labor, non-agricultural wage labor, any kind of wage-employment (agricultural and nonagricultural wage employment), non-agricultural self-employment, both self and wage-employment (off-farm). A main feature to all these activities is that many households do not participate in them. Within the random sample of households, some decide to participate in an activity, while others do not. If they have chosen to participate in an activity, the income from it can be measured. With many zero values for the dependent variable, using ordinary least square (OLS) method to estimate would lead to biased and inconsistent results, instead *Tobit model* was chosen and estimated for each of the seven sources of income models. The *Tobit model* assumes that the two states of the decision making process (for example, the decision to work in non-agricultural wage activities and the decision to receive non-agricultural wage income occur simultaneously [1]. The same stochastic process affects both the participation decision and income generated. The same techniques were also used in the analysis of income activities, as for example in [6] and [1].

According to [13] and [14], the stochastic model underlying *Tobit* may be expressed by the following relationship:

$$y_i = \beta_i x_i + u_i \quad \text{if } \beta_i x_i + u_i > 0$$

$$= 0 \quad \text{if } \beta_i x_i + u_i \leq 0 \quad i=1,2,\dots,N.$$

Where N is the number of observations, y_i is the dependent variable, x_i is a vector of independent variables, β_i is a vector of unknown coefficients, and u_i is an independently distributed error term assumed to be normal with zero mean and constant variance σ^2 . Thus the model assumes that there is an underlying, stochastic index equal to $(\beta_i X_i + U_i)$, which is observed only when it is positive, and hence qualifies as an unobserved, latent variable [15].

It should be noted that the effect of a change in independent variables (x_j) is not equal to the estimated coefficient. Using [15] decomposition of the estimated coefficients of a *Tobit* model, two effects can be identified: (i) changes in the probability of being above the limit (the effect of an independent variable on the probability of having income for the non-participating households (the censored observations)) and (ii) changes in the value of the dependent variable

5 *Tsimdi* is a local measure for agricultural land area and refers to what a couple of oxen could ideally plough in a day. Approximately 4 *tsimdis*= 1 hectare

(marginal effect) conditional on being above the limit.

The *Tobit* regression results are indicated in Appendix A1, where the coefficients with a significance level greater than 90% are shown in bold. The fit of the models, measured by R^2 , range from 10.82% to 71.01%. The percentage of correctly predicted observations is on average 86.83%. This value ranges from 81.50% correctly predicted observations in the non-agricultural wage-employment model to 92.50% in the model of non-agricultural self-employment. However, the coefficients in Appendix A1 show the relationship between income from an activity and independent variables, and they cannot be interpreted as marginal effects of change of explanatory variables. The marginal effects of one-unit changes in the corresponding explanatory variables on activity incomes are given in Appendix A2.

In rural Zoba Maekel rain-fed land ownership is positively and statistically related to the receipts of two types of income: agricultural (crop production) and non-agricultural self-employment. An additional *tsemi* of rain-fed land increases income from crop production by NKF 631.66 and income from non-agricultural self-employment by NKF 524.35. The area of irrigated land owned has the same effect on income from crop production, with a marginal unit of irrigated land increases crop production income by 3,110.52 NKF and it is statistically significant.

The possession of livestock positively influences income gained from agricultural self-employment: livestock production and crop production. Both relationships are statistically significant. With marginal increase in livestock units owned increase income from livestock production by NKF 331.14 and income from crop production by NKF 579.99. In contrast, possession of livestock has significantly negative influence on income from any kind of wage-employment and non-agricultural wage-employment.

Gender of head of household (the probability of being male headed household) has positive and significant effect on incomes generated from any kind of wage-employment and non-agricultural wage-employment. Male headed households on average earn 952.23 NKF and 1,407.69 NKF higher incomes from any kind of wage-employment and non-agricultural wage-employment respectively than female headed households. The lower expected earnings for women headed households could be the result of combination of factors: (i) the lower probability of becoming involved in the activities; (ii) shorter employment spells; and (iii) possibly lower returns for a given job. The probability of being male headed household negatively affects income gained from non-agricultural self-employment, and female headed households gain NKF 3,126.10 higher than their male headed counterparts.

