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PHILOSOPHIAE DOCTOR (PhD) THESIS 2010:20

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RURAL NONFARM EMPLOYMENT IN ETHIOPIA: PARTICIPATION, IMPACTS AND DYNAMICS

RURAL SYSSELSETTING UTENFOR LANDBRUK I ETIOPIA: DELTAKELSE,
EFFECT OG DYNAMIKK

SOSINA BEZU

Rural nonfarm employment in Ethiopia: Participation, impacts and dynamics

Rural sysselsetting utenfor landbruk i Etiopia: Deltakelse, effekt
og dynamikk

Philosophiae Doctor (PhD) Thesis

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Department of Economics and Resource Management
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Dedication

To my father Bezu Chiksa

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Sosina Bezu

Ås, April 2010

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INTRODUCTION

1. Poverty and the rural economy

First in the list of the Millennium Development Goals is eradication of extreme poverty and hunger in the world. Since 75% of the world's poor live in rural areas (WB, 2003), the success of this goal hinges on the performance of the rural economies.

Rural households in developing countries typically engage in a multiple of activities, both agricultural and non-agricultural. The poor are not the only ones that diversify into nonfarm employment. In fact, increased diversification is often associated with higher total income and wealth (Reardon, 1997, Reardon et al., 2001). However, until recently, the pluriactivity of rural households has not been given much attention. Traditionally the rural economy was considered as purely agricultural. Hence policy makers both at national and international levels equate improving the rural economy with promoting and supporting agriculture. But now, with an increase in the wealth of research showing significant nonfarm income in the range of 35%-50% across developing regions¹, more attention is being paid to the alternative sources of rural livelihoods. For example World Bank's revised rural development strategy recognizes the importance of nonfarm activities to rural households and seeks its promotion as a key feature of broad-based economic growth (WB, 2003).

Although recent years have seen an increase in the number of studies dealing with rural nonfarm economy, there are still several issues that are not well researched. Particularly, studies examining the dynamic issues such as the impact of participation in nonfarm activities on income growth and the evolution of nonfarm employment as a response to changing capacity, opportunities and challenges.

This thesis tries to contribute to our knowledge of the nonfarm economy and its impact on household welfare. The thesis consists of four papers that examine the factors that explain observed choice in nonfarm activities, the impact of participation on agricultural investment, the

¹ See Reardon (1997), Ellis (1998), Lanjouw and Lanjouw (2001) for review and several of the papers published in 2001 in the Food Policy journal - 26(4), Agricultural Economics journal-35 and World Development journal – 29(3)

long-term impact on income dynamics and the changes in households' nonfarm employment decision as a response to shocks experience.

This introductory chapter summarizes the four papers and connects them with the broader theoretical and empirical discussion on rural poverty. Section 2 discusses the theoretical and empirical literature on the rural nonfarm economy in developing countries and its place in economic development. In Section 3, I present a theoretical model for activity choice and a conceptual framework that connects opportunities, capacities, challenges, decisions and welfare outcome. Section 4 discusses methodological issues. In Section 5 and Section 6, I discuss the data and summarize the findings of the thesis respectively. In Section 7, I conclude by discussing policy issues highlighted by the thesis.

2. The rural nonfarm economy in the literature

2.1 The nonfarm economy in the rural development debate

The rural development thinking has passed through several shifts, from the dual economy view of the modernization paradigm to that of the agriculture-led growth paradigm (Ellis and Biggs, 2001). In the dual economy view, the contribution of the agricultural sector to growth is to transfer resources, particularly labor, to the manufacturing sector (Lewis, 1954, Fei and Ranis, 1964) while the agriculture-led growth paradigm sees agriculture playing an active role in driving growth through production and consumption linkages (Johnston and Kilby, 1975, Mellor and Johnston, 1984). In the different versions of the debates in these two major paradigms the central point of discussion was the role of agriculture in rural development. The nonfarm economy came into the discussion in reference to its relation with agriculture. Those who argue that agriculture can be an engine of growth saw nonfarm employment enhancing the productivity and income of agriculture through production and consumption linkages (Mellor and Lele, 1973). On the other hand, Hymer and Resnick (1969) argue that since nonfarm activities in rural areas produce inferior goods and services they will eventually die out with agricultural development as the goods produced by the rural nonfarm sector give ways to goods produced in the manufacturing sector. Ranis and Stewart (1993) challenge the assumption of inferior goods production and the consequent pessimistic prediction. They argue that the nonfarm sector can itself be disaggregated into the modern and the traditional with the modern sector having the potential to grow and play a more positive role.

With the sustainable livelihood approach, the nonfarm economy appear more explicitly and frequently into rural development thinking. The livelihood approach recognizes and emphasizes the diversified nature of rural households' assets and livelihood strategies² (Ellis, 2000, Bryceson and Jamal, 1997, Bryceson, 2002a). Because nonfarm activities have become an important component of rural households' livelihood, much of this literature focuses on diversification into rural nonfarm activity (Haggblade, 2007). Diversification is explained by the 'push factors' such as limited risk-bearing capacity, constraints in labor and land markets and climatic uncertainty or the 'pull factors' such as presence of local engines of growth including commercial agriculture or proximity to an urban area (Barrett et al., 2001).

2.2 Empirical literature

Empirical evidences that document nonfarm activities in rural areas have surfaced much earlier than the theoretical and policy recognition of the nonfarm economy. The data collected to investigate the surplus labor assumption of the dual economy model in the 1970s showed large size of nonfarm labor use in developing countries triggering interest in small-scale and rural nonfarm business activities (Haggblade, 2007). The studies on micro and small scale industries and the more recent literature³ on income diversification give some insight into the rural nonfarm economy in developing countries. Below, I briefly discuss the main findings in the literature.

Size of rural nonfarm economy

Nonfarm activities account for 30 percent of full-time rural employment in Asia and Latin America, 20% in West Asia and North Africa and 10% in Africa (Haggblade et al., 2007). These figures are from national censuses and typically include only primary occupation. The real extent of nonfarm participation is likely to be higher than what the national statistics suggest since many farmers engage in nonfarm activities as part-time employment or during agricultural slack seasons (Anderson and Leiserson, 1980). A recent multi-country study that uses data from 15 countries found nonfarm participation rate, including both primary and secondary employment, in the range of 67-94% (Winters et al., 2009).

² See Ellis(1998) for review of articles on livelihood diversification

³ See Reardon (1997), Ellis (1998), Lanjouw and Lanjouw (2001) for review and several of the papers published in 2001 in the Food Policy journal - 26(4), Agricultural Economics journal-35 and World Development journal – 29(3)

The share of income that rural households obtain from nonfarm economy may thus give a better indication of the importance of nonfarm activities to rural households. On average, the share of nonfarm income in household total income is reported to be around 50% in Asia and Latin America and 35% in Africa (Reardon et al., 2007). There are of course variations within each region. In Africa for example the share ranges from 6% in Southern Mali to 93% in the unfavorable zones of Namibia (Reardon et al., 2007). The share of nonfarm income increases with increasing levels of GDP per capita (Davis et al., 2010). Moreover, income from nonfarm activities has been increasing in importance over time in many countries (Bryceson, 2002b, Lanjouw and Lanjouw, 2001, Reardon et al., 2001).

Composition

The composition of rural nonfarm employment for developing countries is 20-30% in manufacturing sector; 20-35% in services; 15-30% in commerce; 5-15% in construction; 5% in transport and the rest in utilities and other activities (Anderson and Leiserson, 1980)⁴. Within each category there are differences across countries and between regions within the same country with regard to the details of the nonfarm activities (Anderson and Leiserson, 1980, Reardon et al., 2007). For example, in Africa the rural metalwork sector is largely confined to blacksmithing and welding while in irrigation regions in Pakistan it includes small-scale manufacturing of diesel and electric well pumpsets (Anderson and Lesierson, 1980).

Studies also indicate that rural nonfarm wage employment is often more important than rural nonfarm self-employment and income from the service sector is more important than income from the manufacturing sector (Reardon, 1997, Reardon et al., 2007, Barrett et al., 2001). The importance of wage income versus self-employment income tends to be correlated with higher incomes and denser infrastructure (Reardon et al., 20007).

Impacts of rural nonfarm economy

Several cross-sectional studies in Africa and Latin America show a positive correlation between nonfarm participation and total income (Reardon, 1997, Reardon et al., 2001). Some studies also found nonfarm employment contributing to increase in agricultural investment (Ruben and Van

⁴ A study that include recent data give an aggregatged figure of 50-75% in tertiary activities and 20-25% in manufacturing activities (Haggblade, 2007)

den Berg, 2001, Bezu and Holden, 2008). Such findings suggest that expansion of nonfarm economy may play a positive role in reducing poverty. Indeed recent studies that use panel data or regional comparison found that increase in nonfarm employment decreases incidence of poverty in Asia and Latin America (de Janvry and Sadoulet, 2001, Elbers and Lanjouw, 2001, Cherdchuchai and Otsuka, 2006, Estudillo et al., 2006).

Nonfarm expansion can play a significant role in reducing poverty if most of the poor have access to employment in the sector. But it is not always the case that the nonfarm sector is more inclusive of the poor. In East Africa household members from low-agricultural potential are found to be more likely to engage in the nonfarm sector than those in high-agricultural potential (Matsumoto et al., 2006) while in Vietnam the ethnic minorities, who are more likely to be poor, were excluded from the expanding nonfarm sector (Van der Walle and Cratty, 2003).

While there is evidence of a positive correlation between nonfarm participation and total income across several countries, the relationship between the share of nonfarm income and total income or wealth is not so uniform. In some cases the poor get a higher share of their income from nonfarm activities (Adams, 1994, de Janvry and Sadoulet, 2001, Adams, 2002) thereby expansion of the nonfarm sector contributes to greater equality while in others, as shown for most of African studies (Reardon, 1997), the rich and wealthy get a higher share of their income from nonfarm activities implying an inequality increasing nonfarm economy. A recent cross-country study of income diversification in developing countries found that for 14 of the 15 countries in the study, share of nonfarm income increases with wealth and expenditure level. The income decomposition analysis in the study confirms that nonfarm income sources are inequality increasing (Davis et al., 2010).

The apparent contradiction in the findings for different countries and regions may be explained by heterogeneity in nonfarm activities which leads to significant variation in the returns and income from employment in nonfarm activities. Some of the nonfarm activities give higher returns typically involving higher initial investment or working capital. These kinds of activities are often accessible for wealthy households while those activities that have very low return, exhibit no entry barrier and often serve as a fall back for households with little asset (Dercon and Krishnan, 1996, Reardon et al., 2000). The direction of correlation between share of nonfarm income and wealth may then depend on the type of activity that dominates in the sector. In

Kenya for example Lay et al., (2008) show that shares of income from low-return activities drop with increasing land holdings while the opposite holds for shares of income from high-return activities giving a U-shaped relationship between share of nonfarm income and land holdings when it is not disaggregated by type of nonfarm income.

2.3 The nonfarm economy in Ethiopia

2.3.1 Size and Trend

According to the survey reports from the nationally representative Household Income, Consumption and Expenditure Survey (HICES)⁵, income from nonfarm sources are non-negligible and increasing in importance in rural areas of Ethiopia. More than 9% of economically active *individuals* in rural areas are employed in the nonfarm sector and nonfarm income account for 11.5% of households' expenditure in 2004/2005 (CSA 2007). This income share is up from 8.9 in 1995/1996 and 9.6 in 1999/2000 (CSA, 1998, 2001, 2007). The bulk of this nonfarm income is obtained from nonfarm enterprises or self-employment.

Central Statistical Agency of Ethiopia, in collaboration with the World Bank, conducted a unique survey of non-farm enterprises that cover the four major regions of Ethiopia (where 90% of the population lives) in 2006/2007 collecting data on households and enterprises in rural areas. The survey covers more than 14000 households and provides information on enterprise start-up, constraints, and other operational characteristics of the enterprises for those who run enterprises. The following summary findings, extracted from the report of the survey, highlight several features of nonfarm enterprises in Ethiopia (CSA 2007).

A quarter of all rural households engage in nonfarm enterprise sector in Ethiopia, either as primary occupation or as part-time employment. There are non-negligible differences in the participation rate across regions with the lowest in Amhara (18%) and the highest in southern region (37%). Most enterprises are in trade sector (52%) and the most common trade activity is retail sale via stall and markets (26%). 41% of female headed households were engaged in nonfarm enterprises while only 15% of male headed households do so.

⁵ The HICE survey cover all parts of the country and include a sample of 21, 600 households. It provides statistics on income, consumption and expenditure of households

Although the proportion of households who engage in nonfarm enterprises is significant, most of the business are small and informal and seem to have income smoothing as the main objective. Almost half of the households report supporting agricultural income as the main motive for starting business while only 3% reported market opportunities as a motive. The average number of employees is 1.3 and only 3% of the enterprises are registered. The growth of the enterprises in terms of employee is negligible but 51% of enterprises report increases in sales since start up.

2.3.2 The Literature on rural nonfarm activities in Ethiopia

The empirical literature that examines the nonfarm sector in Ethiopia is limited in number. The geographical areas and topics covered in the existing studies are also not comprehensive (Dercon and Krishnan, 1996, Block and Webb, 2001, Matsumoto et al., 2006, van den Berg and Kumbi, 2006, Carswell, 2002, Tefera et al., 2005, Woldenhanna and Oskam, 2001, Holden et al., 2004). But these studies, most of which are undertaken in the last decade, provide some insights into the nonfarm sector in Ethiopia. Here I briefly review their findings⁶ on the size of nonfarm employment, its evolution, determinants of participation and welfare impact.

The papers by Tefera et al. (2005) and Carswell (2002) are descriptive in nature and mainly focus on the extent of livelihood diversification. Dercon and Krishnan(1996)⁷ examine choices and constraints in households' income diversification in Ethiopia and Tanzania. The focus of their analysis is on entry constraints for access to different activities, farm and nonfarm. Matsumoto et al. (2006) examine employment choice among farm, local nonfarm and migration activities and the income from the respective activities in Ethiopia, Kenya and Uganda. Block and Webb's (2001) study has wider coverage in terms of topics it examines and the geographical area under study than the others. They examine determinants of income diversification, welfare impact of diversification and changes over time using data from 1989 and 1994 surveys⁸. However, the paper examines income diversification as defined by the share of crop income in total household

⁶ All the studies referred here are published works. This is not the place to properly review all these papers. Where appropriate the limitations of some of these studies have been discussed in the articles in this thesis.

⁷ Dercon and Krishnan used survey data from 1989 covering 423 households and 6 communities. Most of these households have become part of the sample for the Ethiopian rural household survey (ERHS). ERHS collected data on more than 1400 households from 1994-2004. It is the main source of data for the analysis in this dissertation.

⁸ Block and Webb (2001) used 300 households from the 1994 ERHS data that were observed in 1989.

income and as such it can serve only as approximate description of what goes on in nonfarm employment since crop income share is affected also by non-crop farm income, transfers and rents. The studies by Woldenhanna and Oskam (2001), Holden et al. (2004) and van den Berg and Kumbi (2006) exclusively focus on nonfarm activities. Woldenhanna and Oskam (2001) distinguish between wage and self employment nonfarm activities and examine factors associated with participation in the respective activities and income from them. The study by Holden et al. (2004) examines the impact of access to low-wage nonfarm employment on welfare, agricultural production and land. Van den Berg and Kumbi (2006) examine the relationship between poverty, inequality and nonfarm economy.

Size of nonfarm economy

There are variations across studies in the size of rural nonfarm employment and income reported. The proportion of rural households who participate in nonfarm employment is reported to be 81% in Tigray (Woldenhanna and Oskam, 2001), 60% in Hararghe (Tefera et al., 2005) and 25% in Oromia (van den Berg and Kumbi, 2006). In Wolayeta, 19% of all adults participate in nonfarm employment (Carswell, 2002). Likewise, the share of nonfarm income in total income is 35% in Tigray, 20% in Hararghe, 13% in Central and Southern regions of Ethiopia (Matsumoto et al., 2006) and 8% in Oromia⁹. Moreover, nonfarm income account for 44% of *cash* income in Wolayeta. The differences in the shares may be a reflection the varied agroecological, market and infrastructural conditions in the different part of the country. Differences in survey dates and methodology may also contribute to different nonfarm activity visibility. Most of the nonfarm participants are self-employed except in Tigray where the majority (72%) were in wage employment (Woldenhanna and Oskam, 2001). This is probably because of the huge food-for-work programme in Tigray. In fact, 58% of sampled households in the above study were engaged in FFW.

Determinants of participation in RNFE

The studies that examine the factors influencing participation in nonfarm employment used different methodologies and different units of analysis (individual vs. household). This makes

⁹ Although the paper report this figures as income and employment in nonfarm employment, it is not clear from the paper whether it includes data on nonfarm wage employment. Their analysis classify nonfarm income by sub-sector into Handicraft and related, food/drink and related; and Trade and other.

comparison of results difficult. Still some common features arise such as negative effect of agricultural production or income and positive effect of family size and being male (or male headed household).

Tefera et al. (2005) analyzed nonfarm participation decision of households using logit model. They found nonfarm participation to be negatively correlated with agricultural income¹⁰ and self sufficiency and positively correlated with adult male labor. Block and Webb (2001) analyzed determinants of diversification by estimating a median regression for crop share of income. Their results show that better off households and households with more dependents were more diversified. Farm plots owned and education were not, however, statistically significant. Dercon and Krishnan disaggregate both the farm and the nonfarm activities into those that have entry-constraint in the form of skill and/or investment requirement and those that do not have entry-constraint. However, because they have few observations in the group they identified as entry-constrained nonfarm activities, the multinomial estimation on this alternative does not produce any significant variable. But for the low entry-constrained activities, they found that male headed households and households with more children (in the age of 5-15) are more likely to participate. In their participation analysis, Matsumoto et al. (2006) set out to estimate multinomial probit model of occupational choice for individuals in farm, local nonfarm and migration activities in Ethiopia, Uganda and Kenya. However because the number of migrants in the Ethiopian sample was very low (only 15 individuals in the members of 420 households), they combine local nonfarm and migration activities in the Ethiopian data which effectively makes the regression a binary model. The results show that men are more likely to participate in nonfarm employment. Participation increases with age and the number of local language the respondent can speak and decreases with years of schooling. I find the later result counter intuitive and contrary to what is found in other studies and the result they themselves report for Uganda. This may have to do with combining the migrants with local nonfarm participants. None of the household level characteristics were significant but they found that individuals from community with good land productivity are less likely to participate in nonfarm employment. They also estimated households' income from farm and nonfarm activities separately. The results indicate that

¹⁰ The paper did not acknowledge the possible endogeneity of farm income in the model.

nonfarm income increases with total assets owned and average years of schooling for adults in the household. Nonfarm income decreases with the number of children in the household.

Woldenhanna and Oskam (2001) estimated tobit models for household labor supply to nonfarm employment, separately for wage and self-employment. They found an up-ward sloping labor supply curve for both types of activities. Moreover, they found that labor supply is negatively correlated with cultivated land¹¹, livestock and non-labor income. They also estimated a multinomial logit model to analyze the choice between the two types of nonfarm employment. They found that nonfarm wage employment increases with family size and decreases with agricultural production and the number of dependents. On the other hand, self employment increases with agricultural production and is not affected by demographic factors. They argue that the results imply that households engage in self-employment to reap attractive returns while they engage in wage employment because of push factors. Their study does not find significant effect of education. Van den Berg and Kumbi (2006) estimated tobit models for income from handicrafts, food/drink and trade separately. They found that own cultivated land is negatively correlated with income from all the three activities while family size is positively correlated. This is similar to the result from Woldenhanna and Oskam (2001). Moreover, they also found that households with household heads who are married and literate are more likely to engage in food/drink production and trade. Orthodox Christians are more likely to engage in food/drink business but less likely to engage in trade.

Dynamics in nonfarm employment and nonfarm income

From those studies on nonfarm activities in Ethiopia, cited above, only Block and Webb (2001) examined dynamics of income diversification. They estimated a median regression of changes in the crop share of income between 1989 and 1994. The regressors included are perceptions about risk factors, initial income and diversification index. Their results suggest that those who believe less off-farm income to be associated with high risk diversified more over time.

Impact of participation in nonfarm activities

Van den Berg and Kumbi (2006) applied Gini decomposition analysis to examine the impact of nonfarm income on rural income inequality. They found that nonfarm income reduces inequality.

¹¹ They acknowledge possible endogeneity but did not remedy it because of lack of instruments.

Block and Webb (2001) estimated ordered probit for changes in households welfare ranking as a function of their initial diversification, controlling for demographics and agroecology. The results suggest positive contribution of initial diversification on subsequent income and calorie intake. The title of the article by Matsumoto et al. (2006) suggests that the paper investigates the role of local nonfarm activities and migration in reducing poverty but I am not convinced that this has been shown in the analysis. From their analysis on determinants of participation in nonfarm activities they found that the likelihood of participation in nonfarm employment decreases with community land productivity suggesting that individuals from low-potential agriculture are likely to participate. From this, they concluded that nonfarm activities provide an important pathway to reduce poverty.

The most comprehensive study of impact of nonfarm employment is found in Holden et al. (2004) who assess the impacts of access to nonfarm employment on household welfare, agricultural production and land management decisions. However, their study examines only the impact of access to low-wage nonfarm employment and as such cannot be generalized to all types of nonfarm employment. They calibrated a dynamic non-separable bio-economic household model on a less-favoured area in Ethiopia. The results from the model simulations show that unconstrained access to nonfarm income increases households' total and cash income. But they also found that unconstrained access to low-wage employment reduces agricultural production and investment on land conservation.

3. Analytical framework

3.1 Household model

The neo-classical farm household model of Barnum and Squire(1979) assume that the production decision and the consumption decision are linked only through profit because all endowments are valued at market prices. Hence the household optimization problems in such models are solved recursively, first production decision is made to maximize profit, and then consumption decision is undertaken given the full income. In such models wage provide exogenous measure of value of family labor regardless of whether they work on farm or off-farm (Barnum and Squire, 1979, Squire et al., 1986). A more realistic assumption about imperfect substitution between hired and family labor (Lopez, 1984) and presence of self-employment among households members (Jackoby, 1993) result in the recursivity between consumption and

production to break . In these cases, it is the shadow wage, which is a function of household preferences, technology and fixed inputs, rather than the market wage that determines the labor supply and demand choices of the household (Skoufias, 1994). Likewise, absence or imperfection in other factor or product markets creates nonseparability between production and consumption decisions. The most common cause of market failure in developing countries is lack of access to credit, which causes factors that enter in the liquidity constraint to be marked upwards by the shadow price of credit (Sadoulet and De Janvry, 1995).

To illustrate households' choice of activity in the face of missing credit market, I develop below a simple household model. The household is assumed to be primarily a farm household but may choose to engage in nonfarm activities. The resources used in farming are land (A), labor (La) and capital (Ka). Land is assumed to be fixed in the short run. The net income from agriculture is given by:

$$R_A = f^A(L_a, K_a, \bar{A}; p)$$

Where p denotes the vector of prices. The Household does not use land for nonfarm activities but use both labor and capital (physical or human capital) in nonfarm activities. Even for casual labor there is some level of capital investment such as the cash needed to cover transportation cost or to keep clean clothes. For wage employment activities, the capital component of the production function will be typically smaller than for self employment.

There are two types of nonfarm activities households may engage in: Activity N_H or activity N_L . There is a minimum capital requirement for entrance to activity N_H . It does not yield income until a minimum of K_0 is invested. There is no such minimum resource requirement for activity N_L . The income of the household from the nonfarm activity is given by:

$$R_N = f^L(L_l, K_l; p) + f^H(L_h, K_h; p)$$

I assume that both types of nonfarm activities have an income (production) function characterized by diminishing returns to capital. However, there is a certain level of capital \hat{K} such that for $K \succ \hat{K}$, $f^H \succ f^L$. Further more, we assume that for any of the nonfarm activity, labor and capital are complementary. Hence a household's labor supply to a nonfarm activity will be zero if the household did not allocate capital to that activity.

Given these specifications, the household problem of utility maximization can be stated as,

$$\text{Max } U(C, L_e; Z)$$

Subject to the following constraints:

$$C \leq f^A(L_a, K_a, \bar{A}; p) + f^L(L_l, K_l; p) + f^H(L_h, K_h; p)$$

$$K_a + K_l + K_h \leq K$$

$$L_a + L_l + L_h + L_e \leq \bar{L}$$

$$L_a, L_l, L_h, K_a, K_l, K_h \geq 0$$

U is a quasi-concave, twice differentiable utility function. Utility is a function of consumption expenditure, C and leisure, L_e . Z summarizes household characteristics that determine the utility function. The first constraint is the income constraint which states that consumption expenditure should not exceed income from farm and nonfarm activities. The second constraint refers to the capital constraint. K denotes to the maximum capital the household has access to. We can assume that it includes owned asset as well as a fixed amount of borrowing potential. The third and fourth constraints refer to labor constraint and non-negativity constraints, respectively. This optimization problem can be restated using the Lagrangian,

$$L = U(C, \bar{L} - L_a - L_l - L_h) + \lambda(K - K_a - K_h - K_l)$$

Given that the farm household supplies a positive amount of labor to agriculture, the first-order Kuhn-Tucker conditions can be stated as follows:

$$\frac{\partial U}{\partial C} \bullet \frac{\partial f^A}{\partial L_a} - \frac{\partial U}{\partial L_e} \leq 0; \quad \text{if } < \text{ holds, } L_a = 0 \quad (1)$$

$$\frac{\partial U}{\partial C} \bullet \frac{\partial f^L}{\partial L_l} - \frac{\partial U}{\partial L_e} \leq 0; \quad \text{if } < , L_l = 0 \quad (2)$$

$$\frac{\partial U}{\partial C} \bullet \frac{\partial f^H}{\partial L_h} - \frac{\partial U}{\partial L_e} \leq 0; \quad \text{if } < , L_h = 0 \quad (3)$$

$$\frac{\partial U}{\partial C} \bullet \frac{\partial f^A}{\partial K_a} - \lambda \leq 0; \quad \text{if } < , K_a = 0 \quad (4)$$

$$\frac{\partial U}{\partial C} \bullet \frac{\partial f^L}{\partial K_l} - \lambda \leq 0; \quad \text{if } < , K_l = 0 \quad (5)$$

$$\frac{\partial U}{\partial C} \bullet \frac{\partial f^H}{\partial K_h} - \lambda \leq 0; \quad \text{if } <, K_h = 0 \quad (6)$$

$$K - K_h - K_l \geq 0; \quad \text{if } >, \lambda = 0 \quad (7)$$

Equation (1) to (3) state conditions for optimal labor allocation between farm and nonfarm activities. If we assume that the farm household always supply labor in agriculture (hence have interior solution), the first order condition implies that a household supply a positive amount of labor in nonfarm employment if the return from the respective activities is at least as much as the return from farming. If the return from the nonfarm activity is less than that, labor supply will be zero. Labor allocation condition to activity N_L , for example, is given as,

$$\frac{\partial f^L}{\partial L_l} \leq \frac{\partial f^A}{\partial L_a} = \frac{\partial U}{\partial L_e} / \frac{\partial U}{\partial C}$$

Where the marginal value of labor to agricultural income becomes the reservation wage that guides the decision to engage in nonfarm employment. Changes in the production function that changes returns in agriculture will thus affect labor supply to nonfarm employment through the reservation wage.

Equations (4) to (6) state the first order condition for optimal allocation of capital among farm and nonfarm activities. If the capital constraint in equation (7) is binding, $\lambda \geq 0$ represents the shadow price of capital in terms of utility indicating the increase in welfare for a one unit increase in capital endowment.

$$\frac{\partial f^L}{\partial K_l} \leq \frac{\partial f^A}{\partial K_a} = \lambda / \frac{\partial U}{\partial C}$$

$$\frac{\partial f^H}{\partial K_h} \leq \frac{\partial f^A}{\partial K_a} = \lambda / \frac{\partial U}{\partial C}$$

Given these conditions and the information on the difference between income function of N_L and N_H discussed earlier, we have three possible outcomes for investment decision in nonfarm employment depending on the size of capital endowment.

Case 1: $K < K_0$

In this range, activity N_H does not give any income, hence the household's decision involve allocation between agriculture and nonfarm activity N_L . The household allocates a positive amount of capital to activity N_L if its marginal return is at least as high as that of agriculture.

Case 2: $K_0 \leq K < \hat{K}$

With the minimum capital requirement satisfied, the household has the potential to engage in activity N_H . Whether they do so depends on the size of capital and the marginal returns to capital in N_H as opposed to N_L and agriculture. The household will not allocate capital to either of the nonfarm activities if the marginal returns from the respective activities are less than the marginal returns in agriculture in this range.

Case 3: $K \geq \hat{K}$:

Because $f^H > f^L$ in the whole of this region, $\frac{\partial f^H}{\partial K_h} > \frac{\partial f^L}{\partial K_l}$. The household will not invest in

nonfarm activity N_L . The household allocates capital to nonfarm activity N_H until the marginal returns are equalized with that of the return from agricultural activities.

From this, we can see that an increase in capital endowment increases the likelihood of participation in nonfarm employment as λ becomes smaller while a shock on endowment such as loss or destruction of assets results in the opposite effect. Also we can see that agricultural shocks such as land degradation increases participation in nonfarm employment since it reduces the return to capital from agriculture.

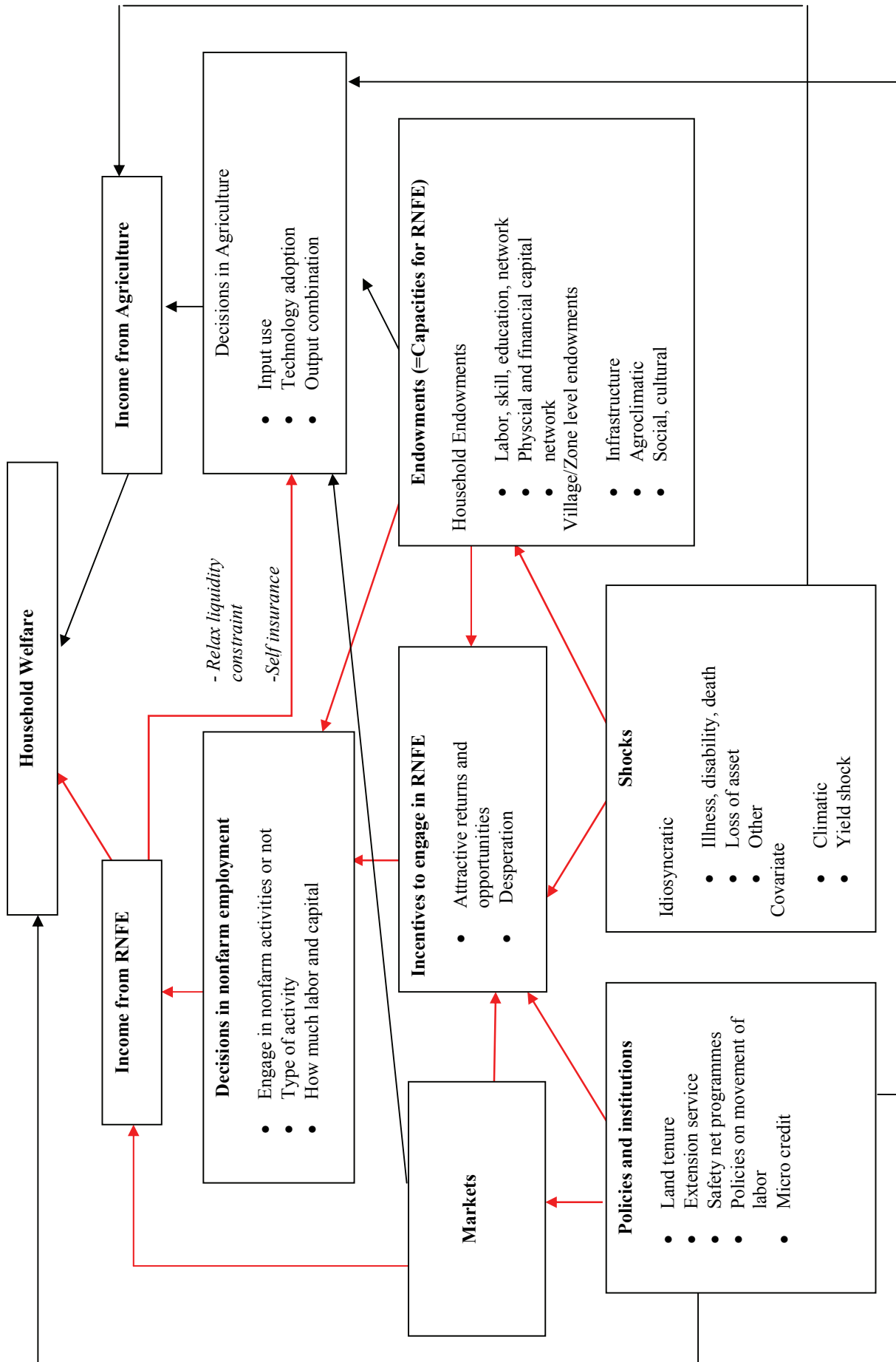


Figure 1: Determinants and outcomes of nonfarm employment

3.2 Nonfarm employment and household welfare-Conceptual framework

Whether or not nonfarm activities result in income growth depends on several factors. One has to acknowledge not only the heterogeneity of activities in rural nonfarm economy but also the heterogeneity in households' incentives to engage in nonfarm activities (Reardon et al., 2007, Barrett et al., 2005).

Earlier studies have shown that the income earned from the rural nonfarm economy has a direct impact on welfare through increased food consumption and reducing intra-year and inter-year income variability (Ellis, 1998). Nonfarm income has a potential to contribute to welfare indirectly through the linkage with agricultural activities by providing finance for input expenditure (Ruben and Van den Berg, 2001) and by serving as self-insurance to encourage farmers to take up high-yielding, high-risk inputs (Collier and Lal, 1984). Nonfarm employment and income also create a virtuous cycle of saving and asset accumulation that increases their future capacity and productivity (Reardon et al., 2000).

Figure 1 tries to capture these issues with a simple chart that shows the core elements involved in the decisions and the outcomes of nonfarm employment for farm households (Red arrows). The decisions to participate in the nonfarm economy and the level of participation are influenced by both the incentives that prompt diversification into the nonfarm economy and the capacity of the participant. For example a household that is unable to satisfy its consumption requirement from agricultural activities may have the incentive to engage in nonfarm employment, but whether it will actually do so depends on availability of the relevant resources.

The incentives are results of market outcomes, policies, institutions and households experience of shocks while the capacity is determine by households' endowment and the physical and natural resources of the village. Incentives are often divided into those that 'pull' households into, often high-return, nonfarm employment and those that 'push' households into diversification out of desperation. For example an increase in demand for handicrafts caused by a new road that passes through the village creates an attractive opportunity that attracts those who have the skill and capital to engage in it. On the other hand, shocks such as drought pushes households into low-paying wage employment as a coping response.

