The Impact of Rural-Rural Migration on Crop Production in North-western Ethiopia: An Application of Endogenous Switching Regression Model

Kibrom Adino*[*], *Bamlaku Alamirew*[**], *Degye Goshu*[***]

Abstract

The emphasis for rural-rural migration has been given very low attention in the development discourses in the context of poor countries. Rural-urban migration in developing countries is not like what the majority of the literature attempt to show. At the same time, previous studies failed to see the synergies existing within the agricultural economy itself. Its heterogeneous agro-ecological and diverse production potential has been buried in migration studies. Deeper studies are still recommended on the impact of migration on agricultural and rural development. Therefore, anchored on the theory of new economics of labour migration that focuses on household level analysis, this study attempts to examine the impact of rural to rural migration on crop production of the sending farm household in North-Western Ethiopia. From Endogenous Switching Regression model, the impact of labour migration was found to be positive and significant that mainly was caused by improved new variety use, fertilizer application and experience sharing through labour migration in the large scale commercial agricultural production belt.

Keywords: Impact, Rural-Rural, Crop Production, Endogenous Switching Regression Model

---

[*]Assistant professor at University of Gondar, E-mail: kibromadino@gmail.com, Postal address , 196

[**]Associate professor at Addis Ababa University

[***]Senior researcher at Ethiopian Economic Policy Research Institute

1. Introduction

Migration is the common phenomenon for the livelihood of the rural poor in Sub-Saharan Africa. Among the various types of migration, internal migration was responsible for nearly 740 million people considered to be migrants within their own country (IOM, 2015). The recent evidence showed that 10% of the world population were moving within the country, whereas about 3% were migrating out of country (FAO, IFAD, IOM, and WFP, 2018). In the past half century, the discourses in migration studies have exhibited tremendous shifts from pessimistic to optimistic views of migration-development interactions (de Haas, 2010; Nzima, Duma and Moyo, 2016). Though, the nexus between migration and development has got a growing support for its developmental effect, the impacts on agriculture have still remained contesting among the various empirical studies (Ochieng, *et al*., 2016).

As a result, there is an emerging concern on role of migration on agriculture as risk minimization and livelihood diversification strategy (Massey, *et al*., 1993; Taylor, 1999; de Haas, 2010) and its implication on rural poverty alleviation (Dey, 2014). Specifically, its relevance to augment financial constraints in poor countries for the agriculture sector has great momentum (Massey, *et al*., 1993; Taylor, 1999). Notably, the smallholder agriculture, which is the basis for Africa's total food supply and contributes 70% of export of agricultural commodities (IFAD, 2013), has intricate synergy with migration of labour. In Ethiopia, agriculture is the prominent sector which contributes more than 46.9% of GDP, hosts about 80% employees, and contributes 60% of country's export earnings. Largely, the sector is hoped to play leading role for food security and poverty reduction (MoFED, 2011).

Studies are ample concerning migration and development, notably in international migration and rural-urban migration. However, the emphasis for rural-rural migration has been given very low attention in the development discourses in the context of poor countries (Lucas, 2007; Carr, 2009; Linger and Terefe, 2018), as a result remained ignored. Unless obsessed with the urban bias migration literature, the rural-urban migration is not like what the majority of the literatures arguing in developing countries (Carr, 2009).

At the same time, previous studies fail to recognize the need to see the synergies existed within the agricultural economy itself given its heterogeneous agro-ecological and diverse production potential and thus, rural–rural migration remained ignored (Lucas, 1997[1]; Lucas, 2007); thereby rural to rural migration has been seen buried in migration studies (Ekpenyong and Daniel, 2015). In Ethiopia, rural to rural migration are still the leading patterns of migration as compared to rural to urban (Getnet and Mehrab, 2010; CSA, 2014; Linger and Terefe, 2018; Kibrom et al., 2020). On the top of that, there are still studies that pointed for the need to delve deeper on the impact of migration on agricultural and rural development (Kaninda and Greg, 2014). Therefore, in this study based on cross-sectional survey an attempt has been made to examine the impact of rural to rural migration on crop production of the sending farm household in North-Western Ethiopia.

2. Methods

2.2. Sampling and data collection

This study was conducted in North-Western Ethiopia, notably in North Gondar Zone. To get the potential respondents from the cross-sectional survey, the study employed multi-stage sampling technique. In the first phase, three districts from North Gondar zone were selected that represent the three agro-ecological zone (Highland, Midland, and Lowland). Then, Kebeles in these districts were grouped as high potential and low in terms of migration experience to have reasonable proportional sample of migrants and non-migrants and to apply simple random sampling. [2] In the third phase, kebeles[3] were selected randomly from the identified districts from which the sample frame was established. Stratified random sampling has been used to minimize heterogeneities and sampling error while taking the sample at household level (Kothari, 2004; Ajay and Micah, 2014). Then, the sample size determined based on some basic determinants of sample size such as representation to the study area, reduction of the sample error and avoiding systematic sample biases as stated in Kothari (2004). Finally, a total sample of 385 households with a contingency sample of (5%) 20 households were employed using the formula by Kothari (2004) which is given in equation below:

$$n = \frac{z^2 Pq}{(e)^2} \quad \text{.......1}$$

In which "n" represents the sample size of the study households that is distributed proportionally to each kebele. Whereas, "z"[4] represented the inverse standard cumulative distribution that corresponds to the level of precision level "e" in which in this study which takes the value of 5%. "P" represents the estimated proportion that is present in the study population and $q = 1 - p$. When, we don't have information about the proportion of variability of the study population in terms of migration status, technical efficiency and level of agricultural technology utilization; it is advised to use the value to p =.5 which is assumed to be most conservative sample size (Kothari, 2004).

$$n = \frac{(1.96)^2 .5(1 - .5)}{(0.05)^2} = 385$$

Thus, using 385 sample of households the probability sampling design that helps to ensure representativeness and respect the statistical uniformity has been implemented to get the potential respondents from the established sample frame.

