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Migration, Remittances and Rural Agricultural Transformation in Ethiopia

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Abstract

Migration is intensifying following globalization. A growing body of literature investigates its impact on various development outcomes. This study examines the impact of migration and remittances on rural households' productivity enhancement choices, namely *technology adoption* measured by chemical fertilizer use and improved seeds. It uses endogenous switching regression model based on the panel datasets of the World Bank Living Standards Measurement Study (LSMS). Moreover, for robustness checks the instrumental variable model among others is estimated. The findings show that migration and the resulting remittances have positive and significant effect on agricultural technology adoption of farm households. Thus, to harness the benefits from migration and to minimize its negative impacts the Ethiopian government should design a comprehensive migration and remittance policy.

Keywords: Migration, Remittances, Agricultural Technology adoption, Ethiopia

1 Introduction

For countries south of the Sahara including Ethiopia; labor migration is intensifying. Yet, inadequate data on migration and remittances prohibits understanding of migration's role in the agricultural transformation process. Insights from literature suggest migration and household decision making dynamics may influence future investments in agriculture and thus farming activity.

Agriculture provides the leading source of employment by engaging at least two-third of the labor force for most SSA countries. Moreover it contributes around 15 percent of total GDP which is generally high in the global context (FAO, 2015). Agriculture in the region is still a subsistence based activity with low productivity growth roughly at half the average rate for growth compared to developing countries (Nepad, 2014).

From a policy perspective, both farming activity and labor out-migration are considered the two primarily livelihood strategies for overwhelmingly large agrarian societies in sub-Saharan Africa (De Haan 1999; Jokisch 2002; World Bank 2008).

Among other factors, numerous studies show credit constraint, risk and uncertainty, and lack of insurance to be responsible for low performance of farming activity (Tiruneh et al. 2001; Gilbert, Sakala, and Benson 2002; Carter and Barrett 2006; Thapa 2008; Dercon and Christiaensen 2011; Peterman et al. 2011; Bhandari and Ghimire 2016). From this perspective migration and remittances has an implication towards through relaxing liquidity constraint on the one hand and reducing labor availability conversely. Hence, understanding how migration impacts agricultural production is critical for understanding the likely impacts of rural demographic changes on rural transformation.

Despite the fact that significant proportion of migrants originates from poor-subsistence agricultural settings and there is ample theoretical reason to believe a link between migration and agricultural production, little empirical evidence explores this plausible relationship[1] (De Brauw 2010; Bhandari and Ghimire 2016). In this regard studies worth mentioning include: a study by Kaninda (2014) in Kenya, Mendola (2006) in Mexico, and a study by Quinn (2009) in Bangladesh. To our knowledge, studies of this nature in Ethiopia are scant[2]. Furthermore, remittances the migrants send home has increasingly emerged as a major share of the national gross domestic product. For example, according to the National Bank of Ethiopia (2016), remittances in Ethiopia increased sharply from 2 billion USD in 2012 to 4.5 billion USD in 2016/17, which exceeded Ethiopia's export earnings during same period. Thus, understanding how rural labor out-migration impacts agricultural transformation provides valuable inputs for policy makers in their effort to reduce poverty and achieve their national development goals (De Brauw 2010; De Haan 1999).

In this respect, the Ethiopian case is interesting for two main reasons. Firstly, relatively large proportion of the population continues to live in rural areas with subsistence agriculture amid backward technology. Furthermore, the potential return for labor out-migration is high with a return as high as 110 percent according to De Brauw, Mueller and Woldehanna (2014).

The general objective of the study is to analyze effects of labor out-migration and remittances on farm households' productivity enhancing choices in the context of Ethiopia. Specifically, the study seeks:

1. To examine the drivers of rural labor out-migration in Ethiopia.
2. To analyze impacts of migration and remittances on rural households' agricultural technology adoption.
3. To analyze policy implications based on the results.

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[1] Methodological challenges such as using appropriate instrument for migration- and data requirements, and measurement issues related to agricultural production and migration, are some of the reasons (De Brauw 2017).

[2] Primarily due to lack of comprehensive data on migration only a few studies have been done in the context of Ethiopia. Most of them use case studies with the objective of describing migration situation in the country. An exception is a study by De Brauw (2014) which indirectly tests the effects of migration on agricultural productivity in Ethiopia.

This paper makes a two-fold contribution to existing literature. First, in the context Ethiopia where agriculture is highly labor-intensive and a dominant activity, this study contributes to existing literature on migration by providing evidence on the developmental impact of labor migration and remittances on agricultural investment. To this end the study uses an appropriate method to account for migration's endogeneity.

The study is based on the representative Ethiopian Household Living Standard Measurement Survey (LSMS) done by the World Bank every other year since 2011-12 (2011-12, 2013-14, and 2015-16). To meet study objectives endogenous switching regression model is used. This model has the advantage of evaluating migration decisions while controlling for self-selection bias caused by both observed and unobserved heterogeneity (Mansur et al., 2008; Wu and Babcock, 1998). Previous empirical studies have used the same approach (for example, Di Falco and Veronesi, 2013). The study found that on average migration had a positive and significant effect on productivity enhancing agricultural technology adoption such as adoption of chemical fertilizers and use of better seeds. The findings imply that Ethiopian government should revisit some of its policies which directly or indirectly hinder rural labor out-migration.