Some of the determinants of participation influence both the incentives and the capacity to engage in nonfarm activities. For example, illness creates an incentive to engage in nonfarm activity to cover medical expenditure but at the same time they reduce the labor availability and hence the capacity to participate. Likewise, household and village level endowments indicate the capacity to engage in the nonfarm economy while at the same time some of the endowments affect the incentives to participate in rural nonfarm economy. For example, land holdings indicate wealth and hence access to capital necessary to engage in nonfarm employment. But farm households with higher land holdings have also less incentive to diversify away from agriculture and have higher opportunity cost for labor. How these opposing force net out is an empirical question.

Regardless of why the household engages in the nonfarm economy, the income from engaging such activities contributes positively to welfare as long as there is no significant competition with farm labor. There is also potential for another positive contribution of nonfarm employment. Given incomplete credit markets in rural areas, households typically face liquidity constraints. Cash income from nonfarm employment may thus relax the liquidity constraints of farmers so that they can purchase inputs and improve productivity. Moreover, the availability of income to fall back on in case of harvest failure may serve as a self-insurance for farmers to invest in high-yielding, high-risk inputs. Although not explicitly indicated in the chart, there is also a second round positive cycle the nonfarm employment can trigger. If a household can save from the nonfarm income and invest in enhancing the assets and capital holdings, productivity in both the farm and nonfarm sectors may increase as households increase agricultural investment and get access to high-return activities with the improved capacity.

4. Methodological issues

Regression models are the main tools used for the analyses in this thesis. The principal regression models employed include Multinomial logit model, Heckman selection model and linear panel data models. Below, I discuss briefly the relevance of these methods for the issues analyzed in this thesis and acknowledge the possible limitations.

Multinomial logit model

I used multinomial logit models to analyze households' choice of nonfarm employment in paper 1 and to analyze employment transition in paper 4. The decision in both cases can be framed in a random utility framework.

Let U_{ij} denote, expected utility of a household/individual i associated with an employment activity j . The random utility model assumes that utility is a random function, either because of imperfect optimization by the individual or because the analyst has incomplete information (Maddala, 1983, McFadden, 1973, 1974). Hence utility U_{ij} is given by:

$$U_{ij}^* = \mathbf{X}_i' \beta_j + \varepsilon_{ij}$$

Where \mathbf{X} is a vector that denotes characteristics of individuals such as age, gender and endowments. The coefficients are different for each alternative. The error term ε_{ij} reflect uncertainty in the random utility model. We can then define an indicator variable D which links the expected utility from different activities with the employment choice made. For each individual i and activity j , the indicator variable D_{ij} is observed.

$$D_{ij} = 1 \text{ if } j = \arg \max U_{ij}^* \in \{U_{i1}^*, U_{i2}^*, \dots, U_{iJ}^*\}$$
$$D_{ij} = \textit{Otherwise}$$

If we assume that the error terms are independently and identically distributed with a type I extreme-value distribution, we get the choice probability model. According to McFadden (1973), only the i.i.d., type 1 extreme value (Gumbel) distribution produces a probabilistic choice model that is consistent with utility maximization. And the resulting choice model is multinomial logit model.

$$P_{ij} = pr(D_{ij} = 1) = \frac{\exp(\mathbf{X}_i' \beta_j)}{\sum_{k=1}^J \exp(\mathbf{X}_i' \beta_k)}$$

Because we do not have quantifiable demand side data that describes the activities such as market wage rates specific to each activity, we don't have alternative-specific regressors. Only individual/household-specific regressors \mathbf{X}_i are included.

The presence of unobserved characteristics such as, attitude to nonfarm work, diligence, social skill, and the like pose a challenge in cross-section analysis of discrete response models, particularly when such unobserved effects are correlated with one of the explanatory variables. For example, a farmer with a positive attitude to nonfarm work is more likely to engage in nonfarm activities. But such farmer is also more likely to accumulate the necessary asset to gain access to RNFE. With panel data, it is possible to alienate the unobserved effect in a fixed or random effect logit and random effect probit models. But if the analysis goes beyond the binary choice of participation to a multinomial model of choice among different activities, estimation becomes difficult. Estimation and inference of panel multinomial models have been made difficult because of the high dimension integral the likelihood function involves. Although different simulation methods have been suggested to solve this problem (Geweke et al., 1994, Keane and Wolpin, 1994) standard econometric packages do not yet allow the direct estimation of such models. In Paper 1 in this thesis I applied a user written **Stata** programme, **gllamm**, to estimate panel multinomial logit.

The drawback with multinomial logit model is the assumption of independence of irrelevant alternatives (IIA) which imply that the odds ratio between two alternatives is the same irrespective of the total number of choices available. This is considered inappropriate for many applications (Maddala, 1983). The multinomial probit model is the most often referred alternative that solve this problem by assuming a multivariate normal distribution for the residuals so that they are allowed to correlate. But the multinomial probit model is difficult to estimate since its computation involves multiple integrals even for very few choices (Maddala, 1983, Wooldridge, 2002).

Heckman selection model

In paper 2 we analyze households' agricultural investment decision. We estimated fertilizer use as a function of income from FFW and other covariates. We observe a positive amount of fertilizer for households who decided to use fertilizer on their plot. For several plots and households, the reported amount is zero. This problem can be analysed in the framework of corner solution model. Such models recognize that the optimal choice for some of the agents is at zero (Wooldridge, 2002). For a random draw of plot i , y_i denotes the amount of fertilizer used.

$$y_i = \mathbf{x}_i\beta + u_i$$

$$y_i = 0, \text{ otherwise}$$

Where \mathbf{x}_i refers to a vector of plot and household characteristics. Estimation of such models with OLS gives inconsistent estimates of β because the $E(u_i) \neq 0$ (Wooldridge, 2002, Maddala, 1983). If we assume that $u_i | \mathbf{x}_i \sim Normal(0, \sigma^2)$, we can write this equation as:

$$y_i = \max(0, \mathbf{x}_i\beta + u_i)$$

This is what is referred as standard censored Tobit model (Tobin, 1958) which can be consistently estimated using maximum likelihood methods.

The limitation of the standard tobit model is that the direction of impact of an explanatory variable on participation decision or selection $p(y>0)$ is the same as that of the amount decision (Wooldridge, 2002). But this may not be true for all covariates. In our fertilize use model for example income from food for work may negatively affect the decision to apply fertilizer if the disincentive effect of food aid holds so that farm households who receive food aid through food for work programme are less likely to apply fertilizer on their land. But for those who are already applying fertilizer, income from food-for-work relaxes liquidity constraint so that the amount of fertilizer may be positively related to income from food-for-work.

Two-part models or hurdle models address this limitation by allowing different mechanisms to drive the participation decision ($y>0$ versus $y=0$) and the amount decision (how much y given $y>0$). For example, the truncated normal Hurdle model (Cragg, 1971) extends the standard Tobit model by assuming that the selection or participation decision follow a probit model while the amount decision have a truncated normal distribution. The central assumption of such models is that conditional on a set of observed covariates, participation and amount decisions are independent (Wooldridge, 2002).

Models that allow for correlation between participation and amount decisions are called selection models. Here I discuss the Heckman selection model (Heckman, 1976) which is applied in this thesis. Let y_1 indicate the amount of fertilizer applied (or any regression of interest) and y_2 denote the selection indicator which takes the value 1 if statement in the bracket is true and 0 otherwise:

$$y_1 = \mathbf{x}_1\boldsymbol{\beta} + u_1$$

$$y_2 = 1[\mathbf{z}\boldsymbol{\gamma}_2 + v_2 > 0]$$

Where (u_1, v_2) is bivariate normal. Note that y_1 is observed only when $y_2=1$. For positive values of y_1 , the regression function is

$$E(y_1 | x, y_1 > 0) = \mathbf{x}_1\boldsymbol{\beta} + E(u_1 | v_2 > -\mathbf{z}\boldsymbol{\gamma}_2)$$

Assume that $E(u_1 | v_2) = \delta v_2$ since participation and amount decision are correlated and u_1 and v_2 are jointly distributed. Thus

$$E(y_1 | x, y_1 > 0) = \mathbf{x}_1\boldsymbol{\beta} + \delta E(v_2 | v_2 > -\mathbf{z}\boldsymbol{\gamma}_2)$$

$$= \mathbf{x}_1\boldsymbol{\beta} + \delta\lambda(\mathbf{z}\boldsymbol{\gamma}_2)$$

Where $\lambda(\cdot) \equiv \phi(\cdot) / \Phi(\cdot)$ is the inverse Mills ratio. A consistent estimation of this model can be performed in two steps as suggested by Heckman (1976). First the ML estimates of $\hat{\lambda}$ is obtained using probit of y_2 on z . Then run OLS of y_1 on x_1 and $\hat{\lambda}$ ¹². It is not necessary that x_1 is a strict subset of z for $\boldsymbol{\beta}$ to be identified but if $x_1 = z$, there will be severe collinearity among the regressors in the OLS regression in the second stage which can lead to large standard errors of the elements of $\hat{\boldsymbol{\beta}}$ (Wooldrdge, 2002).

In many practical applications, getting a variable that belongs to selection equation but not in the amount equation is very difficult (Deaton, 1997). Another concern in applying the Heckman model is that if the normality assumption does not hold, the result and the identification may be compromised (Deaton, 1997).

Linear panel data models

In paper 3, we estimate a linear panel model of change in consumption expenditure to examine the impact of nonfarm income on welfare dynamics. The most common choice of model in panel regression is between fixed effect and random effect models, focusing on how the unobserved individual effects should be treated. Both have their own advantages and limitations. The random effect model is efficient since it uses both the with-in and between variation and it also allows for out of sample prediction since the individual effects are considered random variables. However,

¹² In STATA this is undertaken by the two-step options in the heckman regression command

it assumes that the individual effect is uncorrelated with any of the explanatory variables. This is considered unrealistic in many empirical cases. Fixed effect model, on the other hand, is free from such stringent assumptions. However the estimation which involves differencing will wipe out all time invariant variables and can also be less efficient because it uses only the within household variation. In our empirical model, some of the variables such as village level variables do not vary across periods and others, such as gender of household head, vary only for smaller share of the sample. Hence, fixed effect is not without problem either.

A third estimation method that can be considered as a compromise between the two is the Hausman-Taylor method. Like the random effect model, the Hausman-Taylor method (Hausman and Taylor, 1981) assumes that the latent individual effect is a time-invariant random variable, distributed independently across individuals. And none of the regressors are correlated with the random error term. Unlike the random effect, the Hausman-Taylor specification assumes that some of the regressors are correlated with the latent variable α_i (they are 'endogenous'). To estimate the coefficients for both the time-varying and time-invariant variables consistently, Hausman and Taylor (1981) propose the use of instruments for the variables that are likely to be correlated with the unobserved individual effect. Because it is not easy to get good instruments that are not in the model, they suggest using the time-varying variables that are uncorrelated with the latent variable to instrument the variables correlated with the latent variable α_i . Deviations from the mean of these time-varying 'exogenous' variables can then be used as instrument for the time varying 'endogenous' variables and their mean is used as an instrument for the time-invariant 'endogenous' variables. If there are at least as many time-varying exogenous regressors as there are individual time-invariant endogenous regressors, then the model is identified and the Hausman-Taylor (HT) estimator is more efficient than fixed effect. If the model is under-identified, then one cannot estimate the time-invariant variables and the HT estimator of the time-varying regressors is identical to fixed effect estimator (Baltagi et al., 2003). We estimate our model using all the three methods to check for robustness of the results and report the preferred model.

5. Data source and background of study area

The primary data used in this dissertation are the Ethiopian Rural Household Survey (ERHS) data. The ERHS is a unique longitudinal data that was launched in 1994 by the Department of

Economics at Addis Ababa University and the Centre for the Study of African Economics (CSAE) at Oxford. This data were collected in six rounds over the span of ten years, from 1994 to 2004¹³. There are 15 villages in the sample from different parts of the country. The villages were selected to represent the main farming systems in the country. Within each village an attempt was made to include a proportionate number of female headed and male headed households, using stratified sampling¹⁴. The population share within the sample are consistent with the population share within the three main sedentary farming systems –the plough–based cereals farming, mixed plough/hoe cereals farming and farming systems based around *enset* (false banana). The sample does not include villages from pastoralist regions and the total number of villages in the sample is still very small percentage of the non-pastoralist villages in Ethiopia. The sample is therefore not representative of Ethiopia but can be ‘considered broadly representative of households in non-pastoralist farming systems’ (Dercon and Hoddinott, 2004). Figure 2 shows the geographical location of the villages in the survey. The description of the villages is given Table 1 (see Bevan and Pankhurst (1996) for detailed discussion on the villages included in the sample).

The initial sample in the survey constitutes 1477 households. The sample remains the same in the first four rounds (1994-1997) with very few household dropping out. By the fifth round, five years after the first full survey, some of the households left but the attrition rate was barely 7%. In 2004, 10 years after the initial survey, another 15% of the initial sample has dropped out¹⁵. Analysis on three of the papers is based on this data set. Paper 1 used data from all survey years, Paper 3 used data with the five year gap (1994, 1999 and 2004) and Paper 4 used data from 1999 and 2004 surveys.

¹³ The panel data build on the 1989 survey of seven villages by IFPRI. The IFPRI survey villages were all affected by drought. The 1994 survey re-designed the survey to include nine new villages and six of the original seven villages. The data were collected in 1994 (twice), 1995, 1997, 1999 and 2004.

¹⁴ The questionnaires and data for the first four rounds are available at <http://www.csae.ox.ac.uk/datasets/Ethiopia-ERHS/ERHS-main.html>

¹⁵ Although the surveys in 1999 and 2004 included new samples they are not considered as part of the panel here as the households is observed only once.

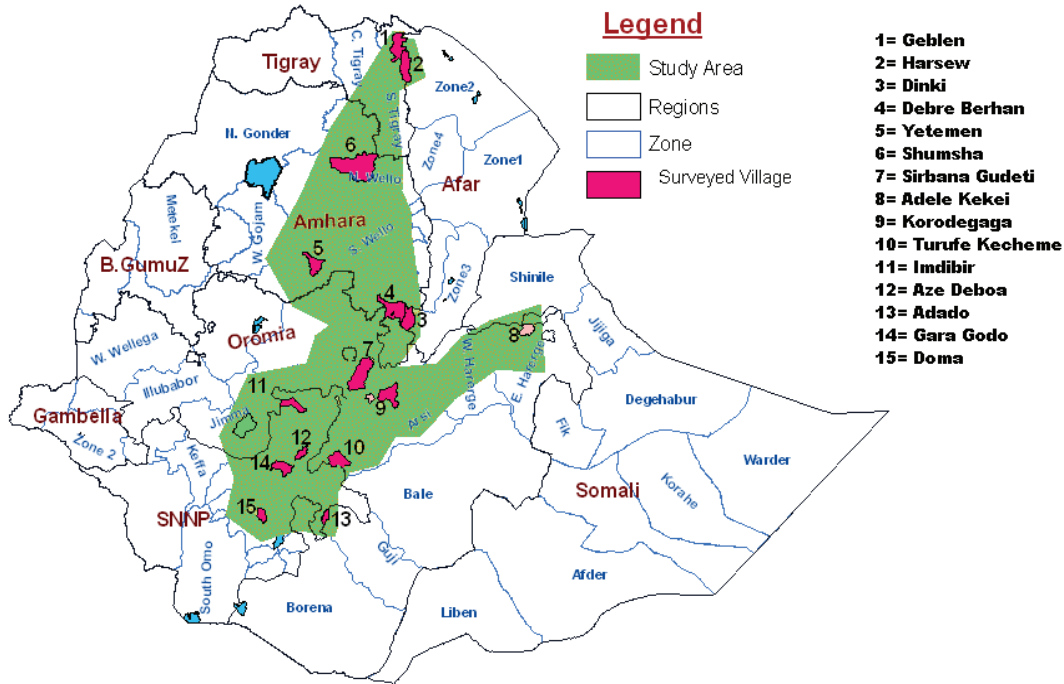


Figure 2 Ethiopian Rural Household Survey sites

Paper 2, examining the impact of food-for-work on agricultural production, is based on another data. The data come from a survey that was conducted in Northern Ethiopia in June and July of 2001. The survey covered 16 villages in the four zones of Tigray (central, eastern, southern and western). The villages in the survey were stratified to capture differences in distance to markets, population density, agricultural potential and access to irrigation.

Table 1: Description of the villages in the ERHS survey

Survey site	Location	wealth	Technology	Main crops	Mean Rainfall mm	Nearest town in (km)	Average land holding(ha)	Remarks
Addado	Sidamo (Dilla)	mixed	Hoe, a few ox plough	Coffee, 'enset'	1417	11	0.67	Densely populated
Adele Keke	Hararghe	rich	Ox plough; irrigation	Millet, maize, coffee, 'chat'	748	13	1.1	Highland
Aze Deboa	Shoa (Kembata)	mixed; migration dependent	hoe ox plough	'enset', coffee, maize, 'teff', sorghum	1509	4.5	0.83	Densely populated
Debre Berhan	N.Shoa	usually self-sup-porting	Ox plough	'teff', barley, beans	919	10	2	Highland, near town
Dinki	N. Shoa	vulnerable	ox plough irrigation	Millet, 'teff'	1664	10	1.25	Not easily accessible
Doma	Gama Gofa	vulnerable	irrigation ox plough	'enset', maize	1150	3.5	1.24	Resettlement area
Gara Godo	Sidamo (Wolayta)	vulnerable	Ox plough, axe, spade	Barley, 'enset'	1245	13	0.5	
Geblen	Tigray	vulnerable	Ox plough water/soil conservation techniques	Cereals	504	18	0.25	Used to be wealthy
Haresaw	Tigray	vulnerable	Ox plough	Cereals	558	17	1.8	Densely populated
Imdibir	Shoa (Gurage)	Migration dependent	Hoe, rare ploughing	'enset', 'chat', coffee,	2205	1	0.75	

					maize				
Korodegaga	Arssi	vulnerable	Ox plough	Cereals	874	25	4.8	Near rich valley	
Shumsha	S.Wollo	vulnerable	Ox plough	Cereals	654	12	1.5	near airport	
Sirbana Godeti	Shoa	rich	Ox plough; tractors; solar pump	'teff'	672	15	4	Targeted by agricultural policy	
Turfe Kechemane	S.Shoa	rich	Ox plough	Wheat, barley, 'teff', potatoes	812	12	0.83		
Yetmen	Gojjam	rich	Ox plough	'teff', wheat and beans	1241	0	1.05		

Source: village studies, Bevan and Pankhurst (1996) and Dercon and Hoddinott (2004)

Nonfarm activities for sample households

On average 40% of the households in the (ERHS) panel participated in rural nonfarm employment. Of those who participate in nonfarm employment activities, 79% participated in self employment and 39% in wage employment, 18% of nonfarm participant households choose both wage and self employment. Most of the households engage in activities that do not have high resource requirements such as skill or capital. For example 23% of households engaged in business activities that have low capital requirement such as petty trade while less than 5% participated in activities that demand high initial investment or working capital such as cattle trade. The participants in skilled wage employment and high-investment business are better off households with more asset and higher income.

While the nonfarm participation rate is already significant, the indication from the survey is that access to nonfarm job is constrained. Asked if they would have liked to work (supply more labor) in wage employment, more than 55% households interviewed in each survey year said yes. This rate is higher ($\geq 70\%$) for those who have at least one member already engaged in nonfarm wage activities. Of those households who would like to increase labor supply to wage employment, 81% cited lack of employment opportunity as the main constraint.

Although similar question have not been asked for self-employment activities, the reports on source of investment capital indicate that access to self-employment is also constrained. The most common source of capital is own saving (for 45% of households in business) followed by loan from relatives (21%), gift from family (12%) and sale of assets (9%). Together personal and relatives' assets are the source of investment for 87% of the households in business. Only two individuals borrowed from the bank to finance their investment. This shows that poor individuals from poor background have very limited access to business.

6. Summary of research findings

Paper 1: Activity choice in Rural Nonfarm Employment (RNFE): Survival versus accumulative strategy

An important first step in understanding the nonfarm economy is identifying factors behind farm households' diversification into the rural nonfarm economy. However, studies of nonfarm employment have produced conflicting results. Partly this is a reflection of genuine differences

in realities across countries and regions. But another important contributing factor for this state of affairs is the fact that several of these studies consider the nonfarm economy as a homogeneous sector.

Paper 1 examines choice of nonfarm activity in rural Ethiopia using panel data that cover the periods 1994-2004 in six survey rounds. The paper analyzes individuals' decision to choose among four types of nonfarm employment activities: skilled wage employment, unskilled wage employment, high investment business and low investment business. We applied a panel multinomial model to estimate participation in the four nonfarm employment activities simultaneously. We control for unobserved heterogeneity both at an individual and household level.

Allocation of one's labor and capital resources into alternative activities involves a constrained optimization with a set of incentives that determine the return from the respective activities and a set of constraints that define the capacity of individuals to undertake the activities. Hence heterogeneity in incentives and capacities lead to heterogeneous nonfarm activities.

We found that activities with high resource requirement- skilled wage employment and high investment business- bring higher returns but employ significantly fewer individuals suggesting entry barriers to accessing most attractive occupations. The econometric regression on the determinants of nonfarm participations confirms this. Determinants of participation in low return activities are dominated by push factors such as low or insufficient income. And participation in high paying activities is dominated by capacity variables such as education and labor resource endowments.

Although there are several studies that examine determinants of participation in nonfarm employment, very few go beyond wage versus self-employment distinction. By disaggregating nonfarm employment into skilled versus unskilled and high-investment versus low-investment activities, this paper was able to reconcile some of the conflicting results in the literature.

The presence of unobserved characteristics such as attitude to nonfarm work, diligence, social skill, and others pose a challenge in cross-section analysis of choice models, particularly when such unobserved effects are correlated with one of the explanatory variables. By using panel data, we were able to control for unobserved heterogeneity both at an individual and household

level. This is a novel contribution. There are no studies, to our knowledge, that control for unobserved heterogeneity in estimating multinomial models of employment choice.

Paper 2: Can food-for-work encourage agricultural production

This paper investigates the linkage between nonfarm employment and agricultural production at household level. Food-for-work is a special kind of nonfarm activity since the wage and the participants are not freely determined by the market forces. Rather, food-for-work is an employment generation scheme that tries to utilize food aid for developmental ends. By setting the wage rate below the market rate, food-for-work programmes try to induce self-selection of participation by the poor. Additional administrative tools are also used to ensure better targeting of the poor.

The paper starts by discussing the disincentive effect of food-for-work that has been the preoccupation of the food aid literature. We then argue that there could be an ‘incentive effect’ of food-for-work. The paper sets the argument for positive contribution of food-for-work employment on agriculture through the presence of missing credit and insurance markets. We develop a simple model which helps highlight the mechanism through which food-for-work affects agricultural production.

The results from a Heckman selection model for fertilizer adoption show that FFW encouraged adoption of fertilizer. The results also show that FFW had no production disincentive effect. Households’ own perception of the benefit of FFW, as revealed in interviews, confirmed this econometric finding.

By highlighting the often neglected contribution of food aid- the relaxation of households’ liquidity constraints, this paper demonstrates the linkage between nonfarm income and agricultural production

Paper 3: Does nonfarm economy offer pathways for upward mobility?

In the presence of seasonality and frequent droughts, participation in nonfarm activities reduces inter-year and intra-year income variability. Hence, controlling for other things, those who engage in nonfarm employment are likely to have higher current income and consumption level. However, it is not necessarily the case that nonfarm activities lead to higher income growth and offer a way out of poverty. It is possible that nonfarm activities are serving the equivalent of

subsistence agriculture with no potential for accumulation and productivity improvement. While several studies investigate the impact of nonfarm participation on poverty and inequality¹⁶ most of the studies of this relation use cross sectional data which allows only comparison across households rather than direct exploration of how specific households' income evolved over time in response to participation in nonfarm employment.

This paper investigates these issues by examining the impact of participation in rural nonfarm employment on households' expenditure dynamics in Ethiopia using panel data that covers 10 years from 1994 to 2004. We apply both panel data models and non-parametric regressions to estimate the relationship between the initial share of nonfarm income and the growth in expenditure observed between two periods. We also investigated whether the returns to assets owned by nonfarm participants are higher by applying the Oaxaca-Blinder decomposition analysis.

The results suggest a positive contribution of nonfarm participation on expenditure growth. The regression results exploring the impact of nonfarm participation on expenditure dynamics indicate that expenditure growth increases with households' initial share of nonfarm income. We also found that the impact is higher for richer households. Furthermore, we found that rural nonfarm employment participants enjoy higher rates of return to their human and physical capital than do non-participants.

Paper 4: Dynamics in rural households' nonfarm employment in Ethiopia: Do the poor have time on their side?

As in any other economic activity, nonfarm employment is likely to evolve over time as a result of resource re-allocation and internal asset dynamics as households try to adjust their employment portfolio to changing opportunities and challenges.

While shocks have often been discussed in the diversification literature in relation to their impact in forcing households to diversify into nonfarm activities, their impact on those who are already engaged in nonfarm activities have been virtually ignored.

¹⁶ See for example, van den Berg and Kumbi (2006), Barrett et al. (2001), Matsumoto et al. (2006), Nargis and Hossain (2006), Reardon et al. (2000), Lay et al. (2008).

In this study I hope to contribute to the limited nonfarm dynamics literature by examining nonfarm employment dynamics of rural households in Ethiopia between 1999 and 2004. I disaggregated nonfarm activities into high-return and low-return activities. This way I was able to examine not only movement to and out of nonfarm economy but also within the nonfarm economy between high-return and low-return activities. Particularly I am interested in identifying the factors that enable households to move from low-return to high-return nonfarm activities as these activities have a potential to be a way out of poverty.

I found that households who accumulated assets between the two periods were able to transit from low-return into high-return rural nonfarm employment (RNFE). Low-return RNFE participants who moved to high-return employment have accumulated significantly more assets than those who stayed in low-return RNFE. The results from the multinomial regressions indicate that initial asset holdings, access to saving and labor accumulation increases the likelihood of transition into high-return RNFE, both for an upgrade from low-return employment as well as for new entry from pure agriculture. Households who experienced illness or death of a household head or their spouse are less likely to make any employment transition. For households engaged in high-return nonfarm activities, shocks that affect their wealth or liquidity trigger movement into low-return employment. On the other hand shocks negatively affecting agricultural income motivate transition into high-return rural nonfarm employment.

7. Policy relevance

According to the most recent nationally representative data available, the proportion of poor people in Ethiopia stood at 38.7 % in 2004/2005 (MoFED, 2008). Guided by the Millennium Development Goals, the current development strategy of Ethiopia sets eradication of poverty as the main objective. Since six out of seven poor Ethiopians live in rural areas, this objective cannot be achieved without development in rural areas. The rural areas are predominantly agricultural where almost all farm households own and cultivate some land. However, agricultural income covers only 65% of rural households' expenditure with the rest coming from non-agricultural activities and transfers (CSA, 2007). The share of nonfarm income is likely to go up as landlessness and land fragmentation increases with population growth. In fact the share of nonfarm income in total consumption expenditure increased from 8.9% in 1995 to 11.5% in 2004 (CSA, 1998, 2007)

A thorough knowledge of both the farm and the nonfarm economy is, therefore, essential to design appropriate policy that can result in poverty reduction in rural areas. In spite of its significant size and its increasing importance, there has been limited research on rural nonfarm activities in Ethiopia. This thesis bridges this gap of knowledge by analyzing different facets of the rural nonfarm economy.

The findings in this thesis suggest that promotion of the nonfarm economy may contribute to poverty reduction. The papers in the thesis found that participation in nonfarm employment is positively associated with expenditure growth. Nonfarm participants enjoy higher return on their human and physical capital endowments than non-participants. Analysis on the linkage between participation in nonfarm activity and agricultural production also show the positive contribution nonfarm income plays in encouraging agricultural investment.

However, the thesis highlights that nonfarm employment is not equally beneficial to all participants. Women and the poor are more likely to engage in low-return nonfarm activities. The high-return activities, which increase the potential for accumulation and open the way out of poverty, are not accessible to the poor because of their lack of assets. Probably because of this, the consumption growth contribution of rural nonfarm participation is higher for the wealthy than for the poor. This suggests that rural nonfarm income may contribute to a rise in income inequality in rural areas.

The results from the analysis in this thesis show that education is the most important determinant of participation in nonfarm employment in general and high-return activities in particular. Hence policies that seek to promote poor households' human capital can help increase households access to nonfarm activities and the benefit from nonfarm employment.

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PAPER I



Activity Choice in Rural Non-farm Employment (RNFE):

Survival versus accumulative strategy

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Abstract

This paper examines the nonfarm employment choice of individuals using panel data from Ethiopia that covers the period 1994-2004. Non-farm activities that require more resources in the form of skill or capital yield higher returns but employ proportionately fewer people. Women have lower participation rate than men, and those women who participate are often engaged in low-return activities. The econometric results suggest that the factors that influence individuals' decision to participate in non-farm employment differ for the different types of activities. Determinants of participation in high-return activities are dominated by capacity variables. Determinants of participation in low-return activities are dominated by push factors. Education is the only factor that has the same (positive) impact on the likelihood of participation in all types on non-farm employment. Education was also found to have more impact on participation of women.

Keywords: Non-farm, off-farm, non-agriculture, income diversification, Ethiopia

1. Introduction

There is an increasing recognition in the literature that agriculture is not the only important sector in the rural economy. Studies in different developing countries have shown that the non-farm sector contributes a significant share to employment and income in rural areas (Ellis, 1998, Lanjouw and Lanjouw, 2001, Haggblade et al., 2007, Davis et al., 2010). Nonfarm activities account for 30% of full-time rural employment in Asia and Latin America and 10% in Africa (Haggblade, 2007). These figures do not include farmers who engage in nonfarm activities as part-time employment or during agricultural slack seasons. When these are considered, the participation rates are 83% for Asia, 82% for Latin America and 78% for Africa (Winters et al., 2009). The size of nonfarm employment is reflected in the level of income rural households earn from it. On average, the share of nonfarm income in households' total income is reported to be around 50% in Asia and Latin America and 35% in Africa (Reardon et al., 2007).

Most studies of income diversification tend to treat nonfarm employment as a homogenous group of jobs regardless of the type of employment or the degree of skill and investment required. However, this kind of aggregation can lead to misleading inferences about issues like determinants of nonfarm participation. It is not realistic to assume, for example, that factors that influence one's participation decision in casual labor are the same factors that influence the decision to engage in a lucrative business. Recent studies that disaggregate nonfarm employment between wage employment and self employment documented that the determinants of participation and the returns from the respective employments are not the same (Barrett, 2005, Woldenhanna and Oskam, 2001, de Janvry and Sadoulet, 2001, Corral and Reardon, 2001, Shi et al., 2007).

But what is largely missing from the literature is a more refined disaggregation of nonfarm employment that goes beyond functional classification to reflect also the level and quality of resources required and the sophistication of production activity involved. Lanjouw's (2001) classification of nonfarm employment into 'high productivity' and 'low productivity' activities, based on earnings from the activities relative to farm labor, gives an important distinction. However while recognizing the productivity difference among activities, this classification ignores the functional classification and considers wage and self employment activities with

similar 'productivity' as comparable. A similar study in Kenya (Lay et al., 2008) distinguishes between high-return and low-return activities but used an ad hoc criteria to group activities as such. We believe that, for a better understanding of nonfarm employment patterns, it is important to disaggregate activities into wage employment and self employment and recognize the differences in resource requirements within these broad groups.

This paper assesses choice of nonfarm activity using panel data that cover 10 years in six survey rounds. We analyze individuals' decision to choose among four types of nonfarm employment activities: skilled wage employment, unskilled wage employment, high investment business and low investment business. There are three important contributions of this paper. First, the disaggregated analysis enable us to test not only whether wage and self employment have different sets of determinants but also whether the capacity and incentive factors that influence participation decision differ for different types of wage employment and different types of self employment. Second, by using multinomial model we are estimating participation in the four nonfarm employment activities simultaneously. The use of panel model enables us to control for unobserved heterogeneity, at both an individual level and the household level. To our knowledge, there are no studies that control for multilevel unobserved heterogeneity in occupational choice model. And third, the paper uses panel data that cover a relatively long period and wide variety of cultural, economic and agro-ecological conditions in rural Ethiopia making the sample more representative than found in most studies.

Several studies in developing countries found positive relationship between nonfarm participation and the income or wealth of the household (Reardon, 1997, Reardon et al., 2001). We found that the relationship between nonfarm employment and wealth or income of the household is not uniform across activities in Ethiopia. Participation in skilled wage employment and high-investment business increases with wealth while the opposite holds for unskilled wage employment and low-investment business. We also found that women are relatively heavily represented in low-return activities.

Comparing determinants of wage and self employment, we found that education is more important in wage employment and wealth, as given by land holding, is more important in self employment indicative of the type of resource relevant in the two groups of activities. However

we also found that there are similarities between activities with comparable level of resource requirement regardless of functional classification. We found that activities with high resource requirement- skilled wage employment and high investment business- bring higher returns but employ significantly fewer individuals. While the determinants of these high paying activities are dominated by capacity variables, that of low paying activities are dominated by push factors.

Among the set of incentives and capacity variables that affect participation in nonfarm employment, education is the most important. It positively influences participation in all types of nonfarm employment. Women are more likely than men to participate in low paying nonfarm activities but educated women are more likely than men to participate in skilled wage employment. Thus education especially affects the quality of nonfarm employment prospects for Ethiopian women.

The rest of the paper is organized as follows. The second section discusses the conceptual framework and relevant literature followed by overview of the data and descriptive statistics in section 3. In section 4 we present the econometric model and section 5 discusses estimation results. The final section presents concluding remarks.

2. Conceptual framework and literature review

2.1 Conceptual framework

In this paper rural nonfarm employment (RNFE) refers to employment outside of the agricultural sector in manufacturing or service sector irrespective of location, function or degree of processing involved. Preparing and selling food and beverages in one's own home (on- farm) is considered a nonfarm activity as is running a cafeteria in the neighboring village or working as an officer in the local administration (off-farm).

We can discuss choice of RNFE in the frame work of individuals' earning maximization decision that involves allocation of one's labor and capital resources into alternative activities. Such a decision involves a constrained optimization with a set of incentives that determine the return from the respective activities and a set of constraints that define the capacity of individuals to undertake the activities. This choice of diversification into nonfarm employment can be

decomposed into two interdependent and simultaneous choices: (1) The decision as to whether or not to participate in nonfarm employment and (2) The decision on the type of nonfarm activity.

The set of incentive variables relevant in these choices can be grouped into two: push and pull variables. One set of push variables represent factors related to the poor performance of the agricultural sector as a sufficient and reliable source of income. Such factors include inter-seasonal and other transitory drops in farm income, chronic food insufficiency and fluctuations in farm income (Reardon et al., 2007). Another source of push variables are incomplete markets for factors, including but not limited to missing credit and insurance markets. In the absence of financial markets, individuals and households diversify to self-insure themselves and provide working capital (Barrett et al., 2001). The pull variables emerge from comparing earnings in nonfarm employment with earnings in farm employment. The most important pull variables are the returns to factors supplied in the nonfarm sector- wage or salary in nonfarm wage employment and profits in self employment. The higher the returns to labor and capital in nonfarm employment, the most attractive nonfarm employment will be compared to farming.

