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The impact of Migrant Remittances on the Technical Efficiency of Arable Crop Farm Households in South Eastern Nigeria

By:

O.R. Iheke
J.C. Nwaru
C. E. Onyenweaku

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Iheke, O. R, J. C. Nwaru and C. E. Onyenweaku
Department of Agricultural Economics
Michael Okpara University of Agriculture, Umudike, Nigeria
ralphiheke@gmail.com, iheke.onuchekwa@mouau.edu.ng

Abstract
This study was designed to examine the impact of migrant remittances on the technical efficiency smallholder arable crop farm households in South Eastern Nigeria. A multi-stage random sampling technique was used in choosing the sample. Primary data collected from 120 respondents comprising 60 migrants' remittance receiving households and non receiving households, respectively were used for the study. Data collected through the cost route method were analyzed using multiple regression analysis employing the stochastic frontier production function analysis in a single stage maximum likelihood estimation method and z test statistic. The results of data analyses show that household size, education, farming experience, and farm size were the significant determinants of technical efficiency of the remittance receiving households; while age, years of education and farm size were the significant determinants of technical efficiency of the non-remittance receiving households. The individual technical efficiency indices range from 0.12 - 1.00 for the remittance receiving households with a mean of 0.42 as against 0.10 – 0.98 for the non-remittance receiving households with a mean of 0.53. The t test revealed that the non-remittance receiving households were more technically efficient than the remittance receiving households in the use of farm resources. It was recommended that there is the need to encourage the households to pursue efficiency in resource utilization by exhibiting higher levels of entrepreneurial capabilities. Policies and programmes that could help them increase their efficiency especially the remittance receiving households should be put in place such as would encourage harnessing and optimizing the use of remittance income, as well as reallocation and redistribution of resources.

Key words: Migrant Remittances, Technical Efficiency, Farm Households,

Introduction
Migration and commuting are now a routine part of the livelihood strategies of the rural poor across a wide range of developing country contexts. While the usual determinants of migration such as drought are still valid and important, there are new driving forces underlying the increase in population mobility. These forces are mostly location specific and include improved communications and roads, new economic opportunities arising from urbanization as well as the changing market context as economies become more globalized and liberalized (Deshingkar, 2004).

The term "remittances" refers to the money that migrant workers send back to their communities of origin. Remittances are an integral feature of the migration system. Remittances occur largely because migration forms part of a strategy for "rural livelihood diversification". This means that rural households spread their earning activities over a range of on-farm and off-farm activities in order to minimize their risks and raise their returns to available labour. The world over, off-farm activities generate more income than agriculture and it is access to this cash rather than the size of land allocations that determines wealth inequalities within rural communities. In localities where the local economy is unable to provide off-farm employment, it becomes necessary for household members to find work in cities (Hare, 1999). Globally, remittances now constitute the largest source of financial flows to developing countries after foreign direct investments. In some countries, they are the largest source of foreign capital. In the developing countries, remittances have become a significant source of income and financing. According to the International Monetary Fund (IMF, 1999), migrant remittances have increased from 45.7 billion dollars in 1990, to 66.2 billion dollars in 1998.

Taylor (2000) noted that typically, although individuals migrate, they do not sever ties with their source households. Source households may pay migration costs and support migrants until they become established at their destinations. Family members who remain behind (often parents and siblings) may reorganize both their consumption and production activities in response to the migrant's departure, and migrants (often children) typically share part of their earnings with their household of origin through remittances. Continuing interactions between migrants and rural households suggest that a household model would be more appropriate than an individual level model of migration decisions. The vast majority of the world's migrations originate in rural areas, where most of the world's poverty is also concentrated. How migration out of rural areas affects those left behind is not only important from a social welfare point of view. In light of the increasing integration of markets, it also may have ramifications for economic growth outside rural areas (e.g. by affecting food production, agricultural exports, the rural demand for manufactured goods and future economic surplus in agriculture available for investment elsewhere in the economy).

Afsar (2003) argues that migration expands rural land and labour markets by making more rural land available for tenancy. Research findings by Tiffen *et.al* (1994) established that remittances played a significant role in agricultural intensification. Finally, migrants may bring back new skills and ambitions that can help them to set up new non-farm enterprises. Harris (2004) cites the example of Mexican migrants establishing plants) or improve agricultural practices.

