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# Youth participation and diversification strategies in rural economy: issues and evidence from Senegal

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**Abstract**

*Despite the importance of rural youth employment as an engine for rural development, little research has been conducted to understand how youth are faring in rural labor markets. In this study, we attempt to fill this gap by focusing essentially on two points. First, we determine the main factors that limit youth participation in rural farm and non-farm activities as well as the effect of participation on rural youth income. Second, we assess the extent to which diversification strategies affect rural youth income. The findings reveal that rural youth do not face the same constraints depending on whether they decide to participate in farm or non-farm activities. We also find that rural youth derive most of their income from non-farm employment. Our results indicate, moreover, that diversification strategies have a positive and significant impact on rural youth income regardless of the method used.*

**Key words:** Rural youth; Farm sector; Non-farm sector; Diversification; Senegal

## 1. Introduction

Rural youth employment issue has attracted considerable interest among researchers and policy-makers in Africa. It is estimated that 440 million young people will enter Africa's rural labor market by 2030 (World Bank & IFAD 2017).

This is also a major concern in Senegal, characterized by a predominantly rural and young population. On the one hand, even if the urbanization process continues to accelerate, Senegalese population remains, so far, mostly rural. According to the last general population and housing census in 2013, rural people accounted for 66 per cent and 61 per cent of the population in 1976 and 1988, before dropping to 59 per cent and 55 per cent in 2002 and 2013, respectively. On the other hand, more than half (60 per cent) of the population is under the age of 24 (ANSD 2014).

Despite the advantages of such demographic dividend, youth economic participation is still low in rural activities in general, and in agriculture in particular (Gaye *et al*. 2015; FAO 2017). Yet agriculture is an important mainstay of the national economy, particularly in rural areas which account for two-thirds of the poor (World Bank 2014) and the largest number of the working population (ANSD 2013). However, the agricultural sector is not very attractive in terms of providing decent

employment opportunities for young people, due to its low productivity growth compared to the secondary and tertiary sectors (Fall *et al.* 2013; FAO 2017). This situation limits the extent to which agriculture can improve livelihood in rural areas and, as a result, drives young people into diversification activities.

The empirical literature points out two main factors that lead to diversification: the " pull " and "push" factors. In the first case, a number of pull factors drive household members to seek better employment opportunities off the farm, while in the second, households are pushed toward diversifying activities as a coping strategy (Barrett *et al*. 2001; Deshingkar 2004; Reardon *et al*. 2006; Davis *et al.* 2009; Senadza 2012; Diiro & Sam 2015; Lui & Lan 2015).

In view of all the above, our purpose here is to address rural youth employment issue in Senegal, focusing essentialy on two points. First, we determine the main factors that limit youth participation in rural farm and non-farm activities as well as the effect of participation on rural youth income. Second, we assess the impact of diversification strategies on rural youth income.

This study contributes to the literature in more than one respect. While several studies have investigated the impact of participation in rural farm and non-farm activities on household welfare, little is known about the effect of participation on rural youth income. Household-level analysis, though relevant, can only provide aggregate results. It fails to highlight the disparities that may exist between young people and adults on the one hand and, between young men and women on the other. Yet, youth generally make up the largest share of the rural labor force. In addition, our study provides a comprehensive analysis of the structure and functioning of the labor market for rural youth. This is timely for a number of reasons. First, the involvement of young people in rural activities is critical in terms of food security and poverty reduction (FAO 2017). Second, rural Senegal is a suitable case for examining youth diversification strategies, not only because of its young population but also because of the limited youth participation in rural activities.

The rest of the study is structured as follows. In section 2, we provide details on our empirical methodology, while in section 3 we present the data and descriptive statistics. In section 4, we discuss the econometric results. We conclude with some evidence and policy implications in section 5.

## 2. Empirical methodology

To provide an understanding of how youth are faring in the rural labor market, we adopt a four-step approach. First, we analyse labor market participation by logit regression model. This first step allows us to detrmine the key factors influencing access to farm and nonfarm employment. Second, we use simultaneous equations system to take into account the interaction between pull and push factors. Third, we examine the determinants of rural youth income successively using ordinary least squares (OLS) and quantile regression methods. Fourth, we evaluate the potential impact of diversification strategies on rural youth income using the propensity score matching and endogenous switching regression methods.