2.3. Analytical framework and estimation strategies

In observational study self-selection[5] is the obvious feature in migration decision. At the same time migration and outcome variables such as crop productivity can have reverse causality which violates the principles of exogeneity of the effect variable. Thus, the model that is capable in addressing self-selection (Heckman, 1979) and endogeneity problem (Hausman, 1978) has to be employed. In this study, the Endogenous Switching Regression Model (ESRM) that have greater advantage over the others in terms of addressing the self-selection and endogeneity employed to examining the impact of rural-rural migration on crop productivity and technical efficiency.

On top of that, there should be also important consideration whether migration decision expected to have an average effect on the whole sample in terms of intercept shit or assumed to have effect on the productivity of crop production ingredients which is reflected in terms of shifts of the production function (Alene and Manyong, 2007).

For efficiency analysis the study followed the seminal work by (Farrel, 1957) which further elaborated by Coelli, *et al*., (2005) in the measurement of production efficiency. In the first place it requires decision over the selection of approaches to be employed for efficiency measures; as they strongly mislead the conclusions to be drown form the result (Tabak, *et al*., 2014). The stochastic frontier approach which is recommended for agricultural related that helps to capture both the measurement errors (statistical disturbances) and inefficiencies production was utilized (Chen, 2007). The functional forms commonly utilized for stochastic frontiers research are either the Cobb-Douglas (CD) or the translog (TL) production function. The choice of one over the other is mainly based on the log-likelihood ratio test and the Alkaike Information Criteria. Thus, both the CD and TL functional forms are specified as follow respectively:

$$ln(y_i) = \beta_0 + \beta_i \sum_{n=1}^{n} ln(x_i) + v_i - u_i \quad \ldots\ldots 2$$

$$ln(y_i) = \beta_0 + \sum_{k=1}^{n} \beta_k ln(x_{ik}) + \frac{1}{2}\sum_{k}^{n}\sum_{j}^{n} \beta_{ij} ln(x_{ik}) * \ln(x_j) + v_i - u_i \quad \ldots\ldots 3$$

Where:

$ln(y_i)$ = is the natural logarithm of the monetary value of total annual agricultural output (the monetary value crop production has been suggested as it helps to aggregate all crops produced by the farmer in different studies (Bamlaku, *et al*., 2009; Wondimagegn and Sebastian, 2018):

- $\beta_i{}'s$ = are coefficients of parameters to be estimated;
- v_i= is the idiosyncratic measurement errors;
- u_i = Non-negative random variable placed to measure technical efficiency of the i^{th} household; and
- $x_i^{i}s$ = are important factors/inputs of production

In this study household migration decision is framed based on the theory of New Economics of Labour Migration (NELM) that helps to centre the migration decision at household level and argued migration as a family strategy (Stark and Bloom, 1985; Stark, 1991; Portes, 2010; Kurekova, 2011; and Kings, 2012). At the same time household decision to migrate is on the bases of utility maximization in which households decide for migration when the utility overweight staying in the origin. Let we represent households migration status as “Mh” for migrant households’ and “NMh” for non-migrants’. Then let P^* denote the difference between utilities that may arise from migration decision and staying home as show in equation 4.

$$P^* = Mh - Nh \qquad (4)$$

However, in the above equation the utility is not observable, thus can be represented as latent variable as expressed in equation 5, in which P represented to denote households migration status.

$$P^* = \alpha Z + v, with\ P = \begin{cases} 1, P^* > 0 \\ 0\ othewise \end{cases} \qquad (5)$$

Where, P is rural-rural migration decision which takes 1, if the utility is assumed to be positive, otherwise, 0. Whereas, v, α and Z, represents, the error term, parameters to be estimated and the explanatory variables for the migration decision, respectively. For this study, a number of explanatory variables based on previous studies (Ackah and Medvedev 2010; Ebihart and Ezekiel and 2013, Kibrom, *et al*., 2015; Dodd, *et al*., 2016) were be assumed to have effect on migration decision. These includes, household characteristics (age of head, sex head, size of active labour, migration experience, Crop income, land size, TLU, perceived migration income, migrants’ contact, cell phone, credit access, social membership, perceived rainfall, and perceived land productivity) were employed to examine the important factors that determines rural-rural migration in the study area.

As stated above, the endogenous switching regression model that exposed farm households for two regimes as migrant and non-migrant with differentials in factors of production for two regimes[6] will be specified as follows:

$P^* = \alpha Z + v$ ……………………………………………………..…………6

$Regime\ 1: Y_{1i} = \beta_{1i} X_{1i} + u_{1i}, if\ P = 1$ ………………………….............7

$Regime\ 2: Y_{0i} = \beta_{0i} X_{0i} + u_{0i}, if\ P = 0$ ……………………………………8

Where, Y_{1i} and Y_{0i} represent crop production (measured in aggregate values of all crops) for migrants' and non-migrants' household respectively. P is the latent variable which is defined in equation 7. Whereas, α, β_1, and β_0 are coefficients of parameters to be estimated. v, u_1 and u_0 are error terms assumed to be have a trivariate normal distribution with mean vector zero and covariance matrix;

$$cov(v, u_1, u_0) = \begin{bmatrix} \sigma^2 u_1 & \sigma u_1 u_0 & \sigma u_1 v \\ \sigma u_1 u_0 & \sigma^2 u_0 & \sigma u_0 v \\ \sigma u_1 v & \sigma u_0 v & \sigma^2 v \end{bmatrix}$$

The error term in the selection equation (v) can be correlated with the error terms in the outcome equation ($u_1\ and\ u_0$); if unobserved effects are existed. This implies that the expected values of u_1 and u_0 will be non-zero conditional upon the migration regime selection. According to Maddala, (1986) the model can be said as exogenous switching and endogenous switching if $\sigma u_1 v = \sigma u_0 v = 0$ and if either $\sigma u_1 v$ or $\sigma u_0 v$ are non-zero respectively.