Thus, the pessimistic perspective of migration is fundamentally challenged by an increasing number of empirical studies showing that international remittances have played a key role in facilitating agricultural investments. As long ago as the early 1970s, Bonnet and Bossard (1973) observed that remittances had made possible intensification of agriculture in the Sous region. In other migrant-sending regions, too, migrants play an important and innovative role in the development of subsistence and commercial agriculture through the purchase of land, modern agricultural equipment, such as tractors and water pumps, the introduction of new crops and techniques and the establishment of new farms. Migrants show a particular preference for investments in the development of new irrigated agriculture (Bencherifa, 1991; 1993; Bencherifa and Popp, 1990; 2000; de Haas, 2001; Popp, 1999). Pascon (1985) observed that investments by international migrants in wells and water pumps have mitigated the effects of the severe drought occurring in the mid-1970s.

Therefore, it has become crucial to analyze the the effect of remittances on the technical efficiency of arable crop farm households in South Eastern Nigeria.this forms the thrust of this paper. It specifically examined the determinants of technical efficiency for remittance rfeceiving and non receiving arable crop farm households, their technical efficiency distribution as well as if their were significant differences between the technical efficiciencies of the two household groups as a result of remittance income acruing to to receiving households.

Theoretical concept

Technical efficiency refers to the ability of firms to employ the best practice in the production process so that not more than the necessary amount of a given set of inputs is used in producing the "best" level of output (Carlson, 1972). Olayide and Heady (1982) defined technical efficiency as the measure of a firm's success in producing maximum output from a given set of inputs.

A stochastic frontier production function is given as:

$$Y_i = f(X_i; \beta) \exp.(V_i - U_i), \quad i = 1, 2, \ldots, n \qquad (1)$$

Where Y_i is the output of the i-th farm, X_i is the vector of input quantities used by the i-th farm, β is a vector of unknown parameters to be estimated, f( ) represent an appropriate function such as Cobb-Douglas, translog, etc; V_i is a symmetric error accounting for the effect of random variations in output due to factors beyond the control of the farmer e.g. weather, diseases outbreaks, measurement errors, etc. V_i is assumed to be independently and identically distributed as N (O, δ_v^2) random variables independent of the U_is which is a non-negative random variable representing inefficiency in production relative to the stochastic frontier. The U_is are assumed to be non-negative truncations of the N (O, δ_v^2) distribution (i.e. half normal distribution) or have exponential distribution. The stochastic frontier model was independently proposed by Aigner *et al* (1977) and Meeusen and Van den Broeck (1977). Its major advantage is that it provides numerical measures of technical efficiency. The technical efficiency of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output given the available technology.

$$\text{Technical efficiency (TE)} = Y_i/Y_i^* = f(X_i; \beta) \exp.(V_i - U_i) / f(X_i; \beta) \exp.(V_i) \qquad (2)$$

$$= \exp(-U_i)$$

Where Y_i is the observed output and Y_i^* is the frontier output and other parameters were as previously defined. The parameters of the stochastic frontier models are estimated using the maximum likelihood techniques (Aigner *et al,* 1977)

Methodology

This study was conducted in South Eastern Nigeria, which comprises of five states namely: Abia, Anambra, Ebonyi, Enugu and Imo. The area lies between latitudes $4^0\ 20^1$ and $7^0\ 25^1$ North and longitudes $5^0\ 25^1$ and $8^0\ 51^1$ East. It covers a land area of about 109, 524KM^2 or 11.86 percent of the total land area of Nigeria. The area lies mainly on plains under 200M above sea level (Obi and Salako, 1995; Monanu, 1975). The population of the area is

29,949,530, comprising of 15, 326,463 males and 14, 623,067 females (NPC, 2006) and farming is the predominant occupation of the rural inhabitants. According to Nwajiuba (2005), four states in Southeast Nigeria (Anambra, Imo, Abia and Enugu) are among the seven most densely populated states of Nigeria, implying that the southeast is the most densely populated area in Nigeria. As a result of this increased human pressure on finite resources, there is intense competition for the available natural resources in the area. Therefore, many people view migration as an alternative option of securing a livelihood.