The rest of the paper is structured as follows. The next section describes the conceptual/theoretical frame work of the study. Section 3 discusses the data and descriptive statistics. Section 4 describes the empirical strategy followed while Section 5 discusses the results. The last section gives a conclusion and some policy implications of the findings of the study.

2 Theoretical Framework

Efforts to explain migration can be categorized into individual and household approaches (Tsegai, 2007). In the first category the neoclassical microeconomic model (see Todaro, 1969; Harris and Todaro, 1970; Todaro & Smith, 2006) which oversimplifies migration as an individual utility-maximizing decision has been criticized for its inadequate capacity to understand the diverse types of migration[3]. Unlike the neoclassical microeconomic model, by shifting the focus away from individuals, the New Economics of labor migration (NELM) (Stark and Bloom, 1985; Stark, 1991) model and the Sustainable Livelihoods Approach (Ellis 2000, 2003) focus on household decisions. Both approaches conceptualize migration in the broader context of household members' mutual and interdependent risk-sharing strategies (Stark and Bloom, 1985; Stark, 1991)[4].

Selecting an appropriate theoretical framework is challenging due to the context-specific nature and complexity of migration patterns, and the associated lack of a comprehensive migration theory (Castles, 2010; King, 2012)[5]. For this study the NELM model is chosen for the following reasons: firstly, in the context of rural Ethiopia, households control the assets and ensure the future of the family and hence are a suitable unit of analysis (De Haan and Yaqub, 2009). Moreover, NELM is appropriate to address both the determinants and consequences of migration strategies (Taylor and Martin, 2001; Hagen_Zaker, 2008). Therefore, the conceptual framework for this study is based on the NELM model and discussed as follows.

Whether a farm household invests in a high-return or low-return local activity,[6] is a function, among other determinants, of fixed resources (f) such as labor and land, and a vector of household characteristics (Zi). Suppose Q_i denotes output from either the high or low activity as i=1, 0 respectively. Given relative prices, a farm household specializes in a high return activity having an output $Q^* = f_1(f, Z_i)$ with corresponding income, $Y^*=g(Q^*)$. In the face of market constraints such as lack of formal credit, farm households invest only f_l of the fixed inputs where $f_l < f$ given by $C(.)=f_l$ where C(.) represents a constraint. Through remittances (R) migration relaxes credit constraints. On the other hand, with imperfect labor markets, migration could constrain investing in high return activities by reducing labor availability. Thus, according to the

[3]See also the expectancy value theory (Fishbein and Ajzen, 1975) and the theory of planned behavior (Ajzen, 1988). Both follow similar approach by considering migration as an individual decision rather than a decision of the household, but both provide more pluralistic perspectives by including contextual factors.

[4]Sustainable Livelihoods Approach perceives migration as a livelihood strategy of households to fulfill their substance need in response to risks and constraining conditions (Ellis, 2000, 2003).

[5]As a result studies such as Atsede and Marianne (2016) used an exploratory research phase in the Ethiopian study site to select an appropriate migration theory.

[6] Such as farm versus non-farm, low return cropping activity versus high return, and food crop versus cattle breeding.

New Economics of Labor Migration (NELM) theory, households' investments in a high return activities is a function of migration and remittances such that C (M, R) = f_I. Since migration reduces household labor while providing capital for production it can be hypothesized that $C_M < 0$ and $C_R > 0$.

In the context of imperfect markets, we expect the impact of migration on farm households' technology adoption and agricultural productivity to be non-zero. The net effect is ambiguous since the relative magnitude of the derivatives C_M and C_R is unknown a priori. Finding significant positive effects of migration and remittances on any non-migration source of income would mean that migration complements agricultural productivity of migrant-sending households via relaxing credit or risk constraints. Whereas a negative net effect implies that migration worsens labor shortages.

A review of empirical studies in the area shows that only a few studies have analyzed the impact of migration on technology adoption (such as studies by Kaninda, 2014 in Kenya; Mendola, 2006 in Mexico; and Quinn, 2009 in Bangladesh). Kaninda's (2014) study is based on cross-section data from rural Kenya using a three-stage least squares method. It found that migration and remittances positively affected the adoption of new farm technologies. Quinn (2009) found that migration had a positive impact on agricultural investments as it reduced credit and risk constraints faced by farming households. However, this positive impact depended on the amount of remittances received by source households. Mendola's (2006) study in Mexico established that international migration had a positive impact on the adoption of high-yielding seed varieties, but this was not the case for internal migration. To our knowledge, studies of this nature in Ethiopia are scant.

3 Data and Descriptive Statistics

3.1 The Data

This study is based on a panel data set of the Ethiopian LSMS.[7] Ethiopian LSMS began in 2011/12 and so far, took place four times (every other year). The first wave of data includes only rural and small towns and covered 333 enumeration areas with 3776 representative households from all regions of the country. However; the second wave 2013/14 and the third round 2015/16 increased the coverage by including major urban areas, both medium and large cities, and thus 5262 representative households were included in the survey.

The survey has modules on household characteristics, including detailed questions on migration and remittances, modules on agriculture together with farm technology uses, and also community-level data. This study specifically uses the datasets of the two rounds: 2013/14 and 2015/16. The survey consisted of five questionnaires. Migration data are recorded in the household questionnaire in the first section, which collects individual information on household members currently abroad or migrated to another destination within Ethiopia. In particular, for each migrant, information is available on his/her gender, age, literacy level, relationship with household head, the length of the migration period, destination, employment.