The recently employed, an efficient estimation method for endogenous switching regression model is Full Information Maximum Likelihood estimation (FIML) (Lokshin and Sajaia, 2004). Thus, Full Information Maximum Likelihood (FIML) estimation method used for endogenous switching regression model.

Counterfactual and treatment effect

The next and the basic task, is to estimate the effect of rural-rural migration on crop productivity. To do so, as conceptualized earlier, two groups migrants' household and non-migrants' household will be viewed as treatment and non-treatment of groups respectively. Adopting the procedures from De Falco, *et al*., (2011) and Asfaw, *et al*., (2012) and supported with specification of Maddala, (1983), the conditional expected crop productivity (measured in crop output values) of the farm household that has characteristics *X* and *Z* and participated in migration can be derived as follow in equation (9):

$$E(Y_{1i}/ P = 1) = \beta_{1i}X_{1i} + \sigma u_1 v\lambda_{1i} \quad \ldots\ldots 9$$

Whereas, the conditional expected crop productivity of the farm household that has characteristics *X* and *Z* and non-participated in migration are specified in equation (10):

$$E(Y_{0i}/ P = 0) = \beta_{0i}X_{0i} + \sigma u_2 v\lambda_{2i} \quad \ldots\ldots 10$$

Similarly, the conditional expected crop productivity of the farm household that the same farm household would enjoy without migration (Counterfactual Hypothetical Case) specified as shown in equation (11):

$$E(Y_{0i}/ P = 1) = \beta_{0i}X_{1i} + \sigma u_2 v\lambda_{1i} \quad \ldots\ldots 11$$

Finally, the conditional expected crop productivity of the non-migrant household if migrated will be obtained through equation (12):

$$(Y_{1i}/ P = 0) = \beta_{1i}X_{0i} + \sigma u_1 v\lambda_{2i} \quad \ldots\ldots 12$$

Then to isolate the treatment effect or the Average Treatment effect on Treated (TT) i.e. the increment of agricultural production due to migration decision for migrants' household, we follow Heckman et al., (2001) as the difference between equation (9) and (11):

$$TT = E(Y_{1t}/P=1) - E(Y_{0t}/P=1) = (\beta_{1t}-\beta_{0t})X_{1t} + (\sigma u_1 v - \sigma u_0 v)\lambda_{1t} \quad \ldots\ldots 13$$

Similarly, to see the effect of migration on untreated (non-migrants) which is TU, we used the difference between equation (12) and (10):

$$TU = (Y_{1t}/P=0) - (Y_{0t}/P=0) = X_{0t}(\beta_{1t}-\beta_{0t}) + (\sigma u_1 v - \sigma u_0 v)\lambda_{2t} \quad \ldots 14$$

The heterogeneity effect that could arise due to unobservable effects regardless of the migration decision has to be taken in to consideration. Thus, heterogeneity effect for migrants and non-migrants named as Base Heterogeneity one (BH_1) and two (BH_2) respectively. Accordingly, base heterogeneity for those who actually have migrants is the difference between equation (9) and (12) while for non-migrants' household it is the difference between (11) and (10):

$$BH_1 = E(Y_{1t}/P=1) - E(Y_{1t}/P=0) = \beta_{1t}(X_{1t}-X_{0t}) + \sigma u_1 v(\lambda_{1t}-\lambda_{2t}) \quad \ldots 15$$

$$BH_2 = E(Y_{0t}/P=1) - E(Y_{0t}/P=0) = \beta_{0t}(X_{1t}-X_{0t}) + \sigma u_0 v(\lambda_{1t}-\lambda_{2t}) \quad \ldots 16$$

The last, but not the least is the Transitional Heterogeneity effect (TH) that which is calculated as the difference between TT and TU defined above in equation (13) and (14), respectively.

$$TH = TT - TU = \quad \ldots\ldots 17$$

3. Results and Discussion

Migration as one of the livelihood strategy of the farm household is argued to have implication on the use of improved agricultural inputs that the current agricultural practice demands so voraciously. In this section the application of new varieties for selected commodities and use of chemical fertilizer were assessed between families with migrants and non-migrants. Firstly, through the support of development agents already disseminated technologies such as fertilizer (Urea, DAP, NPS), new varieties for teff, maize, chickpea and sorghum were identified in North Gondar Zone that are good for comparing migrants and non-migrants' new variety application.

As shown, in Table 1, below, for the selected crops such as Teff, Maize, Chickpea and Sorghum, the chi-square test shows statistically significant except sorghum at less than 1 % probability level. The table also indicated that 58.94 % of families of the migrants are using improved Teff varieties whereas non-migrants' family are only 21.76% with a chi-square and p-value of 39.21 and 0.000 respectively. The result, confirmed that migrants' family are in better position for using new varieties for Teff production. Similarly, the chi-square test revealed that from the total migrant's family almost 76 % of them are using improved maize variety at less than 1 % probability level with a chi-square value of 21.22. The non-migrants families are 42.85 % from the total non-migrants. The higher percentage for maize new variety application in the study area is due to that fact that BH-540 is the widely disseminated variety for maize as compared to other crop technologies. Except sorghum which is not statistically significant, the same result also obtained from the chi-square test for chickpea production. For chickpea the test shows statistically significant percentage difference between migrants' and non-migrants family with 46.15 % and 22.60 % respectively at less than 1 % probability level. Overall, for the three commodities except sorghum, the chi-square confirmed statistically significant results for better use of high yielding varieties by the migrants family than non-migrants. A study conducted in Senegal also supports our finding in which migration remittance found to have positive impact on the adoption of new technologies (Kaninda and Greg, 2014).