A multi-stage random sampling and purposive sampling technique was used in choosing the sample. In the first stage, 2 States, Abia and Imo, were randomly selected from the 5 states in South Eastern Nigeria. Secondly, from each State, 2 Local Government Areas (LGAs) out of the 17 and 27 in Abia and Imo States, respectively, were randomly selected and from each L.G.A, 3 communities were randomly selected. The remittance receiving and non-remittance receiving arable crop farm households formed the respective sampling frames in each chosen community, from which 3 households each were randomly selected. In all, 120 respondents were used for the study comprising 60 migrants' remittance receiving households and non remittance receiving households, respectively.

The cost route technique was used in data collection. Data were collected using structured questionnaire and interview schedules. The translog model was analyzed for the technical efficiency of the arable crop farm households. The model is given by:

$$\begin{aligned} \text{In } Q = \; & \text{In } b_o + b_1 \text{ In } FS + b_2 \text{ In } LAB + b_3 OT + b_4 \text{ In } CAP + 1/2\, b_5 (\text{In } FS)^2 + 1/2\, b_6 (\text{In } LB)^2 \\ & + 1/2\, b_7 (\text{In } OT)^2 + 1/2\, b_8 (\text{In } CP)^2 + b_9 \text{ In } FS \text{ In } LB + b_{10} \text{ In } FS \text{ In } OT + b_{11} \text{ In } FS \text{ In } \\ & CP + b_{12} \text{ In } LB \text{ In } OT + b_{13} \text{ In } LB \text{ In } CAP + b_{14} \text{ In } OT \text{ In } CP + V_j - U_i \qquad (3) \end{aligned}$$

Where in equation (3), In = Natural logarithm, Q = grain equivalent of the output of arable crops (kg) (Olayemi, 1986), FS = farm size (ha), LB = labour (mandays), OT = other variable inputs such as planting materials, fertilizer, pesticides, etc. (₦), CP = capital (₦) (depreciation charges on farm machinery, implements and tools, interest on loan, land rent) and $V_j - U_i$ = error term. Vj is stochastic disturbance term representing the effect of random factors beyond the control of the farmer e.g. weather, diseases outbreaks, measurement errors, etc. V_i is assumed to be independently and identically distributed as N (O, δ_v^2) random variables independent of the U_is which is a non-negative random variable representing technical efficiency. The U_is are assumed to be non-negative truncations of the N (O, δ_v^2) distribution (i.e. half normal distribution) or have exponential distribution. If $U_i = 0$, the farm lies on the profit frontier obtaining maximum profit given the prices it faces and levels of fixed factors. If $U_i > 0$, it shows that the farm is inefficient. The stochastic frontier model was independently proposed by Aigner *et al* (1977) and Meeusen and Van den Broeck (1977).

A statistical test was carried out to confirm that the translog function adequately represent the production rather than the cob-Douglas. For the production function to be Cobb-Douglas, the coefficients of all the second order terms should be zero. The rejection of the hypothesis in the translog function is a confirmation of the fact that the translog function is more suitable for the data and model specification than the Cobb-Douglas (Onyenweaku and Okoye, 2007).

In order to determine the factors contributing to technical efficiency, the following model was formulated and estimated jointly with the stochastic frontier production function model in a single stage maximum likelihood estimation procedure using the computer software frontier version 4.1 (Coelli, 1996):

$$TE_i = [\exp(-U_i)] = a_0 + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + a_6Z_6 + a_7Z_7 + a_8Z_8 + a_9Z_9 \quad (4)$$

Where: TE_i = the technical efficiency of the i-th crop farmer, Z_1 = the age of the farmer (in years), Z_2 = household size, Z_3 = farmer's level of education in years, Z_4 = years of farming experience of household head, Z_5 = number of extension contact made by the farmer in the cropping year, Z_6 = farm size (in hectares), Z_7 = membership of farmers association or cooperative society (a dummy which takes the value of unity for members and zero if otherwise), Z_8 = access to credit (a dummy which takes the value of unity for access and zero if otherwise), Z_9 = gender of household head (male =1, female =0), a_0 = intercept term, and a_1, a_2, a_3, . . ., a_9 were regression parameters estimated. It is expected *a priori* that a_1 and a_2 would be negative while the others would be positive.