Data for indicators of technology adoption are primarily based on a post planting section of the agriculture questionnaires. For each household member engaged in agriculture (for each landholder) there is information on the area of the field, the method of cropping, the crop sowing techniques, the soil conservation methods applied, the use of irrigation, the application of chemical fertilizers, pesticide, herbicides, and improved seeds and a host of other variables.

3.2 Variable measurement

3.2.1 Outcome Variables

[7]LSMS - Ethiopian Living Standard Measurement Survey- is a longitudinal household data set collected in collaboration between the Central Statistics Agency of Ethiopia (CSA) and the World Bank Living Standards Measurement Study – Integrated Surveys of Agriculture (LSMS-ISA).

Migration:

A migrant household in this study follows from the definition previously used in other migration studies (such as Koc and Onan, 2004), where it is extended to not only include members who live together and have communal arrangements concerning subsistence and other necessities of life but also those members who presently reside abroad/locally but whose obligations are to that household. Thus, a migrant household in this study is a household having at least one migrant member in the last twelve months preceding the conduct of the survey for the purpose of employment and who spent at least three months in the destination area.[8]

In order to evaluate the impact, a treatment variable is defined as migrant households and non-migrant households. After rigorous data cleaning and excluding outliers, 544 migrant households are identified and included in this study. Since 4778 households are identified in both rounds in total, the remaining 4234 households are labeled as non-migrant households. Tables 1 present migrants by origin. It shows that, more than three-quarters of the rural migrants from Ethiopia originate from Amhara, Oromia, and SNNP regions.

Remittance income from migration is considered to include both cash and in kind from internal and external sources. Table 2 shows that in 2013/14 from the total migrant households around 20% of them had migrants abroad. This figure rises to around 30% for the latest round of 2015/16. This higher proportion of migrating abroad is due to the growing demand for domestic female workers in the Middle East especially in Saudi Arabia.

Moreover comparing average remittance per household between the two rounds the table shows in 2015/16 on average households receive more remittance than in 2013/14 round. This may be because of the drought that occurred in 2015/16 in the country.

Table 3 displays the relationship between household well-being and migration. In both survey rounds: 2013/14 and 2015/16, compared to non-migrant households, migrant households on average appear to have slightly more oxen and more livestock and thus are more likely to be classified as non-poor.

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[8] A period of three months is the most common in the literature (Marie, 2018 used similar definitions).

Measures of Technology Adoption:

This study focuses on the two well promoted technologies, improved seeds and chemical fertilizers. Use of chemical fertilizers and improved seeds is measured by whether a household used any of these biochemical technologies in crop production in the past 12 months on any of its fields. Hence, a dummy variable is defined, based on the use of chemical fertilizer, and use of improved seeds.

Table 4 summarizes farm technology adoption by migrant and non-migrants households. It shows, there is a discernible pattern in both rounds in terms of technology use between migrant and nonmigrant households. It can be seen that on average more migrant households adopt farm technology in both periods compared to non-migrant households. Since different crops are grown in different places and there is a variety of soil fertility, the use of different farm technologies could vary with location. Hence; accounting for location, could yield more consistent patterns. Consequently, to measure the true impacts, a counter factual analysis is implemented.

3.2.2 Choice of Explanatory Variables

The remaining exogenous regressors included in the model are primarily drawn from literature on migration and technology adoption. Demographic characteristics such as household head's gender, age, and education level are included to capture the effect of human capital on our outcomes. Further, other household-level characteristics such as the number of children and number of active members in the household are included to capture the effects of labor availability on the variable of interest. Households' farm size and livestock holdings which indicate their socioeconomic status are also supposed to affect technology adoption. Farm revenue, excluding remittances is also a critical factor affecting technology adoption via relaxing liquidity constraints. The effects of savings and wealth on adoption are captured using the value of household assets. Finally, heterogeneous effects of technology adoption arising from location and agro-ecological characteristics are also included.

Table 5 presents a summary of the explanatory variables included in the econometric model that could potentially affect the outcome variables. The descriptive statistics show that migrant households have older household heads with larger household size compared to their counterparts. Moreover, compared to non-migrants households, migrant households have a lower proportion of active males and higher dependency ratio. However, both groups have more or less similar endowments in terms of physical capital, such as the size of farmland and livestock holdings. Furthermore, migrant households have greater access to unpaid/mutual labor and more land under farming than non-migrant households.

4 Methodology

As described in the theoretical framework above, by changing availability of labor and income for migrant sending farm households; migration could affect farm households' adoption of technology. To find the effect of migration on the outcome variable a selection equation for participation in migration is given as:

$$Mig_i^* = \boldsymbol{Z_i} \propto + \xi_i \ , \quad With \ \ Mig_i = \begin{cases} 1 & if \ Mig_i^* > 0, \\ 0 & otherwise \end{cases} \qquad (1)$$

That is farm households will choose to send migrants ($Mig_i = 1$) if $Mig_i^* > 0$, 0 otherwise, where Mig_i^* is a continuous latent variable represents the expected benefits of sending migrants with respect to not sending migrants, $\boldsymbol{Z}_i$ is a vector of individual, household and community level characteristic that determine the decision to send migrants. Which is used to obtain an instrument for household i's participation in migration. $\propto$ is a vector of parameters. The binary response outcomes $\boldsymbol{y}_i$-technology adoption is also defined as follows:

$$\boldsymbol{y}_i^* = \boldsymbol{X}_i \boldsymbol{\beta} + \tau \, Mig_i + \pi_i \ , \ \text{where} \ \ \boldsymbol{y}_i = \begin{cases} 1 & \boldsymbol{y}_i^* > 0, \\ 0 & otherwise \end{cases} \qquad (2)$$

Where $\boldsymbol{y}_i$ is the main outcome variable and $\boldsymbol{y}_i^*$ represents a continuous latent variable, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, τ is the coefficient of the endogenous treatment dummy, and π_i is a residual term.