Age of head of household positively influences income generated from all the activities except income from crop production. But only the effects on income from any kind of wage-employment, agricultural wage-employment and non-agricultural wage-employment are significant statistically. The life cycle effect measured by age of head of household squared, as expected, has statistically negative influence on

income gained from any kind of wage-employment, agricultural wage-employment and non-agricultural wage-employment which shows as age of head of household increases income from these activities increases until some point, but as the head of household becomes older and older the income generated from these activities decrease (an inverted U shaped relationship) which results from lower participation in these activities.

Any additional number of dependent in a household contributes significantly to an increased level of income from non-agricultural self-employment and both wage and self-employment (off-farm), with a unit increase in the number of dependents in a household increasing income by NKF 565.84 and NKF 690.40, respectively. Higher number of dependents in a household put higher pressure to earn more to feed its members and cover its basic needs. To do this, household members will have to engage in every possible productive and income earning activities. Thus, number of adult members (≥ 15 & ≤ 65 years of age), has significant effect on income from non-agricultural self-employment and crop production. The marginal effects of a unit increase in adult members of a household are NKF 520.16 for non-agricultural self-employment and NKF 370.00 for crop production.

Average education of household members has a significant effect on income earned from agricultural wage-employment with a marginal effect of NKF 102.92. Moreover, year of schooling of HOH has a significant positive effect on income from both wage and self-employment (off-farm) and negative effect on income from livestock production, with their respective marginal effects of NKF 196.36 and NKF 56.04. In addition to this, the social capital has a positive and significant influence on the incomes gained from livestock production.

Participation in formal credit markets has a positive and statistically significant effect on income from non-agricultural self-employment, and both wage and self-employment (off-farm). Incomes earned from these activities are higher by NKF 1,714.37 (for non-agricultural self-employment) and NKF 2,100.80 (for wage and self-employment (off-farm)) for the participants of formal credit than the non-participants. The relationship between participation in formal credit and incomes from the above two activities might be explained by the fact that access to credit increases participation in the activities by solving liquidity problems, which leads to increase in income from the activities.

Distance to the nearest tarmac road which can be considered as a proxy measure for distance to the market was found to have statistically significant and negative influence on income from any kind of wage-employment and non-agricultural wage-employment. The reason might be, many of the wage-employments are migratory, and as distance to the market increases their participation and incomes from these activities decrease. With every hour of increased distance to the market, income from any kind of wage-employment and non-agricultural wage employment decreases by NKF 29.63 and NKF 40.45 respectively.

Risk measured by number of crop failures in the last five years leads to an increase in income from any kind of

wage-employment, agricultural wage-employment and non-agricultural wage-employment, while its effect on income earned from non-agricultural self-employment was found to be negative and significant. The reason for this relationship could be that agricultural income and participation in non-agricultural self-employment are complementary. Therefore, a higher risk reduces agricultural income which also decreases non-agricultural self-employment income. A unit increase in risk increases income from any kind of wage-employment by NKF 831.02, agricultural wage-employment by NKF 168.59, non-agricultural wage-employment by NKF 696.33, and decreases income from non-agricultural self-employment by NKF 548.37.

And finally the effect the locational variables, dummies for the villages, show that the income earned from non-agricultural self-employment in *Hazega* is lower by NKF 3,919.43 from those who live in *Shimangus Laelay* (the benchmark category). Similarly, living in *Zigib* increases income earned from non-agricultural self-employment and both wage and self-employment (off-farm) activities by NKF 12,210.72 and NKF 12,709.69 respectively, but decreases income earned from agricultural self-employment (crop production) by NKF 887.79 compared to the benchmark category. Finally, the probability of being *Adi-Tsenaf* resident increases income earned from non-agricultural self-employment and from both wage and self-employment (off-farm) activities by NKF 10,822.36 and NKF 14594.84 respectively compared to the benchmark category. All these effects account for the existence of certain regional factors that are not controlled for in the regression models.