The Z-test was used to test the impact of migrant remittances on economic efficiency of the arable crop farm households, by determining whether there were significant differences in the efficiency of resource use by the remittance receiving and non receiving households. The test is given by:

$$Z_{cal} = (\overline{X}_1-\overline{X}_2) / S_{\overline{x}1-\overline{x}2} \quad (5)$$

$$S_{\overline{x}1-\overline{x}2} = \sqrt{(S^2_{x1}/n_1) + (S^2_{x2}/n_2)} \quad (6)$$

Where in (5) and (6), $\overline{X}_1$ is mean efficiencies of the migrant remittance receiving households, $\overline{X}_2$ is mean efficiencies of the non migrant remittance receiving households, $S_{\overline{x}1-\overline{x}2}$ is sample standard error of the means, S^2_{x1} and S^2_{x2} is variance of the efficiencies of the remittance receiving and non receiving households respectively, and n_1 and n_2 are number of households in each group respectively.

Results and Discussion

Technical efficiency of the remittance receiving and non-remittance receiving farm households

The maximum likelihood (ML) estimates of the stochastic frontier translog production parameters for the remittance receiving and non-remittance receiving households were presented in Table 1. The estimated variances (δ^2) for both groups of households were statistically significant at 1 percent indicating the goodness of fit and correctness of the specified distribution assumptions of the composite error. Gamma (γ) is 0.999 and 0.995 for the remittance receiving and non-remittance receiving households respectively, and are both statistically significant at 1 percent. These imply that 99.9 percent of the variations in arable crop output of the remittance receiving households and 99.5 percent of the variations in the arable crop output of the non-remittance receiving households are due to technical inefficiency.

Table 1: Estimated frontier production function for the remittance receiving and non-remittance receiving households

Variable	Remittance receiving household		Non-remittance receiving households	
	Coefficient	t-ratio	Coefficient	t-ratio
Constant	13.963	4.419***	-33.732	-33.810***
Farm size	1.331	6.168***	2.017	1.547*
Labour	0.847	3.127***	2.721	1.833*
Other variable inputs	-2.066	-2.028**	6.966	8.103***
Capital	0.355	0.278	1.341	1.708*
Farm size^2	0.706	2.519**	1.847	6.451***
Labour^2	-0.417	-2.424**	0.077	0.594
Other variable inputs^2	-0.111	-1.879*	-0.431	-3.815***
Capital^2	-0.164	-2.114**	-0.014	-0.133
Farm size X Labour	0.316	1.135	0.326	1.941
Farm size X other variable inputs	0.518	2.425**	0.382	2.982***
Farm size X capital	-0.543	-1.953*	-0.111	-0.665
Labour X other variable inputs	0.181	0.634	-0.165	-0.788
Labour X capital	0.068	0.378	-0.194	-1.334
Other variable inputs X capital	0.333	2.297**	4.545	0.229
Log Likelihood function				
Sigma-squared	0.625	4.410***	0.573	6.539***
Gamma	0.999	80.125***	0.995	30.180***
log likelihood function	-31.025		1.536	

Source: computed from Frontier 4.1 MLE/Survey data, 2009

Note: ***, **, and * indicates statistically significant at 1 percent, 5 percent and 10 percent level of significance respectively

For the remittance receiving households, the coefficients of farm size and labour have the desired positive signs and were statistically significant at 1 percent level, showing direct relationship with output, while that of other variable inputs was negative and significant at 5 percent level of significance. This indicates indirect relationship with output. This might have resulted from the use of these other resources to the point of its diminishing returns. On the other hand, the coefficients of farm size, labour, other variable inputs and capital are all positively signed at 10 percent level of significance except other variable inputs which was significant at 1 percent. These show direct relationship between these variables and output of the non-remittance receiving households.

Among the second other terms, for the remittance receiving households, the coefficients of the square of farm size and the interactions of farm size and other variable inputs, other variable inputs and capital are positive and statistically significant at 5 percent, showing direct relationship with output. Conversely, the coefficients of the square of labour, other variable inputs and labour, and the interaction of farm size and capital are negative and significant at 5 percent, 10 percent, 5 percent and 10 percent level of significance respectively, indicating indirect relationship with output.