Similarity, for the application of chemical fertilizer which is measured in terms of expenditure for inorganic fertilizers such as (Urea, DAP and NPS) and other chemicals (such as insecticides or anti-weed), t-test is employed to see the mean expenditure difference.

Table 1. Chi-square Test results on dummy variables for migrants' family and non-migrants' family

Variables	Use status	Migrants family		Non- migrants family		Chi-sq. Value	Sig. level
		Number	Percent	Number	Percent		
Teff HYV	Yes	56	58.94	42	21.76	39.21***	0.000
	No	39	41.05	151	78.24		
Maize HYV	Yes	54	76	63	42.85	21.22***	0.000
	No	17	24	84	57.15		
Chickpea	Yes	18	46.15	26	22.60	7.91***	0.005
HYV	No	21	53.85	89	77.40		
Sorghum	Yes	3	5.08	6	5.45	0.0104	0.919
HYV	No	56	94.92	104	94.55		

Source: Own Survey (2019)

Note: HYV represents High Yield Varieties and *** represents p<0.01.

As shown in the Table 2 below, there is statistically significant mean difference between migrants' and non-migrants' at p-value less than 5 % probability level. Stated differently, the migrants are expending on average 204.95 birr higher than non-migrants' family. This result is corroborated by Woldie *et al.*, (2010) that strongly recognized the role of rural to rural migration for agricultural inputs including fertilizer use. However, the t-test confirmed statistically no significant difference between the two groups, for anti-weed and other chemicals though quantitatively we noticed a mean difference 48.82 birr.

Table 2. T-Test results for fertilizer and other Chemical inputs, by migration status

Variables	Migrants		Non- Migrants		T-value	Sig. level
	Mean	St.Dv	Mean	St.Dv		
Fertilizer (Birr)	934.50	889.39	729.55	783.79	-2.2151**	0.0274
Anti-weed and others (Birr)	261.11	552.48	309.93	588.32	0.7463	0.4560

***Note:* **** p<0.05

Source: Own Survey (2019)

From the focused group discussion, we came to understand that the origin farming is becoming highly dependent on fertilizer application. Fertilizer application to day is not like it was when they started fertilizer for their farm land. Thus, supplementing farm income through migration can augment the agricultural inputs like fertilizer. Some empirical studies are also found that households with a migrant family are spending migration income on seed, pesticide and farm inputs to improve crop productivity (Imran, *et al.*, 2016), confirming how migration income improves the crop production.

Apart from the labour income, migration towards the cash producing areas also can be a means for new farming experience sharing. In line with this, the key informants and focused group discussants narrated that farming experience sharing like zero tillage practice which is locally known as "SHETET"[7] is one of the new experience that migrants learnt from the destination. According to the discussants such practice is believed to be a strategy to reduce the cost of oxen renting but also from the view point of land management such practices are also believed to improve the soil productivity through the reduction of soil depletion. The result also agreed with Deotti and Estruch, (2016) whose study articulated the role of migration on technology use and knowledge transfer.

Commonly, the straightforward analysis to see the effect of one explanatory variable on continuous response variable is the ordinary least square (OLS) estimation. Thus, for ordinary least square estimation the migration status has been plugged-in in the regression model as dummy variable taking the value 1 for migrants' household and 0, otherwise. Employing OLS, both the conventional crop production inputs and other important variables including dummy migration (as 1 & 0) variables are included in the model. Based on the ordinary least square estimation, migration as dummy variables has shown negative implication on the values of crop outputs but not statistically significant. With this result one can immediately conclude that migration have negative effect on crop production but not statistically significant. However, since OLS estimation suffers from endogeneity problems and inability to tell about the counterfactual treatment estimates, identification of instrumental variables and using endogenous switching regression model has been executed and presented as shown in the last two columns of Table 3.

For the selection of instrumental variables, empirical procedures from (Kabubo-Mariara, *et al*. 2017) were followed. Using the following model, first we regressed the proposed instrumental variables (such as migrants contact, percieved migration income, and migration experience are variables represent z) against migration decision variable (M) and other explanatory variables.

$$z = a_0 + M + x'\beta + u \quad \ldots \ldots (a)$$

Thus, our assumption is if there is endogeneity, then the $cov(M, z) \neq 0$, but what we need is an instrumental variables which is correlated with the migration decision but that doesn't directly affect crop output values.

Using the above equation (a), we found that the above three proposed variables have statistically significant relationship with "M" declaring their relevance as instrumental variables. The results showed statistically significant relationship between migration and migrants contact (0.204, p=0.000). Similarly, the relation between migration decision and perceived migration income and migrants contact have statistically significant relation with migration decision with the values of (0.204, p=0.000) and (0.181, p=0.000), respectively.

The results presented on Table 3 indicates the correlation coefficient for migration equation and crop output value function is negative and statistically significant for migrants' family (ρ_1) but not significant for non-migrants (ρ_2). As indicated in Asfaw, *et al*., (2010), the implication is that having statistical significant in either of suggested the presence of self-selection to be considered. Specifically, the significance in former implies self-selection among the migrants' families. While, the likelihood ratio test result suggests that the three equations are jointly dependent, providing evidence of endogeneity that needs to be controlled in the model specification of crop production function. At the same time, the difference observed in coefficients of the crop production equation and the migration decision equation reflects the heterogeneity of the sample.