These wages and profits are themselves dependent on the demand for goods and services produced by the nonfarm sector. Anderson and Leiserson (1980) identified three sources of demand for rural nonfarm activities: (a) nonfood goods and services for the rural population, which rise with rural income levels ; (b) inputs and services to agriculture which rise with agricultural development; and (c) manufactured and handicraft goods, stemming from external markets in other regions or abroad. An increase in demand from any of these sources directly increases the market and possibly the profit for self employment activities. It also increases the derived demand, and possibly the wage, for labor in those sectors, although the labor demand response of enterprises may also be itself affected by owners' capacity (Randrianarisoa et al., 2009) .

The main capacity variables that affect nonfarm participation are the human, physical and financial capital. Individuals differ in their capacity regardless of the market structure, as we see for example in the difference between educated and uneducated individuals or between individuals who have some startup capital for business and those who do not. The physical and financial constraints are less of a problem in a well functioning market as one can finance a

business by borrowing. However where markets are not functioning, one's human, physical and financial capitals are not easy to augment and become binding constraints. This leads to different outcomes by different individuals facing the same incentives. This capacity limitation restricts resource-poor individuals and households to a few low paying activities, as is observed in many African countries (Reardon, 1997). What is more, according to Barrett, et al. (2005), in rural Africa heterogeneity is not limited to the constraints. There are also differences in the incentives that individuals and households face. Such differences may result from the observable 'spatial variation in transaction costs and gross market prices' and from less observable differences in the shadow prices of factors and goods across individuals. The implication of the heterogeneous incentives and capacities is that different individuals and households face different feasible sets of activities from which they can choose (Barrett et al., 2005). Hence, while those who have more options because of their capacity can choose the activity that maximizes their return and sets them on accumulation path, others who have limited choice in the nonfarm sector but need to complement the insufficient farm income may be relegated to residual activities with very low return and negligible prospects for longer-term accumulation.

Although disaggregating the factors influencing nonfarm participation decision into incentive and capacity variables is very helpful, we have to keep in mind that the distinction between the two is not always clear cut. Some variables such as land can be considered both an incentive variable, indicating farm potential, and a capacity variable indicating wealth. This paper examines how the different forces influence individuals' nonfarm activity choice.

2.2 Literature review

There are several empirical studies on rural income diversification across developing countries. Because the focus of this paper is on the decision to participate in rural nonfarm employment and the choice of nonfarm activity, the relevant literatures are mainly those which deal with determinants of nonfarm employment. Most studies examine the determinants from the supply side (Reardon, 1997). Often such discussions focus on incentive variables with less attention to capacity issues (Reardon et al., 2007). Below we summarize the main determinants of nonfarm participation as identified in several empirical studies. The discussion draws heavily from the review of literature in Africa (Reardon, 1997) and Latin America (Reardon et al., 2001) as well

as studies from three Asian countries- India (Lanjouw and Shariff, 2002) Bangladesh (Deichmann et al., 2009) and China (Shi et al., 2007).

Human capital: An important component of individuals' human capital is education. The impact of education on nonfarm employment is consistent across the regions. Several of the studies document that education increases participation in nonfarm employment and income from it. Recent studies in several African countries¹ also strengthen earlier findings reviewed in Reardon (1997) about the positive impact of education.

The age of the participant or the household head is another component of the human capital indicating work and life experience. Reardon's review of studies in Africa doesn't discuss the impact of age. However, recent studies in Ghana (Abdulai and Delgado, 1999), Tanzania (Lanjouw et al., 2001) and Mali (Abdulai and CroleRees, 2001) show that at younger age, participation increases with age of the individual or the household head (until 30-40 years), after which increase in age is associated with a decline in the probability and level of participation. The same trend holds for India with the negative relation starting only after age 50 while in China age is found to have a negative impact.

Gender of the individual or the household head may also affect participation. Women were found to be less likely to participate in rural nonfarm employment in Tanzania (Lanjouw et al., 2001), China (Shi et al., 2007) and India (Lanjouw and Shariff, 2002). However the findings in Latin America were not conclusive. In the studies reviewed by Reardon et al. (2001), the effect of gender is either not significant or is very different across studies.

Demographic factors: Household labor supply has a positive impact on participation across the studies. However, the presence of children or dependency ratio did not affect participation, even when the study distinguishes between labor supply by husband and wife (Abdulai and Delgado, 1999).

Access to infrastructure and proximity to towns and cities: There seems to be a consensus that participation increases with proximity to cities and towns and with better infrastructure. Reardon,

¹ The studies include Lanjouw et al.(2001) in Tanzania; Abdulai and CroleRees(2001) in Mali; Abdulai and Delgado (1999) in Ghana and Matsumoto et al.(2006) in Kenya, Uganda and Ethiopia.

et al. (2007) argues that sometimes access to urban centers compensates for a lack of private assets such as education. Those individuals' closer to urban centers have a higher probability of getting nonfarm employment and earn more even if they are not educated.

Agroclimatic conditions and the state of agriculture in the region: In Africa, local nonfarm income is higher in more favorable agroclimatic areas while migration is higher in unfavorable areas. Local nonfarm income also increases with the year's rainfall (Reardon, 1997). In Latin America, zones with dynamic agriculture were found to have a higher level of nonfarm income per capita (Reardon et al., 2007). A dynamic agricultural sector has production and expenditure linkages with the nonfarm sector that expand the demand for nonfarm goods and services. A village that has some kind of growth motor, whether agriculture or not, is most likely to see an increase in demand for nonfarm goods and services thereby increase in earnings in nonfarm sector (Reardon et al., 2007).

Farm income and liquidity: Evidences from across studies in Africa suggest that households, who experience a decline in farm income, either temporarily or as a long-term trend, adopt nonfarm employment as an alternative strategy (Reardon, 1997). Land holding, which indicates farming potential, is negatively correlated with the *share* of nonfarm income in Latin America, as those with more land have better farm income (Reardon et al., 2001). However, some of the same studies also found that the *level* of income from RNFE increases with land holdings. This is because land holdings affect not only the incentives but also the capacity to engage in nonfarm employment. Land holdings can increase access to credit, social capital and own-liquidity which are instrumental to access lucrative activities (Reardon et al., 2007). In India, individuals coming from higher land holding households are more likely to participate in nonfarm employment compared to farm wage employment (Lanjouw and Shariff 2002).

Credit market failure, particularly to purchase farm input, may also be one of the reasons individuals want to participate in nonfarm employment. Some studies in Africa document that farm households engage in nonfarm employment to obtain capital for farm investment (Reardon, 1997). While nonfarm activities can be a source of agricultural investment for rural household who have limited access to credit, missing credit markets can also hinder participations in activities that require initial investment (Barrett et al., 2001).

Hypotheses

There are two related hypotheses we want to test in this paper. (1) The returns to nonfarm employment vary markedly across activities. We argue that an activity with high resource requirement gives better returns. This is because in the absence of well developed markets, the high resource requirements serve as entry barrier to help maintain higher returns compared to low input employment, which is relatively open to all individuals and hence involves intense competition that will keep average returns down; (2) the determinants of employment in high-return activities and low-return activities are different. Economic logic implies that high-return activities are attractive for everyone. However, whether or not one engages in such activities depends on the capacity to satisfy the human and financial capital requirements of the activities. Hence capacity variables will be the most important factors for employment in high-return activities. On the other hand, individuals who are willing to work in low-paying jobs must be earning even less from agriculture or need the money from the nonfarm sector for liquidity reasons. Hence the most important determinants will be the push factors.

3. Data and descriptive statistics

3.1. Data

The empirical analysis in this paper is based on the Ethiopian Rural Household Survey (ERHS) data. The paper uses individual level data to analyze activity choice in nonfarm employment. We include only members of the household who are 15 years old and above. From these groups of individuals we excluded members who cannot work because of disability or other health problems. The descriptive statistics are based on this sample of adults, averaging more than 4500 in each survey year. The sample used in the econometric estimation includes only individuals who participated in nonfarm employment or farm wage employment.

Each survey round obtained information on income earned from various activities, including income from nonfarm activities and a set of questions on the individual and household characteristics. Information on wage employment and self employment activities are collected for the past four months. The sampling unit in the surveys is the household. However, for each activity, the labor supply (in days) and the payment received in cash and in-kind is reported at

individual level. In-kind-payments² are converted to their cash equivalent using community level price data collected in the same period.

This is a unique set both in the period it covers and the variation within the sample. However the data also have important limitations. Although the data are rich in covering several topics, they were not collected with the intent of examining rural nonfarm activity. Hence the data miss few important details that interest us. For example, the labor supplied is given in days rather than hours and it was not always fully reported for all participants. In this paper an individual is said to be a participant in rural nonfarm employment if he or she supplied a positive number of labor days to the sector.

We used consumption expenditure and asset values to compare participation by income and wealth. The consumption expenditure variable refers to per capita expenditure on food and nonfood items. Households reported nonfood expenditure for one month. The food expenditure for a month is computed from a one week recall by multiplying the week's expenditure by 4.28. The values of food consumed from own production, in-kind payments and aid are computed using local prices. Consumption expenditure does not include purchases of household durables. For ease of averaging consumption expenditure across years the nominal values are deflated by consumer price index (base year 2000).

The asset variable used in the comparison refers to non-productive assets such as tables, chairs, radio, jewelry etc, so that households are compared on the value of assets they can all potentially own. Moreover, these assets are considered as the most important indicator of wealth in the study area (Bevan and Pankhurst, 1996). The value is based on the households' report on how much the assets will be worth in a local market. This is susceptible to reporting error, but given that we do not have information on asset prices and the details on the state of the respective assets, we believe that households' own evaluation is the best we can do. The asset variable has a positively skewed distribution. The median value of asset owned is ten dollars while five percent of households owned about an average of 460 dollars worth of asset.

² In-kind payments are typically reported in local units. These are converted into metric units using a conversion factor specific to each village that is computed based on the data in the community survey.

3.2. Rural nonfarm employment in Ethiopia: Some descriptive statistics

3.2.1. Definition and typology

The survey identified more than twenty types of nonfarm employment activities. Some of the activities are more common than others. Employment in Food-for-work projects, alternative fuel production³ and petty trade are among the most common nonfarm activities, while very few people participate in traditional medicine or clerical work. There are both demand side and supply side issues at play. It may be possible that a small rural village of 500 households supports only one or two traditional healers or blacksmiths but can support tens of laborers. But, if the returns to labor differ markedly across activities, small number of participants may also signal entry barriers to the more lucrative activities.

To understand the determinants of participation better, we classify activities into different groups. First, using a broad functional classification of RNFE, we distinguish between self employment and wage employment activities. Then activities are further disaggregated into sub-groups based on the resource requirement in the respective activities. While there are different incentives and constraints for participating in different RNFE activities, it is likely that two individuals with the same incentives to participate may face different constraints depending on their human, physical, financial and social resources. The following tabulation shows the grouping between wage and self employment, and sub-grouping within these two based on skills required for wage employment and capital requirements for self employment.

	Low resource requirement	High resource requirement
Wage employment	<i>Unskilled</i> : e.g., food-for-work, other casual labor, working as guards or maid	<i>Skilled</i> : e.g. , teaching, administration, clergy, masonry
Self employment	<i>Low-investment</i> : e.g., homemade food, petty trade, handicraft	<i>High-investment</i> : e.g., livestock trade, transport by pack animals

³ This refers to processing/production of dung cakes, charcoal and fuel wood for sale.

The proficiency required in skilled wage employment may be obtained through formal schooling or through informal training or apprenticeship on the job. In both cases, the skill is acquired over a period of time and involves the investment of time, money and social connections. In self employment, financial resources are the main requirement. In Ethiopia, the difference in capital requirement between the activities grouped in low investment business and high investment business is substantial. The median investment needed to enter into charcoal making, dung cake collection, handicraft production, weaving, or food processing is 0-20 birr (up to US\$3) while for trading livestock, transport services and starting a shop require 300-500 birr (\$45-80) (Dercon, 2002).

3.2.2. Returns from nonfarm employment

Table 1 shows the average daily return for labor in different nonfarm activities. The return from skilled wage employment is about three times as high as the return from unskilled wage employment; and the return for high investment business is twice that of low investment business. Unskilled wage employment is the lowest paying job and its return is the same as the return for labor in farm wage employment.

Averages are highly influenced by extreme values and cannot tell us whether one activity pays better than the other in most cases or if it pays highly only for few but with a very big margin. To investigate this better, we plot the cumulative frequency distribution of income from each of the nonfarm activities and test for first-order stochastic dominance.

As shown in Figure 1, skilled wage employment gives the highest level of income throughout the distribution with the graph much more distinct and further from the next high paying activity- high investment business- in the 60th to 85th percentile range. Both skilled wage employment and high investment business first order stochastically dominate unskilled wage employment and low investment business. The cumulative distributions of incomes from low investment business and unskilled wage employment are not distinct. Hence we cannot rank between the two based on first-order stochastic dominance tests. The two low paying nonfarm activities have a close distribution to farm wage income, however they slightly first order stochastically dominate farm wage income.

From Figure 1, we learn that for any individual maximizing earnings, skilled wage employment is more attractive than all other activities followed by high investment business. Hence, if an individual chooses unskilled wage employment or a low investment business, it must be because they did not have the capacity to engage in better paying skilled wage employment or high investment business. Farm wage labor is the least attractive work in terms of its earnings distributions which helps explain why people routinely try to move into nonfarm employment.

3.3. Participation in rural nonfarm employment

3.3.1. Households

On average 35%⁴ of the households in the panel participated in rural nonfarm employment. Other studies looking into nonfarm employment gave average participation rate different from this and from each other. In Tigray, Woldenhanna and Oskam (2001) reported an 80% rate of participation while in Oromia only 25% participated in nonfarm employment (van den Berg and Kumbi, 2006). The big difference between these rates may indicate the structural difference between the economies in these two agroecologies. There are several food-for-work projects in Tigray that serve as an important source of nonfarm employment. Infact, 58% of the households in the sample in Woldenhanna and Oskam's study were engaged in FFW.

Of those who participate in nonfarm employment activities, 70% participate in self employment and 41% in wage employment. One in six of nonfarm participant households (about 13%) choose both wage and self employment. About 11% of households participated in a portfolio of activities such as combining two types of wage employment, two types of self employment or wage employment and self employment. However, only 5% of nonfarm participant individuals are involved in such a portfolio. This shows household level pluriactivity along with individual level specialization in nonfarm employment.

The literature on nonfarm diversification in Africa documents a positive correlation between wealth or income of households and participation in nonfarm employment, especially with regard to lucrative nonfarm activities (Ellis, 1998, Lanjouw et al., 2001, Reardon, 1997,

⁴ This rate is based on participation by adult members only. The rate based on households' participation regardless of age of participant gives us a higher rate (40%).

Woldenhanna and Oskam, 2001). Table 2 reports households' participation in the different nonfarm employment activities in each consumption expenditure tercile. If we compare the total number of participants in each tercile (the last row in the table) without making any distinction among the different types of activities, we see no positive correlation between nonfarm employment participation and expenditures. Rather, the number of nonfarm participants is higher in the lowest one-third of the distribution.

The activity disaggregated participation numbers reveals a different pattern, however. For skilled wage employment and high investment business, more people in the higher tercile participate while for unskilled wage employment and low investment business, participation decreases as one moves up the expenditure distribution.

The table also shows the average (non-productive) asset holding for households engaged in each activity. We can see that households who participate in the high paying activities have higher asset levels than those in the low paying activities. The average asset holdings of those engaged in skilled wage employment is more than double of those engaged in unskilled wage employment. Hence, in the Ethiopian context, nonfarm participation is not correlated uniformly with income and wealth. It has a positive correlation for skilled wage employment and high investment business and a negative one for unskilled wage employment and low investment business.

3.3.2. Individuals

Because we are examining participation decision by individuals, the units of analysis for the rest of the paper are adult members in the household. There are, on average, three adults per household. While 65% of the households did not have a single member participating in nonfarm employment, for some households more than one adult was involved in the nonfarm sector. Although the proportion of women in the total adult sample is slightly higher than men (51%), their share in rural nonfarm employment is much lower (36%). Women are relatively heavily represented in low paying activities. Almost half of the participants in low investment business are women, compare to only 7% in skilled wage employment.

Occupation versus participation in nonfarm employment

In terms of vocation, the majority of adults are either primarily farmers (36%) or home makers, who take care of the household chores and may sometimes help in the farm (40%)⁵. Only around six percent of individuals reported that their primary occupation is in a nonfarm sector. As Table 3 shows the most common nonfarm occupations are: trade, manual labor, craftsmanship and business in homemade food and beverage. Although only six percent of individuals have a nonfarm primary occupation, the share of participants in nonfarm employment in any year is typically higher. On average, 13% of adults in the sample participated in nonfarm employment. In developing countries, participation figures for nonfarm activities are typically higher than the corresponding employment figures based on occupation (Anderson and Leiserson, 1980, Winters et al., 2009). This discrepancy is because of two reasons. First, nonfarm employment is a secondary occupation for many individuals who engage in nonfarm activities seasonally or as part-time job. Second, individuals' decision to participate in nonfarm employment in a particular year may differ from their long run occupational choice. For example, an individual who is a farmer or a student by vocation may decide to participate in nonfarm wage employment in a particular year because of an agricultural shock that affected the household income.

Participation by employment type

The number of participants in each year in the different nonfarm activities and the relative share of each activity in total nonfarm employment are given in Table 4. The greatest participation, more than half, is in low investment business, followed by unskilled wage employment. The employment share of high investment business and skilled wage employment is less than 10 percent each. The ranking of activities based on returns as given above is inversely related with the ranking based on employment share. The employment share of the highest paying activity (skilled wage employment) is about one-fifth of the employment share of the least paying activity (unskilled wage employment). The two least paying activities account for 88% of nonfarm employment.

In the six rounds of the survey, the least number and share of adult participation is observed in 1997, corresponding to low participation rate in unskilled wage employment and low investment

⁵ More than 93% of the self identified farmers are men and almost all of the home makers (about 98%) are women.

business. The year 1997 brought good rainfall compared to the other periods. The fact that participation did not decline in high investment business and actually increased in skilled wage employment when the low paying activities show a marked decline in this period indicates that push factors are the driving force behind participation in low return activities. When on-farm agricultural returns are good, rural Ethiopians rely less on low-return nonfarm activities.

Some individuals participated in more than one type of nonfarm activities. Table 5 gives the proportion of individuals in each type of nonfarm employment that participated in multiple activities. Compared to other activities, more individuals in high investment employment engage in multiple nonfarm activities even though fewer individuals engage in high investment business itself. It seems that once an individual decides to engage in high investment business, there may be economies of scale or scope that makes a portfolio of activities more attractive than pure specialization. Moreover, compared to skilled wage employment (the activity with the second highest share in multiple activity), high investment business may be less structured in its time demands. Another reason may be related to capacity. A person who has the financial resources to engage in high investment business will also be able to participate in other activities. In Kenya, for example, wealthier households were found to engage both in low-return and high-return activities while the poor engaged only in low-return activities (Lay et al., 2008). The fact that low investment business is the main nonfarm activity simply reflects its low resource requirement.

4. Econometric model

We formulate an individual's choice among alternative employment options in a random utility framework. Let U_{ijt} denote, utility of individual i associated with an employment activity j at time t . The random utility model assumes that utility is a random function, either because of imperfect optimization by the individual or because the analyst has incomplete information (Maddala, 1983, McFadden, 1973, 1974). Hence utility U_{ijt} is given by:

$$U_{ijt}^* = \mathbf{X}_{it}' \beta_j + \varepsilon_{ijt} \quad (0.1)$$

\mathbf{X} is a vector that denotes characteristics of individuals (age, sex, education etc) which vary across individuals and over time. The coefficients are different for each alternative. The error

term ε_{ijt} reflect uncertainty in the random utility model. Given, this latent variable, we can define an indicator variable D which links the expected utility from different activities with the employment choice made. For each individual i and activity j , the indicator variable D_{ijt} is observed.

$$\begin{aligned} D_{ijt} &= 1 \text{ if } j = \arg \max U_{ijt}^* \in \{U_{i1t}^*, U_{i2t}^*, \dots, U_{ij_t}^*\} \\ D_{ijt} &= \textit{Otherwise} \end{aligned} \quad (0.2)$$

What we are eventually interested in is how a change in the independent variables affects the activity choice. If we assume that the error terms are independently and identically distributed with a type I extreme-value distribution, we get the choice probability model. According to McFadden (1973), only the i.i.d., type 1 extreme value (Gumbel) distribution produces a probabilistic choice model that is consistent with utility maximization. And the resulting choice model is multinomial logit model. Our panel multinomial logit model can be given as:

$$pr(Y_{ikt} = 1) = \frac{\exp(\mathbf{X}_{ikt}' \beta_j + \mathbf{Z}_{kt} \mu_j + \alpha_i + \eta_k)}{\sum_{j=1}^5 \exp(\mathbf{X}_{ikt}' \beta_j + \mathbf{Z}_{kt} \mu_j + \alpha_i + \eta_k)} \quad (0.3)$$

X_{ikt} refers to characteristics of individual i in household k at time t (gender, age, education etc.). Some of these variables, such as gender, are time invariant and others, such as age are time varying. The vector Z_{kt} refers to household level variables (land owned, total labor endowment, etc.). The terms α_i and η_k capture unobserved individual and household heterogeneity, respectively. The unobserved effects are assumed to have each a normal distribution and to be mutually independent, and independent of the error term. We estimate the occupational choice model for individuals who work off-farm. We have four choices in nonfarm employment: nonfarm skilled wage employment, nonfarm unskilled wage employment, high investment business, low investment business. A fifth choice-farm wage employment-is used as a comparison. In estimating a multinomial logit model, the coefficient vector and heterogeneity term of the base category has to be set to zero for identification of the model. We used farm employment as the base category so that all nonfarm occupations will be compared with the alternative off-farm employment in the rural economy.

Because the marginal likelihood of such models does not have a closed form, and hence no analytical solution, the maximum likelihood estimation typically involves integral approximation, in our case by Gauss-Hermite quadrature. Our model is estimated using the STATA program GLLAMM⁶.

Variables in the empirical model

In line with the theoretical discussion above, we included two sets of explanatory variables for estimation: incentive variables and capacity variables. It is not easy to get several variables that directly represent the incentive factors. This is because the price data in nonfarm employment are not typically available and many of the individual and household level variables that reflect the push factors, such as farm income, asset holdings and credit, may be endogenous. Having said that, we discuss below the variables we have chosen at a household and village level that directly or indirectly capture the pull and push factors. Table 6 provides exact definitions and descriptive statistics of all of these variables.

At a household level we include the land holdings⁷ both as an incentive and a capacity variable. Land holdings capture food sufficiency in farming whereby household with more land can more easily live on the output and income from farming. Hence, we expect land holdings to be negatively associated with participation in nonfarm employment. However, because land holdings also indicate wealth, higher land holdings may be associated with better access to capital which increases the capacity to participate in nonfarm employment, especially self employment. Larger land holdings may also be associated with higher crop income, which can help finance startup capital. Reardon et al. (2007) termed this opposing effect of land on nonfarm participation, ‘micro paradox’. We may get different impacts at different land holding levels because either the incentive effect or the capacity effect dominates. We include both land per capita and the squared term to allow for a nonlinear relation.

At a village level, the incentive variables include rainfall level and variability, household average consumption expenditure, population density and a dummy variable for villages with net

⁶ See appendix for further discussion.

⁷ Land holding can be considered exogenous since purchase and sale of land is illegal in Ethiopia (the state owns the land) although one may cultivate more or less than they ‘own’ through different rent arrangement.

immigration. We expect individuals in agriculturally favorable areas with high rainfall and low output risk (as captured by rainfall variability) to have less incentive to participate in nonfarm activities. High consumption expenditure reflects the purchasing capacity in the village, hence the demand for nonfarm goods and services, as well as the capacity of individuals coming from this village to satisfy the resource requirements in nonfarm employment. Hence it can be expected to have a positive influence on nonfarm participation. On the other hand, individuals in rich villages may have less (push factor) incentive to engage in nonfarm activities, particularly in low paying activities. The effect is ambiguous for low paying activities but for high paying activities, it can be expected to have a positive effect. We expect individuals coming from village with positive net immigration to be more likely to participate in nonfarm employment because of increased land pressure. The impact of high population density is to increase likelihood of participation in nonfarm employment. It may be interpreted as a push factor if land fragmentation reduces agricultural production or a pull factor if we consider the market potential associated with densely populated areas. Or it may be that both factors are at work.

The capacity variables include: the number of adults in the household, education variables and distance to the nearest town. We have four education dummies: informal literacy, literacy through less than six years of formal schooling, elementary education and high school education or above. The comparison group has no education. We expect all types of education to have a positive impact on nonfarm employment participation. Education increases the willingness and the ability to supply labor to nonfarm employment. Education improves the value of labor of the educated individual making it more costly for the household to keep it at home or in low paying farm employment, and it increases the individual's potential to acquire and utilize relevant employment information. Education also increases access to nonfarm employment by signaling higher labor productivity and by improving individual's network potential. This is true even for unskilled employment because education may be used as a selection mechanism to ration jobs in a situation where there are fewer jobs than potential workers. We expect that the impact of education will be more pronounced as one move up the education ladder.

Access to education and particularly high school education is poor in rural Ethiopia. One in five villages has no school at all and only one of the villages in the whole sample has a high school. This implies that going to school involves long distance walk (from 2-25km) or staying in town

(boarding in group). This puts girls in the disadvantaged position not only because long distance walks and staying away from family are frowned upon but also because compared to boys and men, women and girls spend more time working at home with less time for schooling. Only 18% of all adult women in the sample have some level of formal education compared to almost 40% of men. We include multiplicative term between gender and education, to test whether formal education has additional impact on women.

Individuals coming from households with larger adult labor supply are expected to be more likely to participate in nonfarm employment because of the possibility of other members sharing or fully taking care of the farming and household responsibilities (Barrett and Clay, 2003). Distance to the nearest town captures both the effect of transaction cost and access to wider markets. Individuals who live closer to urban centers have relatively lower job search cost and have access to a wider market if they own a business. We also include multiplicative term between education and distance in order to see if education differentially affects the prospects of individuals who come from villages far from town centers.

The individual level characteristics include: age, gender, and dummies for student and head. We also included age-squared to capture potential life cycle effect. Theory and literature does not suggest a particular direction for the impact of age and gender on RNFE. It may be that age, as an indirect measure of experience, increases access to nonfarm opportunities. On the other hand, as individuals in a farm household get older, they may have less interest in nonfarm employment. With regard to gender, Ellis (1998) argues that women have less access to nonfarm employment than men. This is either because of a direct cultural prohibition to engage in certain activities or an indirect limitation through less time available for women who are busy with domestic duties. However, the participation outcome may also depend on the type of employment examined. It may be easier, for example, for women to combine domestic activities and business in food and beverage production, while the same cannot be said about casual off-farm labor, hence the effect is ambiguous.

To control for the possibility of seasonality influencing the participation pattern observed in the different rounds, we include a 'survey date' variable which indicates the time gap between the peak rainy season and the survey dates for each village in each round. We also include time

dummies, round2-round6, corresponding to the different years of the survey for a time-fixed effect.

5. Estimation results and discussion

The estimation results from the random effects multinomial logit model are given in Table 7. Our estimation controls for heterogeneity both at individual and household levels⁸. We found significant unobserved individual and household heterogeneity. The intra-class correlations at individual and household levels are respectively, 0.6 and 0.34. In a multinomial model, the parameter estimates on choice j are interpreted as the change in the log-odds between the outcome j and the base category for a unit change in the predictor given other variables in the model are held constant. The magnitude of coefficients in a multinomial model are difficult to interpret directly (Wooldridge, 2002), but the sign and size of the coefficients will be enough for our purpose to compare the relative importance of explanatory variables in influencing choice outcomes. For example the log-odds for skilled wage employment relative to farm wage employment are 4.4 higher for individuals with high school education compared to those who have no education. The log-odds are only 1.1 higher for those with less than six years of schooling⁹.

If we compare the size of coefficients and significance level of explanatory variables across functional classification, we see some general differences between wage and self employment. Wealth, as given by land holdings, has more impact on self employment than on wage employment indicative of the importance of access to start up capital for self employment. Agroecological variables are also more important in self employment which shows the importance of farm-nonfarm linkages. On the other hand, education is more important in wage employment than self employment.

Within wage employment, there are differences between skilled and unskilled wage employment. In skilled wage employment, the coefficients on all types of education are positive

⁸ To test for robustness, we estimate a pooled multinomial logit that control for clustering at individual level. The results were generally very similar to the results reported here. But because we sacrifice the panel controls in the pooled model, the model underperforms the panel multinomial.

⁹ One can also report this in terms of odds ratio (e^{β_j}) which show the proportionate change in relative risk of choosing activity j rather than farm wage when x_i changes by one unit.

and statistically significant with the impacts increasing as one move from literacy up through secondary education. Education positively influences participation in unskilled wage employment too but only for those who have at least completed elementary education. Even then, the coefficients are much smaller than those in skilled wage employment. Women are more likely to participate in unskilled wage employment while gender does not affect participation in skilled wage employment. On the other hand, the interaction term between gender (female=1) and formal education is positive and significant for skilled wage employment indicating that the impact of formal education on participation in skilled wage employment is higher for women than men. There is no equivalent gender premium to education's effect on participation in other nonfarm employment activities. Land holdings positively influences participation in skilled wage employment. This shows that those who have the capacity to accumulate human capital and cover the transaction costs related with job search and employment are better positioned to engage in skilled wage employment. At very high levels of land holding, however, households may choose to specialize on farming. Unskilled wage employment is not affected by land holding.

Agroecology does not affect skilled wage employment, indicating that skilled wage employment does not respond to what happens in the agricultural sector. On the other hand unskilled wage employment responds negatively and significantly to mean rainfall. Individuals who live in places with good agricultural potential are less likely to participate in unskilled nonfarm wage employment as are individuals who come from well-off villages. Both of these refer to push factors. The immigration variable, which indicates the dynamism of the village, is positive and significant for skilled wage employment which may result from a demand side effect where a dynamic economy has more skilled job, or a supply side which indicate that there will be more skilled people in such villages. Unskilled wage employment fluctuates across the years while skilled wage employment does not. The log-odds of participating in unskilled wage employment is higher most of the years compared to the reference period (1997) which had better agricultural performance because of good rainfall. Individuals are also more likely to be observed in unskilled wage employment, the further is the survey from the peak rainy season. Both of these indicate that participation in unskilled wage employment is more likely when agriculture is not doing well. None of these are significant for skilled wage employment.

To summarize the determinants of skilled versus unskilled wage employment, we found that determinants of participation in skilled wage employment are dominated by capacity variables while unskilled wage employment is dominated by incentive variables and particularly those related to push factors.

Similarly, there is some difference between the determinants of the two types of self-employment. Age is important in self employment indicative of the relevance of experience in business activities. However, there is higher threshold for high investment business (43) than low investment business (26). Education positively influences participation in self employment. While only high school education is significant in high investment business, in low investment business individuals who completed elementary education are also more likely to participate. Students are less likely to participate in high investment business while individuals who come from household with more adult labor are more likely to participate. Both of these indicate the higher time demands in high investment business in terms of time and experience. One of such activities, cattle trade, may involve being away from the village for several days.

Initially, participation in both types of self employment increases with land holdings. Households with relatively smaller land holding and those with limited farm income seek to diversify into nonfarm employment; for such households an increase in land holding indicates an increase in wealth which will enable them to obtain the capital necessary to engage in nonfarm employment. The negative coefficients on land square imply that at very high level of land holdings households afford to participate in nonfarm employment but may choose to specialize in farming.

Individuals, who live in agriculturally risky areas, as captured by the variance of rainfall, are less likely to participate in both high investment business and low investment business relative to farm wage employment. This may indicate the importance of farm-nonfarm linkages. The main self employment activities- food processing, grain trade, millings depend on agriculture for both input supply and consumer demand. Unreliable input supply and unstable output demand is not conducive for business activities. Surprisingly, high investment business also responds negatively to mean rainfall. The negative coefficient may indicate that in agriculturally favorable areas those capable of participating in high investment business may specialize in farming. The

coefficient for population density, which captures farm land scarcity in the village (push factor) but at the same time reflects the market potential for products and services produced by the nonfarm sector (pull factor), is positive and significant for high investment business. Individuals coming from a village with net immigration are less likely to participate in low investment business relative to farm wage employment probably because the village is exposed to more competitive products from urban areas. Relative to the reference year, participation in low investment business is higher in three of the five years indicating fluctuation as a response to agricultural production.

Comparing the determinants of the high and low investment business, we see that although incentive variables are important in both types of self employment, determinants of high investment business are dominated by capacity variables.

The factor that has a consistent impact across all nonfarm activities is education. Education positively influences participation in nonfarm employment relative to farm wage employment. This is in line with earlier findings in several developing countries as discussed in the literature review. The differential impacts of education by gender we have found for skilled wage employment have also been documented in some other countries. In comparing nonfarm participation by married men and women in Ghana, Abdulai and Delgado (1999) found that the marginal effect of a year of female schooling is higher for women than men. In Mexico de Janvary and Sadoulet (2001) found a larger nonfarm participation-inducement effect of education for women. We have also found that controlling for other factors women are significantly more likely to participate in low-paying nonfarm activities. This may be a result of the low entry barrier in terms of skill and capital in those occupations that makes them accessible to women. This finding is also consistent with results from Ecuador (Lanjouw, 1999) and Brazil (Ferreira and Lanjouw, 2001).

6. Conclusion and policy implications

This paper examined the different incentives and constraints that guide individuals' choice of nonfarm employment activities in Ethiopia. By disaggregating nonfarm employment into different types of wage employment and self employment, we were able to test whether the factors affecting participation differ among alternative nonfarm activities. The use of panel data

allowed us to control for unobserved heterogeneity both among households and among individuals within households.

We found that activities with higher resource requirement- skill wage employment and high investment business- yield more attractive returns per unit of labor. On the other hand these activities employ far fewer individuals. There appear to be important entry barriers to accessing the most attractive occupations in rural Ethiopia. We also found that women were more likely to participate in unskilled wage employment and low investment business, the nonfarm sectors with the lowest entry barriers.

We also found that the most important determinant of nonfarm participation is education. Educated individuals are more likely to participate in all types of nonfarm employment. But especially for skilled wage employment, education matters enormously and it has even more impact on participation of women.

When we compare determinants across different types of nonfarm employment, we can see that determinants of participation in low return activities is dominated by push factors such as low or insufficient income. And participation in high paying activities is dominated by capacity variables such as education and labor availability.

Our findings on the determinants of high paying activities versus low paying activities imply two paths for nonfarm participants. Those who are employed in unskilled wage employment and low investment business earn returns close to farm wage employment. They choose these activities for survival reasons. Because they are not likely to save and accumulate much from their nonfarm income, *ceteris paribus*, these activities remain the only nonfarm employments to which they have easy access. On the other hand, those who have the capacity to engage in high-paying activities such as skilled wage employment enjoy superior returns and put themselves on an accumulative path. Hence policies that seek to promote RNFE as a way out of poverty should recognize the different types of activities with different outcomes. Enhancing the asset endowments and particularly education may improve the poor's access to nonfarm employment activities that provide upward mobility.