More formally, because our participation variables are dichotomous we use a latent variable formulation and express the participation equations as follows:

$$\text{participf}_i^* = Z_i\theta_f + \varepsilon_i \quad (1)$$

$$\text{participnf}_i^* = Z_i\theta_{nf} + \omega_i \quad (2)$$

We define $\text{participf} = 1$ if $\text{participf}_i^* \geq 0$, otherwise $\text{participf} = 0$, illustrating whether or not rural youth participate in farm activities.

Similarly, $\text{participnf} = 1$ if $\text{participnf}_i^* \geq 0$, otherwise $\text{participnf} = 0$, referring to whether or not rural youth participate in non-farm activities. $\theta_f$ and $\theta_{nf}$ are the parameters to be estimated, indicating the farm and non-farm participation equations, respectively, and $\varepsilon_i$ and $\omega_i$ are the errors terms.

Finally, we consider that rural farm and non-farm sectors are closely related through the pull and push factors. We assume that a high value-adding non-farm sector strongly pulls rural youth off the farm as predicted by the pull hypothesis, and conversely agricultural activities that barely meet subsistence needs push rural youth into non-farm work activities as predicted by the push hypothesis. Acknowledging that the two categories of factors may be connected, we estimate the participation equations simultaneously. As a result, we allow $\varepsilon_i$ and $\omega_i$ to be correlated, suggesting a potential combined outcome of the pull and push factors in the rural labor market.

Furthermore, we follow Mincer's (1974) model to investigate empirically the determinants of rural youth income. The OLS is used to estimate the parameters. However, we complete the analysis with the quantile regression technique first developed by Koenker and Basset (1978). OLS regression estimates the mean of the conditional distribution of the dependent variable; yet the explanatory variables may affect the conditional income distribution differently at different points in the distribution.

The quantile regression model is expressed as:

$$\ln W_i = \alpha_\theta X_i + \omega_{\theta i} \quad (3)$$

with $Quant_\theta(\ln W_i | X_i) = X_i \alpha_\theta$ et $Quant_\theta(\omega_{\theta i} | X_i) = 0$

$X_i$ is a vector of covariates including the sector of employment and a set of control variables, $\alpha_\theta$ is a vector of parameter and $\omega_\theta$ the random error terms. $Quant_\theta(\ln W_i | x_i)$ represents the $\theta th$ conditional quantile of $\ln W_i$ given $X$.

In the last step the propensity score matching method is employed to assess the impact of diversification strategies on rural youth income. The propensity score matching method is a non-parametric estimation technique that matches observations of diversified and non-diversified rural youth groups based on the propensity score (Rosenbaum & Rubin 1983; Heckman *et al.* 1998). The propensity score, $P(X)$, conditional on a set of observable characteristics, $X$, is the probability of assignment into treatment, i.e. the probability of adopting diversification strategies. By diversification, we mean participation in both rural farm and non-farm activities.

Let $T_i$ denotes a dummy variable such that $T_i$ equal to 1 if the $i^{th}$ young rural worker diversifies its incomes activities and 0 otherwise. $Y_{i1}$ and $Y_{i0}$ represent monthly income for rural youth engaged in diversification and those who do not, respectively. The average impact of treatment on the treated (ATT) is given by:

$$\text{ATT} = E[Y_{i1} | T = 1, P(X)] - E[Y_{i0} | T = 1, P(X)] \quad (4)$$

Equation (4) cannot be estimated because the component $E[Y_{i0} | T = 1, P(X)]$ is unobserved. However, given the conditional independence assumption, $(Y_{1i}, Y_{0i}) \perp T | P(X)$, i.e., the potential outcomes are independent of diversification strategies but conditional on the propensity score, one can write:

$E(Y_{0i} | T = 1), P(X)] = E(Y_{0i} | T = 0), P(X)]$. Thus, one can compute the ATT as:

$$\text{ATT} = E[Y_{i1} | T = 1, P(X)] - E[Y_{i0} | T = 0, P(X)] \quad (5)$$

One limitation of the PSM method is that it assumes that the diversification decision is based only on observable characteristics, which is unlikely in rural Senegal. Hence, we use also the endogenous switching regression model to check the robustness of our results. This technique accounts for

potential selection biases (Maddala 1983), as it controls for both observed and unobserved factors when estimating the impact of diversification strategies on rural youth income. The endogenous switching regression consists of two stages. In the first stage, a selection equation for diversification decision is modeled with a binary specification, while in the second stage, outcome equations are estimated for diversified and non-diversified rural youth conditional on selection.