The endogenous switching problem, in this case, is that the response $\boldsymbol{y}_i$ for the i^{th} household is not always observed. Besides, $\boldsymbol{y}_i$ is assumed to depend on the endogenous dummy Mig_i and a vector of explanatory variables, $\boldsymbol{X}_i$. The endogenous dummy Mig_i also depends on a vector of explanatory variables $\boldsymbol{Z}_i$. There is a possibility that vectors $\boldsymbol{X}_i$ and $\boldsymbol{Z}_i$ share elements.

The simplest approach to examine the impact of migration on the outcome variable would be to apply ordinary least squares. This approach, however; might yield biased estimates because it assumes that migration is exogenously determined and thus random while it is potentially endogenous. The decision to send migrant member or not may be correlated with observable or unobservable factors hence may be based on individual self –selection. Farm households who send migrants may have systematically different characteristics from those that did not send, and they may have decided to send migrants based on expected benefit. Unobserved characteristics of farm households may affect both the migration decision and outcome variable-technology adoption, resulting in inconsistent estimates.

Endogenous switching probit regression would correct for this bias by simultaneously estimating the selection and outcome equations with proper instrumentation of the migration decision. The endogenous switching probit framework models the decision to send a migrant member is modeled and estimated using a pooled probit model. In the second stage, the relationship between the binary outcomes (technology adoption) and migration dummy a long with a set of explanatory variables is determined using probit model with selectivity correction.

To account for selection biases an endogenous switching regression model of farm technology adoption is defined as follows:

$$\text{Regime 1:} \quad \boldsymbol{y}_{1i} = \boldsymbol{X}_{1i}\boldsymbol{\alpha}_{\boldsymbol{1}} + \varepsilon_{1i} \;\; if \;\; Mig_i = 1 \qquad (3a)$$

$$\text{Regime 2:} \quad \boldsymbol{y}_{2i} = \boldsymbol{X}_{2i}\boldsymbol{\alpha}_{\boldsymbol{2}} + \varepsilon_{2i} \;\; if \;\; Mig_i = 0 \qquad (3b)$$

Where $\boldsymbol{y}_{1i}$ and $\boldsymbol{y}_{2i}$ are the dependent variables or binary outcome variables (technology adoption status) for migrant households and non-migrant households in regimes 1 and 2 respectively, $\boldsymbol{X_{1i}}$ and $\boldsymbol{X_{2i}}$ are vectors of exogenous variables. $\boldsymbol{\alpha_1}$ and $\boldsymbol{\alpha_2}$ are vectors of parameters; and ε_{1i} and ε_{2i} are random disturbance terms.

Finally, the error terms are assumed to have a trivariate normal distribution, with zero mean and covariance matrix $\sum$, i.e., $(\varepsilon_{1ij}, \varepsilon_{2ij}, \xi_{ij}) \sim N(\mathbf{0}, \sum)$ with

$$\sum = \begin{bmatrix} \sigma_\xi^2 & . & . \\ \sigma_{1\xi} & \sigma_1^2 & . \\ \sigma_{2\xi} & . & \sigma_2^2 \end{bmatrix} \quad (4)$$

Where σ_ξ^2 is the variance of the error term in the selection equation (1), σ_1^2 and σ_2^2 are variances of the error terms in the outcome equations (3a) and (3b), and $\sigma_{1\xi}$ and $\sigma_{2\xi}$ represent the covariance between ξ_i and ε_{1i} and ε_{2i}. Since our outcomes $\boldsymbol{y}_{1i}$ and $\boldsymbol{y}_{2i}$ are not observed simultaneously the covariance between ε_{1i} and ε_{2i} is defined.

$$E[\varepsilon_{1i} \mid Mig_i = 1] = \sigma_{1\xi} \frac{\phi(\boldsymbol{Z}_i\alpha)}{\Phi(\boldsymbol{Z}_i\alpha)} = \sigma_{1\xi}\lambda_{1i}, \text{ and } E[\varepsilon_{2i} \mid Mig_i = 0] = -\sigma_{2\xi} \frac{\phi(\boldsymbol{Z}_i\alpha)}{1-\Phi(\boldsymbol{Z}_i\alpha)} = \sigma_{2\xi}\lambda_{2i}$$

(5)

Where $\phi(.)$ is the standard normal probability density function, $\Phi(.)$ is the standard normal cumulative density function, and $\lambda_{1i} = \frac{\phi(\boldsymbol{Z}_i\propto)}{\Phi(\boldsymbol{Z}_i\propto)}$, and $\lambda_{2i} = -\frac{\phi(\boldsymbol{Z}_i\propto)}{1-\Phi(\boldsymbol{Z}_i\propto)}$. If the estimated covariance $\widehat{\sigma_{1\xi}}$ and $\widehat{\sigma_{2\xi}}$ are statistically significant, then migration decision and the outcome variables are correlated, that is one can find evidence of endogenous switching and reject the null hypothesis of absence of sample selectivity bias. According to Maddala and Nelson (1975), this model is defined as 'switching regression model'.