*Table 1: Daily returns for labor in RNFE (in Birr)**

RNF activity	Mean	Std. Err.
High investment business	20.2	6.5
Skilled wage employment	15.1	2.5
Low investment business	8.9	0.8
Unskilled wage employment	5.4	0.7

*This refers to real daily income in 2000 prices. The average is calculated for the pooled data but standard error is controlled for clustering.

Table 2: Households' nonfarm participation by expenditure tercile and wealth tercile

Type of nonfarm employment	Lowest (2838)	Middle (2838)	highest (2837)	Employment share	Value of assets	
					mean (Birr)	Std.Err
Skilled wage employment	81	80	111	0.09	539.9	173.0
High-investment business	126	133	157	0.13	362.5	98.3
Low-investment business	783	639	561	0.64	305.3	28.4
Unskilled wage employment	436	370	301	0.36	113.4	23.5
RNFE participant	1183	1034	920	1*	273.5	23.7

The number of participants and the shares are based on the pooled sample. The values of assets refer to initial level of asset (1994a). *The column sum is not equal to one because some of the households participated in more than one activity.

Table 3: Number of adults whose primary occupation is a nonfarm employment

Type of RNF occupation	1994 ⁺	1994 ⁺⁺	1995	1997	1999	2004
Trader	128	127	130	104	57	79
Construction worker (Builder/Mason/Carpenter, etc.)	38	39	39	32	44	49
Craft worker/Potter	38	39	40	35	14	24
Homemade food & beverage Production and sale (<i>Tella/Tej/Injera</i>)	36	37	38	27	12	6
Soldier	29	30	30	8	5	2
Party official/Administrator/Clerical	17	17	17	7	3	13
Skilled (factory) worker	16	17	17	10	7	1
Teacher	16	18	18	11	6	6
Weaver	12	12	12	15	6	1
Driver/Mechanic	10	10	10	4	3	2
Blacksmith	4	4	4	4	3	5
Health worker	2	2	2		1	1
Others	8	9	11	8	26	25
Number of adults with nonfarm occupation	354	361	368	265	187	214
Share of adults with nonfarm occupation	0.07	0.08	0.08	0.06	0.04	0.05

+, ++, 1994a and 1994b refer to the two rounds in the early and later part of the year in 1994, respectively.

Table 4: The number of nonfarm employment participants by type of activity and year

	Skilled wage employment	Unskilled wage employment	High investment Business	Low investment business	Multiple activities	Proportion of participants in RNFE*
Survey year						
1994a ⁺	44	227	46	582	16	0.18
1994b ⁺⁺	46	192	65	334	29	0.13
1995	44	236	45	276	22	0.12
1997	58	112	60	145	8	0.08
1999	44	208	45	381	47	0.14
2004	16	229	51	276	60	0.14
Panel average						0.13
Number	42	201	52	332	30	
As share of RNFE	0.07	0.33	0.09	0.55	0.05	

+, ++, 1994a and 1994b refer to the two rounds in the early and later part of the year in 1994, respectively.

*the sample is total number of adults in the work force.

Table 5: Proportion of participants in multiple nonfarm employment: by type of nonfarm activity

Type of nonfarm employment	Proportion of individuals who have also participated in:				
	Skilled wage	Unskilled wage	High investment business	Low investment business	Multiple employment
Skilled-wage employment		0.02	0.02	0.08	0.12
Unskilled-wage employment	<0.01		0.01	0.10	0.11
High-investment business	0.01	0.05		0.14	0.20
Low-investment business	0.01	0.06	0.02		0.08

Table 6: Variable descriptions

Variable	Description	Mean*	Std.Dev
Age	Age of the individual	37.67	14.09
Female	male=0, female=1		
Informal literacy	individual got the education from religious training or literacy programme=1, =0 otherwise	0.06	0.24
Formal schooling	The individual has gone to school but did not complete elementary school=1, =0 otherwise	0.18	0.38
Elementary/Junior high	The individual finished elementary school (six years) and may have attended Junior high school(grade 7 & 8) =1, =0 otherwise	0.10	0.30
High school /above HS	The individual has attended a high school or above	0.05	0.23
Household head	the individual is household head	0.62	0.49
Student	the individual is a student	0.03	0.16
Land pc	Per capita land holding in hectares	0.25	0.38
Adult members	the number of adult members of the household	3.40	1.96
Distance to town	Distance to the nearest town from the village (in Km)	10.56	6.80
Rainfall CV	Variability of rainfall in the village. Coefficient of variation	0.20	0.09
Rainfall Mean	Mean village rainfall (based on 1995-200 data)	1061.79	264.33
Village cons. expenditure	the average household consumption expenditure (in Birr) in the village	426.09	228.68
Net immigration	=1 for villages with more people moving in to the village than leaving, =0 otherwise	0.30	0.46
Population density	population density in 1994 in the district	192.01	109.24

*N=2460 for all except adult members (2452) and land pc (2447)

Table 7: Estimation result for multinomial logit model: A three level random intercept model

Coefficients	Skilled wage employment		Unskilled wage employment		High investment business		Low investment business	
	Coefficients	p-values	coefficients	p-values	coefficients	p-values	coefficients	p-values
Age	0.102	0.109	-0.040	0.430	-0.086	0.145	-0.052	0.287
Age2	-0.001	0.327	0.001	0.367	0.001	0.092	0.001	0.097
Female	-0.566	0.499	1.853	0.000	0.588	0.300	2.751	0.000
Informal literacy	1.114	0.061	0.255	0.641	-1.317	0.142	0.496	0.359
Formal literacy	1.548	0.027	0.815	0.170	0.343	0.609	0.812	0.160
Elementary/Junior high	2.534	0.000	1.674	0.006	0.699	0.320	1.661	0.006
High school /above HS	4.436	0.000	2.387	0.003	1.576	0.078	2.366	0.003
Household head	-0.119	0.789	0.184	0.624	0.695	0.122	-0.071	0.848
Student	-0.479	0.578	-0.746	0.288	-1.678	0.090	-0.796	0.250
Land per capita	1.810	0.032	0.284	0.703	2.274	0.020	2.340	0.001
Land pc2	-0.812	0.023	-0.423	0.189	-1.410	0.011	-1.167	0.000
Adult members	0.047	0.590	0.090	0.240	0.168	0.050	0.103	0.169
Distance to town	0.054	0.176	0.051	0.108	-0.014	0.702	0.037	0.228
Rainfall, CV	-3.382	0.121	-0.699	0.711	-8.327	0.001	-12.615	0.000
Rainfall, Mean	-0.001	0.159	-0.002	0.004	-0.002	0.046	0.000	0.772
Average consumption exp.	0.000	0.816	-0.001	0.041	0.001	0.216	0.000	0.675
Net immigration	0.934	0.022	0.250	0.480	0.369	0.370	-0.934	0.008
Population density	0.001	0.770	-0.002	0.400	0.006	0.004	0.001	0.546
Female X schooling	3.528	0.028	1.416	0.300	1.561	0.319	1.459	0.278
Distance X schooling	-0.048	0.381	-0.040	0.384	0.046	0.398	-0.008	0.851
Survey month	0.019	0.834	0.191	0.013	-0.107	0.254	-0.054	0.472
R1(1994a)	-0.330	0.521	0.632	0.140	-0.841	0.110	0.725	0.078
R2(1994b)	-0.468	0.342	-0.517	0.220	0.011	0.983	0.613	0.147
R3(1995)	0.374	0.509	1.837	0.000	-0.119	0.830	0.751	0.100

R5(1999)	0.310	0.478	1.052	0.005	0.333	0.445	1.321	0.000
R6(2004)	-0.839	0.149	1.713	0.000	-0.292	0.566	0.710	0.098
Constant	-2.366	0.222	3.566	0.023	2.123	0.240	3.191	0.037

Random Intercept

Variance: individual effect $\hat{\psi}^{(2)} = 2.15(1.00)$

Variance : Household effect $\hat{\psi}^{(3)} = 2.76(0.96)$

Intra-class correlation:

Individual-level $\rho^{(iid)} = 0.60$

Household-level $\rho^{(hid)} = 0.34$

Log likelihood -2489.77

$$\rho^{(hid)} = \frac{\hat{\psi}^3}{\hat{\psi}^2 + \hat{\psi}^3 + \pi^2/3}, \quad \rho^{(iid)} = \frac{\hat{\psi}^2 + \hat{\psi}^3}{\hat{\psi}^2 + \hat{\psi}^3 + \pi^2/3}$$

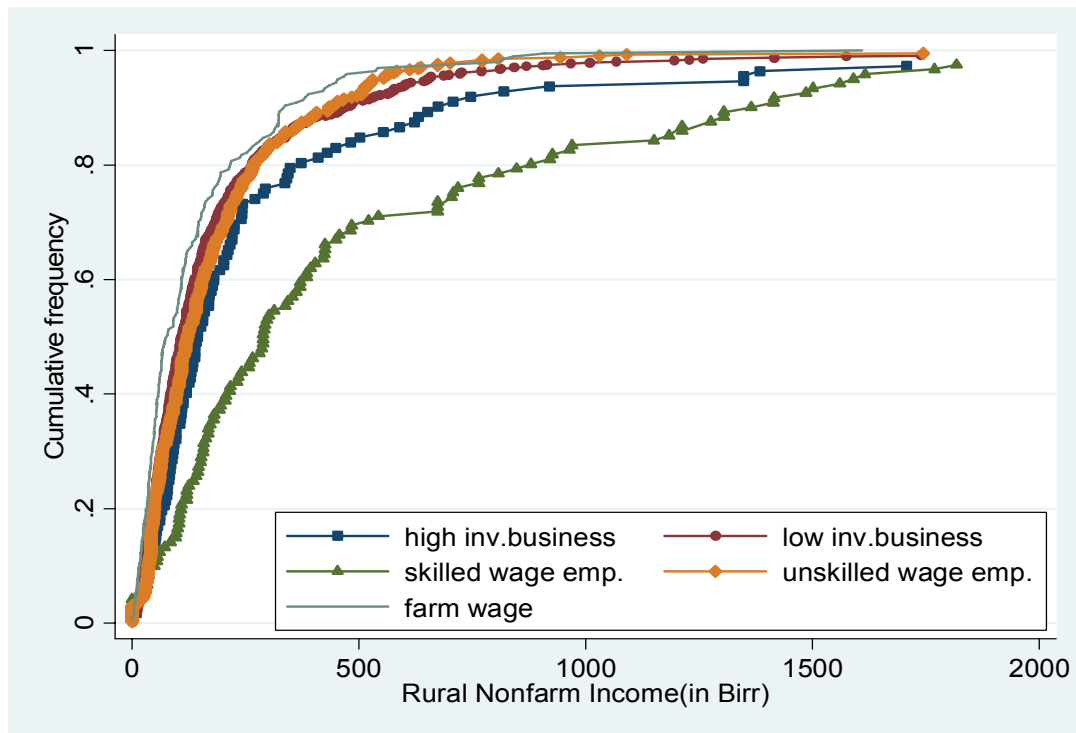


Figure 1 Comparison of income from off-farm activities

Appendix

Estimation procedure

The Stata routine used to estimate our model, **gllamm**, implements maximum likelihood estimation and empirical Bayes prediction for many kinds of generalized linear mixed models with latent variables (Rabe-Hesketh et al., 2002, Rabe-Hesketh et al., 2004). The marginal log-likelihood in a model like ours can be obtained using numerical integration by Gauss Hermite quadrature or adaptive quadrature. Gauss-Hermite quadrature approximates the integral by a specified number of discrete points. Adaptive quadrature is a Bayesian method that extends Gauss Hermite quadrature by making use of the posterior distribution of the unobserved heterogeneity.

The numerical integration and numerical derivation can be very slow when there are many latent variables in the model, many quadrature or free mass-points, many parameters to be estimated and many observations. Roughly, execution time is proportional to the number of observations and the square of the number of parameters. Performance of adaptive quadrature is much better than ordinary quadrature, particularly for large cluster sizes and large intra-class correlations. Furthermore, adaptive quadrature usually requires fewer quadrature points than ordinary quadrature to obtain the same precision (gllamm manual).

Estimation time

Our model has a fairly large number of observations (about 2500) and more than 20 explanatory variables, including the year dummies. It is a three level model with unobserved heterogeneity at individual and household levels. The estimation can take weeks to converge. Before we estimate the full model, we started out with simple models with fewer basic covariates and fewer quadrature points to see how the efficiency as well as the computational time changes with a more complete specification (see Table A.3). In comparing the coefficients and the likelihood between the estimates, we see that the estimates based on the Gauss Hermite quadrature with 7 quadrature points and 10 quadrature points are close. The results from estimation with 4 quadrature points are somewhat different but not very far off. In all the three cases, the sign, relative magnitude

and the statistical significance level of the coefficients are the same. Adaptive quadratures are generally considered to have higher accuracy. We also estimated the same model using adaptive quadrature. We estimated the adaptive quadrature using 7 quadrature points. The estimation took 30 hours to converge, more than seven times the time it takes the ordinary 4 quadrature to solve and double that of ordinary quadrature with 7 quadrature points. However the efficiency gain was not as great as the computational cost.

We estimate our full model with 25 explanatory variables using Gauss Hermite quadrature with 7 quadrature points. We control for heterogeneity both at an individual and household level. The estimation took nine days to converge.

Table A1: Comparison of random intercept models estimated using Gauss-Hermite quadrature and Adaptive quadrature

Quad. Points Time (hours: minutes) Loglikelihood	Gauss Hermite Quadrature				Adaptive Quadrature				
	4 04:36 -2915.193	7 17:21 -2915.45	10 31:05 -2915.324	7 29:47 -2915.34	10 43:15 -2915.34	Coefficient	Std.D	Coefficient	Std.D
Skilled wage employment									
Gender (=1 female, 0 otherwise)	-0.556	-0.595	-0.599	-0.599	-0.597	0.552	0.552	-0.599	0.552
Age of individual	0.026	0.023	0.023	0.023	0.023	0.012	0.012	0.023	0.012
Individual is household head	-0.353	-0.292	-0.300	-0.301	-0.301	0.387	0.389	-0.301	0.389
Land holdings per capita	0.417	0.396	0.400	0.401	0.401	0.351	0.354	0.401	0.353
Household size	0.084	0.050	0.051	0.051	0.051	0.051	0.051	0.094	0.051
Distance to town	0.041	0.025	0.025	0.041	0.041	0.025	0.025	0.041	0.025
constant	-1.002	-1.076	-1.058	-1.060	-1.062	0.614	0.618	-1.062	0.617
Unskilled wage employment									
Gender (=1 female, 0 otherwise)	1.850	1.810	1.807	1.806	1.808	0.357	0.359	1.806	0.359
Age of individual	0.014	0.011	0.011	0.012	0.012	0.010	0.010	0.012	0.010
Individual is household head	-0.182	-0.120	-0.128	-0.128	-0.128	0.333	0.335	-0.128	0.335
Land holdings per capita	-0.938	-0.957	-0.953	-0.952	-0.952	0.346	0.349	-0.952	0.348
Household size	0.012	0.045	0.022	0.022	0.022	0.045	0.046	0.022	0.046
Distance to town	0.102	0.103	0.102	0.102	0.102	0.023	0.022	0.102	0.022
constant	0.553	0.480	0.497	0.495	0.493	0.544	0.547	0.495	0.546
High investment Business									
Gender (=1 female, 0 otherwise)	0.076	0.036	0.032	0.032	0.034	0.486	0.488	0.032	0.488
Age of individual	0.004	0.002	0.002	0.002	0.002	0.012	0.012	0.002	0.012
Individual is household head	0.287	0.347	0.339	0.339	0.339	0.392	0.393	0.339	0.393
Land holdings per capita	-0.060	-0.081	-0.077	-0.076	-0.076	0.390	0.392	-0.076	0.392
Household size	0.110	0.119	0.120	0.120	0.120	0.050	0.050	0.120	0.050
Distance to town	0.023	0.024	0.023	0.023	0.023	0.025	0.025	0.023	0.025
constant	-0.503	-0.577	-0.560	-0.562	-0.563	0.609	0.613	-0.562	0.611
Low investment Business									
Gender (=1 female, 0 otherwise)	2.247	2.208	2.204	2.204	2.206	0.350	0.353	2.204	0.353
Age of individual	0.019	0.016	0.017	0.017	0.017	0.010	0.010	0.017	0.010
Individual is household head	-0.420	-0.358	-0.366	-0.367	-0.367	0.326	0.327	-0.367	0.327
Land holdings per capita	0.441	0.303	0.425	0.426	0.426	0.306	0.308	0.426	0.308
Household size	0.073	0.044	0.083	0.083	0.083	0.044	0.044	0.083	0.044
Distance to town	0.074	0.022	0.075	0.074	0.075	0.022	0.022	0.074	0.022
constant	0.519	0.548	0.463	0.461	0.459	0.532	0.536	0.461	0.535

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PAPER II





Can food-for-work encourage agricultural production?

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ABSTRACT

Food-for-work (FFW) is the most widely used type of public works program in Ethiopia through which a high share of the food aid is distributed. This paper assesses the impacts of FFW in Tigray, a chronically food insecure region in Ethiopia, in terms of relieving liquidity constraints and thereby improving input use in agriculture. A Heckman selection model on the adoption and intensity of fertilizer use demonstrated that FFW positively influenced the decision to adopt fertilizer and there was no evidence of disincentive effect.

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Introduction

Ever since [Schultz \(1960\)](#) discussed the theoretical possibility of food aid causing disincentive for farmers through the price mechanism, much of the discussion and debate in the food aid literature focused on whether or not food aid has a disincentive effect. Although the empirical evidence is not yet conclusive, there are more and more evidences emerging to suggest that in a developing country context with significant market imperfections, it may not be even the right question. It may well be more relevant to ask whether or not food aid help improve agricultural production.

We explore this issue using household survey data from Ethiopia, which has been among the leading recipients of food aid. In 2005, Ethiopia received 24% of World Food Programme's and 27% of global food aid to Sub-Saharan Africa ([WFP, 2006](#)). A large portion of the food aid in Ethiopia is distributed through food-for-work (FFW) projects. These are public works projects where participants supply a certain amount of labor in exchange for the food aid received. As a policy, no able-bodied person in Ethiopia gets free food aid and the government has decided to channel 80% of its food assistance resources through FFW projects ([FDRE, 1996](#)). This paper therefore focuses on FFW as a specific type of food aid.

The benefits of FFW to the poor households can go beyond increased food consumption from the food transfers and improved productivity from the physical assets constructed. Income from

FFW can relax an important limitation for rural households: the liquidity constraint. The fact that rural economies of developing countries are affected by pervasive market imperfections is now widely accepted. Missing credit and insurance markets prohibit liquidity constrained household from investing in agriculture ([Holden and Binswanger, 1998](#)). If a FFW job is additional, it can relieve the liquidity constraint of participants and thereby enable farm households, who are both producers and consumers, to purchase more inputs.

Using survey data from one of the poor and drought-prone regions in Ethiopia, we test the hypotheses that FFW encourages adoption of fertilizer. We are not aware of any similar studies before. The results from the Heckman selection model showed a positive impact of FFW in the adoption of fertilizer and there was no evidence of disincentive effect to farming due to households' supply of labor to FFW job.

Literature review

It is often argued that food aid depresses food prices, discourages food production and contributes to inadequate agricultural policies ([Isenman and Singer, 1977](#)). It has been also argued that food aid creates labour disincentives either by increasing the demand for leisure as a result of increase in income or, in the case of FFW, attracts labour away from agricultural and other productive activities ([Lentz et al., 2005](#); [Abdulai et al., 2005](#)).

Although both the production disincentive effect and labour disincentive effect of food aid are often emphasized by development practitioners, policy makers and researchers alike as an

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important source of concern, it is not often identified through empirical research. Most studies and reports that claim that there are disincentive effects of food aid are based on anecdotal evidences (Lentz, 2003; Lentz et al., 2005). Studies by Lavy (1990) and Abdulai et al. (2005) examined whether food aid has disincentive effects on food production in Sub-Saharan African countries. In spite of the difference in the number of countries considered and the time period covered in the two studies, both papers found no significant disincentive effects. An earlier paper by Maxwell and Singer (1979) examined 21 empirical studies dealing with food aid. They found that more than half of the reviewed studies reported no negative impacts on production. Absence of production disincentive effects does not mean that domestic prices are unaffected by food aid. It is possible that a significant inflow of food to the market depresses the food prices and there are evidences of this in some African countries (Barrett and Maxwell, 2005), and yet the net effect of food aid on agricultural production may not necessarily be negative. Maxwell and Singer (1979) maintain that often appropriate mix of policy tools such as market differentiation and producer supports mitigate price disincentives from food aid. In fact, Abdulai et al. (2004) argue that the decrease in price 'can even be favourable in well-integrated markets for producers of complementary or some substitute goods' (Abdulai et al., 2004, p. 13).

The 'incentive effect' of food aid

The possible positive contribution of food aid to agricultural development has now been acknowledged and is being examined after decades of an almost exclusive focus on the disincentive effect. Barrett (2002) argues that because food aid recipient countries are both producers and consumers, food aid may have factor market effects that overshadow the product market effects. The study by Abdulai et al. (2005) on 42 Sub-Saharan African countries provides empirical evidence for this argument. The results from their vector autoregressive model showed that food aid has a positive effect on food production with up to two years lag. They explained the result as the contribution of income from food aid in relaxing factor market constraints, and particularly financial liquidity constraints that often limit food production in Africa. Bezuneh et al. (2003) examined the short-term, interim and cumulative effects of food aid on Tunisia agriculture. They found a positive impact. Their multiplier analysis showed that an increase in food aid is associated with an increase in domestic demand and supply of food grains as well as increase in per capita income both in the short-run and long-run.

A household level study in Baringo District, Kenya, by Bezuneh et al. (1988) and Barrett et al. (2001) examined the impact of FFW on household welfare. Both studies found a positive contribution. The study by Bezuneh et al. (1988) used farm household model and estimated it using a linear programming model for the production side and the almost ideal demand system (AIDS) for the consumption component.¹ They showed that the net returns for FFW participants are 52% higher than for those without FFW. The food-for-work income relaxes capital constraints and increases own farm production. The study by Barrett et al. (2001) involves comparison of mean income, from different activities, for participants and non-participants of FFW. They found that, in the lower half of the income distribution, FFW decreases reliance on sale of livestock and increases both crop income and non-farm income. In the upper half of the income distribution, the impact of FFW is to increase sale of livestock which brings higher returns. They

argue that in both the upper and lower income groups, FFW impacts come about through its effects in relaxing the liquidity constraints.

Most studies that discussed impact of food aid and FFW on agricultural production in Ethiopia reject the production and labour disincentive effect (Holt, 1983; Kohlin, 1987; Webb et al., 1992; Maxwell et al., 1994). However, since the focus of most of these studies is not the impact of FFW on household production, the studies are neither rigorous in their methodology nor extensive in their data with regard to the effect on agricultural production at household level. A recent study by Abdulai et al. (2005) addresses this problem in that it examined food aid in Ethiopia focusing explicitly on its impact on food production at household level. They rejected the disincentive hypothesis. They observed that simple test statistics, that does not control for endogeneity of food aid, suggest disincentive effect of food aid on household behavior. However, the negative correlation reflects the response of food aid receipt to exogenous factors that likewise affect labor supply and investment.

In view of the size of food aid and FFW in Ethiopia, studies exploring its impact on agricultural production and welfare of recipients are few in number. Quisumbing (2003) and Yamano et al. (2005) examine impact of food aid on child nutrition and found significant positive impacts. The study by Holden et al. (2006) is the most comprehensive household simulation study so far. They used dynamic non-separable bio-economic household model to assess the impacts of FFW on income, own production, farm labour use, conservation and soil erosion. They run simulations of the model under different scenarios about FFW project design and labour market conditions. They showed that in all the different scenarios, household income increases. But the effect of FFW on food production and conservation activities can differ greatly depending on how and for what activities FFW is used, on the characteristics of the local labour market, and on the impact of conservation technologies on short-term yields (Holden et al., 2006, pp. 30–31). In light of the upward trend in the global food prices and the decline in food aid availability, we believe that the impact of food aid should be thoroughly examined. We hope our paper contributes to the empirical literature and debate on food aid and its impact on farm production and investment.

Survey setting and scope

This paper is based on a survey that was conducted in Ethiopia in June and July of 2001. The survey collected data with one year recall period from 1st of May the previous year to capture the full production period. The surveys covered 16 villages in the four zones of Tigray (central, eastern, southern and western). The villages in the survey were stratified to capture differences in distance to markets, population density, agricultural potential and access to irrigation. Twenty-five households were randomly sampled from each village (see Hagos and Holden (2002) and Hagos (2003) for detail). The sample size was 400. There were 234 households who participated in FFW in 2001. Because the FFW job access is generally lower than the demand for it, households' access to FFW is likely to be rationed and the amount of labor they can supply and food income they get are administratively determined. As a result, many of the participating households were not allowed to work as many days as they wanted to. Roughly 60% of those who participated in FFW have indicated that they would have liked to supply on average an additional 45 days of labor.

The estimation on fertilizer use is based on 1755 plots owned by the 400 households surveyed. About three fourths of the plots were owner-operated. Fertilizer was applied only on 808 of these plots accounting for about 46%. The average farm size in the sample was 1.1 hectares with less than 10% of the households having more

¹ The separability of production and consumption decisions in their paper depends on the assumption that markets exist for all goods and labour and also wages and prices are exogenous. We feel that these are strong assumptions for rural Kenya.

than 2 hectares. The farm land is typically divided into plots which may be dispersed in different locations. The median number of plots per household is three.

Survey area: Tigray

Tigray is the northern-most region of Ethiopia and has a common boundary with Eritrea in the North and Sudan in the west. It has a total population of more than four million, with growth rate of 3% per annum. The greater part of the population in Tigray (81%) lives in the rural areas and is engaged mainly in agriculture (CSA, 2005). Tigray has rainfall that is lower than the country average but is higher in variability (Rest and Noragric, 1995). The peak agricultural season is from June to August while the slack period is from December to April. One of the main challenges in Tigray is chronic food insecurity that is exacerbated by frequent droughts. The agricultural sector has been highly constrained by severe degradation problems in the form of high levels of soil erosion and nutrient depletion (Hagos et al., 1999). The statistical computation on food requirement and production of the sample households showed that more than 85% of households were unable to meet their food requirements from own production.

There are virtually no banks in the rural areas. The only formal credit is offered through Dedebit Rural Credit and Saving Institution (DECSI). DECSI provides limited farm input credit through group lending² but no consumption credit and the credit is only seasonal. In 2000/2001, around 30% of the households participated in such programme credit. The non-farm job opportunities available in the region are also very limited (Woldenhanna and Oskam, 2001). In the survey period, around 31% of the sample households earn income from wage employment. However, except in the few cases where individuals work as teachers, health practitioners or officials in the government bureaucracy, the wage employments are usually in the form of casual labor in low paying and seasonal jobs. Given these facts, the cash constraint is bound to be an impediment for input purchase and farm investment.

FFW in Tigray

Public works programs have been widely used in Ethiopia since the early 1960s. FFW as a specific kind of public work program came into effect in 1972 with the WFP funded projects in Eritrea, Tigray, Wello and Harar following the drought in these areas (von Braun et al., 1991). Hence, Tigray is one of the first regions to have experience with FFW projects. It is also the region which is receiving the highest share of food aid – both free food and FFW (Clay et al., 1999). Most FFW jobs in Tigray are offered in the slack season in order to avoid labor competition with agricultural activities. FFW participants in Tigray are selected through administrative criteria (Sharp, 1997 in Gebremedhin and Swinton (2001)). First the regional authorities determine the food aid quota for each woreda (district) based on crop assessment, early warning and food stock information. The Woreda council then allocates quotas to the tabias (the smallest administrative unit in Tigray). Each tabia council has a Relief and Rehabilitation Committee of three to five people that prepares a list of beneficiaries. The criteria typically used are (a) ownership of oxen or other livestock, (b) off-farm income and (c) remittances received (Gebremedhin and Swinton, 2001, p. 88). In our research area, the criteria differ slightly from place to place and from drought to normal periods.

² Input credit from DECSI has to be repaid within one year and often immediately after the harvest (when prices are low). If one member of the group defaults for any reason, the others cannot clear their own debt and have to keep paying interest until the group loan is fully paid. This makes borrowing and group participation itself risky. DECSI has recently adopted relaxed guideline.

In some villages, the land management and conduct of the household, and output levels are also included in the criteria. FFW projects in the research area mainly focus on natural resource rehabilitation and involve such activities as construction of ponds, soil and water conservation structures, rural access roads, area enclosures and afforestation. Furthermore, FFW is also used as a method to implement development projects like investments in irrigation dams. In such cases all households in a community may be required to be involved and contribute to the project (Holden et al., 2006).

The customary daily wage rate paid for FFW in Ethiopia is 3 kg of wheat and 12 g of vegetable oil per person. This wage level is a continuation of the original FFW 'ration' devised in the early 1970s for rehabilitation after famine. The ration was intended to cover the energy requirements of the average family of six people including the FFW participant, offering some 1800 kcal per head per day (Admassie et al., 1985).

Theoretical framework

We develop a simple non-separable household model with missing market for land and imperfect markets for labor and credit. The analysis will help highlight the mechanism through which FFW encourage agricultural production. The model builds on a static model of household labor allocation developed by Holden et al. (2006). Let the household maximize its utility:

$$U = U(C, L_e)$$

where U is quasi-concave, continuous and non-decreasing utility function; C is a vector of consumption goods and L_e represents leisure. Utility of the household is subject to the following constraints.

Production technology constraint (with usual concavity assumptions):

$$q = q(L_a, K, A) \quad (1)$$

Time constraint:

$$T = L_a + L_e + \bar{L}_{ffw} \quad (2)$$

Income constraint:

$$C \leq P_q q - P_k k + W_{ffw} \bar{L}_{ffw} \quad (3)$$

Liquidity constraint:

$$P_k k \leq W_{ffw} \bar{L}_{ffw} + S \quad (4)$$

The non-negativity constraints:

$$L_a \geq 0, \quad L_e \geq 0, \quad K \geq 0, \quad C \geq 0 \quad (5)$$

L_a is the labor input in farm production; K is a vector of non-labor variable inputs such as fertilizers and A represents the stock of fixed assets such as land. Leisure is represented by L_e and \bar{L}_{ffw} stands for labor time in FFW. Because of the administrative allocation of job in FFW, we assume \bar{L}_{ffw} to be exogenously determined. P_q, P_k and W_{ffw} represent market prices for agricultural output, non-labor farm input and FFW labor, respectively. It is assumed that there is no market for formal credit, land and farm labor. S in the liquidity constraint equation represents loan from money lenders and friends. The liquidity constraint is relevant during the planting season, where cost of inputs has to be paid but the return of those inputs will not be obtained until after the harvest.

The household problem of maximizing utility with respect to L_a and K subject to the constraints is given by the Lagrangian:

$$L = U(P_q q(L_a, K, A) - P_k k + W_{ffw} \bar{L}_{ffw}, T - L_a - \bar{L}_{ffw}) + \delta(W_{ffw} \bar{L}_{ffw} + S - P_k k)$$

The first order conditions for interior solution imply the following equilibrium conditions.

$$P_q \frac{\partial q}{\partial L_a} = \frac{\partial U / \partial L_e}{\partial U / \partial C} \quad (6)$$

$$P_q \frac{\partial q}{\partial K} = P_k + \frac{\delta P_k}{\partial U / \partial C} \quad (7)$$

The additional term $\frac{\delta P_k}{\partial U / \partial C}$ in Eq. (7) indicates that for liquidity-constrained households non-farm input is effectively more expensive than for unconstrained households. The stronger the liquidity constraint, the more expensive the input will be for the particular household. This will decrease the probability of use and the amount of use of these inputs.

The focus of this paper is on the impact of FFW on the liquidity constraint and how it affects input use decision. In particular, this paper tests whether FFW encourages adoption of fertilizer of cash-constrained households.

FFW effect on adoption of fertilizer

In a country like Ethiopia, poor farmers may avoid improved technology for reasons other than risk. They may be unable to secure the funds necessary to purchase such inputs even if they are convinced of the benefits. There is only one institution that provides input credit and the non-farm employment opportunities are limited. We argue that FFW eases the liquidity constraint either by providing food income, which can be sold at the local market, or by reducing the need to buy food for household consumption, thereby making more cash available for input purchase. In other words, FFW income reduces the 'decision price' of fertilizer.

Econometric methods and variables

We estimated the following reduced form constrained demand function for fertilizer use.

$K = f(\text{wealth, household labor, access to credit, food aid income, oxen holding, FFW income, non-farm income, distance from market, distance from homestead, biophysical characteristics of plot, household characteristics})$.

The dependent variable (K) represents fertilizer use in kilograms per plot in 2001. The first vector, 'Wealth' is proxied by farm size, the values of livestock holding. 'Household labor' is separated into male labor and female labor. A household is considered to have 'Access to credit' if the household obtained credit for farm inputs in the last three years. It is represented by a dummy, which is one if the household had access. Wealth and access to credit are expected to have a positive effect on fertilizer adoption. Food aid can also be expected to positively influence the decision to use fertilizer as it may relax the liquidity constraint. On the other hand, according to the regulations, no able-bodied person is supposed to receive free food aid (Jayne et al., 2002). If targeting is efficient, this implies that food aid participants have less capacity to do farming than the others. Then there is the possible disincentive effect of food aid because leisure is a normal good and this may cause food aid to be negatively correlated with fertilizer adoption after controlling for differences in ability in the form of adult labor available. To differentiate between the two opposing forces, we include 'Access to food aid' in the participation decision and 'Food aid income' in the intensity decision. Oxen holding, which is used for ploughing, is expected to have a positive effect, assuming that oxen (traction power) and fertilizer are complementary inputs. 'FFW income' refers to the food income from employment in FFW activities. We used the lagged value of FFW income, that is, income earned in the previous period. We used the income from

previous period rather than the income from the current period because most of the FFW income from the current period is earned in the slack season after the crops have already been planted. And hence the income cannot be used for input purchase. Using the lagged income also helps avoid possible endogeneity associated with FFW income. The hypothesis on impact of FFW income will be discussed below. Other non-farm income sources are also expected to positively affect households' decision in adopting fertilizer and its intensity once adopted if the non-farm income primarily relaxes the liquidity constraint limiting fertilizer use. On the other hand, if the non-farm activity primarily limits the availability of household labor for farm production, it may be associated with less use of fertilizer. 'Non-farm income' is proxied by an 'occupation' dummy that is one if the household head has any other occupation besides farming. We used participation dummy rather than income because we do not have data on non-farm income earned in the previous period and also because non-farm income is likely to be correlated with FFW income. 'Distance from homestead' and 'distance from market' are given in terms of the time it takes (walking) to the respective locations. Distance from market is measured from the household's home not from the respective plot. 'Biophysical characteristics' is a vector that includes the type of soil, the size of plot, the quality of land, the degree of degradation, susceptibility to erosion, whether there is conservation structure and irrigation on the plot and the agroecological zone the plot is found. 'Household characteristics' includes age, education level and sex of the household head as well as the household's demographic structure.