We specify the selection equation for the adoption of diversification strategies as:

$$T_i^* = \alpha Z_i + u_i \quad (6)$$

$$\text{with } T_i = \begin{cases} 1 & \text{si } T_i^* > 1 \\ 0 & \text{otherwise} \end{cases}$$

where $T_i^*$ is a latent variable, $T_i$ is a binary dependant variable equals to 1 if the young rural worker diversifies its income activities, $Z_i$ is a vector of exogenous variables, $\alpha$ is a vector of parameters to be estimated and $u_i$ is the error term.

Following Equation (6), the outcomes are observed for two groups: (1) rural youth involved in diversification strategies and (2) those who are not involved:

$$\text{Regime 1} : Y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i} \quad \text{if } T_i = 1 \quad (7)$$

$$\text{Regime 2} : Y_{0i} = \beta_0 X_{0i} + \varepsilon_{0i} \quad \text{if } T_i = 0 \quad (8)$$

where $Y_i$ is the monthly youth income in regimes 1 and 2, $X_i$ represents a vector of explanatory variables and $\beta$ is a vector of paramters.

If unobserved characteristics of rural youth, such as youth ability and motivation, influence both the diversification decision and the monthly income, then the error term in the selection equation (6) would be correlated with the error terms in (7) and (8). These three equations are estimated simultaneously using the full information maximum likelihood (FIML). This is because the FIML remains the most efficient method (Lokshin & Sajaia 2004).

Our interest here is to determine the treatment effect of participation in diversification strategies, i.e., how diversification strategies influence rural youth income. Thus, we use the endogenous switching regression model to compare expected income of youth that diversified (a) with respect to youth that did not diversify (b), and to estimate expected income in the counterfactual hypothetical cases (c) that the diversified rural youth group did not diversify, and the non-diversified rural youth group diversified (d).

Following Heckman *et al.* (2001), we calculate the average treatment effect on treated (ATT), that is the change in income due to participation in diversification strategies, as the difference between (a) and (c):

$$ATT = E(Y_{1i}|T_i = 1) - E(Y_{0i}|T_i = 1) \quad (9)$$

Similarly, we compute the effect of the treatment of the untreated (ATU) for rural youth that did not actually diversify their income activities as the difference between (d) and (b) :

$$ATU = E(Y_{1i}|T_i = 0) - E(Y_{0i}|T_i = 0) \quad (10)$$

Moreover, we define "the effect of base heterogeneity" for rural youth group that diversified as the difference between (a) and (d):

$$BH_1 = E(Y_{1i}|T_i = 1) - E(Y_{1i}|T_i = 0) \quad (11)$$

For rural youth that did not diversify, "the effect of base heterogeneity" is given by the difference between (c) and (b) :

$$BH_2 = E(Y_{0i}|T_i = 1) - E(Y_{0i}|T_i = 0) \quad (12)$$

We also calculate transitional heterogeneity as the difference between (9) and (10). This enables us to check whether the effect of diversification strategies is larger or smaller for youth that actually diversified or for youth that did not diversify in the counterfactual case that they did diversify.

## 3. Data and Descriptive Statistics

The main source of data for this study is the Poverty Monitoring Survey (ESPS-II), conducted from August to December 2011 by the Senegalese National Bureau of Statistics (ANSD) in collaboration with the World Bank, the Canadian International Development Agency (CIDA), the United Nations Development Programme (UNDP) and the World Food Program (WFP).

The sampling design used was a two-stage stratified. Out of the 18,216 households drawn from 1,012 census enumeration areas (EAs), 17,891 were actually surveyed. Because of the stratification, sampling weights are used when analyzing the data. The ESPS-II were collected with two kinds of questionnaires – household and individual questionnaire, covering socio-economic and demographic characteristics of households. In addition, the survey provides community-level data including information on shocks affecting the locality, as well as access to basic infrastructures. The unit of analysis in our study is rural youth aged 18 to 30 who have reached the minimum legal age for employment in accordance with ILO Convention No. 182.

Table 1 reports descriptive statistics for selected variables used in the analysis, both for the full sample, and for young rural men and women as well as statistical test results for differences in means. For convenience, the variables are divided into three groups: individual characteristics, household characteristics, and community characteristics.

Results show that non-farm self-employment emerges as the most important monthly income source for rural youth in Senegal (115214 CFA), followed by non-farm wage employment[1] (77537 CFA), farm wage employment (41113 CFA), and farm self-employment[2] (30912 CFA).