Unlike for continuous outcome variables, in our case with binary outcome variables (technology adoption), accounting for sample selection and endogenous switching for binary outcomes where the data is fit using non-linear models is challenging (Heckman, 1978, 1986; Miranda & Rabe-Hesketh, 2006). Hence estimations using two-stage procedures (such as Heckman's sample selection model) would lead to wrong conclusions and produce inconsistent results.

Consequently, one can account for the endogeneity of migration decision by estimating a simultaneous equations model with endogenous switching by full information maximum likelihood (FIML).

The FIML estimates of the parameter of the endogenous switching regression model can be obtained using the STATA command *Switch_probit.* After estimating the model's parameters, the actual and counter factual outcomes can be calculated.

Exclusion Restrictions:

An exclusion restriction is used for better identification of endogenous switching probit model. Selection of the exclusion restriction is guided by economic theory and empirical studies. To address the potential endogeneity bias of migration, the instrument used is: *lagged prevalence of migration in the area*, defined as the percentage of households with at least one migrant, as an instrument for migration[9]. This facilitates migration as it lowers risks and transaction costs of movement, by providing information regarding available economic opportunities in the destination (Mckenzie and Rapoport, 2009). However; household agricultural decisions such as whether to adopt technology or not may be influenced by the prevalence of migration in the area by adversely affecting local farm labor supply, which is a potential threat to the validity of the instrument. This concern is addressed by controlling for family agricultural labor supply using household size in the estimation. Moreover as migration is cumulative and the potential effect on labor market is persistent; thus its potential effect can be accounted by controlling community level fixed effects.

McKenzie and Rapoport (2010) among others illustrate how community level variables can serve as strong exclusion restrictions as they capture the influence of exogenous historical, cultural, and geographic factors.[10] They use historical community migration propensities to reflect the opportunity to engage in migration, which can be conceived as an exogenous reduction in the cost of migration.

[9] The following measure is constructed for each community based on the 2011/12 LSMS:= $\frac{\#\ households\ with\ migrants}{total\ \#\ of\ households\ in\ the\ community}$

[10] Other noteworthy examples of identification in migration research via historical community level measures include: McKenzie and Rapoport (2009).

Robustness Checks

To check if results are consistent irrespective of the type of econometrics model applied. The instrumental variable method and two stage pooled probit model are also estimated. To this end some type of a two-step approach is required. In the first stage, the endogenous variable, in this case migration is regressed on the instrument-lag of prevalence of migration in the area and other exogenous variables. In the second stage the predicted probabilities are used in the outcome model. According to Semykina and Wooldridge (2015) in non-linear panel data models with a short time period such as in this study, the random effects approach is much less robust as it requires serial independence of the errors whereas the pooled method does not one simply cluster the standard errors (Murtazashvili and Wooldridge, 2016; Semykina and Wooldridge, 2015).

5 Results and Discussion

In this section, first I briefly discuss the determinants of rural labor out-migration in Ethiopia, and then, its implication for farm households' agricultural technology adoption followed.

5.1 Drivers of Rural Labor out-migration

The regression results of the outcome and parameter estimates of the migration equation are discussed briefly. Table 6 gives the results of the estimation of migration based on Equation 1. The error terms are clustered by villages. The migration equation is estimated using pooled probit model. The results shows, the instrument used for identifying migration '*lagged prevalence of migration in the area*' is positive and significant. This implies that the prevalence of migration encourages further migration by information-provision at the source community level and risk-management in the host country (Masey et al., 1993).

According to the results in Table 6 the determinants of rural labor migration in Ethiopia includes; household level factors such as household asset index[11] and total land owned in hectares which

[11] The asset index was created using the principle components analysis (see, Filmer and Pritchett, 2001 for an overview).

proxy household wealth being strongly correlated with migration. This may be because migration involves significant costs. Household level demographic characteristics such as 'household size' are positively and significantly related to the probability of a household's participation in migration. This is mainly because larger households have more labor to allocate across various activities. However, 'number of children' in the household and 'number of old age' household members are negatively related to the probability of sending a migrant. This may be because high dependency ration in a household affects negatively the probability of other active household members to engage in migration. Moreover, household head characteristics such as 'gender of the household head' and 'age of the household head' also affect decision to migration. Though, statistically insignificant, households with access to credit are more likely to participate in migration because credit might soften households' liquidity constraints allowing them to participate in migration.

Looking at migration location wise; the result also shows on average compared to the control region; farm households in Amhara have a significantly higher likelihood of having a migrant, other things being equal. This is in line with our descriptive statistics results.

5.2 Impact of Migration on Agricultural Technology Adoption

5.2.1 Results based on Endogenous Switching Regression Model

Table 7 presents the results of the effect of migration on productivity enhancing agricultural technology adoption using endogenous switching regression model. The findings show that if a household sends a migrant its likelihood of adopting chemical fertilizer, and improved seeds increased by about 5 and 7 percentage points respectively than the counterfactual scenario of not participating in migration. That is, in all the counterfactual cases, had households not sent migrants, they would on average have been less likely to adopt any of the farm technologies (see first column of table 7).