We estimate this function using the Heckman Selection model (1979). This model is best suited to estimate our function not only because of possible selection bias and the need to correct it, but also because it allows us to test for disincentive effect. As we have discussed in the literature section, there is an argument and some anecdotal reports on the labor disincentive effect of FFW. At a more general level, Holden and Shiferaw (2004) analyzed the impact of non-farm income on farming activity. Using a calibrated dynamic bio-economic farm household model on data from Andit Tid, Ethiopia, they demonstrated that access to low wage non-farm employment reduces incentives for farming. It is, therefore, possible that there are two opposing effects of FFW on fertilizer use in Tigray – a positive effect on fertilizer adoption because of relaxation of the liquidity constraint and a negative effect on fertilizer use because of less labor use in agriculture if the hypothesis on disincentive effect of FFW holds. In this model, we can assume the decision taking place in two stages. First the household decides whether or not to adopt fertilizer (the selection equation), and then, conditional on selection, how much fertilizer to use (the intensity equation). The dependent variable in the first stage (selection equation) is a binary variable, which is one if households adopt fertilizer and zero otherwise. Unlike in the intensity equation, we use access to food aid instead of the income from food aid in the selection equation; we also include extension service and access to credit in the selection equation. These differences in the two equations solve the identification problem. In the intensity equation we used the lagged value of FFW income and food aid income. We used farm plot as the unit of analysis to account for the effect of soil characteristics and other plot specific traits on households' adoption of fertilizer. We also included dummies for the different zones to control for regional differences.

Results and discussion

In 2000/2001 production period, 60% of households have used fertilizer and of those who have used fertilizer, roughly two-thirds were FFW participants. The FFW participants received on average

Table 1
Determinants of fertilizer use: Heckman two-step selection model

Variables	Probability of fertilizer use		Intensity of fertilizer use	
	Coefficient	Std. err.	Coefficient	Std. err.
Sex of HHH	0.06023	0.125329	-27.784	6.465786***
Ln(HHH age)	-0.18223	0.129954	-2.51933	6.565607
Education of HHH	0.010308	0.079206	-8.20498	3.96668**
Female labor per hectare	0.037307	0.028983	1.080915	1.27912
Male labor per hectare	0.00504	0.030615	2.20248	1.441496
Ln(consumer-worker ratio)	-0.05962	0.106598	4.411187	5.374648
Occupation	-0.04225	0.11435	27.86143	5.828413***
Ln(farm size)	-0.05783	0.103988	13.95557	4.975538***
Ln(livestock)	0.001494	0.007167	0.312438	0.365531
Oxen per hectare	0.087478	0.041498**	-0.47147	2.051653
Aid access	-0.07703	0.069841		
Credit access	0.535148	0.102078***		
Ln(ffw income)	0.011498	0.005502**	0.144315	0.307693
Ln(aid income)			0.085537	0.26973
Distance to market	-0.00331	0.000446***	-0.18265	0.040806***
Distance to plot	-0.00382	0.001503**	-0.33481	0.097579***
Poor quality land	-0.05259	0.088595	-7.90473	4.493464*
Degraded plot	0.085012	0.141148	-2.68847	7.235819
Owner-operated plot	0.148358	0.107173	-2.47606	6.010217
Rented-in plot	-0.05536	0.151907	6.862017	8.034871
Eroded land	-0.09341	0.124029	-1.25238	6.45894
Conserved plot	0.303371	0.088478***	7.506283	5.444001
Plot size	0.041402	0.029662	14.82828	1.863517***
Soiltype2	0.097897	0.09781	2.738419	5.102265
Soiltype3	0.135862	0.096214	0.805733	5.112729
Soiltype4	0.187065	0.108004*	-7.95504	5.561071
Soiltype5	0.036995	0.165292	6.219859	8.463983
Irrigated	-0.19215	0.146311	-18.8144	7.943726**
Agroecology2	0.157383	0.078616**	7.328516	4.164142*
Agroecology3	0.193852	0.18719	-2.25051	10.00942
Region2	-0.13926	0.101456	-37.2596	5.759853***
Region3	0.43874	0.115239***	-5.97919	6.755158
Region4	0.106883	0.107286	-16.4553	5.802055***
Extension	0.031999	0.137196		
Constant	0.033505	0.584356	45.1753	30.82879
Mills lambda			39.41612	15.87853**
Number of observations=		1535		
Censored observations=		814		
Wald $\chi^2(28)=$		475.04		
Prob. > $\chi^2=$		0.0000		

*, **, *** represent levels of significance at 10%, 5% and 1%, respectively.

154 kg of wheat as FFW income in that year. Those households that have adopted fertilizer have used on average 58 kg of fertilizers in their farms (which typically have more than one plot).

The results from the regression using the Heckman model is given in Table 1 and the description of the variables used in this estimation are given in the Appendix. The probit result on probability of fertilizer use shows the coefficient of FFW income to be positive and significant at 5% level. This indicates a positive impact of FFW in the form of relaxing the liquidity constraint of households and enabling them to adopt fertilizer. This result also conforms to the findings by Bezuneh et al. (1988) and Barrett et al. (2001) in Kenya. The studies showed that FFW helps relieve the seasonal liquidity constraints of participants and thereby enable farmers to increase farm input purchase.

The regression result for the amount of fertilizer used shows that there was no indication of FFW's disincentive effect. FFW income was not significant in the intensity equation and did not even have a negative sign.³ This result should not be surprising for the study area; FFW jobs are often available during the slack season and hence the competition for labor between FFW job and that of farming may not be important. Moreover, we have

mentioned earlier that participating households indicated an excess demand for FFW job suggesting that at the given wage rate there is more labor available for FFW employment although it is possible that this labor may be engaged in lower paying non-farm activity or livestock caring. A statistical computation on the food production and food requirement of households indicates that more than 85% of the households are not food self-sufficient in 2001 and for those deficit producers who were participating in FFW jobs, the food income from FFW covered, on average, only less than 20% of the deficit. This observation indicates that households are far from 'satisfied' in their need for food and hence the income effect of FFW may not yet cause any disincentive. The disincentive effect of FFW on farming in Ethiopia has also been rejected by FAO (1982), Admassie et al. (1985), Holt (1983), Kohlin (1987), Webb et al. (1992), Maxwell et al. (1994) and Abdulai et al. (2005) based on household surveys in different parts of Ethiopia.

We will not discuss in detail the other factors affecting fertilizer use. However, we should say something about the variables that seemed to have counter-intuitive effects. The first is the negative coefficient on the variable 'Education of HHH', referring to a dummy for literate household head, in the intensity equation. This may be because literate household heads are engaged in other non-farm activities and hence there is competition for head's labor. One fourth of the literate household heads are church educated and

³ Infact, a Tobit estimate showed that FFW income is positively correlated with amount of fertilizer used (significant at 5%). See Appendix.

Table 2
Determinants of fertilizer use: The full maximum likelihood and the two part Heckman models that control for household effects

Variables	Heckman full maximum likelihood estimates ^a		Heckman two part model estimates ^b	
	Selection	Fertilizer used (kg)	Selection	Fertilizer used (kg)
Sex of HHH	–0.0105 (0.149)	–36.41*** (10.01)	0.0856 (0.199)	–31.87*** (8.534)
Ln(HHH age)	–0.188 (0.145)	–0.0890 (7.660)	–0.248 (0.206)	1.313 (6.133)
Education of HHH	–0.0217 (0.106)	–9.047* (4.884)	–0.0116 (0.132)	–8.387* (4.289)
Female labor per hectare	0.0236 (0.0323)	0.287 (1.033)	0.0558 (0.0449)	0.0450 (1.139)
Male labor per hectare	0.0114 (0.0394)	1.166 (1.287)	0.0370 (0.0499)	1.554 (1.368)
Ln(consumer-worker ratio)	–0.0671 (0.136)	6.066 (6.085)	–0.0142 (0.170)	4.729 (5.751)
Occupation	0.0345 (0.145)	36.47*** (14.01)	–0.000740 (0.182)	31.66*** (10.22)
Ln(farm size)	–0.184 (0.131)	15.50** (7.536)	–0.0892 (0.166)	14.25** (5.851)
Ln(livestock)	0.00145 (0.00867)	–0.172 (0.445)	0.00337 (0.0115)	0.116 (0.420)
Oxen per hectare	0.0577 (0.0542)	–2.919* (1.715)	0.0952 (0.0656)	–1.929 (1.690)
Aid access	–0.131 (0.0813)		–0.0943 (0.113)	
Credit access	0.471*** (0.153)		0.668*** (0.163)	
Ln(FFW income)	0.0143** (0.00711)	–0.291 (0.375)	0.0154* (0.00913)	–0.0527 (0.300)
lnaidincome		–0.211 (0.270)		0.105 (0.264)
Distance to market	–0.00414*** (0.000644)	NA NA	–0.00406*** (0.000708)	–0.101*** (0.0390)
Distance to plot	–0.00423*** (0.00164)	–0.112 (0.0981)	–0.00352* (0.00180)	–0.274** (0.122)
Poor quality land	–0.0486 (0.0981)	–8.848** (3.969)	–0.0704 (0.105)	–8.154** (3.375)
Degraded plot	0.104 (0.150)	–8.436 (7.187)	–0.00790 (0.173)	0.338 (7.768)
Owner-operated plot	0.157 (0.121)	–12.13** (6.016)	0.226 (0.140)	–7.363 (5.749)
Rented-in plot	–0.0506 (0.175)	7.080 (11.28)	–0.0418 (0.189)	4.827 (7.435)
Eroded plot	–0.0785 (0.136)	5.562 (6.354)	–0.104 (0.151)	–4.784 (7.029)
Conserved plot	0.360*** (0.0969)	2.569 (5.209)	0.344*** (0.111)	–0.610 (5.729)
Plot size	0.0430 (0.0361)	14.06*** (2.756)	0.0822** (0.0350)	14.34*** (2.571)
Soiltype2	0.111 (0.107)	0.909 (5.616)	0.161 (0.119)	–1.554 (4.575)
Soiltype3	0.0626 (0.105)	1.108 (5.287)	0.155 (0.119)	–4.908 (4.240)
Soiltype4	0.255** (0.112)	–15.11*** (4.842)	0.215 (0.136)	–9.318* (4.986)
Soiltype5	0.0616 (0.206)	1.604 (9.420)	0.205 (0.202)	3.789 (6.790)
Irrigated	–0.148 (0.176)	–11.64* (6.976)	–0.234 (0.168)	–19.26*** (6.309)
Agroecology2	0.0902 (0.0989)	0.601 (4.710)	0.117 (0.121)	0.576 (5.394)
Agroecology3	0.0427 (0.218)	–14.22 (11.31)	0.114 (0.278)	–1.545 (10.64)
Region2		NA	–0.185 (0.165)	–32.23*** (5.608)

Table 2 (continued)

Variables	Heckman full maximum likelihood estimates ^a		Heckman two part model estimates ^b	
	Selection	Fertilizer used (kg)	Selection	Fertilizer used (kg)
Region3		NA	0.533*** (0.183)	-11.87* (7.165)
Region4	0.168 (0.185)	NA	0.131 (0.170)	-17.53*** (6.374)
Extension			0.0293 (0.218)	
Constant	0.244 (0.691)	59.65* (34.22)	0.0444 (0.921)	74.50*** (26.08)
Rho(ρ)	-0.3343			
Walid test ($\rho = 0$)	(12.88)***			
IMR				4.435 (24.25)
Number of observations	1535	1535	1547	721
Censored observations		814		
Number of households			371	282
Walid χ^2		124.77	126.53	231.15
Prob. > χ^2		0.0000	0.0000	0.0000

*, **, *** represent levels of significance at 10%, 5% and 1%, respectively.

^a The standard errors in the full ML estimation are robust SE and control for clustering at household level.

^b This is a modified Heckit model where we estimated a household random effect probit followed by a household random effect regression.

may work as priests. The other unexpected result is the negative correlation between irrigated plots and intensity of fertilizer use. We are not sure why this is the case but a personal observation in the research area by Hagos (2003) indicated that farmers tend to use manure on irrigated plots rather than inorganic fertilizer, probably because fertilizer availability outside the main season is limited (Hagos, 2003, p. 125).

The result presented in Table 1 and discussed above shows the estimates from Heckman's two-step consistent estimator. Because the unit of analysis in the regression is plot and there are typically more than one plot owned by households, there is a possible correlation between observations with in a group defined by household number. Although the two-step estimator produces consistent estimates and is generally more stable than the full maximum likelihood estimator for problematic data, it does not allow for controlling household level effect. The Heckman model that uses full maximum likelihood estimator, allows for clustering at household level. To test for the robustness of the results from the two step model, we estimated a modified version of the Heckit model that controls for household level effects. We estimated random effects probit model followed by random effect regression that includes the invers Mills ratio. The results are comparable with that of the two-step model. The coefficient of FFW income in the probit model is positive and significant, although now the significance level is at 10%. Like in the two-step Heckman model, FFW income is not significant in the intensity equation. Almost all the other variables which were significant in the two-step model are also significant in the modified Heckit and have the same sign as before. See Table 2.

We tried to estimate the probit and regression equations in our fertilizer model using the full maximum likelihood estimator, but it could not converge when we include the same set of variables used in the two-step model. However, we were able to estimate a modified version of the model that excludes the regional dummies from both equations and the 'distance to market' variable from the intensity equation. The results are reported in Table 2. The coefficient of FFW income is positive and significant at 5%, consistent with the estimates of the two-step method. All but two of the other variables that were significant in the two-step method are also significant in the full maximum likelihood estimation of the modified

model. These results indicate that the conclusions are robust to alternative model specification and estimation methods.

On FFW distribution

The results above indicate the potential of FFW in enhancing agricultural production. Given that the poor are the ones most likely to face a liquidity constraint, access of poor farm households to FFW income may have an important implication in their productivity. But it is not only a matter of access, the size of the FFW income may influence whether or not it will affect input use decision and to what extent. The survey revealed that administrative rationing on FFW job, which is caused by excess supply of labor for FFW at the given wage, led to a thin distribution among households. Around 60% of households expressed unsatisfied demand for FFW job. The relative high FFW wage may have crowded in less needy households at the expense of more needy ones. A hypothetical question posed for participating households showed that more than 70% were willing to supply labor at a price as low as 2 kg of wheat per day as opposed to the present wage rate of 3 kg. However, whether or not such a change in the FFW payment can be adopted is a policy issue that should take into consideration the distributional implications across households and nutritional implications across and within households.

Conclusion

Food-for-work (FFW) is the most widely used type of public works program in Ethiopia through which a significant part of the food aid is distributed. In this paper we evaluated the impact of FFW on the use of farm input in the face of poor credit market. Using household survey data from Tigray, we tested the hypotheses that FFW relieves liquidity constraint thereby encourage adoption of fertilizer. The results from the Heckman model for fertilizer adoption show that FFW encouraged adoption of fertilizer. The results also show that FFW had no production disincentive effect. Households' own perception of the benefit of FFW, as revealed in interviews, confirmed this econometric finding. The study also revealed that there may be room for improvement in the distribution

of FFW through targeting of the poorest as well as through price revision to 'self-select' the needy.

One issue that has not been examined here but could be studied to have a more complete picture on the impact of FFW on agricultural production is, whether the conservation structures constructed through FFW improve land productivity. This is a crucial question for food security in the long run and is one of the key justifications for implementing the program in the first place.

Appendix

See Tables A1 and A2.

Table A1
Fertilizer use: description of variables and summary statistics

Variable	Description	Mean	Std. dev.
<i>Household level</i>			
Fertilizer used	Dummy for fertilizer use (yes = 1)	60%	
Sex of HHH	Sex of household head (female = 1 and male = 0)	27%	
Education of HHH	Whether the household head is literate or not (yes = 1)	37%	
FFW participation	participation (yes = 1)		
Dummy for FFW	participation (yes = 1)	58%	
Aid access	Dummy for access to food aid (access = 1 if the household received food aid in the last three years and zero otherwise)	58%	
Credit access	Dummy for access to credit for farm input (access = 1 if the household received credit for input in the last three years and zero otherwise)	74%	
Occupation	Dummy for participation in off-farm activities by the head of the household	26%	
HHH age	Age of the household head	51	15.6
Female labor per hectare	Number of female adults per hectare	1.8	2
Male labor per hectare	Number of male adults per hectare	1.6	1.6
Farm size	Owned farm size	1.1	0.72
Consumer-worker ratio	Consumer-worker ratio	2.2	0.94
FFW income	Food income from food for work in kg	154	173.7
Aid income	Income from free food aid	169	143.9
Livestock	Monetary value of livestock owned (excluding oxen)	1392	1919
Oxen per hectare	Oxen holding per hectare	1.3	1.74
Distance to market	Walking distance to district markets in minutes	143	91.8
<i>Plot level</i>			
Fertilizer in kg	Total Urea and Dap applied in each plot (in Kilograms) for all sample	23	43
Plot size	Size of plot in 'tsimidi'. 1 tsimidi = 0.25 hectares	1.24	1.17
Distance to plot	Distance from homestead to plot in minutes	25	27
Poor quality land	Land quality considered poor by household	21%	
Erosion exposure	Plot exposed to moderate to high susceptibility to erosion	23%	
Degraded plot	Highly degraded plot according to household perception	17%	
Land ownership	Owner operated plot, Rented-in plots, plots in other arrangements	77%	
Conserved plot	Dummy for conserved land (yes = 1)	76%	
Soil type	Soil type as classified by the household (1 = clay, 2 = black, 3 = sandy, 4 = red 5 = other)		
Extension	Dummy for extension support (yes = 1)	87%	
Irrigated	Dummy for irrigated plot (yes = 1).	6%	
Agroecology	Dummy for agro-ecological zone (1 = Degua, 2 = Hausi degua, 3 = Hausi kola)		
Region	Dummy for zone (1 = Southern, 2 = Eastern, 3 = Central and 4 = Western)		

Table A2
Determinants of fertilizer use: Tobit model

Variables	Tobit model	
	Coefficients	Std. err.
Sex of HHH	-16.6912	7.147582**
Ln(HHH age)	-2.04306	7.292354
Education of HHH	-3.88865	4.450016
Female labor per hectare	2.226039	1.441049
Male labor per hectare	2.248923	1.671723
Ln(consumer-worker ratio)	2.209438	6.008765
Occupation	17.34491	6.422666***
Ln(farm size)	10.20885	5.716938*
Ln(livestock)	0.267757	0.399103
Oxen per hectare	1.665293	2.278686
Ln(ffw income)	0.638154	0.304066**
Ln(aid income)	0.055699	0.335646
Distance to market	-0.25578	0.025129***
Distance to plot	-0.35941	0.088653***
Poor quality land	-6.16381	4.998805
Degraded plot	-2.18421	7.98315
Owner-operated plot	7.856924	6.112833
Rented-in plot	6.770882	8.669547
Eroded land	-0.59253	7.068108
Conserved plot	16.73147	5.099333***
Plot size	8.471245	1.7089***
Soiltype2	7.666421	5.511381
Soiltype3	6.836912	5.48499
Soiltype4	2.683219	6.02269
Soiltype5	7.49952	9.445696
Irrigated	-21.0225	8.55535**
Agroecology2	8.838522	4.436175**
Agroecology3	6.098894	10.89326
Region2	-31.1798	5.913297***
Region3	7.431184	6.230569
Region4	-3.53432	6.022361
Constant	5.933467	31.95928
Number of observations	1535	
Left censored observation=		811
LR $\chi^2(31)=$		271.93
Prob. > $\chi^2=$		0.0000
Pseudo R ² =		0.0291

*, **, *** represent levels of significance at 10%, 5% and 1%, respectively.

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PAPER III



Does nonfarm economy offer pathways for upward mobility?

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Abstract

Several empirical studies across developing countries document a positive correlation between participation in rural nonfarm employment and the wealth and income status of households. This may be an indication of the rich's superior access to nonfarm employment or a positive effect of nonfarm employment on welfare dynamics. Using household panel data that spans 10 years from 1994 to 2004, we explore the relationship between nonfarm participation and consumption expenditure growth in Ethiopia. We find that; 1) Household consumption expenditure growth is positively correlated with the initial share of nonfarm income. Households who are initially intensively involved in nonfarm employment experience higher growth in subsequent years; 2) The growth elasticity of nonfarm income share is higher for wealthier households; and 3) The source of growth for nonfarm participants lies in the higher rates of return participants enjoy on their human and physical capital.

Key words: rural nonfarm, income diversification, income dynamics, Ethiopia, panel data, impact

1. Introduction

Several studies across developing countries have shown that participation in rural nonfarm employment (RNFE) is positively correlated with total income, wealth and even agricultural productivity (Reardon, 1997, Lanjouw and Lanjouw, 2001, Reardon et al., 2001, Haggblade et al., 2007).

The observed positive correlations between nonfarm participation and higher income have fostered the hope that nonfarm employment may serve as a way out of poverty. However, studies of determinants of participation indicate that this positive correlation may be a result of superior access by rich households to remunerative nonfarm employment (Corral and Reardon, 2001, de Janvry and Sadoulet, 2001, Woldenhanna and Oskam, 2001, Lanjouw and Shariff, 2002, Kung and Lee, 2001, Dercon and Krishnan, 1996)¹. These findings thus call into question the direction of causality in the relationship.

The literature on impacts of RNFE on income growth is limited. A panel study of income diversification and poverty in India by Kijima and Lanjouw (2005) tries to link regional changes in poverty level with nonfarm sector expansion. They found no evidence for a direct impact of nonfarm employment on poverty. However, they noted that by raising the agricultural wage rate and providing the poor with a safety net, nonfarm employment play an important indirect role. Recent studies that address the welfare impact of nonfarm employment at a household level limit themselves to the comparison of poverty status or inequality (van den Berg and Kumbi, 2006, Barrett et al., 2001b, Matsumoto et al., 2006, Nargis and Hossain, 2006, Reardon et al., 2000, Lay et al., 2008, Oostendorp et al., 2009). Most of the studies of this relation use cross sectional data which allows only comparison across households rather than direct exploration of how specific households' income evolved over time in response to participation in nonfarm employment. An exception is Block and Webb(2001) who examine the dynamics of livelihood diversification in Ethiopia. One of the issues they examine is whether higher diversification in one period is associated with higher income and consumption outcomes in subsequent period.

¹ See also Reardon (1997) and Ellis (1998) for reviews of earlier studies.

They found that more diversified households in the initial period subsequently increased their relative income and calorie intake.

While Block and Webb (2001) make an important contribution in exploring the impact of diversification on welfare dynamics, the sample used in the analysis and the initial period under consideration are too specific to make broad generalization. The survey sites in the sample were selected because of their famine experience and the two periods used for comparison are the post famine year 1989 and post reform 1994. Moreover, they use crop share of income as a measure of diversification. But this is not equivalent to share of nonfarm income since even the income of pure agriculturalists constitute income from crop, livestock, farm wage employment and transfers. Hence the conclusions from crop share, while giving some kind of indication, can not be fully extended to what happens with participation in nonfarm employment. This paper addresses these issues by examining the impact of participation in rural nonfarm employment on households' expenditure dynamics in Ethiopia using panel data that cover 10 years from 1994 to 2004. The study goes further and investigates the sources of income growth for nonfarm participants.

Consistent with the pattern in other African countries, we find that total nonfarm income increases across expenditure and wealth terciles. Households at the top tercile of the distribution earn 75% more per capita than those in the bottom.

The results from our analysis suggest that participation in nonfarm activities accelerate income growth and hence enable upward mobility. Our regression results exploring the impact of nonfarm participation on expenditure growth indicate that growth increases with households' initial share of nonfarm income. We also find that the impact is higher for wealthier households. Furthermore, our decomposition analysis shows that rural nonfarm employment participants enjoy higher rates of return to their human and physical capital than do non-participants.

The remainder of the paper proceeds as follows. Section 2 discusses the data and the macroeconomic conditions in Ethiopia during the study period. Sections 3 and 4 present the conceptual framework and empirical model, respectively. Results are discussed in section 5. The final section presents concluding remarks.

2. Background, data and descriptive statistics

2.1. Background: Ethiopia 1994-2004

The 1990s brought important macroeconomic policy and political changes to Ethiopia that had tremendous impact on the incentives and opportunities available to households (Dercon, 2006). There was a transition of power in 1991/1992 when the decades old civil war ended with the overthrow of the socialist Derg regime. Although a modest liberalization had already started in 1989, significant changes were made in the early 1990s. The new government agreed on a policy framework paper with the International Monetary Fund (IMF) and the World Bank in September 1992, which led to the structural adjustment program of 1993-1996 (ADB, 2000). The policy changes that had the most direct relevance to farm households may be the removal of the grain quota system and import subsidies and the relaxation of restrictions on grain trade. The quota system required farmers to supply a significant share of their output to a government trade agency at a price that was below the market price, effectively serving as a tax (Dercon, 2006). There was not as much economic policy change in the second half of the 1990s. But in the last years of the 1990s, Ethiopia went to war with Eritrea. The war lasted from 1998 to 2000.

In the period 1994-2004, the economy performed reasonably well. The average per capita annual income over this period was 138 US dollars. Total real GDP grew by an average of five percent per year and GDP per capita by two percent (see Table A-1 in the appendix). But because the exchange rate depreciated from an average of 6 Birr/USD in 1994 to 9 Birr/USD by 2004, the per capita GDP in US dollars declined over this period.

2.2. Data

The analysis is based on the Ethiopian Rural Household Survey (ERHS) data. We use three data points, 1994, 1999 and 2004 to compute two growth rates over five years each. The panel data are unbalanced covering 1792 households in these three surveys. Eighty percent of these households were observed at least twice while 65% were observed in all the three years. The descriptive statistics and the income equation are computed based on the full sample (1792 households) while for the growth model we used only those households who were observed in at least two consecutive periods.

The sample in this paper does not include landless households. The proportion of landless households is very small in rural Ethiopia. Hence an effort to incorporate landless households in the panel yielded very few observations. And of these few observations most left the sample between surveys rounds. Because the state owns all land, farmers have only user rights to the land they cultivate, which they keep only if they live in the village. Those who cultivate land are thus ‘tied up’ while the landless move more frequently. To avoid introducing subtle selection bias by incorporating the landless households who did not move, we drop all landless households from the sub-sample.

Consumption expenditure is composed of food and non-food expenditures. Food expenditures were reported with a recall period of one week. It includes food consumed from own production, from free food and from the market. The monetary value of food consumed from own production, food aid and in-kind payments are computed using prices collected in the village markets at the time of the survey. The non-food goods consumed are reported with a recall period of one month. To make comparison across time possible, we report real values using the national consumer price index with December 2000 as a base period. The average monthly consumption expenditures per adult equivalent² for the three years are reported in Table 1. Consumption expenditures increased from 108 Birr in 1994 to 136 Birr in 2004, giving us an annual growth rate of 2.6%. This is higher than the 1.4% growth rate reported for rural Ethiopia in the period 1995-2005³ (MoFED, 2006, CSA, 2007). Table 1 also reports the average monthly income for comparison. Total rural income is composed of rural nonfarm income (RNFI), agricultural income (including crop income, livestock income and agricultural wage) and income from transfers (including aid and remittances). Consumption expenditure per adult equivalent is higher than that of income per adult equivalent indicating under reporting in income in our

² To normalize using adult equivalent units we use a weight of 0.40 for children aged less than four and 0.50 for children aged from 5 to 14. All adults aged 15 or more have weight equal to one.

³ This is based on consumption expenditure data from the nationally representative Household Income, Consumption and Expenditure (HICE) survey undertaken by Central Statistical Agency (CSA) with more than 20,000 households in almost all urban and rural areas. The HICE surveys were conducted only in 1995, 2000 and 2005.

sample⁴. However, both have a positively skewed distribution. Because expenditure data are typically considered more reliable than income data in rural areas of developing countries, growth analysis in this paper was based on the expenditure data.

Rural nonfarm income (RNFI) includes income from all types of wage and self-employment activities in the non-agricultural sector. For self-employment, respondents were asked to report net income or alternatively, the cost of raw materials and the proceeds from sale of products, from which we computed the net income. The questionnaire elicits the details of nonfarm activities and income from the nonfarm employment for the four preceding months. While a four months recall period may allow households to better recall labor supply and income than would a full year recall period, there may be under reporting for those households whose main nonfarm engagement is seasonal and falls outside the four months covered by the survey. Share of nonfarm income (RNFIsh) refers to total monthly RNFI expressed as a share of total monthly consumption expenditure. It is always zero for non-participants. For participants it could be negative, since some households earn negative income from self employment activities, or more than one, when there is saving.

Assets are reported in value terms. We report separately the values for farm equipment, nonfarm equipment and non-productive asset owned by households. We compute the value of the assets based on households' self reporting of the assets' current worth in a local market. This is susceptible to reporting error, but given that we do not have data on asset prices or details on the physical state of the assets, we believe that households' own evaluation is the best valuation method. The asset variables, like expenditures and income have a positively skewed distribution.

2.3. Descriptive statistics: 1994-2004

We distinguish between two groups of nonfarm activities: high-return RNFE and low-return RNFE. As the name indicates, the *high-return RNFE* refers those wage and self employment activities that give higher daily returns. These activities typically have higher resource requirements. It includes skilled wage employment such as teaching, government office,

⁴ This is also the case for the HICE data where 68% of rural households reported income that is lower than their expenditure (CSA, 2001).

masonry and the like and high-investment businesses such as cattle trade, transportation business, etc. *Low-return RNFE* refers to unskilled wage employment and self-employment activities that have low investment requirement. These activities are found to have lower daily returns. Examples of these activities include working as a casual labor, guard or maid; and business activities such as food and beverage production, petty trade and the like.

Participation in RNFE

Close to half of the total households (48%) participated in RNFE in these periods. If we consider only adult participation the rate falls to 40%. Most were engaged in the low-return, unskilled wage employment and low investment self-employment (Table 2). Only 7% of households participate in high-return, skilled wage employment or high investment self-employment. A quarter of the nonfarm participants are female headed, which is the same as their share in the sample. However, only 14% of the high-return RNFE participants are female headed.

Income from RNFE

There are heterogeneities in the incentives and capacities of households who participate in RNFE. Some participate because of push factors and have limited capacity to access employments offering superior returns. As a result, they engage in casual labor which brings meager returns that are often no better than, and at times worse than, returns in agricultural activities. Others engage in nonfarm employment for accumulative purpose and have the capacity to invest in activities that have superior returns (Reardon et al., 2007, Dercon and Krishnan, 1996). Although the poor have less capacity to access high return activities, it is not obvious that their total nonfarm income or share of nonfarm income should be lower than that of the rich. There are different patterns in different countries (Reardon et al., 2000).

In our sample, nonfarm income accounts for 21% of consumption expenditure for RNFE participant households. Table 3 reports expenditure levels and shares from RNFE income. The share of rural nonfarm income declines across expenditure terciles. For the poor, it accounts for one-third of household consumption expenditure, while for those in the top tercile, it is barely 10%. This indicates that RNFE is an important source of income for the poor, although they are typically involved only in low-return activities because of entry barriers. However, the high

share for the poor seems to be a result of lower total income from other sources rather than greater involvement in and income from RNFE. Although the relatively rich have an expenditure share of only 10% from nonfarm income, their average income from RNFE is 75% higher. Moreover, classifying households based on assets, a more robust measure of wealth status, we found that the share of income from RNFE is almost the same for all participant households but the rich get considerably higher income from RNFE sources.

Total Income, expenditures and capital

RNFE participants have higher total expenditures and income levels than do non-participants and the difference is statistically significant. However, they also have larger households. Hence, the average income and expenditure per adult equivalent are not statistically significantly different between participants and non-participants (Table 4). Nonetheless, participants in high-return nonfarm employment, who account for a very small share of the sample, have significantly higher expenditure in both total and per capita terms than low-return nonfarm participants.

Nonfarm participants have significantly more labor endowment and more nonfarm equipment, while the RNFE non-participants have more farm equipment. RNFE participants and non-participants have effectively the same endowment of land, livestock and education. Non-participants earned higher income from crop sale although the participants cultivated more land.

3. Conceptual framework and some evidence

3.1. How does RNFE participation influence income dynamics?

There are different channels through which rural nonfarm employment can potentially influence households' income realization from their human and physical assets. We now discuss the most important ones.

a) High return nonfarm activities lead to accelerated income growth

Participation in nonfarm employment activities that yield high returns such as skilled wage employment or livestock trade generate higher contemporaneous income and also lead to better capacity to accumulate and reinvest. Such livelihood strategies have higher potential to pull households out of poverty. The main problem with these kinds of activities is, of course, access.

Typically, the poor do not have the necessary resources to be able to enjoy the superior returns and hence wealthy households are the ones most able to enjoy the benefits of high return activities (Lanjouw and Lanjouw, 2001, Woldenhanna and Oskam, 2001, Dercon and Krishnan, 1996).

b) RNFE as an additional source of employment

One of the salient features of agriculture is its seasonality. Even households who have labor scarcity during the planting and harvest periods may have excess labor in the slack season. In the absence of RNFE options, this labor may not be productive. This is particularly true in areas with little or no irrigation and migration. Nonfarm activities can be an important source of off-season employment and income. Nonfarm employment also provides economic security for members of the society that may have restricted access to agricultural employment (Lanjouw and Lanjouw, 2001). For example in the villages under study, one of the main farm activities, ploughing, is considered men's domain (Bevan and Pankhurst, 1996), hence women's employability in the farm sector is restricted. The nonfarm sector can serve as the residual employer. Even if it offers lower hourly returns to labor than other activities, it still can make a positive contribution towards total returns for the resources that would have been, at least partially, idle otherwise.

c) Relaxing liquidity constraints

Given financial market imperfections in rural economies, farm households face liquidity constraints to invest in agricultural inputs and human capital (Reardon, 1997). Earnings from nonfarm employment may thereby have added value if it enables farmers to purchase agricultural inputs that are complementary with other inputs. For example, Bezu and Holden (2008) show that, controlling for plot and household level characteristics, food-for-work participants in Tigray were more likely to use fertilizer on their farm than non-participants, presumably because the transfer relaxed households' liquidity constraints. In Honduras, Ruben and Van den Berg (2001) showed that the amount of purchased inputs increases with households' nonfarm income. A relaxation of the liquidity constraint also means that households may be able to pay for school fees and books for their children, thereby accumulating human capital that will eventually yield high returns. RNFE participation may even open the door to credit access. Lenders may use the

evidence of steady pay in the non-farm market as collateral for loans (Collier and Lal, 1984, Reardon et al., 2000).

d) RNFE and risk

In the face of a virtually nonexistent rural insurance markets, even moderate shocks may have long term impacts on households' welfare, especially if households have to sell their productive assets or significantly reduce consumption to an extent that compromises human capital. For example, Dercon (2004) documents that rainfall shocks in Ethiopia have an impact on consumption growth that persists for several years. Participation in nonfarm employment can serve as a safety net for households facing income shocks thereby protecting their productive assets. Kijima et al. (2006) showed that Ugandan households' nonfarm labor supply increases if they experience agricultural shocks in the previous harvest, especially if they are asset poor households. A similar labor supply response was also observed in India (Kochhar, 1995). The RNFE is, however, probably more effective as a safety net in the face of idiosyncratic as opposed to covariate shocks such as due to rainfall or prices, because many nonfarm activities are linked with agricultural activities for input supply and output demand and also because the market may be quickly saturated if many households in the same village enter the RNFE simultaneously in response to a shock.