All the significant variables in the model have the expected direction of influence on crop productivity for both migrants and non-migrants households. Firstly, it would be appropriate to see the implication of each of the conventional inputs (land, labour, seed and fertilizer) and other important explanatory variables used in the model such as (social participation and literacy level). In the analysis, land has showed positive and statistically significant effect on the values of crop outputs. The effect of land for migrants' family is higher which 39% whereas for non-migrants' it is only 15%. This could be associated due to the fact investment on land is more productive for migrants' family than non-migrants' family.

Based on endogenous switching regression Table 4 presents the average expected crop output values, the treatment effect on both treated (Migrants' family) and untreated (Non-migrants' family) and the heterogeneity effect. In the first case, cells (a) and (b) are the expected values of all crops observed in the sample. Put differently, the expected values for all crops produced by the families of the migrants is 28, 764.36 birr. While for those of the non-migrants' family the expected values of all crops produced is 31, 613.36 birr. At this point, one can made straightforward comparison between migrants' family and families without migrants. On the bases of this, result we can say that non-migrants' family are better off by nearly 10% which is estimated to 2849.23 birr. However, such comparisons are misleading due to the fact that they can't tell the isolated treatment effect using the observed characteristics per se (Asfaw *et al*., 2010). As expected, the treatment effect on treated (the effect of labour migration) is positive and significant, contributing about 20% (4787.77) higher for migrants' family. The difference can be equivalently associated with 235.96 Kg[8] or 2.35 quintal of Teff which dominantly produced in the study area. This is due to the fact that migration income is contributing for agricultural inputs (Kaninda and Greg, 2014), because they leave their farm during slack time as well as due to the fact that they can manage their farm with circular migration (Gete *et al*., 2008, Woldie *et al*., 2010; Imran, *et al.*, 2016).

Table 3. Parameter estimates of migration decision and crop output values equation

			Endogenous Switching regression			
Model	OLS		Migration=1		Migration=0	
Dependent	Crop output values (Ln)		Crop output values (Ln)		Crop output values (Ln)	
Explanatory	**Coef.**	**Std. err**	**Coef.**	**Std. err**	**Coef**	**Std. err**
Llobor	0.000636	(0.0557)	0.000887	(0.104)	-0.0282	(0.0668)
Lfert	0.115**	(0.0438)	-0.104	(0.0911)	0.199***	(0.0507)
lnall_land	0.275***	(0.0505)	0.397***	(0.117)	0.158**	(0.0559)
lnall_chem	0.0855	(0.0560)	0.239	(0.123)	0.0152	(0.0592)
Lseed	-0.00399	(0.0410)	-0.187	(0.102)	0.0394	(0.0451)
Tlu	0.0276*	(0.0130)	0.0341	(0.0250)	0.0294*	(0.0142)
Social	0.173***	(0.0519)	0.281*	(0.109)	0.101	(0.0555)
Extcontact	0.00327	(0.00271)	0.00430	(0.00505)	0.00188	(0.00311)
land_certf	0.251***	(0.0670)	0.227	(0.144)	0.221**	(0.0709)
lnland_seed	0.107***	(0.00956)	0.0765***	(0.0194)	0.128***	(0.0108)
lit_stat	0.0708	(0.0581)	0.168	(0.118)	0.0235	(0.0623)
Ruralmig	-0.0902	(0.0566)				
_cons	8.327***	(0.301)	9.807***	(0.846)	8.159***	(0.347)
σ_i			-0.828***	(0.0867)	-.963***	(0.0478)
ρ_1, ρ_2			-.0.4055*	(0.237)	0.0175634	(0.306)
adj. R^2 = 0.726			LR test of indep. eqns.: chi2(1) =19.39 Prob> chi2 = 0.0000			

Note: p < 0.05, ** p < 0.01, *** p < 0.001, Nb: The selection equation is not included

Source: Own survey (2019)

On the other hand, there are arguments that positively support this study in which the migration of labour can be a means to improve productivity through meticulous allocation of labour (Deotti and Estruch, 2016).

On the contrary, the treatment effect on the untreated is negative and statistically significant. This implies the non-migrants' family had they send a family member they may produce about 16 % less than from total production without migration. More importantly, the transitional heterogeneity (TH) found to be positive which further confirm stronger and higher effect of migration over the non-migrants. The result of the study confirms that the farm households are rational in terms of the decision to send family members weighting the benefits and the costs that could be linked with labour diversification.

Table 4. Average expected crop output values, treatment and heterogeneity effects (all samples)

Subsamples	Decision stage		Treatment effect
	To Migrate	***Not to Migrate***	
Migrants	(a)y11= 28764.13	(c)y22 = 23976.36	TT=(a-c)= 4787.77**
Non-Migrants	(d) y12 = 26522.68	(b)y21= 31613.36	TU (d-b)=-5090.959**
Heterogeneity effect (BHi)	BH1=2241.454NS	BH2 =7637.281***	TH= (9878.73)

NB: ***& ** represents significant level at 1% & 5% respectively, NS=Not significant
Source: Own Survey Computation

One of the empirical question in this study was to examine the implication of labour-out on production efficiency. An attempt to respond for this question will inform the way through which labour migration compensates the missed labour or if it causes inefficiencies in production. For this purpose, the two important production function forms, i.e. the Cobb-Douglas (CD) and the translog (TL) production function were executed prior to the selection of one over the other. Once running both models, we chose the one with low value of AIC (Alkaike Information Criteria)[9] which is a general recommendation to choose low value. Accordingly, the translog functional form has been selected due its low value as compared to the Cobb-Douglas.