5. Conclusions and Recommendations

It can be generally concluded that rural households with better access to assets and who reside in areas with better access to rural infrastructure tend to diversify their income sources and earn more income. Based on the results of the study, some policy recommendations may be drawn with respect to activity diversification and rural development which can be helpful in rural poverty reduction by addressing the underlying factors that hinders households' participation in non-farm activities.

1. Due to shortages of rainfall and its subsequent crop failures coupled with growth in population, it is becoming very difficult to increase regional employment in agriculture. Therefore, to reduce the pressure on land, opportunities to participate and earn income from rural non-farm activities should be expanded.
2. Diversification of income can be achieved to a greater extent through the promotion of off-farm activities. Increasing the availability of off-farm activities and improving the wage rates can increase farmers'

involvement in off-farm activities. Therefore, policies aimed at the rural sector must be oriented toward providing incentives that stimulate households' participation in rural non-farm jobs such as roads, electricity, information and market institutions that enable them to access dynamic markets, as well as improving the capacity of households so as to respond to such incentives.

3. The study reported that participation in formal credit increases income from non-agricultural self-employment and both wage and self-employment (off-farm) by enabling households to change their stock of physical capital within a short time and take advantage of income opportunities outside agriculture. Therefore, it is recommended that policy measures should focus on improving the available rural credit facilities in terms of their distribution and ease the burden (like interest rate and loan repayment time) of households so that they can participate in formal credit schemes. Furthermore, training and advice on business extension, especially targeted towards the non-agricultural self-employment activities should be given to rural households.
4. At the policy level, major attention should be given to improving rural access to education and the establishment of training centers to tackle skill barriers required for diversification of activities. To this end, establishment of mini vocational training centers directed towards the rural inhabitants is recommended.
5. Women headed households participate, to a considerable extent in non-agricultural self-employment activities. However, it appears that they are poorly placed vis-à-vis the income they gain from non-agricultural wage-employment and any kind of wage-employment compared to their male headed counterparts. Similarly, as the heads of households get older the income they earn from all activities decreases. This applies to both poor male and female headed households. So rural poverty reduction-focused, rural non-farm promotion policies need to focus on activities, which are accessible to women headed households and the aged.

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Appendix

Appendix A1. Tobit estimations of activities income equations.

| Variables | Any kind of Wage-employment | | Agricultural wage Employment | | Non-agricultural wage Employment | |
|---------------------|-----------------------------|--------|------------------------------|--------|----------------------------------|--------|
| | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| Constant | -25025.94 | -3.83 | -20343.25 | -3.57 | -26588.67 | -3.0 |
| Rain-fed area owned | 33.87 | 0.11 | -346.923 | -1.54 | 202.38 | 0.49 |