Related with the safety net function of the rural nonfarm employment is its impact on the willingness of households to adopt technologies that give higher returns on average but may also entail higher risk. Compared to households who depend only on farming, households who participate in nonfarm activities may be relatively less worried about the worst outcome of an investment or input use decisions because they have alternative income to fall back on. Collier and Lal (1984) demonstrate that in Central Kenya, poorer households who have access to nonfarm employment were able to invest in tree planting and hybrid livestock, which are considered to be high-return, high-risk activities often undertaken by the rich.

3.2. The evidence on RNFE and income dynamics

Several studies in Africa show a positive correlation between nonfarm participation and total income. In a review of 23 field studies in Africa, Reardon (1997) found that the rich not only

earn higher nonfarm income but also get a higher share of their income from nonfarm activities. On average, the share of nonfarm income for the upper income tercile households was twice as much as the share for households in the lower income tercile. A study looking at nonfarm employment in Ghana and Uganda (Canagarajah et al., 2001) found that the shares of nonfarm income were larger in higher income brackets, and that over time the share of self-employment increases. Likewise, in the majority of Latin American studies, the level of rural nonfarm income increased with household income (Reardon, 1997, Reardon et al., 2001). A study in Bangladesh shows a positive relationship between the share of income and total household income that worsened over time in favor of richer households. (Nargis and Hossain, 2006). On the other hand, a study in India indicates that although the aggregate share of total nonfarm income is the same across income quintile, the share of casual wage income decreases with total household income and that of regular wage income increases with total income (Lanjouw and Shariff, 2002).

The existing evidence thus tends to suggest a positive correlation between share and level of income from RNFE and total income, at least in the African context. But the direction of causality is not clear. Do the rich earn higher nonfarm income because of their preferential access to it or is it nonfarm participation that has enriched them?

The literature on rural nonfarm employment has focused on identifying the determinants of participation and nonfarm income (Ellis, 1998, Lanjouw and Lanjouw, 2001, Reardon, 1997). Few studies have systematically examined the impact of participation on households' welfare dynamics. Barrett et al. (2001a) showed that households who participate in skilled nonfarm employment experience increase in income in Cote d'Ivoire following exchange rate reform. Holden et al. (2004) used a dynamic non-separable bio-economic household models to assess the impacts of access to nonfarm employment on household welfare and land management decisions in Ethiopia. Although they examine only access to low-wage employment, their results show that access to nonfarm employment has a significant positive impact on households' total income as such sources of income are constrained. Another study on Ethiopia that is closely related to our own is Block and Webb's (2001) evaluation of the dynamics of livelihood diversification. They found that higher diversification is associated with higher subsequent welfare outcome. Other studies show the impact indirectly. For example, Nargis and Hossain (2006) show that the

returns on adult labor and education used in nonagricultural activities were higher than those used in agriculture and increased over time. Canagarajah et al. (2001) show that the contribution of growth to poverty reduction was higher for nonfarm participant households in Uganda and Ghana.

3.3. A simple model of income growth

This conceptual discussion can be captured in a relatively straightforward model. Following Barrett (2005) we write the income equation as the product of households' capital and the returns to capital.

$$Y_{it} = K_{it}r_{it} \quad (1)$$

Where K_{it} refers to a vector of human and physical capital and r_{it} refers to a vector of net returns to these resources. We assume that households do not have financial capital such as cash, stocks and bonds. Instead we assume that some of the physical capital, at least partially, serves insurance and wealth accumulation purposes. These assumptions are not far from the reality in rural Ethiopia where the financial sector is almost nonexistent.

From total differentiation of the income equation we get growth in income as a function of changes in capital and in returns to capital:

$$dY_{it} = dK_{it}r_{it} + dr_{it}K_{it} \quad (2)$$

Where dK_{it} refers to change in capital i.e, investment and dr_{it} refers to change in returns to the capital owned. For households with little potential to increase their resource endowments, changes in the rate of returns are the only source of income growth.

In well functioning factor markets, households allocate their resources among different activities until the marginal returns from the respective activities are equal. However, this is not often the case in the rural economy of a developing country. Markets routinely fail, with the implication that households may not have access to some activities that yield marginal and average returns higher than the ones in which they are currently engaged. For example, we find that skilled wage employment and relatively high-investment businesses yield higher average and marginal returns

than farming or other nonfarm activities; but they are not accessible by poorer households. The returns to households' capital holdings in such markets will then be highly influenced by the types of activities in which the household engages. To capture the different combinations of farm and nonfarm activities, we define a variable AC_{it} as an index indicating the share of capital employed in the nonfarm economy. Returns may then be written as a function of AC :

$$r_{it} = f(AC_{it}, K_{it}, E_{it}) \quad (3)$$

The inclusion of K_{it} in the return function allows for variable returns to scale. E_{it} refers to a vector of exogenous variables such as prices, infrastructure and policies that may lead to different rates of returns across time or place for the same level of capitals and activity index. We now express growth as a reduced form function of initial human and physical capital, the activity index and changes in the capital and the activity index as well as the initial exogenous conditions and changes in these conditions.

$$dY_{it} = f(K_{it}, AC_{it}, dK_{it}, dAC_{it}; E_{it}, dE_{it}) \quad (4)$$

Hypotheses

The main objective of this paper is to examine the impact of participation in nonfarm employment on households' welfare dynamics. From the theoretical discussion and earlier empirical evidence, we set out to test two related hypotheses.

1. Participation in nonfarm employment accelerates income growth. This follows from our theoretical argument that in the absence of fully functioning markets, as is the case in rural Ethiopia, the nonfarm activities will improve the returns to the resources owned and hence the household's welfare dynamics .
2. Nonfarm employment has relatively more impact on the welfare dynamics of the poor than of the rich. Because the poor are more liquidity constrained, more risk averse and potentially more abundant in labor, the impact of participation on their production decision and efficiency may be higher. Alternatively, since poorer households have diminished access to nonfarm activities that yield higher returns, the welfare impact of their participation may be lower than that of the rich.

4. Empirical model

In the theoretical model growth in income is mainly a function of initial capital holdings, the activities those resources are employed in and the changes in capital and activities. However, in the empirical model, we run into econometric difficulty if we want to include all the change variables. While we can argue that the pre-determined initial level of capital holdings and activity are exogenous, the same cannot be said of the changes in those variables. Hence the reduced form of our growth model is a function of initial capital and activities and other controls:

$$\Delta Y_{it} = \beta_0 + \beta_1 AC_{it-1} + \beta_2 \mathbf{K}_{it-1} + \beta_3 \mathbf{H}_{it-1} + \beta_4 V_{it} + \beta_5 \Delta R_{it} + \gamma_1 \mathbf{Z}_i + \alpha_i + \varepsilon_{it} \quad (5)$$

Where ΔY_{it} refers to growth in expenditure between period t and $t-1$, \mathbf{K}_{it-1} refer to a vector of initial levels of human capital (labor supply and education) and physical capital (farm and nonfarm assets, livestock and land), AC_{it-1} refers to the activity index in the initial period. If households can choose employment in any sector and all markets function without friction, then they will allocate their resources to equalize their marginal returns across activities, and activity composition will not affect the returns. In that case, the coefficient estimates associated with AC would not be statistically significantly different from zero. Ideally we would want AC to be the share of capital employed in the nonfarm activities. However, because it is difficult aggregate different types of capital and to distinguish between different uses of indivisible assets such as land, we use the share of nonfarm income instead.

Similar resource endowments and activity portfolios may lead to different income growth patterns for different households. Observed and unobserved characteristics of households may affect their income growth. \mathbf{H}_{it-1} is a vector of observed household characteristics in the initial period, such as age and gender of household head, while α_i refers to unobserved household-specific effects. Examples of unobserved household heterogeneity are the inherent ability and work ethics of household heads and members. The exogenous variable \mathbf{E}_{it} discussed in the theoretical model is captured through a set of village level characteristics that indicate agroecological and market conditions and through year dummies to control for policy changes. \mathbf{Z}_i refers to a vector of village level characteristics such as population density, distance to town and agroecological characteristics. About 3/4th of income in rural Ethiopia is obtained from Agriculture (CSA, 2001). Since Ethiopia's agriculture is mainly rain-fed, weather conditions are

important determinants of income dynamics. The vector V_{it} is included in the regression to control for total annual rainfall in the base period and coefficients of variation for monthly (seasonal) and annual rainfall variation. We also control for changes in total rainfall ΔR between the survey years. All continuous values are expressed in logarithmic terms. The term ε_{it} is a mean zero, identically and independently distributed random error which is assumed uncorrelated with all the explanatory variables. We estimated our growth model using fixed effects model, random effects model and Hausman-Taylor estimator⁵.

Decomposition analysis

To examine the growth differential due to differences in returns to assets owned by RNFE participants and non-participants, we perform Blinder-Oaxaca decomposition⁶ (Blinder, 1973, Oaxaca, 1973). We briefly discuss below the technique used to decompose the growth differential into its components. First, write the growth equation separately for RNFE participants and non-participants.

$$\text{Growth equation for RNFE participant: } G_i^P = \beta_0^P + \sum_{j=1}^n \beta_j^P X_{ji}^P + u_i \quad (6)$$

$$\text{Growth equation for non- participants: } G_i^N = \beta_0^N + \sum_{j=1}^n \beta_j^N X_{ji}^N + u_i, \text{ then:} \quad (7)$$

$$\overline{G^P} - \overline{G^N} = \underbrace{\sum \beta_j^P (\overline{X_j^P} - \overline{X_j^N})}_E + \underbrace{\sum \overline{X_j^N} (\beta_j^P - \beta_j^N)}_C + \underbrace{(\beta_0^P - \beta_0^N)}_U \quad (8)$$

If the growth equation of the RNFE participant is the high growth equation, as we hypothesize, the first part E in equation (8) refers to growth difference due to participants having higher endowments while the second part C refers to growth difference due to participants having higher marginal returns (coefficient estimates). The component C would be non-zero only if returns to assets differ by participation status. U refers to the growth difference unexplained by endowments or efficiency.

⁵ Refer the Introduction chapter of this thesis for a discussion on these three estimators.

⁶ Blinder-Oaxaca decomposition is a method used to measure income differential between groups. It was initially designed to analyze wage differential between races and sexes.

5. Results and Discussion

5.1. Non-parametric regression

Comparison of the mean consumption growth rate for RNFE participants and non-participants show that households who participate in RNFE grow faster, although significant only at 10%. However, mean comparison by participation status reveal very little. There is no reason to believe that all RNFE participant households have similar expenditure growth. We have argued in the conceptual discussion that the activity index may affect the growth path. Using the share of nonfarm income in total expenditure as an activity index, Figure 1 presents the nonparametric regression of expenditure growth on activity index⁷. The Kernel-weighted polynomial regression shows a positive relationship between expenditure growth and nonfarm share. Households who engage more intensively in nonfarm employment experience higher consumption growth, especially in the range where (positive) nonfarm income constitutes up to half of consumption expenditure. The result seems to confirm our hypothesis that nonfarm participation accelerates income growth.

5.2. Econometric estimation

Following our theoretical discussion earlier, the econometric estimation explores the relationship between growth and the activity index in a multivariate regression setting. We regress the change in the logarithm of expenditure per adult equivalent on initial nonfarm share. Because a very small percentage of households participated in high-return employment, of whom half also participated in low-return employment, there is not enough observation and variation for disaggregating nonfarm income share by type of employment. To allow for the nonlinear relation we include a third order polynomial in the nonfarm share. The other regressors are: human and physical capital variables, household characteristics and village characteristics. We include village median expenditure per adult equivalent to control for initial level expenditure in the

⁷ The nonparametric regression is given for nonfarm share between -1 and 1. This domain covers 97% of the sample. The reported regression has a bandwidth of 0.4. For comparison, the regressions with bandwidth 0.8 and 0.2 are given in the appendix. The general pattern is similar and the plots for (positive) nonfarm share up to 0.5 are especially very close.

community⁸. Except for change in rainfall, all variables are in level form and refer to the base period. We estimate the growth model using all the three estimators: fixed effect, random effect and Hausman-Taylor, controlling for clustering at the village level in the first two methods. The estimation from the three methods shows that there is no fixed effect. Hence we report and discuss here the estimation result from the random effects estimator. The results from the other two estimators are given in the appendix.

As shown in Table 5, there is a positive correlation between the share of income from RNFE and expenditure growth⁹. The coefficients on the linear and squared terms are positive and significant and the coefficient on cubic term negative and also significant giving a highly nonlinear relationship. We compute the marginal effect of nonfarm share on growth at its mean value using the **Stata** command **nlcom**. The result shows that a 0.1 increase in the share of nonfarm income increases expenditure growth by 6%. We also compute the predicted growth from the model and plot the result in Figure 2 for nonfarm share in the range of -1 and 1¹⁰. This range includes 97% of the sample. The plot shows a strongly positive relationship between the initial expenditure share of income from rural nonfarm employment and subsequent expenditure growth.

The strongly positive relation between household's nonfarm income share and its subsequent expenditure growth indicates that, controlling for other differences, households who participate in RNFE experience higher growth in expenditure with the growth rate increasing as one engage in nonfarm employment more intensively. This may be a result of higher returns to resources employed in rural nonfarm economy as opposed to agriculture. At least for some activities such as skilled wage employment, labor returns are typically much higher than the average or marginal returns to farming. Moreover, given market conditions in rural Ethiopia, one or more of the possible channels through which nonfarm participation increases contemporaneous income

⁸ Including households' own initial expenditure will introduce endogeneity.

⁹ The results from fixed effects and Hausman-Taylor estimators suggest an even stronger positive relation between share of income from RNFE and expenditure growth (Appendix Table A2).

¹⁰ The plot for the whole range of nonfarm share shows a highly nonlinear relationship between initial nonfarm share and growth (see Figure A-2 in appendix). Growth in expenditure is negatively associated with nonfarm share at higher (absolute) values of nonfarm share. However, the density of this regime is small and the confidence band is broad which imply weak relation in those ranges.

(as discussed in section 3) may also lead to higher subsequent growth. For example, almost all the survey sites are characterized by rainfed agriculture with only one major rainy season. Households that participate in nonfarm employment, even if it was a low-return activity, get better total income from their endowments than those households who use their full resource only during agricultural season. Given that the credit markets function poorly, participation in nonfarm employment may also improve households' capacity to invest in agriculture and subsequently improve their welfare.

Turning to the other regressors in Table 5, age, dependency ratio, labor and asset holdings also have statistically significant effect on expenditure growth. Households with older heads experience lower growth. Households that started out with higher levels of human and physical capital grow faster. Note that the coefficients in the growth model reflect changes in returns to capital. Hence the positive coefficients imply increasing returns to both male and female labor, with the returns to female labor higher than male labor. Physical assets, on the other hand, exhibit decreasing returns over time.

Growth impact by poverty status

Because of risk, insufficient farm income and lack of investment capital for agriculture, the poor may have higher incentive to participate in nonfarm employment. But they are also typically less able to choose among alternative nonfarm activities because of lack of the necessary resources such as skill or capital. As a result, the poor households in our sample tend to engage more in low-return activities while the relatively rich are far more likely to engage in the high-return activities such as salaried or skilled wage employment and high-investment self-employment. This suggests that nonfarm participation might have greater expected returns and income for ex ante better-off households than for the poorest. But does it bring better-off households faster growth?

On the one hand, because the rich are less liquidity constrained and less risk averse than the poor, participation in nonfarm employment may not affect their input use and consumption decisions in a way that influences their production and income dynamics. Nonfarm participation may, thereby, have more impact on the growth of the poor than of the non-poor. On the other

hand, if the rich participate more in nonfarm activities that offer superior returns, they might accumulate more resources and enjoy higher growth than the poor.

To test for growth differences by wealth status, we estimate the preceding growth model separately for households in the lower and upper tercile of the initial livestock holdings. The village studies reveal that livestock is the most common indicator of wealth in all the survey sites. The estimation results (Table 6) show that growth increases with an increase in nonfarm share both for poor and rich households. However, households who are in the upper wealth tercile have much higher growth elasticity than the poor. Compared to poor households, the coefficient of nonfarm share is more than three times higher for the livestock rich households. The plots of predicted growth in Figure 3 show that the rich have higher growth rate at each level of nonfarm share. This may be because the rich are more engaged in high return activities as compare to the poor households who do not have capacity to participate in these activities. The effect could also result from complementarities between nonfarm participation and agricultural activities. For example, those who have donkeys and camels earn income from RNFE by providing transport service. But their farm also benefits from the animals' manure. It is also easier to transport inputs from and output to markets. Crop residuals in turn are used as fodder for their livestock, generating important economies of scope.

Of course there is a possibility of endogeneity here. Households with more wealth may simply be better farmers who are also more productive in nonfarm employment. The difference we observe between rich and poor in the estimated growth effects of nonfarm participation may thus merely reflect unobserved productivity differences between two groups. However, because we have used a random effect model, we expect that some of this effect, if not all, is controlled for. The fixed effect estimation also gave the same result.

Nonfarm employment participation and its impact on asset returns

Although the regression results discussed above show a positive correlation between growth and the share of nonfarm income, and that the growth effects of rural nonfarm employment are greater among the relatively wealthy, they do not establish that the returns to assets owned by RNFE participants are in fact different from the returns to assets owned by non-participants. In

this section we explore this possibility and also see whether higher returns (if any) accrue for all assets or only for some asset classes.

We estimate the same function as before except that nonfarm share is no longer an explanatory variable. Rather, we estimate the growth model separately for RNFE participants and non-participants using village fixed effects. We then perform Blinder-Oaxaca decomposition to see how much of the growth difference between RNFE participants and non-participants is attributable to differences in resource endowments and how much is due to differences in the returns to their respective assets.

Table 7 reports estimation results from the village fixed effects regressions that are used to compute the decomposition and table 8 shows the decomposition analysis. RNFE participants enjoy a 29 percent higher total growth than non-participants. The decomposition analysis shows that this is composed of a +64% growth differential attributable to differences in endowments and coefficient estimates (E+C) and a -35% growth differential due to differences in the intercepts (U)¹¹. More than two-third of the explained difference is due to higher estimated returns on resources owned by RNFE participants; the rest is due to higher endowments.

This result indicates that RNFE participants enjoy higher rates of return than do non-participants. Hence, it is possible to argue that higher growth rate associated with nonfarm participation results from nonfarm participants earning higher returns to their endowments.

Higher average aggregate return for RNFE participants does not mean that each and every asset earns higher returns in the RNFE. The estimation result from the regression used for the decomposition analysis shows that the significant variables are labor and assets. RNFE participants enjoy higher returns on asset holdings. Participants' higher returns to assets explain 37% of the growth differential in their favor. This may be explained by higher earnings for assets employed in nonfarm economy. It may also imply higher return for farm equipments employed in farming because of households' ability to buy complementary inputs which improve the productivity of these assets, consistent with the argument that nonfarm participation help relax

¹¹ From the regression results we can see that both RNFE participants and non-participants have negative constants. However, because the magnitude of the constant for RNFE participant households is much higher than that of the non-participants, the unexplained difference U (shift coefficient) favors the non-participants.

households' liquidity constraint. RNFE participants enjoy higher estimated returns on female labor and lower estimated returns on male labor than non-participants. This is in line with our earlier argument that nonfarm employment increases the utilization of labor that is not fully used in agriculture. Female employment in agriculture in Ethiopia is constrained for cultural reasons. Participation in nonfarm employment enables households to utilize adult female labor more productively. On the other hand, male labor favors non-participants.

6. Conclusions

Several studies across Africa document a positive correlation between nonfarm participation and household income and wealth status. However, there is limited evidence as to the direction of causality. This could reflect the preferential access of the rich to lucrative RNFE opportunities or the positive impact of rural nonfarm employment on earnings and investment. This paper examines the impact of participation in the rural nonfarm economy on welfare dynamics by using household panel data from rural Ethiopia.

The results of our analysis suggest that nonfarm economy offer a higher income path for participant households. The regression results show that growth in consumption expenditure increases with the household's ex ante share of nonfarm income. The positive relationship between share of nonfarm income and expenditure growth holds for both the poor and wealthy. However, relatively wealthy households benefit more from RNFE participation than do poorer ones. The Blinder-Oaxaca decomposition sheds some light on the source of this growth. Faster growth among nonfarm participants results from higher returns to their physical assets and female labor.

The positive relationship between share of nonfarm income and growth rates and the observed higher growth elasticity among wealthy households, suggests a positive feedback loop. Rural households can increase their expected income by engaging more in nonfarm activities. This enables them to invest more in the farm sector or access the high-return activities, which typically require initial investment. Either strategy further accelerates expenditure growth. This can aggravate rural income inequality as RNFE participants accumulate wealth and increase expenditure faster, with the greater gains enjoyed by those who were richer to begin with.

Table 1: Monthly expenditure and income of sample households in 1994, 1999 and 2004

Year	Consumption Expenditure per adult equivalent			Income per adult equivalent		
	Mean	Std. Dev	Median	Mean	Std. Dev	Median
1994	108	109	77	50	67	32
1999	131	224	82	71	188	41
2004	136	137	93	85	106	50

Table 2: Proportion of RNFE participant households

Year	RNFE*	High-return RNFE	Low-return RNFE
1994	0.57	0.06	0.53
1999	0.43	0.08	0.38
2004	0.44	0.06	0.41
Average	0.48	0.07	0.44

* Some households participated in more than one type of RNFE.

Table 3: Share of income from RNFE by expenditure and asset tercile*

	Expenditure Tercile			Asset Tercile		
	Lowest	Middle	Highest	Lowest	Middle	Highest
Share of income from RNFE	0.34 (0.03)	0.17 (0.01)	0.10 (0.01)	0.20 (0.02)	0.21 (0.02)	0.21 (0.02)
Amount of income from RNFE (birr/month)	42.26 (3.18)	59.71 (4.14)	74.51 (5.87)	42.01 (3.20)	59.18 (3.94)	73.49 (5.76)

*Standard deviations in parentheses.

Table 4: Total income, expenditure and assets by nonfarm participation status

Assets ⁺ , income and expenditure	Not participate in RNFE			t-test	Participate in RNFE			By type of RNFE		
	Mean		Std. Err.		Mean		Std. Err.	High -pay		Low- pay
	Mean	Std. Err.	Mean		Std. Err.	Mean	Std. Err.	Mean	Std. Err.	
Total monthly expenditure (in Birr)	496.8	14.20	513.3	16.8		619.1	33.4	510.4	18.0	
Total monthly income(in Birr)	265.2	10.1	310.4	14.2	***	416.9	26.2	306.6	15.2	
Monthly expenditure in adult equivalent	129.5	3.9	120.4	3.5		140.4	7.8	118.8	3.7	
Monthly income in adult equivalent	67.1	2.9	71.0	3.0	**	93.0	6.4	69.5	3.1	
Farm equipment owned (in Birr)	10.00	0.60	8.80	0.30	**	10.50	0.90	8.60	0.40	
Nonfarm equipment owned (in Birr)	10.10	0.70	11.80	0.80	**	15.90	2.30	11.20	0.80	
Nonproductive assets owned (in Birr)	81.80	10.50	70.90	4.50		106.10	13.40	67.10	4.50	
Livestock owned (in Birr)	0.82	0.02	0.81	0.03		0.82	0.06	0.82	0.03	
Land holding (in hectares)	0.41	0.01	0.39	0.01	**	0.37	0.03	0.39	0.01	
Total cultivable land owned (in hectares)	1.30	0.03	1.42	0.05	***	1.25	0.07	1.44	0.05	
Proportion of illiterate adults in the household	0.64	0.01	0.63	0.01		0.53	0.02	0.64	0.01	
Proportion of adults with < 6 years of education (including informal education)	0.24	0.01	0.23	0.01		0.28	0.02	0.23	0.01	
Proportion of adults with ≥ 6 years of educ.	0.13	0.01	0.14	0.01	**	0.19	0.02	0.13	0.01	
Number of male adults	1.39	0.03	1.56	0.03	***	1.78	0.07	1.55	0.03	
Number of female adults	1.45	0.02	1.69	0.03	***	1.68	0.07	1.70	0.03	
Share of income from RNFE			0.21	0.01		0.27	0.03	0.20	0.01	
Annual income from sale of crops (in Birr)	463.0	21.0	301.0	16.00	***	413.0	46.0	291.0	17.0	
Monthly income from RNFE			58.40	2.93		82.35	7.26			
Monthly income from High-return activities								50.84	2.90	
Monthly income from Low-return activities										
Number of observation		2287		2070			290		1908	

+ All assets are given in adult equivalent units. *, **, *** difference between RNFE participants and non-participants significant at 10%, 5% and 1% respectively

Table 5: Random effects regression estimates of expenditure growth

Dependent variable: $\Delta \ln$ (Expenditure per adult equivalent)	Coefficients	Robust Std.err
Average per capita expenditure in the village	-0.732 ***	0.184
Age of household head	0.11	0.179
(Age of household head) ²	-0.12 ***	0.045
Female HH head	-0.056	0.058
HH head is literate	-0.027	0.065
Dependency ratio	0.236 **	0.111
Adult education: Above elementary	0.092	0.205
Adult education: Elementary	-0.004	0.184
Distance to town	-0.017	0.112
Population density	-0.19	0.179
Kolla zone: Lowlands between 500-1500 meters	-0.243	0.239
Dega zone: Highlands between 2300-3200 meters	0.139	0.192
Number of male adult members	0.302 ***	0.078
Number of female adult members	0.483 ***	0.103
Land holdings	0.391	0.249
Assets owned (in Eth Birr)	-0.106 ***	0.033
Number of sheeps and goats owned	0.115	0.12
Number of cattle owned	0.051	0.079
Number of pack animals owned	-0.095	0.148
Change in annual rainfall (RFt-RFt-1)	-0.264	0.265
Annual rainfall in the initial period(RFt-1)	0.392	0.671
Annual Rainfall variability in the village	-1.051	1.01
Monthly rainfall variability (seasonality) in the village	0.135	1.702
Share of income from RNFE in total expenditure	0.591 ***	0.128
(Share of income from RNFE in total expenditure) ²	0.028 ***	0.01
(Share of income from RNFE in total expenditure) ³	-0.019 ***	0.005
Year dummy R1(growth 1994-1999)	-0.338 **	0.169
Constant	1.426	5.708
Number of observations	2586	
Prob > χ^2	0.000	
R ² -within	0.16	
R ² -overall	0.10	

*, **, *** refer to significance at 10%, 5% and 1% respectively. 1) All continuous variables are given in log form except share of income from RNFE and rainfall variation 2) All asset variables are given in adult equivalent terms. 3) All time varying variables, except change in rainfall and rainfall variation, refer to base period value.

Table 6: Random effects regression estimates of expenditure growth by wealth status⁺

	Poorest households		Wealthiest households	
	Coeff.	Std.Err	Coeff.	Std.Err
Average per capita expenditure in the village	-0.006 **	0.003	-0.003	0.002
Age of household head	-0.257	0.244	0.108	0.150
Female HH head	0.119	0.160	-0.402 ***	0.138
HH head is literate	-0.038	0.149	-0.137 *	0.078
Dependency ratio	0.123	0.125	-0.133	0.167
Adult education: Above elementary	0.189	0.271	0.528 **	0.262
Adult education: Elementary	-0.134	0.285	0.059	0.179
Distance to town	0.035	0.102	-0.032	0.068
Population density	0.01	0.209	-0.271	0.388
Kolla zone: Lowlands between 500-1500 meters	0.096	0.208	-0.44 **	0.200
Dega zone: Highlands between 2300-3200 meters	0.402	0.379	-0.143	0.302
Number of male adult members	0.291 ***	0.109	0.029	0.105
Number of female adult members	0.544 ***	0.164	0.34 **	0.135
Land holding	0.366	0.514	0.212	0.294
Asset owned (in Eth Birr)	-0.105 *	0.056	-0.076 *	0.042
Number of sheeps and goats owned	-0.456 *	0.236	0.19	0.115
Number of cattle owned	0.385	0.523	-0.074	0.112
Number of pack animals owned	1.007	1.153	-0.346 *	0.201
Change in annual rainfall (RFt-RFt-1)	0.092	0.464	0.301	0.787
Annual rainfall in the initial period(RFt-1)	0.177	0.881	-0.656	1.332
Annual Rainfall variability in the village	-0.859	2.121	-3.584 **	1.413
Monthly rainfall variability (seasonality) in the village	0.962	2.788	-1.534	3.072
Share of income from RNFE in total expenditure	0.632 ***	0.176	1.979 ***	0.415
(Share of income from RNFE in total expenditure) ²	0.04 **	0.016	-0.594 *	0.354
(Share of income from RNFE in total expenditure) ³	-0.019 **	0.008	0.045	0.056
Year dummy R1(growth 1994-1999)	-0.262	0.292	-0.426 **	0.176
Constant	-0.803	8.003	7.26	11.937
Number of observations	858		866	
Prob > chi ²				
R ² -within	0.121		0.174	
R ² -overall	0.095		0.129	

+ - wealth refers to livestock holding: Poor (bottom tercile), wealthy (top tercile)

*, **, *** refer to significance at 10%, 5% and 1% respectively. Note: 1) All continuous variables are given in log form except share of income from RNFE and rainfall variation 2) All asset variables are given in adult equivalent terms. 3) All time varying variables, except change in rainfall and rainfall variation, refer to base period value.

Table 7: Village fixed effects estimates of expenditure growth 1994-2004 used for decomposition analysis

	RNFE participant		RNFE non-participant	
	Coefficient	Std. Err	Coefficient	Std. Err
Age of household head	0.086	0.169	-0.053	0.199
Female HH head	-0.135	0.139	0.118	0.196
HH head is literate	0.064	0.126	-0.065	0.175
Dependency ratio	0.190	0.187	0.125	0.229
Adult education: Above elementary	-0.270	0.342	-0.223	0.424
Adult education: Elementary	-0.116	0.309	0.586	0.416
Number of male adult members	0.230	0.144	0.584 ***	0.185
Number of female adult members	0.371 **	0.154	0.197	0.201
Land holding	-0.313	0.296	0.360	0.479
Asset owned (in Eth Birr)	-0.043	0.044	-0.160 ***	0.053
Number of sheeps and goats owned	0.174	0.214	0.377	0.253
Number of cattle owned	-0.140	0.142	0.094	0.185
Number of pack animals owned	0.363	0.383	0.083	0.399
Constant	-0.685	0.650	-0.333	0.818

*, **, *** refer to significance at 10%, 5% and 1% respectively. Note: 1) All continuous variables are given in log form 2) All asset variables are given in adult equivalent terms. 3) Village dummies included in estimation but not reported.

Table 8: Blinder-Oaxaca decomposition of growth difference by RNFE participation (as %s)

Variables	Amount attributable* (E+C)	Differential due to endowments (E)	Differential due to Coefficients (C)
Age of household head	52.6	-0.3	52.9
Female HH head	-5.0	-0.1	-4.9
Head is literate	4.6	-0.1	4.7
Dependency ratio	2.8	-0.4	3.2
Adult education: Above elementary	-0.8	-0.3	-0.5
Adult education: Elementary	-8.2	0.7	-8.9
Number of male adult	-25.9	6.1	-32.0
Number of female adult	19.3	2.3	17.0
Land holdings	-19.2	0.6	-19.8
Assets owned (in Eth. Birr)	39.5	2.1	37.4
Number of sheep and goats owned	-3.5	-0.5	-3.0
Number of cattle owned	-13.6	0.7	-14.2
Number of pack animals owned	4.6	0.3	4.2
<i>Subtotal</i>	<i>63.8</i>	<i>20.4</i>	<i>43.4</i>

Summary of decomposition results (as %)

Total growth differential (E+C+U):	29
<i>Amount attributable (C+E) :</i>	64
<i>Shift coefficient (unexplained portion)(U):</i>	-35
Coefficients as % of attributable difference [$C/(C+E)$]	68

* Positive values show difference in favor of nonfarm participants. Note: 1) All continuous values are in log form.
2) All assets are given in adult equivalent.