Once estimating the technical efficiency through translog functional form, the effect of labour migration on technical efficiencies was examined. Firstly, the t-test has been used to see technical mean efficiency difference between the two groups. As shown in the Table 5, there is no statistically significant mean difference between the two groups. However, it should be noted that t-test can’t isolate the problems of self-selection or the skill differences among the migrants’ and non-migrants’ family.

Table 5. Technical mean difference between migrants and non-migrants’ household

Variables	Migrants		Non- Migrants		T-value
	Mean	St.Dv	Mean	St.Dv	
Technical efficiency	0.66	.192	0.65	.162	0.6414^{NS}

NS= non-significant
Source: Own Survey Computation

Secondly, based on the Endogenous Switching Regression Model (ESRM), (see, Appendix ID model output) the effect of labour migration on technical efficiency were estimated. The results in Table 6 showed that the treatment effect on treated is negative though not quantitatively large (-0.014) and not statistically significant. However, the effect of labour migration for those who have no migrants showed positive and statistically significant effect on technical efficiency if they were in a position to send family members for labour income. The treatment effect on untreated (TU) is about 0.031 increment on technical efficiency had they have at least one migrant family member. Further, the transitional heterogeneity effect (TH) which is negative and non-significant that explains the effect of labour migration on the migrants is very low whereas for those of the non-migrants sending a family member is larger. On the other hand, non-migrants if they send family members they can improve technical efficiencies through reducing the congested labour within a given small plots of land. Related with this, different studies showed mixed implication on technical efficiencies. Against this study, in Lesotho labour migration have showed positive effect on technical efficiency (Mochebelele and Winter, 2000). However, the study by Sauer, *et al*., (2014) labour migration affected farm technical efficiency negatively, that shows agreement with our study despite our study was statistically insignificant. Generally, from this result we can say that the impact of labour migration on the migrants' level of technical efficiency is not statistically significant implying no change due to migration of labour to technical efficiency.

Table 6**.** Average expected technical efficiency, treatment and heterogeneity effects (all samples)

Subsamples	**Decision stage**		**Treatment effect**
	To Migrate	Not to Migrate	
Migrants	(a)y11= 0.642	(c)y22 = .657	TT=(a-c)= -0.014^{NS}
Non-Migrants	(d) y12 = 0.668	(b)y21= .585	TU (d-b)=0.0831***
Heterogeneity effect (BH_i)	BH_1= - 0.025*	BH_2 =0.0717***	TH= - 0.0971^{NS}

NB: ***& ** represents significant level at 1% & 5% respectively, NS=Not significant
Source: Own Survey Computation

4. Conclusion and policy implications

This study first and foremost came to understood that in the discourses of migration studies, much has been stressed on the international migration. Though there are attempts in domestic migration, virtually all studies skewed towards the rural to urban migration understating the important phenomenon of rural to rural migration in areas where agricultural productivities are highly heterogeneous.

We concluded that migration is not a random phenomenon, rather it is on the bases on costs and benefit analysis conducted at household level. Thus, the study supports the theoretical arguments of the new economics of labour migration in which migration (NELM) decision is done at household level weighting the gains and losses as family. As a result, migration also viewed as labour division among the household to collaborate and improve livelihood (Tacoli, 2011) and thus regarded as a family strategy than individual decision (Azam and Gubert, 2006; King, 2012).

The synergy of the of the two rural economies found to have positive impact on agricultural productivity in terms of using improved inputs (such as high yielding seed varieties, fertilizer and farming experience sharing). From Endogenous Switching Regression model the impact of labour migration found to be positive and significant that mainly caused by improved new variety use, fertilizer application and experience sharing through labour migration in the large scale commercial agricultural production belt. Moreover, non-migrants can improve technical efficiencies through sending the congested labour in their farm land.

Lastly, probably the most important conclusion in this study is, this. This study brings an alternative option for agricultural and rural development improvements through the synergy of the heterogeneous rural economics via rural to rural migration in areas where opportunities are higher like the current studies, apart from the dominantly perceived rural to urban migration. Thus, the former type of migration can be one means of livelihood improvement in countries where urban economy is proliferated with huge unemployment, lack of job opportunities and non-existence of job for rural labour skill.

Researchers, policy makers and practitioners at different level should view that migration has heterogeneous impact for different setting. This study, suggested that in situations where rural-urban migration is less productive, the rural-rural migration can be effective. Thus, it is important to re-consider urban biased approaches of viewing rural - urban migration as means of rural transformation and to rethink the ways how the interaction within rural economy can bring synergetic effects on both sides.

Notes

1. It clearly informs that the persistence of the dualistic approach in the contemporary studies as stated in Lucas, (1997:729) "…the early dualistic development models envisioned a rather homogeneous rural sector, within which migration was seen to confer no real benefit."

2. The classification of high and low potential Kebeles has been done in consultation with personnel from district social and labour affairs as well as through pre-survey assessment.

3. The lower administrative unit.

4. The value of Z is can be obtained the table (the normal curve of 95% confidence level which is 1.96).

5. The one who have information about migration income or experience at least can be sources of selection bias in migration studies.

6. Against the use of pooled sample that assumed both migrants and non-migrants have the same factors of production and therefore, the difference is only in terms of intercept shift (see, Alene and Manyong, 2007).

7. SHETET is a ploughing activity without pair of oxen which is practiced through sharp soil digging farm implements.

8. The average price for one kilogram of Teff in the study area is 20.29 Birr.

9. The Akaike's information criterion (AIC) for Cobb-Douglas and Translog are 312.624 and 308.13 respectively.

References

Ackah Charles and Medvedev Denis 2010. Internal Migration in Ghana: Determinants and Welfare Impacts. Paper prepared as a background paper for the 2010 World Bank Ghana Poverty Assessment.