| Variables | Any kind of Wage-employment | | Agricultural wage Employment | | Non-agricultural wage Employment | |
|-------------------------------------|-----------------------------|---------|------------------------------|---------|----------------------------------|--------|
| | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| Irrigated area owned | 571.039 | 0.30 | 416.612 | 0.31 | 323.675 | 0.12 |
| Possession of Livestock | -516.14 | -1.69* | 101.177 | 0.49 | -700.84 | -1.65* |
| Sex of head of HoH | 2509.403 | 2.46** | -600.08 | -0.84 | 5052.066 | 3.39** |
| Age of HoH | 650.174 | 2.62** | 657.047 | 2.91** | 621.125 | 1.87* |
| Age of HoH 2 | -5.65 | -2.48** | -6.914 | -3.10** | -4.964 | -1.66* |
| Average education of HH members | 534.281 | 1.62 | 517.2113 | 2.38** | 221.8297 | 0.49 |
| Year of schooling HoH | 6.042 | 0.04 | -147.4289 | -1.47 | 154.2234 | 0.76 |
| Adult members | 12.34 | 0.03 | -237.7436 | -0.86 | 379.8593 | 0.63 |
| Number of Dependents | 38.851 | 0.09 | 327.5201 | 1.09 | -488.351 | -0.82 |
| Dependency Ratio | 334.432 | 0.39 | 197.3764 | 0.32 | 73.07 | 0.19 |
| Risk | 2063.572 | 5.87** | 847.229 | 3.51** | 2282.719 | 4.63** |
| Distance to the nearest tarmac road | -73.584 | -1.69* | 4.0808 | 0.15 | -132.6086 | -1.90* |
| Social capital index | -2.555 | -0.42 | 2.3369 | 0.60 | -11.016 | -1.28 |
| Access to formal credit | 9.12.873 | 0.94 | -435.4667 | -0.69 | 1515.384 | 1.13 |
| Access to Electricity | | | | | | |
| Dummy for the village (Hazega) | 4623.396 | 1.04 | -596.088 | -0.22 | 8614.861 | 1.22 |
| Dummy for the village (Zigib) | 391.246 | 0.27 | -527.6359 | -0.52 | 214.3513 | 0.11 |
| Dummy for the village (Adi-Tsenaf) | 3521.759 | 1.04 | 1314.903 | 0.63 | 4753.206 | 0.9 |
| R ² | 0.20032 | | 0.108254 | | 0.22465 | |
| Log likelihood | -1282.8 | | -614.95 | | -903.2891 | |
| LR chi ² (18) | 83 | | 61.88 | | 72.56 | |
| % of correctly predicted | 83 | | 91 | | 81.5 | |
| Left censored obs. | 74 | | 138 | | 117 | |
| Uncensored obs. | 126 | | 62 | | 83 | |

Appendix A1. Continued.

| Variables | Non-agricultural self Employment | | Both wage and Self-employment (Off-farm) | | Agricultural self-employment (livestock production) | | Agricultural self-employment (Crop production) | |
|-------------------------------------|----------------------------------|---------|--|--------|---|--------|--|--------|
| | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| Constant | -88731.66 | -3.05 | -51875.0 | -4.0 | -3323.011 | -1.08 | -265.102 | -0.11 |
| Rain-fed area owned | 3026.09 | 2.69** | 240.25 | 0.41 | 146.5665 | 1.00 | 696.7396 | 5.51** |
| Irrigated area owned | -6244.525 | -0.86 | -3593.77 | -0.94 | -265.4352 | -0.33 | 3430.987 | 5.00** |
| Possession of Livestock | -1887.45 | -1.55 | -437.03 | -0.73 | 779.2706 | 5.56** | 639.74 | 5.38* |
| Sex of head of HoH | -15341.23 | -3.38** | -3096.32 | -1.59 | -301.8702 | -0.64 | 430.9313 | 1.10 |
| Age of HoH | 301.689 | 0.27 | 568.11 | 1.19 | 94.17274 | 0.80 | -87.0696 | -0.92 |
| Age of HoH 2 | -3.07462 | -0.30 | -4.32 | -0.99 | -0.965758 | -0.90 | 0.84135 | 0.97 |
| Average education of HH members | 1322.531 | 1.05 | 671.82 | 1.07 | -18.09622 | -0.12 | 188.576 | 1.44 |
| Year of schooling HoH | 365.4011 | 0.67 | 494.23 | 1.07* | -131.8717 | -1.81* | -72.5116 | -1.19 |
| Adult members | 3001.889 | 1.75* | 1252.88 | 1.48 | -94.03457 | -0.45 | 338.6311 | 1.93** |
| Number of Dependents | 3265.511 | 2.14** | 802.845 | 2.16** | 109.2948 | 0.56 | 136.6057 | 0.82 |
| Dependency Ratio | 3726.086 | 1.19 | 697.25 | 0.43 | -210.3599 | -0.52 | -89.8057 | -0.27 |
| Risk | -3164.695 | -2.80** | 927.33 | 1.49 | -81.312 | -0.54 | -17.70156 | -0.14 |
| Distance to the nearest tarmac road | 195.1559 | 1.29 | -45.53 | -0.54 | 29.34938 | 1.43 | 17.3843 | 0.97 |
| Social capital index | 13.15025 | 0.60 | 1737.69 | 0.21 | 7.681043 | 2.74** | 2.95702 | 1.23 |
| Access to formal credit | 8664.277 | 2.39** | 4794.64 | 2.53** | -584.0204 | -1.16 | -292.041 | -0.71 |
| Access to Electricity | 53378.64 | 6.25** | 23516.02 | 5.05** | | | | |
| Dummy for the village (Hazega) | -28823.62 | -1.81* | 1938.77 | 0.22 | -2730.929 | -1.29 | -2684.429 | -1.45 |
| Dummy for the village (Zigib) | 40360.05 | 4.71* | 22997.84 | 4.61** | 299.7346 | 0.45 | -1001.85 | -1.78* |
| Dummy for the village (Adi-Tsenaf) | 36505.74 | 2.70** | 25072.03 | 3.15** | -2242.266 | -1.40 | 682.1945 | 0.49 |
| R ² | 0.710108 | | 0.36892 | | 0.48316 | | 0.635848 | |
| Log likelihood | -526.5399 | | -1542.05 | | -1293.38 | | -1795.11 | |
| LR chi ² (18) | 84.45 | | 85.26 | | 84.32 | | 201.28 | |
| % of correctly predicted | 92.5 | | 90.5 | | 87.48 | | 82.5 | |
| Left censored obs. | 155 | | 57 | | 63 | | 2 | |
| Uncensored obs. | 45 | | 143 | | 137 | | 198 | |