The result suggests that migration has a positive effect on farm households' adoption of productivity enhancing agricultural technologies. This may be probably because Ethiopia has long faced severe problems of land scarcity and a dwindling farm size[12]. With the scarcity of land in one hand and higher population density conversely the labor lost effect associated with migration may less likely to bind adoption of labor-intensive technology. In light of this, it may not be surprising that participation in this activity responds positively.

Hence, it can be hypothesized that, migration affects the adoption of farm technology positively, mainly through a remittance effect that cancels out any labor lost effect associated with migration. Thus, this findings support both risk and liquidity constraint hypotheses. Previous studies in this area, such as Quinn (2009), Mendola (2006), and Zahonogo (2011) also showed that migration has a positive effect on the adoption of modern farm technologies.

Table 8 in the appendix section displays coefficient estimates of the outcome equation for migrant households and non-migrant households. The result indicates that the self-selection term is positive and significant indicating the endogeneity of migration.

5.2.2 Results based on Pooled OLS and IV regress Model

For robustness checks two stage Pooled OLS and IV regress model are estimated as displayed in Table 9 and the findings are pretty much similar.

Table 9 columns (1)-(2) present the results of the impact of migration using two stage pooled probit model and columns (3)-(4) depict using the IV regress model for the outcome variables dummy for chemical fertilizer use and dummy for better seeds use. Starting with our key variable of interest, results reveal that migration is positively correlated with farm households' adoption of chemical fertilizer and use of better seeds which ever estimation method followed. Estimates from pooled OLS method revealed that; on average households with migrants have approximately 16 percent and 40 percent higher likelihood of adopting chemical fertilizer and use of better seeds compared to non- migrant farm households respectively. Moreover using IV regress method the results are more or less similar. These findings support both risk and liquidity

[12]For example, during the 2011-2012, more than half of households in Ethiopia cultivated less than 1 hectare of land (CSA, 2012).

constraint hypotheses. Moreover substantiate previous related studies in the area that both migration and remittance have positive effect on adoption of modern farm technologies.

Moreover, the findings also reveal that other significant determinants of farm technology adoption-dummy for chemical fertilizer use, and dummy for better seeds use- include the gender of the household head, education of household head, number of children in a household, household asset index, household head used unpaid labor, access to animal plow, land under farming in hectares, access to credit, distance to the nearest market, and advisory service among other factors affects positively or negatively to the propensity of adopting any of the farm technologies.

6 Conclusions and Policy Implications

6.1 Conclusions

For countries south of the Sahara including Ethiopia; labor migration is intensifying. Yet, inadequate data on migration and remittances prohibits understanding of migration's role in the agricultural transformation process. Insights from literature suggest migration and household decision making dynamics may influence future investments in agriculture and thus farming activity.

Using a panel data from the 2013/14 and 2015/16 Ethiopian Living Standard Measurement Survey (LSMS), this study examined the impact of migration and remittances on productivity enhancing agricultural technology adoption in Ethiopia. To this end, the study used a counterfactual analysis and employed endogenous switching regression model for measuring these impacts. Moreover, for robustness checks Pooled probit model and IV regression models are estimated.

The empirical results shows that irrespective of the type of model used migration and the resulting remittances have positive and significant effect on productivity enhancing agricultural technology adoption such as use of chemical fertilizer and use of improved seeds in Ethiopia. The findings imply that Ethiopian government should revisit some of its policies which directly or indirectly hinder rural labor out-migration.

6.2 Policy Implications

Based on the study finding the following policy implications are derived for the study:

1. For harnessing migration and remittances towards enhancing farm households' adoption of productivity enhancing farm technologies in the one hand and minimize its negative impacts the Ethiopian government should design a comprehensive migration and remittance policy which is context specific with gender perspective into account. In one way or another the policy should take into account the following[13]:

    - To cope up with determinant effects of migration on human capital accumulation the government should bolster support systems in healthcare and education for migrant households.
    - To fill the gap following the loss of economically active members due to migration; the government should work to improve the functioning of the rural labor market.
    - For hassle free and less costly remittance inflows; government should promote and further improve money transfer technologies including mobile banking. Moreover, it is also equally important to strengthen formal insurance and credit markets.
    - Though recently there have been some initiatives, the Ethiopian government should work extensively to inform and give short-term training to migrants before they leave, especially to female migrants going to the Middle East.

[13] Except South Africa and Nigeria SSA countries including Ethiopia do not have a clear migration policy.

2. Ethiopian government should revisit some of its policies which directly or indirectly hinder rural labor out migration. For instance, land policy. Different studies indicate that the policy hinders rural labor out migration.

3. Government should replicate the urban youth revolving funds implemented in major urban areas of the country into the rural areas to create employment opportunities for unemployed rural youth.

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7 Tables

Table 1 Migrants and destination areas

Region	Of total stock of Migrants' (%)
Oromia	23
Amhara	28
SNNP	19
Tigray	9
Other regions	21
Total Migrants	544

Source: Own computation using Ethiopian LSMS 2013/14 and 2015/16.

Table 2 Remittance and Migration by Destination

	Migrant Households
2013/14 Round	
Average remittance (HH level)	1,395 (4,376)
% of international Migrants	19.54
2015/16 Round	
Average remittance (HH level)	2,116 (7,343)
% of international Migrants	29.67
No. of Observations	544

Note: 1 dollar is approximately 18 and 23 Ethiopian birr respectively for the rounds.
Source: Computed from ESES 2013/14 and 2015/16.