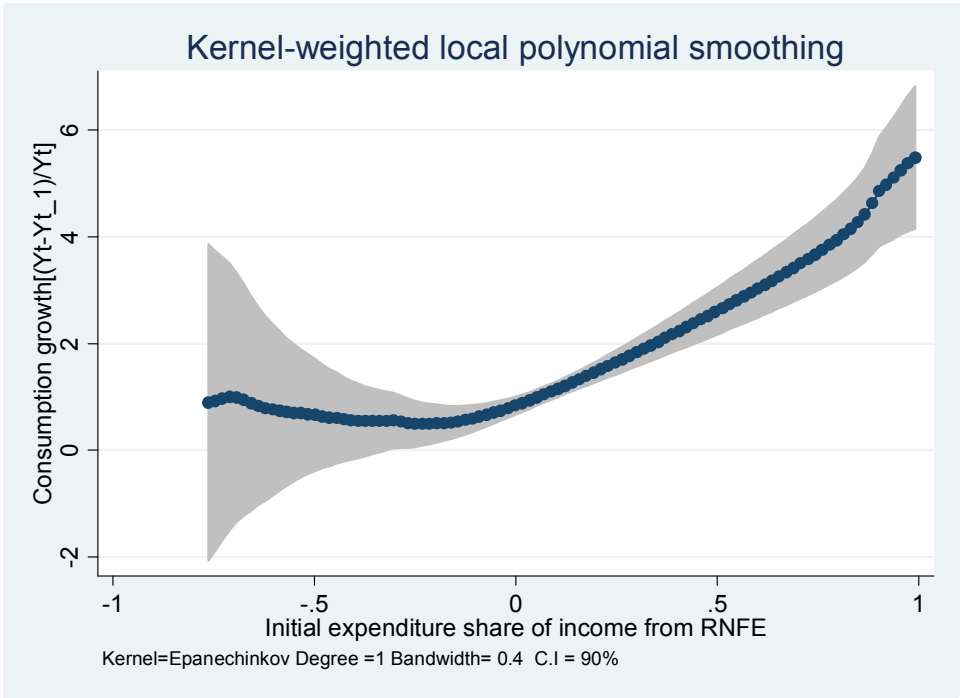


Figure 1: Non-parametric regression of expenditure growth on nonfarm income share

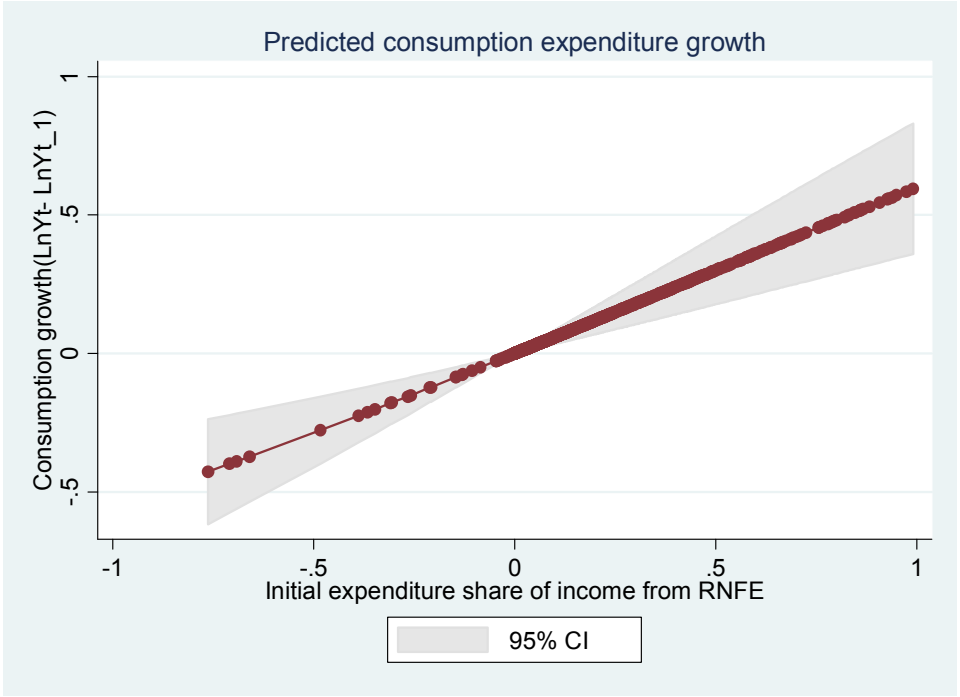


Figure 2: Plot of predicted consumption expenditure at different level of nonfarm share

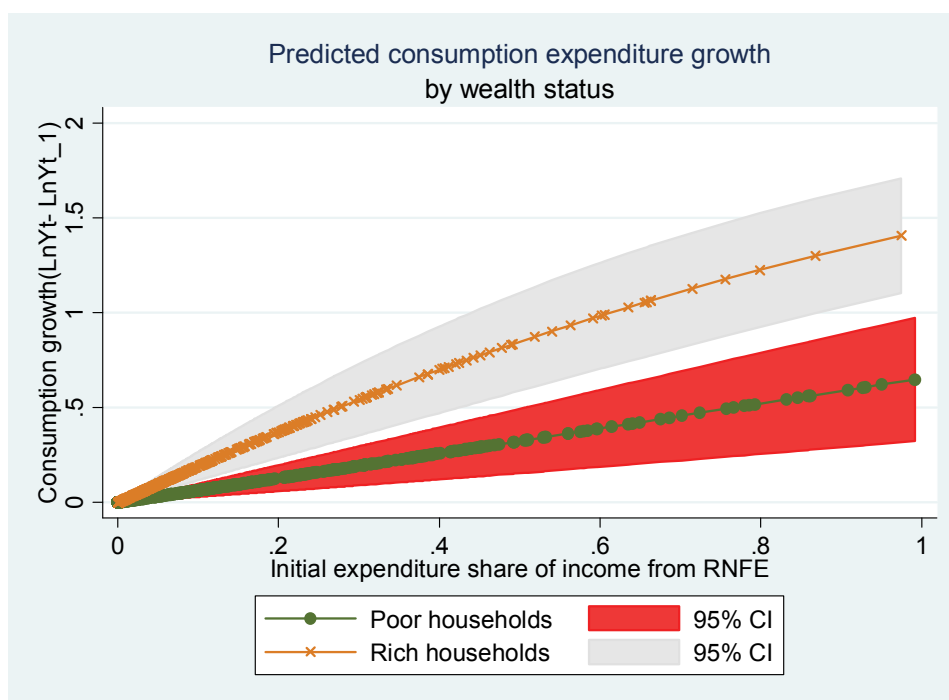


Figure 3: Plot of predicted consumption expenditure for poor versus wealthy households

Table A.1: GDP and growth in GDP in Ethiopia: 1994-2004

Year	Real GDP(in 2000 prices)			Growth rates		
	Total (in millions birr)	Per capita (birr)	Per capita (USD)	Real GDP	Real GDP per capita	Nominal GDP
1994/95	52254	971	156			
1995/96	58776	1059	167	12.48	9.04	12.16
1996/97	60939	1065	161	3.68	0.60	3.61
1997/98	58252	987	144	-4.41	-7.33	-4.02
1998/99	62284	1025	136	6.92	3.79	7.57
1999/00	65629	1048	129	5.37	2.31	11.64
2000/01	69361.8	1077	129	5.69	2.73	1.33
2001/02	70219.2	1060	124	1.24	-1.56	-3.39
2002/03	67755.1	993	116	-3.51	-6.30	8.57
2003/04	76652.5	1093	127	13.13	10.07	18.66
2004/05	84553.1	1174	136	10.31	7.40	14.24

Source: Compiled from Annual Reports on Macroeconomic Developments. Ministry of Finance and Economic Development.

Table A.2: Regression estimates of expenditure growth: Fixed effect and Hausman -Taylor models

Dependent variable: $\Delta \ln$ (Expenditure per adult equivalent)	Fixed Effect		Hausman-Taylor	
	Coeff.	Robust Std.err	Coeff.	Std.err
Average per capita expenditure in the village	-1.338 ***	0.174	-1.21 ***	0.122
Age of household head	0.193	0.414	-0.012	0.471
(Age of household head) ²	-0.123 *	0.061	-0.084	0.227
Female HH head	0.136	0.24	-0.206 **	0.105
Head is literate	-0.215	0.144	-0.172	0.144
Dependency ratio	0.487 *	0.244	0.25	0.22
Adult education: Above elementary	-0.004	0.494	0.132	0.394
Adult education: Elementary	-0.066	0.25	-0.064	0.255
Distance to town			-0.367 ***	0.074
Population density			-0.625 **	0.309
Kolla zone: Lowlands between 500-1500 meters			-0.297	0.59
Dega zone: Highlands between 2300-3200 meters			1.353 ***	0.329
Male adult	0.504 ***	0.169	0.271 *	0.156
Female adult	0.737 ***	0.183	0.620 ***	0.163
Land holdings	-0.064	0.539	0.29	0.226
Assets owned (in Eth Birr)	-0.08	0.054	-0.201 ***	0.04
Number of sheep and goats owned	0.174	0.133	0.122	0.121
Number of cattle owned	-0.174	0.14	-0.21	0.141
Number of pack animals owned	-0.5 *	0.249	-0.691 **	0.308
Change in annual rainfall ($RF_t - RF_{t-1}$)	0.582	0.349	0.398	0.416
Annual rainfall in the initial period (RF_{t-1})	-0.374	0.753	-0.257	0.808
Annual Rainfall variability in the village	-0.251	1.002	-0.792	0.716
Monthly rainfall variability (seasonality) in the village	-2.015	1.813	-0.634	1.273

Share of income from RNFE in total expenditure	1.066 ***	0.249	1.01 ***	0.165
(Share of income from RNFE in total expenditure) ²	0.059 ***	0.019	0.056 **	0.026
(Share of income from RNFE in total expenditure) ³	-0.033 ***	0.009	-0.032 ***	0.008
Year dummy R1(growth 1994-1999)	-0.232	0.149	-0.481 ***	0.094
Constant	8.472	6.002	12.067 *	7.173
Number of observations	2586		2586	
F statistic	88.602			
Chi2 statistic			414.375	
p-value	0.000		0.000	
R2-within	0.202			
R2-between	0.009			
R2-overall	0.06			
Rho(panel variance fraction) ⁺	0.474			

Note: 1) All continuous variables are given in log form except share of income from RNFE and rainfall variation 2) All asset variables are given in adult equivalent terms. 3) All time varying variables, except change in rainfall and rainfall variation, refer to base period values

*, **, *** refer to significance at 10%, 5% and 1% respectively. + F-test on household effect did not reject that $\alpha_i=0$

Table A.3: The village fixed effect estimates of expenditure growth 1994-2004 that are used for decomposition analysis

Variable	RNFE participant			Non-participants		
	Coefficient	Mean	Prediction	Coefficient	Mean	Prediction
Age of household head	0.105	3.806	0.4	-0.041	3.745	-0.155
Female HH head	-0.144	0.194	-0.028	-0.052	0.201	-0.01
Head is literate	0.071	0.367	0.026	-0.089	0.351	-0.031
Dependency ratio	0.178	0.493	0.088	0.113	0.522	0.059
Adult education: Above elementary	-0.316	0.105	-0.033	-0.274	0.093	-0.025
Adult education: Elementary	-0.123	0.127	-0.016	0.517	0.115	0.06
Male adult	0.221	0.905	0.2	0.561	0.8	0.449
Female adult	0.363	0.975	0.354	0.147	0.857	0.126
Land holdings	-0.31	0.295	-0.091	0.485	0.278	0.135
Farm asset owned (in Eth Birr)	0.009	1.51	0.014	-0.28	1.52	-0.425
Nonfarm asset owned (in Eth Birr)	-0.07	1.573	-0.111	-0.071	1.299	-0.093
Non-productive asset owned	-0.001	2.41	-0.003	-0.01	2.703	-0.027
Number of sheep and goats owned	0.178	0.148	0.026	0.453	0.16	0.073
Number of cattle owned	-0.143	0.609	-0.087	0.12	0.539	0.065
Number of pack animals owned	0.362	0.152	0.055	0.129	0.11	0.014
Constant	-0.813	1	-0.813	-0.304	1	-0.304
Predicted growth (ln):		0.094	0.094			-0.193
Predicted growth (Birr):		1.1	1.1			0.82

* All continuous values are in log form and assets are given per adult equivalent. Although not reported here, village dummies are included in the regression.

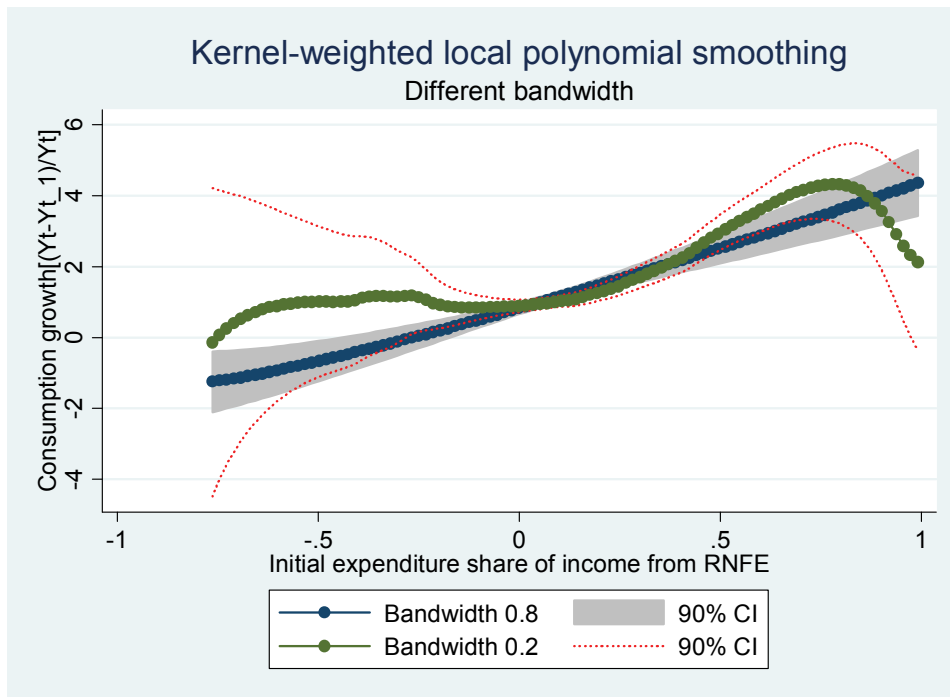


Figure A.1 Non-parametric regression of expenditure growth on nonfarm income share

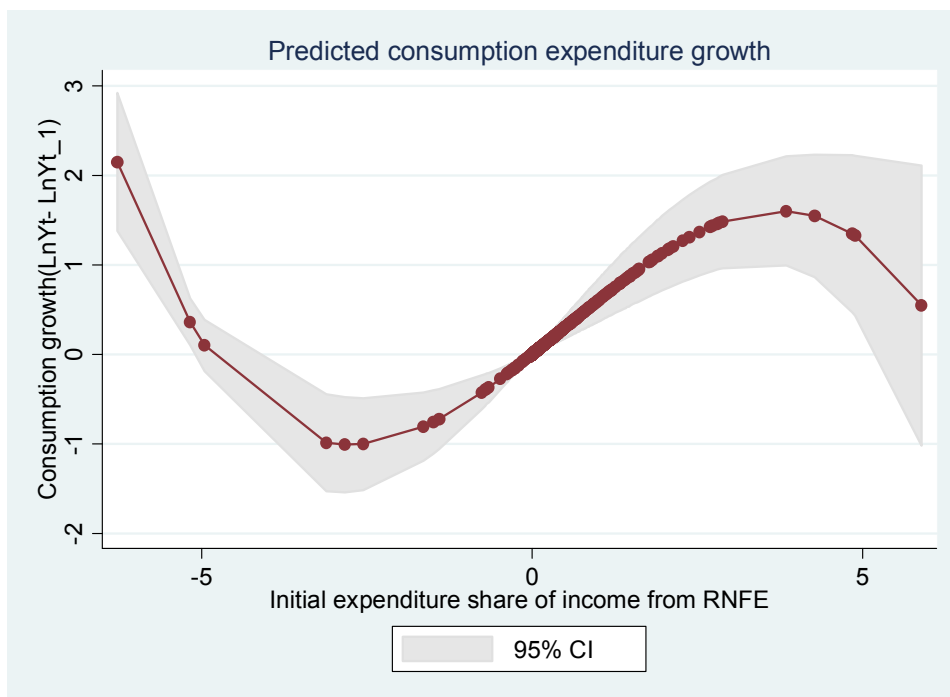


Figure A.2 Plot of predicted consumption expenditure at different level of nonfarm share

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PAPER IV



Dynamics in rural households' nonfarm employment in Ethiopia

Do the poor have time on their side?

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Abstract

This study examines nonfarm employment dynamics of rural households in Ethiopia between 1999 and 2004. We find that those households who accumulated assets in this period were able to transit from low-return to high-return rural nonfarm employment. The results from multinomial regressions indicate that access to saving and credit, which imply capital accumulation, is an important factor for transition into high-return rural nonfarm employment, both for an upgrade from low-return employment as well as for new entry from pure agriculture. Increase in adult labor was also found to be positively correlated with transition from low-return to high-return rural nonfarm employment. Moreover, wealthier households are better placed to transit from low-return to high-return nonfarm activity over time. The results in this paper suggest that households' participation in high-return rural nonfarm activities is robust to their experience of health shocks. There is no evidence, in this data, that health shocks trigger transition out of high-return nonfarm employment. On the other hand, shocks that affect their wealth or liquidity may trigger descents into low-return employment. We also found that by altering the relative returns between the sectors, shocks that reduce agricultural income motivate transitions into high-return rural nonfarm employment.

Key words: rural nonfarm, income diversification, employment transition, Ethiopia, shocks

1. Introduction

There is an extensive recent literature on rural households' diversification into nonfarm employment. Most studies have focused on the determinants of diversification (Corral and Reardon, 2001, de Janvry and Sadoulet, 2001, Kung and Lee, 2001, Lanjouw and Shariff, 2002, Woldenhanna and Oskam, 2001, Barrett et al., 2005)¹ while others examine the impact on investment, poverty and inequality (Lay et al., 2008, Matsumoto et al., 2006, Nargis and Hossain, 2006, Reardon et al., 2000, van den Berg and Kumbi, 2006). Several of these studies identified shocks as a major incentive for diversification into rural nonfarm employment, to smooth income ex ante or to smooth consumption ex post. For some of the nonfarm activities, superior expected returns which offer possibility for upward mobility are the driving factors. However, such activities are typically taken up by the non-poor (Lanjouw, 2001, Dercon and Krishnan, 1996, Lay et al., 2008).

As in any other economic activity, nonfarm employment is likely to evolve over time as a result of resource re-allocation and asset dynamics as households try to adjust their employment portfolio to changing opportunities, capacities and challenges including experience of shock. An understanding of the dynamics of nonfarm employment is, therefore, imperative for any policy intervention that seeks to improve households' access to and income from nonfarm employment.

While there are some studies that examine micro and small firm dynamics in developing countries (Liedholm, 2002, Liedholm et al., 1994, Maloney, 2004, Mead and Liedholm, 1998, Deininger et al., 2007) and several that examine the transition from wage to self employment in middle-income and developed countries (Mandelman and Montes-Rojas, 2009, Dunn and Holtz-Eakin, 2000, Carrasco, 1999, Bruce, 2000, Fairlie, 1999), studies that deal with dynamics of households' participation in *rural nonfarm activities* in developing countries are very rare.

One such study evaluates households' diversification behavior in response to macroeconomic shocks in Cote d'Ivoire (Barrett *et al.*, 2001). The study found that currency devaluation increased the returns to skilled nonfarm activities and depressed real returns to low-wage non-

¹ See also Reardon (1997) and Ellis (1998) for reviews of earlier studies.

farm activities. However, entry into the high return activities was low and the poor were not able to utilize the opportunity created by the macroeconomic shock.

A study of the dynamics of livelihood diversification in Ethiopia (Block and Webb, 2001) likewise examines factors associated with changes in income diversification over time, particularly focusing on whether perceptions of risk factors (as reported by households in a survey) were translated into changes in diversification and whether initial income diversification was associated with subsequent welfare changes. They found suggestive evidence indicating that those who believe less off-farm income to be associated with high risk diversified more over time. They also found that initially less diversified households subsequently diversified the most.

While the Block and Webb (2001) study gives important insights, it has some limitations as a study of nonfarm dynamics. First, the data used are unique in that the villages included in the sample were drought prone regions and the two surveys used to compare diversification are collected immediately after famine (1989) and in the first years of the reform period (1994). Second, they use share of crop income as a measure diversification. But the share of crop income may decline as a result of decrease in output or crop prices or profitability of non-crop activities rather than as a result of increased diversification. Finally, the regression model explaining change in diversification included only perceptions, initial income level and diversification index as covariates and does not control for other factors.

In this study we hope to contribute to the limited nonfarm dynamics literature by analysing rural households' engagement in nonfarm employment over time based on the Ethiopian Rural Household Survey (ERHS) data from 1999 and 2004. This paper addresses the limitations of the Block and Webb (2001) study by using a larger data set and by controlling for initial asset endowments and subsequent shock experiences in a multinomial regression of employment transitions. Moreover, this paper evaluates changes in households' rural nonfarm employment status by addressing the problem associated with price changes when one uses nonfarm income shares or crop shares. By disaggregating nonfarm employment into high-return and low-return activities, we are able to examine not only movement to and from rural nonfarm employment but also within rural nonfarm employment.

Although this paper examines movement to and from all rural nonfarm activities, the focus is on employment transition involving high-return RNFE. Earlier studies indicated that high-return activities offer upward mobility but are often accessible only by wealthier households. In this paper we assess whether the dynamic behavior is different. The paper also examines how employment in high-return RNFE is affected by households' shock experience.

Our findings suggest that low-return RNFE participants who accumulated capital were subsequently able to access high-return RNFE. The descriptive statistics show that low-return RNFE participants who moved to high-return employment have accumulated significantly more assets than those who stayed. The results from the econometric regressions strengthen this supposition. Increases in adult labor and participation in the traditional saving associations in 1999 were positively correlated with transitions from low-return to high-return nonfarm employment. Similarly, pure agricultural households who have assets that can be used in nonfarm activity and those who have access to saving and credit are more likely to transit into high-return RNFE. Wealthier households (with larger livestock holdings) who were engaged in low-return activity subsequently move to high-return nonfarm employment in 2004.

Surprisingly, none of the health shocks triggered transitions out of high-return RNFE. On the contrary, households who experience illness of household head or spouse were less likely to move to either low-return RNFE or pure agriculture. On the other hand, Shocks that diminish the wealth and liquidity of the household lead to transition out of high-return RNFE. The regression results show that households who experience pests and disease that affect crop and livestock holdings were more likely to move from high-return to low-return RNFE. Shocks that affect agriculture reduce the risk-adjusted returns from the sector, making high-return nonfarm employment more attractive. We found that pure agriculturalists that experienced pest or disease and low-return participants who experienced agricultural goods demand and price shocks are more likely to transit into high-return RNFE rather than stay in their respective sector.

The remainder of the paper proceeds as follows. We outline a conceptual framework and put forward the hypotheses in section 2. Sections 3 and 4 present descriptive statistics and empirical methods, respectively. Results are discussed in Section 5. The final Section presents concluding remarks.

2. Conceptual framework

The dynamics of nonfarm diversification refers to entry into and exit from the nonfarm sector as well as movement between different activities within the nonfarm sector. Below, we analyze household decisions in a simple model with two types of nonfarm activities that have different investment requirements. Although this is a static model of activity choice, it can be used to illustrate movement into, out of and within nonfarm employment.

The households in our model, as in our sample, are all farm households and as such they are involved in agricultural activities regardless of their nonfarm employment decision. We assume that they have a pre-established amount of capital and land. Their capital holdings can be broadly classified into agricultural and non-agricultural. The agricultural capital refers to farm tools and equipment that are of no use for other activities and have very low liquidity. The non-agricultural capital includes three types of assets: non-farm tools and equipment that cannot be used in agricultural production, dual purpose assets that can be used in either agriculture or nonfarm activity (such as carts), and non-productive assets with different levels of liquidity such as jewelry, household durables and personal effects. Skilled labor is also considered as part of non-agricultural capital. The capital relevant for decision on nonfarm employment is the non-agricultural capital.

There are two types of nonfarm activities the households may engage in: N_H or N_L . Figure 1 shows the income function for the two types of nonfarm activities. On the horizontal axis we have non-agricultural capital and on the vertical axis, the income associated with each level of capital. Y_H and Y_L show the income function of the two activities N_H and N_L , respectively. Both types of nonfarm activities have an income (production) function characterized by increasing but diminishing returns to capital for a fixed amount of other inputs. The two activities differ both in the rates of returns and their startup capital requirement. Activity N_H does not yield income for a capital below K_0 and yields income less than activity N_L until a capital level K_{hat} is invested. After that, it yields an income higher than activity N_L .

The cost of capital, which reflects the expected rate of return in agriculture given the households' labor, land and agricultural capital endowments, is given by r . We assume constant returns to capital in agriculture. If a household participates in nonfarm employment, which activity it

chooses and the amount of capital it optimally allocate to the activity depends on the asset endowments of the household and the resulting household-specific rate of return in agriculture.

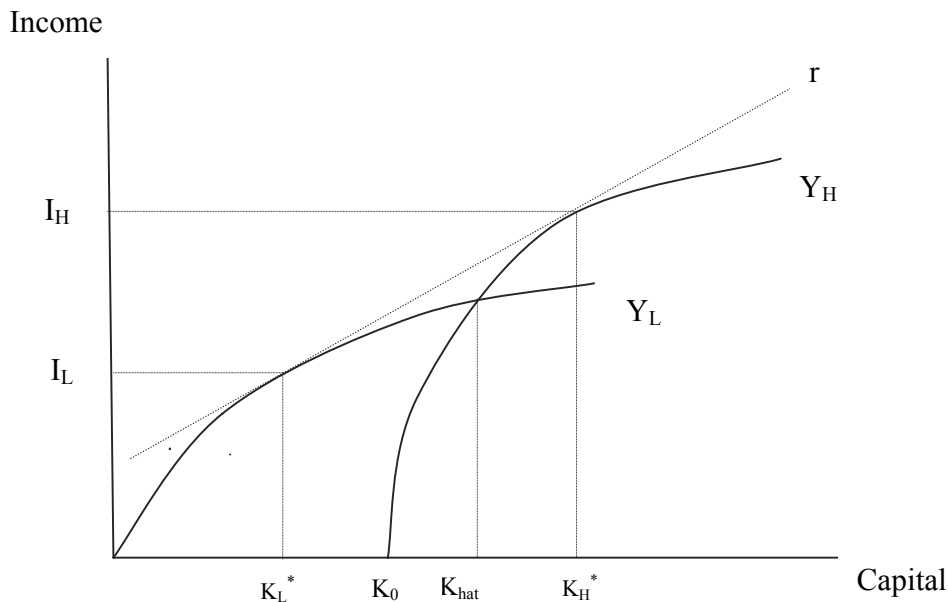


Figure 1: Income from alternative rural nonfarm activities

A household with an agricultural rate of return r and capital endowment less than K_{hat} will engage in activity Y_L and optimally choose to invest capital K_L^* if it has access to at least K_L^* capital. Such a household will then earn income I_L from the nonfarm sector. A household that faces the same rate of return but who can access nonfarm capital greater than K_{hat} may optimally choose to invest up to K_H^* in the high-return nonfarm activity Y_H and earn up to income I_H from nonfarm sector².

The expected rate of return in agriculture is in turn determined, among other things, by agricultural risk. The parameter θ refers to the household's subjective valuation of agricultural risk, formulated from its assessment of current weather conditions and from past shock experience. We assume that the risks in nonfarm activities are not related to risks in agriculture.

² Of course it is possible also that a household who owns enough capital may optimally invest in both types of activities. We ignore this possibility for the sake of simplicity.

Figure 2 depicts how change in the risk parameter, θ , influences the nonfarm employment decision and the optimal capital to invest in the activity. Assume that the capital endowment of our household is below K_{hat} suggesting that only the low-return activity N_L is an option. Consider θ_0, θ_1 and θ_2 , where $\theta_0 < \theta_1 < \theta_2$ implying that the risk-adjusted returns to agriculture are $r_2(\theta_2) < r_1(\theta_1) < r_0(\theta_0)$. At the agricultural rate of return r_0 associated with the lowest agricultural risk θ_0 , it will not be optimal to engage in nonfarm employment at all ($K_0^* = 0$) as agriculture gives risk-adjusted returns that are higher than nonfarm employment at all levels of available capital. On the other hand, at the highest agricultural risk θ_2 , the household will engage in the low-return nonfarm activity and invest K_2^* . Intermediate risk, θ_1 , leads to intermediate optimal investment in nonfarm activities, $0 < K_1^* < K_2^*$.

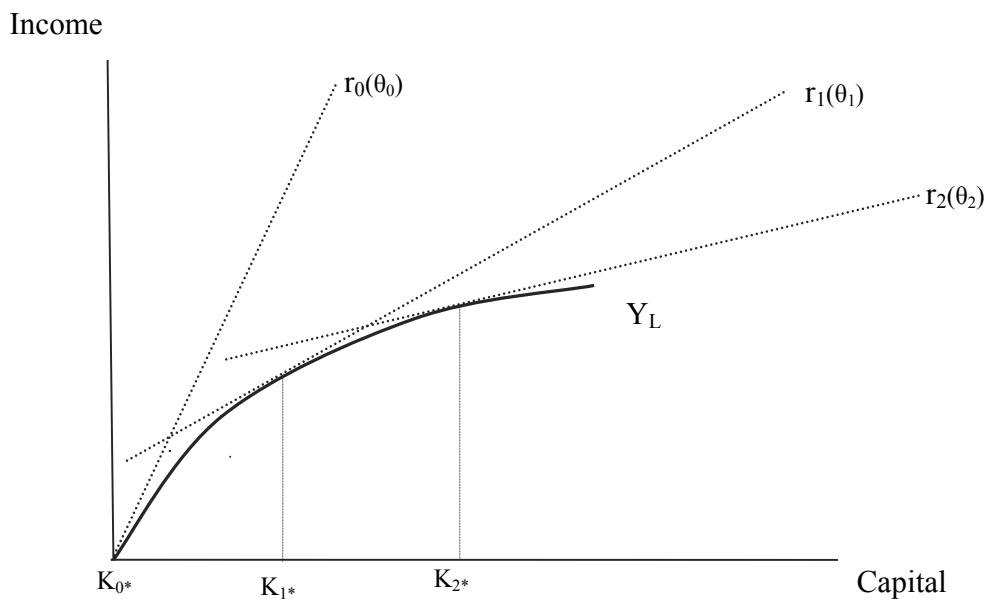


Figure 2: Investment in nonfarm employment at different levels of agricultural risk

Dynamic implication

From the above discussion, we can make some observations about possible dynamics in nonfarm employment. First, ceteris paribus, households who save and accumulate capital beyond K_{hat} may be able to move from the low-return nonfarm employment, N_L , to the high-return nonfarm employment, N_H . Second, agricultural shocks will encourage diversification from pure

agriculture into nonfarm activities, as $r(\theta)$ falls. Third, for households with significant agricultural capital, low agricultural risk and limited non-agricultural capital, the low-return activity N_L may never be attractive. And if such households choose to engage in nonfarm activity, they are likely to skip activity N_L entirely and enter N_H if they have the potential to access the necessary capital to engage in this activity. Finally, capital shocks such as loss of assets may push households from the high-return activity N_H to low-return activity N_L as capital holdings contract.

Hypotheses

We group the different nonfarm activities found in the data into two groups: high-return RNFE and low-return RNFE, corresponding to returns to labor in the respective activities. We assume that the two groups of activities correspond to those of N_L and N_H in our theoretical model above. Since our data do not include capital invested in each activity, we cannot empirically model the income/production function. However, the data do show that those households who participate in high-return activity group report higher levels of asset holding. Moreover, activities which are likely to demand higher human or physical capital are found to yield higher daily return to labor. The econometric analysis on the determinants of choice of nonfarm activity below confirms this.

This paper examines patterns of change in households' nonfarm employment over time. The main objective is to assess households' movement to and from high-return activities and to identify the factors that explain these changes. From our theoretical model above and an intimate knowledge of our sample households from the sociological and household economic surveys, we identify the following hypotheses.

H1: Low-return RNFE participant households climb out of poverty by accumulating capital and entering high-return RNFE. Besides the difference in risk-adjusted returns, we see also from our data that the mean per capita income and expenditure of households who participate in high-return RNFE are higher than those of low-return RNFE participants. Mean expenditure per adult equivalent of high-return RNFE participants is 137 birr per month, while it is only 118 birr per month for low-return RNFE participants, with the differences statistically significant at the 5% level. Since movement from low-return to high-return nonfarm employment is thus welfare

improving, households should routinely try to accumulate capital and access high-return RNFE. This hypothesis relates to their success in doing so.

H2: Diversification from pure agriculture into high-return RNFE is positively correlated with capital endowment and accumulation. Shocks that adversely affect the risk-adjusted returns in the agricultural sector trigger a movement from pure agriculture to high-return RNFE for those households who have the necessary capital endowment to access such activities. If there is no change in the relative returns, movement from pure agriculture to high-return RNFE is explained by capital accumulation by farm households.

H3: By adversely affecting their employment opportunities, shocks knock households out of high-return RNFE. Given the fact that the poor households who were originally involved in low-return employment end up also having lower total income, the potential for capital accumulation and transition to high-return employment is not great for most of them. On the other hand losses of assets through man-made or natural disaster, illness or death erode the capital of high-return participants. Lack of access to insurance also means that households may have to liquidate their assets to meet their financial needs in time of shocks. The impact of shocks will thus go beyond the transitory reduction of income to force high-return RNFE participant households move into low-return employment and may thus lead to structural transition to poverty. This hypothesis tests the impact of shocks and the associated loss of capital on high-return employment opportunities.

3. Data and descriptive statistics

3.1 Data

The analysis in this paper uses Ethiopian Rural Household Survey (ERHS) data. The sample includes 1275 households who were observed in both 1999 and 2004³. The nonfarm employment evolution we analyze is based on households' employment status in the nonfarm sector in 1999 and 2004. We use employment at the household level rather than at an individual level because of the survey setting. As the household was the sampling unit, the surveys follow households

³ It excludes landless households who are few in number and have higher attrition between rounds.

rather than individuals over time. Hence an individual who ceases to be a member of the household for any reason was not observed in the subsequent period. Over the span of the five years we expect the demographic structure of many households to change significantly. Some of the adult members, mainly non-heads, left to establish their own household while those who were not adults in the previous round had joined the ranks five years later. While 80% of the households who were interviewed in 1999 were again interviewed in 2004, only 54% of adults were again observed in 2004. Following only the adult members would, therefore, give us an insufficient and unrepresentative sample. Moreover, shocks and capital accumulation relevant for nonfarm employment evolution commonly happen at household level due to intra-household sharing arrangements.

The information on the shocks households experienced is based on recall data from the 2004 survey. The ‘shocks’ module in the questionnaire asks: ‘Has the household been affected by a serious shock - an event that led to a serious reduction in your asset holdings, caused your household income to fall substantially or resulted in a significant reduction in consumption?’ The household is then prompted to give details for the shocks listed in the questionnaire. The details refer to i) the time the shocks occurred, ii) the impacts on income, assets and consumption, and iii) how widespread the shocks were. The list of shocks includes different categories: climatic and yield shocks; market shocks; legal and political problems; crime involving loss of human, financial and physical assets; death or illness of household members; and dispute within the household or with other households. Some of the shocks are idiosyncratic while others are more covariate, affecting other households in the village or even in neighboring villages.

These data provide us with information on nonfarm employment status, the capital holdings of the households in both periods and the shock experience of households between these two periods. This information allows us to evaluate how households’ nonfarm participation is influenced by ex ante capital holdings and idiosyncratic and covariate shocks. However, because the data were not collected for the purpose of evaluating nonfarm employment decisions, they lack some details that would have been useful for a more thorough analysis of the dynamics. For example, with regard to employment transitions, all we observe is employment status in 1999 and 2004. But there may be more than one movement between the two periods, or the transition may be a permanent or temporary one. We cannot distinguish between these. With regard to the

shocks data the main weakness is that although the questionnaire distinguishes illness and death of household head or spouse from that of other members, it lumps the illness and death of all other members together. Death of an adult is likely to have quite different impact on production activities than the death of a child as it implies loss of labor. We are also unable to test the impact of health shocks on skilled labor because of this aggregation.

3.2 Terms and definitions

Types of rural nonfarm activities

We distinguish between two groups of nonfarm activities: high-return RNFE and low-return RNFE. As the name indicates, the *high-return RNFE* refers to wage and self employment activities that give higher daily returns. These activities typically have higher resource requirements. It includes skilled wage employment such as teaching, civil service jobs, masonry and the like and high-investment businesses such as cattle trade, transportation, etc. *Low-return RNFE* refers to wage employment and self employment activities that have low daily returns. These activities have lower resource requirements. It includes unskilled wage employment and low investment business activities such as food and beverage production.

Shock experiences

We grouped the main shocks according to their similarity and relevance for the analysis. The description of the shocks included in each group and the proportion of households reporting those shocks are given in Table A in the appendix.

In the econometric estimation, the shock variables are included as dummies that take the value one if the household experienced the shock at least once between 1999 and 2004. The idiosyncratic shocks we included are: theft or destruction of assets and illness or death of household members. We distinguish illness or death of a household head or spouse from that of other members of the household. The covariate shocks we include are climatic shocks such as drought, flood, frost and hail storm; pests and diseases that affect crop or livestock; market

shocks that affect inputs, including large increases in input prices or lack of access to inputs⁴; market shocks that affect sales, including large decreases in output prices or decline in demand for produce.

Shocks can affect the evolution of nonfarm employment by changing households' incentives and capacities. For households who were initially engaged in pure agriculture, shocks that reduce the returns to capital in agriculture should induce nonfarm diversification. On the other hand, the impact of illness or death on rural nonfarm employment transitions may be either positive or negative. The financial cost of illnesses and funeral expenses may force farm households to engage in nonfarm employment while the resulting decline in labor supply may discourage it⁵.

For households who already participate in RNFE, idiosyncratic shocks may be more important in affecting movement within and exit from the sector. We would expect loss of nonfarm assets to increase the likelihood of exit from rural nonfarm employment and to decrease transitions from low-return to high-return RNFE.