Note:**,* indicate statistical significance at 5% an 10% respectively

Appendix A2. Changes in the value of the dependent variables (marginal effects) conditional on being above the limit after Tobit estimation $Y_i^ = E(Y_i | Y_i > 0)$*

| Variables | Any kind of Wage-employment | | Agricultural wage Employment | | Non-agricultural wage Employment | |
|-------------------------------------|-----------------------------|-------|------------------------------|-------|----------------------------------|-------|
| | slope | z | slope | Z | Slope | z |
| Rain-fed area owned | 13.64 | 0.11 | -69.03 | -1.57 | 61.74 | 0.49 |
| Irrigated area owned | 229.96 | 0.30 | 82.90 | 0.31 | 98.74 | 0.12 |
| Possession of Livestock | -207.85 | -1.69 | 20.13 | 0.49 | -213.79 | -1.65 |
| Sex of head of HoH | 952.23 | 2.60 | -122.95 | -0.81 | 1407.69 | 1.87 |
| Age of HoH | 261.83 | 2.63 | 130.75 | 3.25 | 189.44 | 3.75 |
| Age of HoH 2 | -2.28 | -2.49 | -1.38 | -3.52 | -1.51 | -1.66 |
| Year of schooling HoH | 2.43 | 0.04 | -29.34 | -1.48 | 47.04 | 0.76 |
| Average education of HH members | 215.16 | 1.62 | 102.92 | 2.43 | 67.67 | 0.48 |
| Adult members | 4.97 | 0.03 | -54.47 | -0.85 | 115.87 | 0.63 |
| Number of Dependents | 15.65 | 0.09 | 65.17 | 1.08 | -148.97 | -0.82 |
| Dependency Ratio | 134.68 | 0.39 | 39.28 | 0.33 | 73.07 | 0.19 |
| Risk | 831.02 | 6.17 | 168.59 | 3.73 | 696.33 | 4.91 |
| Distance to the nearest tarmac road | -29.63 | -1.70 | 0.81 | 0.15 | -40.45 | -1.92 |
| Social capital index | -1.03 | -0.42 | 0.47 | 0.60 | -3.36 | -1.29 |
| Access to formal credit | 381.36 | 0.91 | -83.91 | -0.71 | 485.78 | 1.08 |
| Access to Electricity | | | | | | |
| Dummy for the village (Hazega) | 2168.25 | 0.90 | -114.57 | -0.23 | 3352.63 | 0.98 |
| Dummy for the village (Zigib) | 159.31 | 0.27 | -102.19 | -0.54 | 65.71 | 0.11 |
| Dummy for the village (Adi-Tsenaf) | 1588.73 | 0.93 | 284.10 | 0.58 | 1647.35 | 0.80 |