For the non-remittance receiving households, the coefficients of the square of farm size and the interaction of farm size and other variable inputs are positive and significant at 1 percent level indicating direct relationship with output; while the square of other variable inputs is negative and significant at 1 percent level depicting indirect relationship with output.

Sources of technical efficiency of the farm households

The estimated determinants of technical efficiency of the remittance receiving households and non-remittance receiving households are presented in Table 2. For the remittance receiving households, the coefficients of household size, education, farming experience and farm size were significant and positive. These signify direct relationship with technical efficiency. For the non-remittance receiving households, the coefficients of education and farm size were positive and statistically significant at 1 percent level while that of age of household head was negative and significant at 1 percent, implying indirect relationship with technical efficiency.

The result with respect to age is consistent with *a priori* expectation and Idiong (2005) and Nwachukwu (2006). Idiong (2005) explained that the older a farmer becomes, the more he is unable to combine his resources in an optimal manner given the available technology. Nwaru (2004) further posited that the risk bearing abilities and innovativeness of a farmer, his mental capacity to cope with the daily challenges and demands of farm production activities and his ability to do manual work decrease with advancing age. Therefore, economic policies for enhancing arable crop production should be skewed more towards encouraging the youths to get involved in farming.

Table 2: Determinants of technical efficiency of the remittance receiving households and non-remittance receiving households

Variable	Remittance receiving household		Non-remittance receiving households	
	Coefficient	t-ratio	Coefficient	t-ratio
Age	-0.003	-0.431	-3.956	-4.499***
Household size	0.081	1.539*	0.010	0.279
Years of education	0.055	2.142**	3.915	2.847***
Farming experience	0.023	1.730*	0.002	0.177
Extension contact	0.057	0.106	-0.004	-0.055
Farm size	0.480	3.465***	1.974	9.466***
Membership of association	0.086	0.780	-0.422	-2.613***
Access to credit	-0.102	-0.426	-0.108	-0.758
Gender of household head	-0.321	-1.445	0.079	0.654

Source: computed from Frontier 4.1 MLE/Survey data, 2009

Note: ***, **, and * indicates statistically significant at 1 percent, 5 percent and 10 percent level of significance respectively

Nwaru (2004) noted that farm operations in Nigeria have remained labour intensive. The positive and significant relationship between household size and technical efficiency for the remittance receiving households is consistent with *a priori* expectation. According Onyenweaku and Nwaru (2005), large household size ease labour constraints thereby leading to increases in productivity and income of the farm household. Moreover, household labour supply should be more predictable than hired labour, especially where the structure of the household is such that it is composed more of those in the active age. Therefore, policies that enable farmers source more of their labour needs from their households are encouraged.

Education increases the ability of the farmers to adopt agricultural innovation and hence improve their efficiency. This explains the direct relationship between education and technical efficiency for the two households. This result is consistent with those of Idiong (2007),Onyenweaku and Ohajianya (2005), Onyenweaku *et al,* (2004), Onu *et al,* (2000) in Nigeria; Bravo-Ureta and Pinheiro (1997) in Dominca; Kalirajan and Shand (1986) in Malaysia; and Belbase and Grabowski (1985) in Nepal. Obasi (1991) stated that the level of education of a farmer not only increases his farm productivity but also enhances his ability to understand and evaluate new production techniques. Therefore, efforts at increases crop production should involve policies that strengthen educating the farmer, especially agricultural education. This should involve educating the youths who are the future farmers and informal education of the current farmers.

According to Nwaru (2004), experience may be defined as the knowledge and skill gained by contact with facts and events. It has been noted that farmers will count a lot more on their farming experience for increased productivity and efficiency. The result with respect to farming experience is in line with *a priori* expectation and consistent with the findings of Onyenweaku and Nwaru (2005), Onyenweaku and Ohajianya (2005), Onyenweaku *et al,*(2004), Nwaru (2004), kalijaran and Flinn (1983), and kalijaran (1981). However, this result differs from that of Onu *et al* (2000). This result has some positive implications for increased crop productivity because according to Nwaru (2004), the number of years a farmer has spent in the business of farming may give an indication of the practical knowledge he has acquired on how to overcome certain inherent farm production problems. Therefore, policies that harness the experience and practical knowledge of the farmers for increased production should be used.