Ajay S Singh and Micah B Masuku. 2014. Sampling techniques and determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management*, Vol. II, Issue 11, 1-22.

Alene, A. and Manyong, V.M. 2007. The effect of education on agricultural productivity under traditional and improved technology in northern Nigeria: an endogenous switching regression analysis. *Empirical Economics,* 32: 141-159.

Asfaw, Solomon., Shiferaw Bekele., and Simtowe Franklin. 2010. Does technology adoption promote commercialization? Evidence from chickpea technologies in Ethiopia. *In CSAE 2010 Conference on Economic Development in Africa*, University of Oxford, UK, pp. 21-23.

Asfaw Solomon Shiferaw Bekele Simtowe Franklin and Lipper Leslie. 2012. Impact of modern agricultural technologies on smallholder welfare: Evidence from Tanzania and Ethiopia. *Food Policy*, 37, 283–295

Bamlaku A. Alemu, Nuppenau and Boland. 2009. Technical Efficiency of Farming Systems across Agro-ecological Zones in Ethiopia: An Application of Stochastic Frontier Analysis. Unpublished PhD thesis, Justus-Liebig University of Giessen, Germany.

Carr David. 2009. Rural migration: The driving force behind tropical deforestation on the settlement frontier. *Progress in Human Geography*, 33(3), 355.

Chen Ching-Fu. 2007. Applying the stochastic frontier approach to measure hotel managerial efficiency in Taiwan. *Tourism Management, 28* (2007) 696–702.

Coelli, T., Prasada Rao, D.S., O'Donnell, C.J. and Battese, G.E. 2005. *An Introduction to Efficiency and Productivity Analysis*. Second edition, Springer science, New York, USA.

CSA 2014. *The Federal Democratic Republic of Ethiopia, Analytical Report on the 2013 National Labour Force Survey*, Statistical Bulletin Abstract, Addis Ababa, Ethiopia.

De Haas, H. 2010. Migration and development: A theoretical perspective. *International Migration Review*, 44, 227–264.

Dey Sagarika. 2014. Impact of remittances on poverty at origin: a study on rural households in India using Covariate Balancing Propensity Score Matching. *Migration and Development*, DOI: 10.1080/21632324.2014.979022.

Deotti L., and Estruch E. 2016. Addressing rural youth migration at its root causes: A conceptual framework. Knowledge materials, Food and Agriculture Organization of the United Nations (FAO), Social Policies and Rural Institutions Division, Rome.

Di Falco, S., Veronesi, M., Yesuf, M. 2011. Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. *American Journal of Agricultural Economics 93* (3), 829–846.

Dodd Warren, Humphries Sally, Patel Kirit, Majowicz Shannon & Dewey Cate. 2016. Determinants of temporary labour migration in southern India. *Asian Population Studies*, 12:3, 294-311, DOI: 10.1080/17441730.2016.1207929.

Ebihart Msigwa AND Ezekiel Mbongo. 2013. Determinants of Internal Migration in Tanzania. *Journal of Economics and Sustainable Development*, Vol.4, No.9, 2013

Ekpenyong S. Alfred, Daniel Egerson. 2015. Rural-Rural Migration in Bayelsa State, Nigeria: A Case Study of Rural-Rural Migrants along Tombia-Amassoma Expressway. *International Journal of Scientific and Research Publications*, Volume 5, Issue 2.

FAO, IFAD, IOM, and WFP. 2018. The Linkages between Migration, Agriculture, Food Security and Rural Development. Rome. 80pp. (http://www.fao.org/3/CA0922EN/CA0922EN.pdf). Licence: CC BY-NC-SA 3.0 IGO

Farrell, M.J. 1957. The Measurement of Productive Efficiency. *J. Royal Statistical Society, Series A.*, 120: 253–290.

Gete Zeleke, Woldie Asfaw, Degefa Tolosa, Betre Alemu and Trutmann P. 2008. Seasonal Migration and Rural Livelihood in Ethiopia: An Empirical Study. *Working paper series on rural-urban linkage*. The theme of Global Mountain Program (GMP) Working Paper 3.

Getnet Alemu Zewdu and Mehrab Malek, 2010. Implications of Land Policies for Rural-urban Linkages and Rural Transformation in

Ethiopia. *Ethiopia Strategy Support Program (ESSP) ESSP II Working Paper No. 15*

Hausman, J.A. 1978. Specification tests in econometrics. *Econometrica* 46: 1251-1272.

Heckman, J. J. 1979. Sample Selection Bias as a Specification Error. *Econometrica*, Vol. 47, No. 1 (Jan., 1979), pp. 153-161.

Imran Muhammad, Bakhsh Khuda, and Hassan Sarfaraz 2016. Rural to urban migration and crop productivity: evidence from Pakistani Punjab. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi*, 29(1): 17-19.

International Fund for Agricultural Development (IFAD). 2013. Smallholders, Food Security, and the Environment. Retrieved from http://www.ifad.org/climate/resources/smallholders_report.pdf (accessed 03 Aug 2016).

International Organization for Migration (IOM). 2015. World Migration Report 2015: Migrants and Cities: New Partnerships to Manage Mobility.

Jane Kabubo-Mariara Richard M. Mulwa and Salvatore Di Falco. 2017. Adaptation to Climate and Variability and Its implication for household food nutrition in Kenya. *Environment for Development*,1-29. Retrieved November 27, 2018, from http://www.efdinitiative.org/sites/default/files/publications/efd_dp_17-05.pdf.