Moreover, young men and women derive a large part of their income from non-farm wage employment (83522 CFA and 52189 CFA) and non-farm self-employment (194536 CFA and 39562 CFA). Farm activities provide the lowest earnings both to male and female workers. In fact, young men and women, respectively, earn 48965 CFA and 29902 CFA from farm wage employment on the one hand, and 43653 CFA and 15108 CFA from farm self-employment, on the other. Thus, it can be noted that young rural women earn considerably less than young rural men in both farm and non-farm sectors. For instance, young men earn about three times and five times more than their female counterparts in farm and non-farm self-employment, respectively. While significant, the gender earnings gap is less important in farm and non-farm wage employment.

Table 1 also indicates that rural youth are relatively poorly educated. In the sample as a whole, the proportion of rural youth with no education is roughly 72 per cent. Only 14 per cent have completed the primary and secondary levels of education, respectively. University graduates constitute less than 1 per cent of the sample. Analyzing the distribution of education by gender, Table 1 reveals that young rural women are less educated than their male peers: 77 per cent of young rural women are uneducated compared to 64 per cent of young rural men. Besides, a higher proportion of young men than young women completed primary (15 per cent vs. 13 per cent), secondary (19 per cent vs.10 per cent) and tertiary levels of education (0,53 per cent vs. 0,23 per cent). Overall, the results show

[1] Non-farm employment refers to rural youth participation in non-farm activities as wage workers or self-employed.

[2] Farm and non-farm employment are disaggregated into wage employment and self-employment using the socio-professional category. A young rural worker is a wage earner if he or she is : a) Senior executive, engineer and assimilated ; b) Medium executive/foreman ; c) Skilled employee/worker ; d) Semi skilled employee / worker ; e) Labourer. In contrast, a self-employed one is : a) employer/boss ; b) Own account worker.

that the skill level of rural youth is low in Senegal. Average age of rural youth is 23 years for the entire sample and is higher for young rural women (24 years) compared to young rural men (23 years).

There are also significant differences across gender with respect to household characteristics. Rural youth live in large households and the average size ranges from 14 members in young women's households to 13 members in young men's households. The economic dependency ratio, which is defined as the ratio of family members below age 15 and above age 64 to total working age population, is also higher among young women's households compared to young men's households (1.2 vs. 0.9). This implies that for every 10 workers there are 9 and 12 people not of working age in young men's and young women's households, respectively. In addition, over 80 per cent of rural youth live in farm households[3], with an average cultivated area between 1,144 and 1,559 hectares.

Table 1 also shows that most rural youth have limited access to basic infrastructure needed to expand their activities. In fact, only 4 per cent of rural youth live in communities with access to all-weather roads, and the proportion of rural youth living in communities with access to food markets does not exceed 6 per cent.

[3] In this context, a farm household refers to a household having practiced agriculture during the last agricultural year.

**Table 1.** Descriptive statistics

| | Total rural youth | | Male rural youth | | Female rural youth | | T-value[b] |
|---|---|---|---|---|---|---|---|
| VARIABLES | Mean | Std.Dev. | Mean | Std.Dev. | Mean | Std.Dev | |
| ***Monthly income generation (in CFA)*** | | | | | | | |
| Farm wage employment | 41113.42 | 396.436 | 48965.44 | 535.420 | 29902.15 | 564.037 | -0.2967 |
| Farm self-employment | 30911.64 | 185.968 | 43652.67 | 321.577 | 15108 | 94.132 | 9.7726*** |
| Non-farm wage employment | 77537.43 | 756.718 | 83522.17 | 921.411 | 52188.65 | 606.825 | 1.8267* |
| Non-farm self-employment | 115214.8 | 6287.959 | 194536.3 | 12856.78 | 39562.1 | 512.096 | 1.2905 |
| Variables explicatives | | | | | | | |
| ***Individual characteristics*** | | | | | | | |
| Education | | | | | | | |
| Aucun (=1) | .7181 | .00036 | .6455 | .00061 | .7680 | .00044 | -20.3733*** |
| Primary education (=1) | .1410 | .00028 | .1531 | .00046 | .1327 | .00035 | 5.4410*** |
| Secondary education (=1) | .1372 | .00028 | .1958 | .0005 | .0969 | .00031 | 20.3348*** |
| Tertiary education (=1) | .0035 | .00004 | .0053 | .00009 | .0023 | .00005 | 4.4221*** |
| Age | 23.49 | .0032 | 23.18 | .0051 | 23.70 | .0042 | -5.7304*** |
| ***Household characteristics*** | | | | | | | |
| Household size | 13.59 | .0057 | 13.53 | .009 | 13.64 | .0074 | -2.2471** |
| Economic dependency ratio | 1.09 | .0005 | .9288 | .0007 | 1.20 | .0007 | -28.4285*** |
| Farm household[a] (=1) | .8182 | .0003 | .8418 | .0005 | .8018 | .0004 | 1.7262* |
| Farmland size (in ha) | 1319.40 | 121.798 | 1559.54 | 204.08 | 1144.08 | 149.005 | 0.3111 |
| ***Community characteristics*** | | | | | | | |
| Access to all-weather roads (=1) | .0454 | .0001 | .0448 | .0002 | .0458 | .0002 | 0.0736 |
| Access to food markets (=1) | .0590 | .0001 | .0589 | .0002 | .0591 | .0002 | -0.0732 |