Table 3 Household wealth (household asset) and Migration Status

	Migrant households	Non-Migrant households
2013/14 Round		
Tropical Livestock Units (TLUs)	3.79(3.32)	3.49(3.25)
Average # of Oxen owned	0.98(1.08)	0.88(1.07)
Landholdings in Hectares per Capita	0.22(0.23)	0.25(0.27)
2015/16 Round		
Tropical Livestock Units (TLUs)	3.85(3.16)	3.51(3.25)
Average # of Oxen owned	0.97(1.03)	0.90(1.09)
Landholdings in Hectares per Capita	0.24(0.24)	0.25 (0.27)
Number of Observations	544	4234

Source: Computed from ESES 2013/14 and 2015/16.

Table 4 Technology Adoption and Migration Status of farm households

	Migrant households	Non-Migrant households
2013/14 Round		
Chemical fertilizer (1=used)	0.57(0.49)	0.47(0.49)
Improved Seeds (1=used)	0.14(0.34)	0.12(0.32)
2015/16 Round		
Chemical fertilizer (1=used)	0.56(0.49)	0.49(0.49)
Improved Seeds (1=used)	0.14(0.34)	0.11(0.31)
Number of Observations	544	4234

Source: Own computation using Ethiopian LSMS 2013/14 and 2015/16.

Table 5 Descriptive Statistics of Relevant explanatory variables and instruments used (N=4447)

Variable Description	Migrant HHs	Non-Migrant HHs	Difference b/n means	Standard error
Household head is male (1=yes)	0.733	0.809	0.076	0.018***
Age of head (in years)	52.110	45.599	-6.511	0.665***
Head Comp. Secod. Educ (1=yes)	0.031	0.038	0.007	0.009
Size of household	5.832	5.492	-0.340	0.103***
Number of children< 15yrs of age	1.775	2.333	0.557	0.075***
Number of adults>=65	0.230	0.162	-0.068	0.019***
Household Asset wealth index	0.422	0.345	-0.077	0.227
Tropical livestock unit (TLU)	3.788	3.773	-0.015	0.450
Head employed off-farm (1=yes)	0.064	0.048	-0.017	0.010
Dummy access to animal plow (1=yes)	0.180	0.248	0.068	0.019***
Household used unpaid labor (1=yes)	0.230	0.168	-0.062	0.017***
Proportion of flat land	0.611	0.542	-0.069	0.019***
Proportion of fertile land	0.271	0.323	0.052	0.019**
Land under irrigation (in ha)	0.022	0.019	-0.003	0.006
Land under farming (in ha)	1.929	1.109	-0.820	0.317**
Log(non-farm income excld. remit)	0.668	0.788	0.121	0.108
Distance to nearest mkt. (km)	6.821	6.974	0.153	0.534
Dummy HH access advisory service (1=yes)	0.705	0.649	-0.056	0.022**
Lag of migration prevalence (inst)	0.317	0.256	-0.060	0.009***
Observations	544	3903		

Note: significant at *** p<0.01, ** p<0.05, * p<0.1

Table 6 Determinants of Rural Labor Out-Migration in Ethiopia

VARIABLES	Dummy Migration (1=yes)
Gender of Head (1=male)	-0.057***
	(0.012)
Age of HH head (in years)	0.002***
	(0.000)
Household head no educ. (1=yes)	-0.016*
	(0.010)
Household size	0.032***
	(0.003)
No. of children in HH (<14yrs)	-0.043***
	(0.004)
No. of old HH member (> 65 yrs)	-0.034**
	(0.013)
Asset Wealth Index	0.100***
	(0.001)
HH access credit (1=yes)	0.016
	(0.011)
Dummy HH used unpaid labor (1=yes)	0.028***
	(0.011)
Total land hectares owned	0.001*
	(0.000)
Ln(Non_farm_income excld remit)	-0.002
	(0.002)
Distance to nearest Market (Km)	-0.000
	(0.000)
Lag of Migration Prevalence **(instrument for migration)**	0.114***
	(0.022)
Control region (other_region)*	
Tigray	-0.019
	(0.018)
Amhara	0.026*
	(0.015)
Oromia	-0.021
	(0.016)
SNNP	-0.018
	(0.014)
Observations	4,777

*Other regions include: Afar, Ethio-Somalia, Gambela, and Benshangul-Gumuz

Table 7 Impacts of migration on farm technology adoption

Outcome	ATT	ATU	ATE
Dummy for chemical frtilizer use (1=yes)	0.045***	0.052***	0.051***
	(0.005)	(0.001)	(0.001)
Dummy for Better seeds use (1=yes)	0.074***	0.116***	0.103***
	(0.004)	(0.001)	(0.001)

Note: the figures in parenthesis are bootstrapped standard errors; *** indicate statistical significance at 1%.