Arable land rather than land *per se* has remained the greatest constraint in arable crop production in Nigeria (Iheanacho, 2001; Nwaru, 2004). The coefficient of farm size being statistically significant at 1 percent and positively related to technical efficiency for both the remittance receiving and non-remittance receiving farm households agrees with *a priori* expectations. It is consistent with Onyenweaku and Okoye (2007), Onyenweaku and Nwaru (2005), Onyenweaku and Effiong (2005), Onyenweaku *et al* (2004), Ohajianya and Onyenweaku (2001) and Ali and Flinn (1986). However, the result contrasts those of Kalirajan (1991), Belbase and Grabowski (1985), Haung and Bagi (1984), Lingard *et al*

(1983) and Kalijaran and Flinn (1983) who found no significant relationship between farm size and technical efficiency. Researchers have observed that given the severe scarcity, unsustainability and insecurity of land and its fast deterioration (Nnadozie and Nwaru, 2002; Iheanacho, 2001); increase in arable crop output should be expected more from the application of superior technology rather from land area expansion.

Distribution of technical efficiency for the remittance receiving and non-remittance receiving farm households

The summary of the frequency distribution of the technical efficiency of the remittance receiving and non-remittance receiving farm households is presented in Table 3. According to the Table, the individual technical efficiency indices ranged from 0.12 to 1.00 for the remittance receiving households with a mean of 0.42 percent as against 0.10 to 0.98 for the non-remittance receiving households with a mean of 0.53. Only about 30 percent of the remittance receiving households and 51.67 percent of the non-remittance receiving households has an efficiency index of above 60 percent. This is consistent with the high variance of the farm effects. The level of technical efficiency obtained in this study suggests that ample opportunities exist for both groups of farmers to increase their productivity and income through increased efficiency in resource utilization in their farms.

Table 3: Technical efficiency distribution of the remittance receiving and non-remittance receiving households

Range of efficiency	Remittance receiving household		Non-remittance receiving households	
	Frequency	Percentage	Frequency	Percentage
0.01 - 0.20	17	28.33	14	23.33
0.21 - 0.40	13	21.67	9	15.00
0.41 – 0.60	12	20.00	6	10.00
0.61 – 0.80	9	15.00	6	10.00
0.81 - 1.00	9	15.00	25	41.67
Minimum	0.12		0.10	
Maximum	1.00		0.98	
Mean	0.42 (0.03)		0.53 (0.36)	

Source: computed from Frontier 4.1 MLE/Survey data, 2009
Figures in parenthesis are the standard deviations

A statistical test for differences in technical efficiency between the remittance receiving and non-remittance receiving households was carried out and is presented in Table 4. The test indicated that a significant difference in technical efficiency exists between the two households at 10 percent significant level. The Z value was -0.931 implying that the non-remittance receiving households have higher technical efficiency than their counterpart. This may be as a result of optimizing their limited resources, since their income sources were less than those of the remittance receiving households.

Table 4: Test for difference in technical efficiency of the remittance receiving and non-remittance receiving farm households

Household	Obs	Mean	Std. error	Std dev.	Z value
Remittance receiving household	60	0.4181	0.0364	0.0282	-1.931*
Non-remittance receiving household	60	0.5330	0.0468	0.3624	
Combined	120	0.4755	0.0300	0.0328	
Difference		-0.1115	0.0593		

Source: computed from Frontier 4.1 MLE/Stata 8.2/Survey data, 2009

Conclusion

This study show that the technical efficiency of the farmers decreases with advances in age and that household size, education and farming experience increases the efficiency of the farmers. Therefore, economic policies for enhancing arable crop production should be skewed more towards encouraging the youths to get involved in farming. Since household labour supply should be more predictable than hired labour, especially where the structure of the household is such that it is composed more of those in the active age, policies that enable farmers source more of their labour needs from their households are encouraged. Also, efforts at increasing crop production should involve policies that strengthen educating the farmer, especially agricultural education. This should involve educating the youths who are the future farmers and informal education of the current farmers. It is equally necessary to formulate and implement policies that harness the experience and practical knowledge of the farmers for increased production.

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