Notes :[a] Farm household captures whether or not the household have practiced agriculture during the last agricultural year ; [b]t-test for continuous variables and z-test for dichotomous variables. Asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Source : Authors

## 4. Econometric results

This section presents the econometric results. Analysis is divided into four parts. First, we investigate the main factors that limit rural youth participation in farm and non-farm sectors. Second, we check the robustness of our results while controling for the pull and push factors. Third, we address the determinants of rural youth income, and fourth, assess the impact of diversification strategies on rural youth income.

### Rural youth participation in farm and non-farm activities

The summary statistics discussed above enabled us to profile rural youth based on socio-economic and demographic factors. We use here the logit model to identify, among these factors, those that limit and/or promote rural youth participation in farm activities, on the one hand, and in non-farm activities, on the other.

For ease of comparaison, the marginal effects are reported for both models[4] rather than the estimated coefficients. Table 2 below presents the marginal effects of the explanatory variables included in the models.

**Table 2.** Probability of rural youth participation in farm and non-farm sectors

| | Farm sector | | Non-farm sector | |
|---|---|---|---|---|
| VARIABLES | dy/dx | P>\|z\| | dy/dx | P>\|z\| |
| ***Individual characteristics*** | | | | |
| Education | | | | |
| Primary education | -0.0535*** | 0.000 | 0.0373*** | 0.000 |
| Secondary education | -0.0933*** | 0.000 | 0.00110 | 0.894 |
| Tertiary education | - | - | 0.117* | 0.069 |
| Gender | | | | |
| Female | -0.115*** | 0.000 | -0.0546*** | 0.000 |
| General Experience | | | | |
| Age | 0.0103*** | 0.000 | 0.00803*** | 0.000 |
| ***Household characteristics*** | | | | |
| Household size | -0.00155*** | 0.006 | 0.000319 | 0.392 |
| Economic dependency ratio | -0.00797 | 0.221 | 0.00109 | 0.808 |
| Farm household (=1) | 0.131*** | 0.000 | 0.199** | 0.022 |
| Farmland size | 2.14e-08** | 0.023 | -0.00169** | 0.013 |
| ***Community characteristics*** | | | | |
| Access to all-weather roads (=1) | 0.00685 | 0.715 | -0.0179 | 0.192 |
| Access to food markets (=1) | -0.0229 | 0.103 | 0.00444 | 0.685 |
| | | | | |
| Number of observations | 11,014 | | 11,034 | |
| Pseudo R | 0.053 | | 0.098 | |
| LR-chi-square | 351.28*** | | 315.87**** | |

Notes: P>|z| are P-valuues based on standard errors robust to heteroskedasticity. Asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Source : Authors

The results show that the probability of youth involvement in farm activities decreases as education attainment increases. In fact, rural youth with complete primary education are 5.3 percentage points less likely to participate in farm activities than their non-educated counterparts. The probability decreases even more with the secondary level of education: having completed secondary education reduces the probability of participating in farming activities by 9.3 per cent. Hence, relative to the non-educated, rural youth with education are generally less likely to be employmed in the agricultural sector. One possible reason is that farm activities do not generate sufficient revenues to draw skilled

[4] We use the same set of explanatory variables to model the participation in farm and non-farm activities.

rural youth into the sector. This is especially plausible given that non-farm activities turn out to be the main source of rural youth income.