Table 8 Endogenous Switching Probit Model Estimates

	Dummy for Chemical fertilizer use (1=yes)		Dummy for Better seeds use (1=yes)	
VARIABLES	Migrant HHs	Non-Migrant HHs	Migrant HHs	Non-Migrant HHs
Household head is male (1=yes)	0.256	0.057	0.021	0.141*
	(0.158)	(0.059)	(0.178)	(0.079)
Age of HH head (in years)	-0.003	-0.004**	-0.002	0.001
	(0.007)	(0.002)	(0.008)	(0.003)
Household head has no educ. (1=yes)	-0.293**	-0.046	-0.057	0.066
	(0.143)	(0.045)	(0.123)	(0.057)
Household size	-0.061	0.005	0.084	-0.009
	(0.060)	(0.018)	(0.057)	(0.029)
No. of Children (<14yrs of age)	0.043	0.039*	-0.131*	0.057
	(0.091)	(0.023)	(0.079)	(0.037)
No. of HH members >65 yrs. of age	0.188	0.057	-0.099	-0.134
	(0.181)	(0.068)	(0.174)	(0.094)
Household Asset index	0.025*	0.031***	-0.010	0.019***
	(0.013)	(0.004)	(0.012)	(0.005)
Access to credit (1=yes)	0.609***	0.679***	-0.009	0.057
	(0.198)	(0.066)	(0.148)	(0.065)
HH head employed in off-farm income (1=yes)	-0.089	-0.084	0.072	-0.095
	(0.228)	(0.097)	(0.215)	(0.135)
HH has access to animal plough (1=yes)	-0.334**	-0.495***	0.156	-0.140**
	(0.168)	(0.051)	(0.149)	(0.070)
HH used unpaid labor (1=yes)	-0.112	0.093*	0.366***	0.501***
	(0.143)	(0.057)	(0.128)	(0.077)
Land under farming in (ha)	0.004	0.018**	-0.029	-0.006
	(0.005)	(0.008)	(0.044)	(0.010)
Ln(Non-farm income excld. Remit)	0.028	-0.020**	0.031	0.027**
	(0.026)	(0.009)	(0.025)	(0.011)
Distance to nearest Mkt. in (KM)	-0.033***	-0.020***	-0.006	-0.005*
	(0.008)	(0.002)	(0.005)	(0.003)
Dummy for Extent. Advisory service (1=yes)				
	1.101***	0.833***	0.183	0.522***
	(0.218)	(0.049)	(0.132)	(0.069)
Constant	0.690	-0.565***	-0.978***	-2.004***
	(0.886)	(0.117)	(0.731)	(0.171)
Wald χ^2	298.62***		290.6***	
	(0.000)		(0.000)	
σ_i	0.461**	0.654*	0.618**	-0.504
	(.038)	(0.09)	(0.041)	(0.678)
Obs.	4,777		4,768	

Table 9 Estimation results of the impact of migration on Agricultural Technology Adoption (Pooled OLS & IV regress model)

	2 Stage Pooled Probit Model		IV regress Model	
VARIABLES	Dummy for Chemical Fertilizer Use (1=yes)	Dummy for Improved seed use (1=yes)	Dummy for Chemical Fertilizer Use (1=yes)	Dummy for Improved seed use (1=yes)
Migrant Household	0.161**	0.394***	0.0431**	0.0858***
	(0.070)	(0.075)	(0.021)	(0.019)
HH head is male (1=yes)	-0.068	0.0830	0.0037	0.0160
	(0.074)	(0.082)	(0.019)	(0.012)
Age of HH head (in years)	0.002	0.0006	-0.0002	0.0002
	(0.003)	(0.003)	(0.0007)	(0.0004)
HH head has no education (1=yes)	-0.112**	0.0334	-0.033**	0.008
	(0.051)	(0.054)	(0.015)	(0.010)
Household Size	0.088***	0.0146	0.0132***	0.002
	(0.027)	(0.030)	(0.004)	(0.003)
No. of Children in HH	-0.083**	0.0194	-0.006	0.005
	(0.038)	(0.042)	(0.006)	(0.005)
No of older HH	-0.030	-0.132	0.003	-0.025*
	(0.077)	(0.086)	(0.022)	(0.015)
HH Asset wealth Index	0.032***	0.0154***	0.010***	0.0034***
	(0.004)	(0.0046)	(0.001)	(0.001)
HH has access to credit (1=yes)	0.776***	0.0537	0.239***	0.013
	(0.059)	(0.061)	(0.016)	(0.014)
HH head emyed in off farm act. 1=yes)	-0.084	-0.0460	-0.028	-0.011
	(0.097)	(0.121)	(0.029)	(0.020)
HH Access Animal Plough(1=yes)	-0.537***	-0.0910	- 0.164***	-0.012
	(0.059)	(0.065)	(0.017)	(0.010)
HH used unpaid labor (1=yes)	0.155***	0.496***	0.036**	0.116***
	(0.056)	(0.059)	(0.016)	(0.014)
Land under farming in ha	0.018**	-0.00743	0.0017***	-0.0007***
	(0.008)	(0.006)	(0.0005)	(0.0002)
Ln(non-farm income excluding remit)	-0.020**	0.0280***	-0.007**	0.006***
	(0.009)	(0.009)	(0.002)	(0.002)
Dist. to nearest market (in KM)	-0.023***	-0.00549*	-0.0051***	-0.0009**
	(0.002)	(0.0029)	(0.0004)	(0.0003)
HH access ext. advisory service(1=yes)	0.915***	0.464***	0.317***	0.0785***
	(0.047)	(0.058)	(0.015)	(0.009)
lambda	0.328**	0.0155	-	-
	(0.151)	(0.177)		
Constant	-1.405***	-1.881***	0.273***	0.005
	(0.382)	(0.443)	(0.0390)	(0.024)
Observations	4,777	4,768	4,777	4,768
R-squared			0.264	0.052