Variable specification

The human and physical capital variables included in the regression are education, labor, livestock, land, farm tools and equipment, nonfarm and dual purpose tools and equipment and non-productive assets such as household durables and jewelry. The village studies for the survey sites, compiled from the community questionnaire, show that livestock and household durables such as radios, tape recorders, modern furniture and the like are the most important indicators of wealth (Bevan and Pankhurst, 1996).

Assets that increase the capacity of households to participate in nonfarm employment should positively influence entry into nonfarm employment and the transition from low-return to high-return nonfarm employment. Hence, education, adult labor and nonfarm tools and equipment are expected to positively influence entry into nonfarm employment and the transition from low-

⁴ The questionnaire does not distinguish between agricultural and non-agricultural goods with regard to price shocks and lack of access to inputs. Because all households are farm households, we assume that this is mainly agricultural goods.

⁵ A review of the economic consequence of illness in low-and middle-income countries finds that the direct cost of illness ranges from 2.5% in Paraguay to 16% in Guatemala (McIntyre et al. 2006).

return to high-return RNFE. Livestock and non-productive assets, indicating household wealth, are likewise expected to positively influence the transition from low-return RNFE to high-return RNFE. The impact on the transition from pure agriculture into high-return RNFE can be positive or negative depending on whether the incentive or the capacity effect dominates. Land holdings can also be an indicator of wealth, which increases capacity, but higher land holdings may also increase the marginal returns to a farm labor. Therefore, the impact on the transition from pure agriculture into high-return RNFE is ambiguous and depends on the wealth effect relative to labor returns effect.

Two variables can, at least partially, control for households' human and physical capital accumulation in the period 1999 to 2004. One variable takes a value one (zero) if the household was (not) a member of an *Equib*, a traditional rotating saving/credit association, in 1999. Members of *Equib* are more likely to have access to savings and credit instruments that allow households to finance business investments. We also included the number of children in 1999 who were 5 to 14 years, as they become available labor by 2004. Household characteristics include age, gender and literacy of the household head and the proportion of short-to-medium term dependents in the household. The latter refers to household members, ages 65 or above or less than 5 in 1999.

3.3 Descriptive statistics

Nonfarm employment transitions, 1999-2004

The top panel of table 1 presents the 1999-2004 transition frequencies between different nonfarm employment statuses. P_{ij} refers to the frequency that the household engaged in employment j in 2004 given that it was engaged in employment i in 1999 based on a discrete Markov process. The row percentages sum to 100 percent; and the column totals refer to the share of households that ended up in employment situation j in 2004. The frequency of participant households exiting nonfarm employment is higher than the frequency of pure agriculturalists entering the nonfarm sector, and the frequency of exiting high-return nonfarm activities was especially high. Furthermore, high-return RNFE participants were ten times more likely to move to low-return RNFE than the other way around. If high-return employment is more welfare improving than low-return employment, we should see households routinely trying to enter and maintain high-

return employment. Households who exited will therefore typically be those who experienced a shock that knocked them out of high-return RNFE.

However, this pattern may be a reflection of the small size of high-return nonfarm employment rather than the true tendency. The limited scale of high-return nonfarm employment itself makes transition into that sector less likely. To control for this difference, the bottom panel of table 1 reports the standardized transition frequencies ($[p_{ij}/p_j] / [p_{jj}/p_j]$) which show the likelihood of moving into activity j , given one's starting position, relative to staying in the incumbent employment. Unlike the simple transition frequencies reported in the top panel of table 2, the standardized frequencies show that stasis (no change in status) is the norm especially in the high-return RNFE sector.

Shock experiences

The most common idiosyncratic shock was the death of a household member⁶. One-third of the sample households lost a member over the five years, 1999-2004. The main covariate shock was climatic; 63% of households experienced some kind of climatic shock: drought, flooding, frost or hail storm. Table 2 reports the proportion of households affected by different shocks, disaggregated by their nonfarm participation status in 1999. Climatic shocks were the most common problem followed by death and illness of household members. There is no meaningful difference between RNFE participants, taken as a whole, and non-participants with regard to their exposure to shocks. However, when disaggregated by the type of nonfarm employment, the share of high-return RNFE participants who report asset shock and market shock is higher while those who report climatic shock is lower. Of course, high-return RNFE participants had more assets to lose than did either pure agriculturalist or low-return RNFE participants and high-return nonfarm activities are less subject to climatic variation than are agricultural or low-return nonfarm jobs. So these modest differences are unsurprising.

⁶ See Dercon et al. (2005) for a detailed descriptive analysis of the shocks.

Capital endowments and accumulation

Table 3 reports the mean initial human and physical capital by nonfarm employment status. High-return RNFE participants have higher elementary education and physical capital holding (land, livestock and assets) than low-return RNFE participants with the differences statistically significant at the 5% level. High-return RNFE participants also have higher mean labor, elementary education and asset endowments than pure agriculturalists, with the difference significant at the 5% level. Low-return RNFE participants have higher mean labor endowment but lower physical capital than pure agriculturalists; the differences are significant at the 5% level for labor, the 1% level for livestock and assets, and the 10% level for land.

The theoretical model outlined earlier implies that capital accumulation is central for transition into high-return RNFE. Table 4 contrasts the initial endowment and subsequent accumulation of capital for households who transit into high-return RNFE in 2004 with those who stayed in their initial activity in low-return RNFE or pure agriculture. Compared to those who stayed in the sector, low-return RNFE participants who move to high-return RNFE had higher mean initial endowment of secondary education and livestock and lower mean land holdings. They also accumulated significantly more assets and labor between 1999 and 2004, although accumulation is likely endogenous to the transition. Pure agriculturalists that moved to high-return nonfarm employment also had initially more human capital and wealth and accumulated more labor than those who stayed in pure agriculture.

The descriptive statistics suggest that households that are able to move to high-return RNFE are those who are well placed in terms of their initial asset endowment or those who accumulated capital and labor over time. Especially noticeable is the economically and statistically significant difference in asset accumulation between low-return RNFE participants who move to high-return employment and those who stayed. The change in assets between 1999 and 2004 is four times higher for those who move to high-return RNFE than those who did not.

4. Econometric model

To examine the evolution of households' employment in rural nonfarm activities, we estimated multinomial logit models based on the familiar random utility model (McFadden, 1973, 1974, Maddala, 1983). Households move into and out of sectors to maximize utility given changing

opportunities and constraints. The household compares expected utility U^E associated with participation in different nonfarm employment activities:

$$U_{i1}^E = U(\arg \max N_{ij1}(\mathbf{X}_0, \Delta\mathbf{X}(N_{ij0}), \mathbf{H}, \mathbf{S}))$$

Where $i=1, 2, \dots, N$ refer to households and $j=1, 2, 3$ refer to nonfarm employment choices (pure agriculture, low-return RNFE and high-return RNFE, respectively). N_0 and N_1 refer to employment status in 1999 and 2004, respectively. U_{i1}^E is, therefore, expected utility associated with optimal employment j . The vector \mathbf{X}_0 reflects the households initial human and physical capital while $\Delta\mathbf{X}$ refers to changes in asset and capital stocks between the two periods. This is endogenous, so we do not include this directly in our estimation but rather include exogenous proxy variables that control for it. The vector \mathbf{H} refers to household characteristics such as age and gender of household head and \mathbf{S} refers to the vector of shocks the households experienced between the two periods.

We estimated three multinomial logit models to examine transition from each of the initial states of employment into a different employment status in 2004. The three employment choices in these multinomial models are: pure agriculture (no RNFE), low-return RNFE and high-return RNFE. We estimate three specifications of this model to progressively expand the covariates. Model 1 includes only the initial asset endowments. In the second specification (Model 2) we add the shock variables and finally we added the interaction between some of the shocks and assets in Model 3.

5. Estimation results

Tables 5-7 report the results from the estimation of the three sets of models⁷ examining employment transition from different initial rural nonfarm employment statuses. The results are generally consistent across the different specification. However, in all the models, the specifications that included the shock variables are better fit than those with only initial

⁷Because of the smaller number of observations for this group, we could not include interaction terms as it leads to perfect prediction for some of the interaction terms.

asset/capital endowments indicating that shocks are important in explaining employment transition decision.

5.1 Transition from low-return to high-return RNFE

As expected asset accumulation is positively correlated with transition from low-return RNFE to high-return RNFE (Table 6). Membership in the rotating saving/credit association increases the probability of transiting from low-return to high-return RNFE indicative of the importance of access to capital to engage in high-return nonfarm activities (though significant only at the 10% level). The variable indicating potential for labor accumulation, number of children aged 5 to 14 in 1999, is also positive and significant, showing the importance of labor for high-return RNFE (significant at the 5% level). High-return RNFE is more demanding in terms of capital, time, skill and experience than low-return activities. For example, cattle trade demands long distance travel over many days, as opposed to petty trade which can be done from the homestead or local market. Hence, although these children who became 10-19 years old by 2004 may not themselves engage in high-return RNFE, they may release other adult labor and also increase the human capital of the household through their mid-high school education.

The estimation results also show that wealthier households are better placed to make a transition to high-return RNFE. A higher initial livestock holding is positively correlated with transition from low-return to high-return RNFE. The coefficient is statistically and economically highly significant.

Market shocks that affect the prices and demand for produce positively influence transition from low-return to high-return RNFE. Such shocks decrease the return to agriculture relative to nonfarm activities, resulting in resource re-allocation from agriculture to rural nonfarm employment. For households who already combined agriculture and low-return nonfarm activities, resource re-allocation implies more flow of capital to nonfarm employment which enables movement from low-return RNFE to high-return RNFE.

5.2 Transition from pure agriculture to high-return RNFE

As expected, non-farm asset holdings and membership in a local saving/credit association increase the likelihood of moving to high-return RNFE relative to staying in pure agriculture

(both significant at the 1% level) indicating to the importance of capital for accessing high-return RNFE (Table 7).

The death of a non-head household member decreases the likelihood of transition to high-return RNFE. This may be explained by the resulting decline in household labor endowment and possibly an increase in expenditures associated with a death in the household. Households who experience an agricultural shock in the form of pests or diseases are, on the other hand, more likely to enter high-return RNFE than to stay in pure agriculture, because nonfarm employment has grown more attractive. Both are significant at the 5% level.

In the specification with interaction terms, we found that wealthy households with large livestock holdings are less likely to move from pure agriculture to high-return RNFE. However, the positive coefficient estimate on the interaction term between asset shock and initial livestock holding (significant at the 5% level) shows that for those households who experience a shock that negatively affects their asset endowment, higher initial livestock holding is positively correlated with transition to high-return RNFE.

5.3 Transition out of high-return RNFE

Surprisingly, none of the health shocks trigger transition out of high-return RNFE suggesting a robust high-return activity to shocks on human capital. On the contrary, illness of household heads or their spouses negatively affects transition from high-return to low-return RNFE, although significant only at the 10% level. The negative relation may indicate that such shock do not affect the human capital endowment as much as it increases the financial costs of illness and hence households prefer to keep the nonfarm employment that yields better returns and income and perhaps affords more flexibility in labor timing than does low-return nonfarm wage labor.

On the other hand, shocks on households' crop and livestock holdings in the form of pests and diseases increase the likelihood of transition from high-return to low-return RNFE. This may be explained by liquidity constraints that result from cash expenditures, loss of revenue or reduction of productive wealth following such shocks. This is also significant only at the 10% level.

Households with higher educational endowment are less likely to transit out of high-return RNFE. This is consistent with the importance of skill in high-return RNFE activities. On the

other hand, households with older household heads and with higher share of dependents are more likely to move out of high-return RNFE over time because of deterioration in human capital and more pressing need for cash to meet immediate household needs.

Land and non-productive asset holdings are positively correlated with transition out of high-return RNFE and into pure agriculture indicating an incentive effect. The impact of land holdings is both statistically and economically more significant than non-productive assets. With large land holdings, farming labor returns may be higher. The negative relation may also indicate competition between agriculture and high-return RNFE. The fact that high-return activities are not of a casual nature and demand commitment in time, skill and management makes them difficult to combine with agricultural activities for those households who have higher land holdings and hence more demanding farm work.

5.4 Other employment transitions

Low-return RNFE to pure agriculture

Initial endowments and household characteristics are not strongly correlated with exit from low-return RNFE to pure agriculture. We found that households with more education are less likely to move to pure agriculture relative to staying in low-return nonfarm employment; in the specification with interaction terms, households with more nonfarm assets are also less likely to move to pure agriculture (both significant only at the 10% level). On the other hand, wealth as given by non-productive assets, increases the probability of exit, indicating that wealthier households have less incentive to maintain less rewarding employment. However the coefficient estimate is not economically significant. Households with older household heads and with a high share of dependents are also more likely to move out of low-return RNFE because of deterioration in human capital. Both are significant only at the 10% level. Female headed households are also more likely to exit low-return RNFE to take up a purely agricultural livelihood.

Households who experience death of household head or spouse are less likely to exit low-return RNFE (significant at the 5% level) , probably because such a shock leads to a decline in income from agriculture, as documented in Kenya (Yamano and Jayne, 2004), which makes nonfarm employment even more important. In the specification with interaction terms, death of other

household members is also statistically significant. Low-return RNFE participant households who lost non-head/spouse are more likely to exit RNFE because it implies contraction in available labor. In the model with interaction terms, farm asset holdings also positively influence exit from low-return RNFE to pure agriculture consistent with the incentive effect, but shocks on asset holding reduce this impact.

Pure agriculture to low-return RNFE

Wealth, as given by livestock holding, decreases the likelihood of transition to low-return RNFE relative to staying in pure agriculture (significant at the 1% level). As is the case for contemporaneous participation decision, wealthy households have less incentive to combine farming with low-return RNFE over time. On the other hand, nonfarm asset and land holdings positively influence transition into low-return RNFE. Pure agriculturalists who have more assets that can be used in rural nonfarm activity find it easier to diversify to that sector compared to those who have to buy it. Land holdings indicate access to capital that increases the likelihood of entry into RNFE, although this effect is statistically significant only at the 10% level. And since there may not be high competition between low-return nonfarm activities and farming, the capacity effect may outweigh the negative incentive effect of land holdings.

Shocks in access and prices of inputs negatively affect transition to low-return RNFE. This is contrary to our expectation since shocks in agriculture are expected to push farm households into nonfarm diversification (Reardon, 1997). One possible explanation is a potential correlation between input prices for agriculture and input price for non-farm goods production. The most common low-return nonfarm activities such as food and beverage production and petty trade depend very much on agricultural output. An increase in agricultural input prices makes such production unprofitable, and hence unattractive.

6 Conclusion

The literature on nonfarm employment diversification routinely identifies human and physical capital as the main constraints for access to high-return employment and shocks as the main incentive for low-return nonfarm diversification. If poor households accumulate over time and access high-return employment, it may provide a way out of poverty. However, given poor financial and insurance markets in rural places, gradual accumulation and smooth transition may

not be a possible path for most. In the presence of frequent idiosyncratic and covariate shocks, keeping their high-return employment options may be difficult even for the wealthy as shocks may erode assets and knock participants out of the more remunerative employment.

The findings here suggest that low-return rural nonfarm employment participants who accumulated capital eventually managed to transit into high-return employment. The descriptive statistics show that, compared to those who stayed in the low-return RNFE, households who move to high-return RNFE accumulated significantly more asset and labor. The regression results also confirm this finding. Wealth, access to saving and labor improve the likelihood of transition to high-return nonfarm employment. On the other hand, having older household heads and more dependents in the household increase the likelihood of transition from high-return RNFE to low-return RNFE as it imply deterioration in labor resource.

Our results also indicate that shocks that affect liquidity are more important than shocks that affect labor for transition out of high-return RNFE. We found that pests or diseases that affect crop and livestock holdings are more likely to trigger movement from high-return RNFE into low-return RNFE as it may result in loss of wealth and revenue as well as increase cash expenditure requirements which intensifies liquidity constraints. On the other hand, none of the health related shocks trigger transition out of high-return RNFE. On the contrary, illness of the household head or their spouse decreases the likelihood of transition out of high-return RNFE.

For nonfarm employment to serve as a way out of poverty, the poor need instruments to gradually accumulate assets and access high-return activities. In this regard, local saving and credit associations in rural Ethiopia seem to play an important positive role. Improving financial market reduces the need for personal wealth and saving to access high-return employment as well as allow households maintain their activity in the face of shocks that otherwise affect their liquidity.

Table 1: Disaggregated transition probabilities for RNFE participants (in %)

1999 RNFE status	2004 RNFE status			Total % (N)
	Pure agriculture	Low-paying RNFE	High-paying RNFE	
Pure agriculture	65	29	6	100(679)
Low-return RNFE	45	50	5	100(504)
High-return RNFE	54	34	12	100(92)
Total %(p_j)	56	38	6	100(1275)
<i>Standardized probability (p_{ij}/p_i) / (p_{ij}/p_j)</i>				
Pure agriculture	1.00	0.67	0.82	
Low-pay RNFE	0.60	1.00	0.66	
High-pay RNFE	0.47	0.44	1.00	

Table 2: Household shock experiences by initial RNFE participation status (proportion of households)

Type of shock	All Households	RNFE participants		
		All types	Low- return	High- return
Idiosyncratic Shocks				
Death of a household member	0.33	0.31	0.31	0.32
Illness of a household member	0.28	0.26	0.25	0.28
Loss of assets (theft or destruction)	0.17	0.18	0.18	0.22
Covariate Shocks				
Climatic shocks	0.63	0.65	0.67	0.50
Pests and diseases that affect livestock	0.12	0.12	0.12	0.09
Pests and diseases that affect crops	0.23	0.24	0.23	0.25
Erosion	0.10	0.10	0.10	0.10
Market shock on inputs	0.25	0.24	0.23	0.32
Market shock on outputs	0.23	0.24	0.23	0.32

Table 3: Initial human and physical capital endowments by employment status in 1999

	Employment status in 1999					
	Pure agriculturalist		Low-return RNFE		High-return RNFE	
	Mean	Se	Mean	Se	Mean	Se
Number of adult HH members	2.83	0.06	3.05	0.07	3.16	0.18
Adult education(share): Elementary	0.25	0.01	0.25	0.01	0.32	0.03
Adult education: Above elementary	0.12	0.01	0.11	0.01	0.12	0.02
Livestock (tropical livestock unit)	0.85	0.03	0.68	0.03	0.96	0.13
Land holding (hectars)	0.38	0.02	0.35	0.02	0.45	0.07
Assets owned (in Birr)	105.7	5.8	83.7	7.7	146.2	21.5

+ All asset/capital endowments except education are expressed per adult equivalent unit. Education of adults is given as a share to total adults.

Table 4: Initial capital endowments and accumulation by transition into high-return RNFE

	Transition into high-return RNFE							
	Pure Agriculturalist				Low-return RNFE participant			
	Stay		Move		Stay		Move	
	Mean	Se	Mean	Se	Mean	Se	Mean	Se
Capital endowments in 1999								
Number of adult HH members	2.78	0.08	3.16	0.23	3.23	0.11	3.27	0.27
Adult education(share): Elementary	0.24	0.01	0.28	0.05	0.26	0.02	0.23	0.06
Adult education: Above elementary	0.11	0.01	0.16	0.04	0.12	0.01	0.20	0.06 ^b
Livestock (tropical livestock unit)	0.96	0.04	0.72	0.11	0.62	0.04	0.83	0.17 ^c
Land holding (hectars)	0.40	0.02	0.31	0.04	0.36	0.02	0.25	0.07 ^c
Tools and equipments (in Birr)	112.5	7.5	119.3	29.7	74.3	6.2	76.9	13.8
Changes in relevant assets (1999-2004)								
Adult labor	-0.04	0.07	0.32	0.24	-0.21	0.09	0.27	0.34 ^c
Education: Elementary	0.02	0.02	0.05	0.07	0.06	0.02	0.02	0.06
Education: Above elementary	0.03	0.01	0.06	0.04	0.00	0.01	0.04	0.04
Tools and equipments	-15.0	10.8	6.5	27.7	28.0	10.0	130.6	67.0 ^a

a, b, c refer to statistically significant difference between the mean values for those who move to high-return RNFE and those who stay in their respective employment at 1%, 5% and 10% respectively.

Table 5: Multinomial logit estimation of determinants of transition for households who were engaged in High-Return RNFE in 1999

	Transit to pure agriculture vs. stay in high-return RNFE				Transit to Low-return RNFE vs. stay in high-return RNFE			
	Model 1		Model 2		Model 1		Model 2	
	Coef.	Robust Std.Err	Coef.	Robust Std.Err	Coef.	Robust Std.Err	Coef.	Robust Std.Err
<u>Household characteristics</u>								
Age of household head	0.203 ***	0.069	0.343 ***	0.107	0.177 ***	0.064	0.325 ***	0.104
Literate household head	2.019	1.365	2.775	2.351	1.640	1.466	2.413	2.199
Share of HH members aged <5 and aged >65	8.112 *	4.791	18.716 **	7.947	2.544	4.798	13.404 **	6.667
<u>Initial asset/capital holdings⁺</u>								
Adult education(share): Above elementary	-5.522 **	2.642	-9.801 **	4.467	-3.780	2.664	-8.099 **	4.086
Adult education: Elementary	-6.486 ***	1.644	-8.055 **	3.466	-2.589	1.778	-3.606	3.970
Tropical livestock units	0.353	0.856	0.599	0.858	-0.906	0.932	-0.773	0.776
Land holdings (hectares)	2.741 ***	1.050	3.403 **	1.588	1.243	0.997	1.740	1.596
Farm equipments and tools (Birr)	-0.005	0.050	-0.059	0.047	0.011	0.035	-0.038	0.033
Non farm and dual purpose tools and equipments(Birr)	-0.002	0.005	-0.011	0.010	0.000	0.006	-0.009	0.009
Non-productive assets (Birr)	0.007 **	0.004	0.012 *	0.007	0.004	0.003	0.010	0.006
Number of adult HH members	0.134	0.225	-0.022	0.380	-0.330	0.244	-0.558	0.392
Number of HH members aged 5-14 yrs	-0.197	0.356	-0.028	0.563	-0.661 *	0.353	-0.506	0.600
HH is member of rotating credit association	0.600	1.162	0.329	1.666	1.041	1.061	0.638	1.709
<u>Shock experience (yes=1)</u>								
Illness of HH head/spouse			-2.879 *	1.557			-3.045 *	1.801
Illness of other HH member			0.087	1.834			0.154	1.635
Death in the household			-0.771	1.345			-1.483	1.685
Theft or destruction of assets			0.805	1.548			1.038	1.402
Climatic shock			-0.193	1.114			-0.131	1.496

Pest or disease affecting crop or livestock			3.227	1.983		3.419*	1.805
Large increase in prices of inputs or reduced access to inputs			0.525	1.398		0.356	1.382
Large decrease in prices or demands for produced goods			0.026	1.458		-0.020	1.090
Constant	-7.445**	3.372	-12.502***	4.176	-3.658	3.273	-8.789**
Number of observations	87		87		87		87
McFadden's (Pseudo) R ²	0.32		0.37		0.32		0.37
Log likelihood	-55.26		-51.07		-55.26		-51.07
Proportion of correct predictions	0.66		0.66		0.66		0.66
Control for interaction terms	No	No	No	No	No	No	No

*, **, *** refer to significance at 10%, 5% and 1%, respectively. Standard errors are adjusted for village level clustering.
+ All asset/capital endowment except education is expressed in adult equivalent unit. Education of adults is given as a share to total adults.

Table 6: Multinomial logit estimation of determinants of transition for households who were engaged in Low-Return RNFE in 1999
 Transit to pure agriculture vs. Stay in low-return RNFE vs. Stay in high-return RNFE vs. Stay in low-return RNFE

	RNFE					
	Model 1		Model 2		Model 3	
	Coef.	Robust Std.Err	Coef.	Robust Std.Err	Coef.	Robust Std.Err
<u>Characteristics of household</u>						
Age of household head	0.01	0.01	0.01*	0.01	0.02*	0.01
Female headed household	0.47**	0.21	0.39*	0.23	0.47**	0.22
Literate household head	0.19	0.35	0.16	0.31	0.27	0.33
Share of HH members aged<5 and aged>65	1.20*	0.64	1.30*	0.76	1.22	0.81
<u>Initial asset/capital endowments</u>						
Adult education(share): Above elementary	-0.31	0.48	-0.42	0.48	-0.35	0.52
Adult education: Elementary	-0.75*	0.41	-0.80*	0.43	-0.83*	0.45
Tropical livestock units	-0.13	0.19	-0.18	0.19	-0.27	0.79
Land holdings (hectares)	0.16	0.57	0.07	0.58	-0.01	0.64
Farm equipments and tools (Birr)	0.01	0.01	0.01	0.01	0.08***	0.03
Non farm and dual purpose tools and equipments(Birr)	-0.01	0.01	-0.01	0.01	-0.07*	0.04
Non-productive assets (Birr)	0.00***	0.00	0.00***	0.00	0.01	0.01
Number of adult HH members	0.00	0.08	-0.02	0.08	-0.03	0.08
Number of HH members aged 5-14 yrs	0.04	0.08	0.05	0.08	0.05	0.09
HH is member of rotating credit association	-0.06	0.31	-0.07	0.33	-0.14	0.31
<u>Shock experience (yes=1)</u>						
Illness of HH head/spouse			-0.10	0.29	-0.13	0.29
					-0.36	0.87
					0.87	0.13
					0.12	0.65
					0.75	0.76
					1.19	1.18
					0.76	0.87
					1.41	1.40
					3.45***	1.14
					1.62	1.50
					0.02	0.07
					0.04	0.04
					0.00	0.01
					0.14	0.13
					0.28**	0.12
					1.12*	0.64
					0.58	1.09*
					0.87	0.87
					-0.13	0.87

Illness of other HH member	-0.04	0.53	-0.05	0.53	-0.69	0.76	-0.64	0.85
Death of HH head/spouse	-0.79**	0.31	-0.79**	0.32	-0.09	1.24	-0.01	1.33
Death of other HH member	0.38	0.23	0.43**	0.22	0.74	0.97	1.02	0.92
Theft or destruction of assets	-0.08	0.25	-0.10	0.25	0.41	0.97	0.28	0.92
Climatic shock (drought, flood, frost ...)	-0.28	0.34	-0.11	0.42	-0.41	0.74	0.15	0.91
Pest or disease affecting crop or livestock	0.05	0.22	0.08	0.21	-0.68	0.55	-0.47	0.61
Large increase in prices of inputs or reduced access to inputs	0.23	0.40	0.26	0.40	-0.14	1.00	-0.04	1.03
Large decrease in prices or demands for produced goods	0.45	0.39	0.54	0.40	2.57***	0.68	2.48***	0.68
Farm asset * Shocks that affect asset endowment			-0.07***	0.03			0.00	0.07
Non farm asset * Shocks that affect asset endowment			0.06	0.04			-0.01	0.05
Non-productive asset * Shocks that affect asset endowment			0.00	0.01			0.00	0.01
Livestock* Shocks that affect asset endowment			0.04	0.80			-2.19*	1.23
Constant	0.93**	0.47	1.12*	0.61	0.83	0.67	-2.11**	0.96
Number of observations	494	494	494	494	494	494	494	494
McFadden's (Pseudo) R ²	0.23	0.26	0.28	0.23	0.26	0.26	0.28	0.28
Log likelihood	-325.9	-314.69	-307.66	-325.9	-314.69	-314.69	-307.66	-307.66
Proportion of correct predictions	0.70	0.71	0.70	0.70	0.71	0.71	0.70	0.70
Control for interaction terms	No	No	Yes	No	No	No	Yes	Yes

*, **, *** refer to significance at 10%, 5% and 1% respectively. Standard errors are adjusted for village level clustering.

+ All asset/capital endowment except education is expressed in adult equivalent unit. Education of adults is given as a share to total adults.

Table 7: Multinomial logit estimation of determinants of transition for households who did not participate in any RNFE in 1999
 Enter High-return RNFE vs. Stay in pure agric. Enter Low-return RNFE vs. Stay in pure agric.

	Model 1			Model 2			Model 3			Model 1			Model 2			Model 3		
	Coef.	Robust	Std.Err	Coef.	Robust	Std.Err	Coef.	Robust	Std.Err	Coef.	Robust	Std.Err	Coef.	Robust	Std.Err	Coef.	Robust	Std.Err
<u>Characteristics of household</u>																		
Age of household head	-0.01	0.02		-0.01	0.02		-0.01	0.02		-0.01	0.01		-0.01	0.01		-0.01	0.01	
Female headed household	0.45	0.37		0.43	0.50		0.39	0.48		0.25	0.31		0.19	0.30		0.17	0.30	
Literate household head	0.52	0.66		0.45	0.73		0.51	0.76		0.19	0.34		0.18	0.33		0.18	0.33	
Share of HH members aged<5 and aged>65	0.66	1.45		0.55	1.57		0.52	1.54		0.08	0.82		0.03	0.92		0.03	0.88	
<u>Initial asset/capital endowments⁺</u>																		
Adult education(share): Above elementary	-0.85	1.08		-0.76	1.12		-0.82	1.21		0.51	0.48		0.58	0.49		0.58	0.50	
Adult education: Elementary	-0.42	0.91		-0.19	0.92		-0.21	0.92		0.14	0.48		0.18	0.47		0.17	0.46	
Tropical livestock unit	-0.49	0.33		-0.49	0.34		-1.44***	0.48		-0.62***	0.18		-0.63***	0.19		-0.81***	0.22	
Land holdings (hectares)	-0.26	0.44		-0.06	0.35		-0.07	0.39		0.40*	0.24		0.44*	0.26		0.47*	0.24	
Farm equipments and tools (Birr)	-0.02	0.02		-0.02	0.02		-0.01	0.01		0.00	0.00		0.00	0.00		0.00	0.00	
Non farm and dual purpose tools and equipments(Birr)	0.01***	0.00		0.01***	0.00		0.01	0.09		0.01***	0.00		0.01***	0.00		0.01	0.01	
Non-productive assets (Birr)	0.00	0.00		0.00	0.00		0.00	0.01		0.00	0.00		0.00	0.00		0.00	0.00	
Number of adult HH members	0.05	0.11		0.04	0.12		0.04	0.12		0.00	0.09		-0.01	0.09		-0.01	0.09	
Number of HH members aged 5-14 yrs	0.06	0.14		0.06	0.16		0.07	0.16		0.02	0.05		0.02	0.05		0.02	0.05	
HH is member of rotating credit association	1.21***	0.34		1.57***	0.32		1.67***	0.34		0.29	0.47		0.36	0.49		0.40	0.49	
<u>Shock experience (yes=1)</u>																		
Illness of HH head/spouse				-0.46	0.37		-0.56	0.43					-0.33	0.28		-0.37	0.29	
Illness of other HH member				0.27	0.43		0.22	0.43					-0.19	0.27		-0.20	0.27	
Death of HH head/spouse				0.09	1.06		-0.02	1.05					0.08	0.37		0.02	0.38	

Death of other HH member	-1.02 **	0.42	-1.09 **	0.45	-0.03	0.28	-0.10	0.30		
Theft or destruction of assets	0.57	0.50	0.58	0.54	0.26	0.22	0.27	0.22		
Climatic shock (drought, flood, frost ...)	0.14	0.40	-0.35	0.70	-0.10	0.27	-0.25	0.25		
Pest or disease affecting crop or livestock	0.86 **	0.35	0.80 **	0.36	0.15	0.24	0.11	0.24		
Large increase in prices of inputs or reduced access to inputs	-0.43	0.43	-0.36	0.45	-0.43 **	0.21	-0.42 **	0.22		
Large decrease in prices or demands for produced goods	-0.74	0.75	-0.73	0.76	-0.25	0.17	-0.26	0.18		
Farm asset * Shocks that affect asset endowment			-0.02	0.02			0.00	0.01		
Non farm asset * Shocks that affect asset endowment			0.00	0.09			0.00	0.01		
Non-productive asset * Shocks that affect asset endowment			0.00	0.01			0.00	0.00		
Livestock* Shocks that affect asset endowment			1.08 **	0.49			0.25	0.24		
Constant	-3.02 ***	0.85	-2.88 ***	0.97	-2.35 **	1.02	-1.17 **	0.50	-1.00 *	0.55
Number of observation	666	666	666	666	666	666	666	666	666	666
McFadden's (Pseudo) R2	0.17	0.19	0.20	0.17	0.19	0.17	0.20	0.19	0.20	0.20
Log likelihood	-443.44	-433.84	-431.78	-443.44	-433.84	-443.44	-431.78	-433.84	-431.78	-431.78
Proportion of correct prediction	0.69	0.72	0.72	0.69	0.72	0.69	0.72	0.72	0.72	0.72
Control for interaction terms	No	No	Yes	No	No	No	Yes	No	Yes	Yes

+ All asset/capital endowment except education is expressed in adult equivalent unit. Education of adults is given as a share to total adults*, **, *** refer to significance at 10%, 5% and 1% respectively. Estimation includes village fixed effects.

Table A: Description of shocks

Shock Experience	N(share)	Description
Covariate shocks		
Climatic shock	0.63	Drought, flood, erosion, frosts or hailstorm
Pests and disease affecting livestock	0.12	Pests or disease affecting livestock holdings
Pests and disease affecting crop	0.23	Pests and disease that affect crop before they are harvested or in storage
Market shock-input	0.25	Lack of access to inputs, large increase in input prices
Market shock-output	0.23	Large decrease in output prices, lack of demand or inability to sell agricultural products
Idiosyncratic shocks		
Loss of asset	0.17	Destruction or theft of tools of production or housing or consumer goods; theft of cash, crops, livestock
Death of head/spouse	0.09	Death of husband, death of wife
Death of other HH member	0.25	Death of another person in the household member
Illness of head/spouse	0.23	Illness of husband, illness of wife
Illness of other HH member	0.12	Illness of another person in the household member

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Sosina Bezu was born in Addis Ababa, Ethiopia, in 1977. She holds a B.A degree in Economics from Addis Ababa University (1999) and MSc degree in Development and Resource Economics from Agricultural University of Norway (2004).

This thesis consists of four papers analyzing the different facets of rural nonfarm employment in Ethiopia. The analyses in this thesis are mainly based on panel data of more than 1400 rural household in Ethiopia. The papers in this thesis make an extensive use of various econometric methods for the analyses. The first paper identify the different types of nonfarm activities and analyze the factors behind rural households' choice among these nonfarm activities. It was shown that some nonfarm activities yield superior returns while others yield a return very close to farm wage employment. Capacity is the most important determinant of participation in high-return activities while the low-return activities are driven by need. The second paper investigates the impact of participation in a particular nonfarm activity, food-for-work (FFW), on agricultural investment. Participation in FFW was found to positively influence fertilizer adoption and there was no evidence for disincentive effect. The third paper examines whether nonfarm participation goes beyond increasing current consumption to offer a way for upward mobility. The results indicate that nonfarm participation improves income dynamics. An increase in the nonfarm share of income leads to higher rates of growth in consumption expenditure. The fourth papers evaluates how the nonfarm employment portfolio of rural households evolve over time, especially focusing on whether poor households in low-return employment eventually access high-return activities and how the high-return employments are affected by shock experiences. The results suggest that low-return participants who accumulated asset and have access to saving are eventually able to enter high-return activities. High-return activities are robust to health shocks but not to shocks that affect their liquidity.

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