Kaninda Tshikala Sam and Greg FonsahEsendugue. 2014. Assessing the impact of migration and remittances on technology adoption in rural Senegal. *Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Dallas, TX*, February 1-4, 2014.

Kibrom Adino, Haimanot Atinkut, Sisay Yehuala, Tigist Petros. 2015. The Determinant Factors for Internal Migration in Rural Areas of North Gondar: The Case of Dabat District. *Radix International Journal of Research in Social Science*, Volume 4, Issue 8 (August, 2015).

Kibrom Adino, Bamlaku Alamirew and Degye Goshu. 2020. The implication of intra-rural migration on crop output commercialization in Ethiopia. *Migration and Development*, DOI: 10.1080/21632324.2020.1723212.

King Russell. 2012. Theories and Typologies of Migration: An Overview and a Primer. *Willy Brandt Series of Working Papers in International*

Migration and Ethnic Relations 3/12. Malmö Institute for Studies of Migration, Diversity and Welfare (MIM).

Kothari C.R. 2004. *Research Methodology: Methods and Techniques*. (3rd ed). New Delhi: New age International publisher.

Kurekova Lucia. 2011. Theories of migration: Conceptual review and empirical testing in the context of the EU East -West flows. *Paper prepared for Interdisciplinary Conference on Migration. Economic Change, Social Challenge*. April 6-9, 2011, University College London.

Linger Ayele and Terefe Degefa. 2018. Temporary Rural-rural Migration, Vulnerability of Migrants at the Destination and Its Outcomes on Migrant Households: Evidence from Temporary Migrant Sending Households in Quarit District, Northwestern Ethiopia. An Unpublished PhD Dissertation, College of Development Studies, Addis Ababa University, Ethiopia.

Lokshin M, and Sajaia Z. 2004. Maximum likelihood estimation of endogenous switching regression models. *Stata J* 4(3):282–289.

Lucas R. 2007. Migration and rural development. *Electronic Journal of Agricultural and Development Economics*, Vol. 4, No. 1, 2007, pp. 99-122.

Lucas, R. 1997. Internal Migration in Developing Countries. ***In:*** M. Rozenweig and O. Stark (Eds.), *The Handbook of Population and Family Economics*. Amsterdam: Elsevier, pp. 721–798.

Maddala, G. S. 1983. *Limited-dependent and qualitative variables in econometrics*. Cambridge: Cambridge University Press.

Maddala, G. S. 1986. Disequilibrium, self-selection, and switching models. ***In*** Z. Griliches, and Magnani Robert, (1997), *Sampling Guide*. Food and Nutrition Technical Assistance.

Massey D., Arango J., Hugo G., Kouaouci A., Pellegrino A. and Taylor E. 1993. Theories of International Migration: A Review and Appraisal. *Population and Development Review*, Vol. 19, No. 3), pp. 431-466.

Mochebelele Motsamai and Winter-Nelson. 2000. Migrant Labor and Farm Technical Efficiency in Lesotho. *World Development* Vol. 28, No. 1, pp. 143-153.

MoFED (Ministry of Finance and Economic Development). 2011. Ethiopia: building on progress. *A Plan for Accelerated and Sustained Development to End Poverty (PASDEP)* (2005/06-2009/10). *Volume I: Main Text*. MoFED, Addis Ababa.

Nzima Divane, Duma Vusumzi and Moyo Philani. 2016. Theorizing migration-development interactions: towards an integrated approach. *Migration and Development*, pp, 1-14. DOI: org/10.1080/21632324.2016.1147897.

Ochieng Justus, Knerr Beatrice, Owuor George & Ouma Emily. 2016. Migration and agricultural intensification at origin: evidence from farm households in Central Africa. *Migration and Development*, DOI: 10.1080/21632324.2015.1123837

Portes Alejandro. 2010. Migration and Social Change: Some Conceptual Reflections. *Journal of Ethnic and Migration Studies,* Vol. 36, No. 10, 2010, pp. 1537-1563.

Sauer Johannes, Gorton Matthew and Davidova Sophia. 2014. Migration and Agricultural Efficiency. *Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2014 AAEA Annual Meeting*, Minneapolis, MN, July 27-29, 2010.

Tabak M., Cajueiro O., and Dias V. B. 2014. The Adequacy of deterministic and Parametric Frontiers to Analyze the Efficiency of Indian Commercial Banks. *Working Paper Series,* 350, ISSN 1518-3548. Retrieved online at https://www.bcb.gov.br/pec/wps/ingl/wps350.pdf.

Tacoli, C. 2011. Not only climate change: mobility, vulnerability and socio-economic transformations in environmentally fragile areas in Bolivia, Senegal and Tanzania (No. 28). IIED.

Taylor, J. E. 1999. The New Economics of Labor Migration and the role of remittances in the migration process. *International Migration*, Vol. 37, No. 1, pp. 63–88.

Stark, O., Bloom, D. E. 1985. The new economics of labour migration. *American Economic Review,* 75, 173–178.

Stark, O. 1991. *The Migration of Labour*. Oxford: Basil Blackwell.

Woldie Asfaw, Degefa Tolossa and Gete Zeleke. 2010. Causes and impacts of seasonal migration on rural livelihoods: Case studies from Amhara Region in Ethiopia. *Norsk Geografisk Tidsskrift- Norwegian Journal of Geography*, 64:1, 58-70.

Wondimagegn Tirkaso and Sebastian Hess. 2018. Does commercialization drive technical efficiency improvements in Ethiopian subsistence agriculture? *African Journal of Agricultural and Resource Economics*, Volume 13, Number 1, pages 44-57