Appendix A2. Continued.

| Variables | Non-agricultural self Employment | | Both wage and Self-employment (Off-farm) | | Agricultural self-employment (livestock production) | | Agricultural self-employment (Crop production) | |
|-------------------------------------|----------------------------------|-------|--|-------|---|-------|--|-------|
| | Slope | z | slope | z | Slope | z | slope | z |
| Rain-fed area owned | 524.35 | 2.77 | 95.45 | 0.41 | 62.28 | 1.00 | 631.66 | 5.48 |
| Irrigated area owned | -1082.03 | -0.86 | -1427.84 | -0.94 | -112.79 | -0.33 | 3110.52 | 4.96 |
| Possession of Livestock | -327.05 | -1.57 | -173.64 | -0.73 | 331.14 | 5.56 | 579.99 | 5.34 |
| Sex of head of HoH | -3126.10 | -3.38 | -1280.29 | -1.53 | -130.27 | -0.63 | 387.58 | 1.11 |
| Age of HoH | 52.28 | 0.27 | 225.72 | 1.20 | 40.02 | 0.80 | -78.94 | -0.92 |
| Age of HoH 2 | -0.53 | -0.30 | -1.71 | -0.99 | -0.41 | -0.90 | 0.76 | 0.97 |
| Year of schooling HoH | 63.32 | 0.66 | 196.36 | 1.70 | -56.04 | -1.81 | -65.74 | -1.19 |
| Average education of HH members | 229.16 | 1.05 | 266.92 | 1.07 | -7.69 | -0.12 | 170.96 | 1.44 |
| Adult members | 520.16 | 1.77 | 497.78 | 1.48 | -39.96 | -0.45 | 307.00 | 1.92 |
| Number of Dependents | 565.84 | 2.13 | 690.40 | 2.16 | 46.44 | 0.56 | 123.85 | 0.82 |
| Dependency Ratio | 645.64 | 1.20 | 277.03 | 0.43 | -89.39 | -0.52 | -81.42 | -0.27 |
| Risk | -548.37 | -2.81 | 368.44 | 1.51 | -34.55 | -0.54 | -16.05 | -0.14 |
| Distance to the nearest tarmac road | 33.82 | 1.29 | -18.09 | -0.54 | 12.47 | 1.42 | 15.76 | 0.97 |
| Social capital index | 2.28 | 0.60 | -0.98 | -0.21 | 3.26 | 2.72 | 2.68 | 1.22 |
| Access to formal credit | 1714.37 | 2.12 | 2100.80 | 2.30 | -236.83 | -1.22 | -262.54 | -0.72 |
| Access to Electricity | 12196.48 | 4.48 | 10071.46 | 4.44 | | | | |
| Dummy for the village (Hazega) | -3919.43 | -2.18 | 794.87 | 0.22 | -988.06 | -1.51 | -2233.45 | -1.63 |
| Dummy for the village (Zigib) | 12210.72 | 2.86 | 12709.69 | 3.56 | 129.57 | 0.44 | -887.79 | -1.83 |
| Dummy for the village (Adi-Tsenaf) | 10822.36 | 1.67 | 14594.84 | 2.44 | -835.16 | -1.59 | 626.54 | 0.49 |

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