Young men are 11.51 percentage points more likely to participate in farm activities than young women. The probability of being involved in the agricultural sector also increases with age, reflecting the positif effect of experience on farm employment. Household characteristics are also important for explaining rural youth involvement in farm sector. In fact, household size negatively influences the probability of being engaged in farm activities. Young people living in large households are less likely to be in farm employment, possibly indicating that there are enough household members working in agricultural sector. Rural youth living in households with high economy dependency ratio tend to participate less in farm activities, but the marginal effect on probability is small (0.79 percentage points) and not statistically significant. Youth from farm households and those living in household with large cultivated areas are significantly more likely to be engaged in farm activities. In addition, the estimated marginal effects show that variables accounting for access to infrastructure at community level, such as access to all-weather roads and access to food markets, have no statistically significant effects on the probability of rural youth participation in farm activities.

The second part of Table 2 above examines factors influencing rural youth participation in non-farm activities. The results reveal that the level of education, gender, age, household type (whether or not the household practiced agriculture during the last agricultural year), and the farmland size are the main determinants of rural youth participation in non-farm activities.

In terms of education, rural youth with primary and tertiairy education tend to participate more in non-farm activities than do their uneducated peers. In fact, having completed primary and tertiary education raises the probability of participation in non-farm activities by about 4 per cent and 12 per cent, respectively. Hence, the likelihood of being employed in the non-farm sector rises with increased skill level, except for secondary education where the marginal effetc is insignificant. This is contrary to what occurrs in the farm sector, where educated youth tend to engage less in this sector than the uneducated ones. The findings are however consistent with the significant role of education in non-farm employment reported in previous work (e.g. Oseni & Winters 2009; Senadza 2012; Corral & Radchenko 2017). Results also show that young female workers are 5.45 percentage points less likely to be employed in the non-farm sector than do their male counterparts. General experience (proxied by age) significantly increases the probability of rural youth involvement in non-farm activities: more experienced youth workers are more likely to be employed in the non-farm sector although the marginal effect associated with the coefficient is very small (0.8 percentage points). Rural youth from farm households are less likely to engage in non-farm activities. In fact, living in a farm household decreases the probability of rural youth participation by 19.8 per cent. The size of agricultural land area negatively and significantly affects the probability of involvement in non-farm activities, that is, rural youth living in households with small farmland size tend to participate more in non-farm activities. This is expected, because rural youth are more likely to seek employment opportunities off the farm when households do not hold large farm size. In addition, access to all-weather roads and access to food markets appear to have no significant effect on youth engagement in non-farm activities. Such results contrast with those found in the literature that consider access to basic infrastructure as an important factor that drive diversification towards off-farm activities (Barrett *et al.* 2001; Deininger & Olinto 2001; Escobal 2001; Reardon *et al.* 2006; Pfeiffer *et al.* 2009; Senadza 2012; Liu & Lan 2015; Corral & Radchenko, 2017).

**Robustness Check**

Overall, the results found above are very informative but the regression analysis does not take into account the interaction that may exist between participation equations. As discussed previously, rural farm and non-farm activities can be closely linked through the pull and push factors. To investigate the relative importance of the pull and push factors and test the robustness of the logit models

estimates, we estimate participation equations simultaneously. We find that controlling for the push and pulls factors affects some of the results established above[5].

On the whole, result indicate that rural youth face multiple constraints preventing them from involving in farm and non-farm activities. On the one hand, young people with less work experience, those living in large households with low economy dependency ratio, as well as young female workers are less likely to engage in rural farm activities. One the other hand, we find that young people without access to infrastructure services such as access to all-weather roads and to food markets, those with low levels of education and experience, and young women tend to participate less in rural non-farm sector.

**Determinants of rural youth income**

After identifying the main constraints related to youth participation in rural farm and non-farm activities, we now examine the effect of rural employment on youth income, while controlling for the effects of the other factors. Four rural employment categories are identified: farm and non-farm wage employment, and farm and non-farm self-employment. We first present basic OLS estimates of the Mincerian income equation, which we complete with the quantile regression analysis. The two methods are complementary and they should be applied together. In fact, the OLS regression models the conditional income distribution, while the quantile regression technique estimates the income equation at different points along the conditional income distribution. More specifically, the 25th, 50th, and 75th quantiles are used in the analysis. Rural youth income is modeled by using log monthly income as dependent variable. The results are reported in Table 3 below. Column [1] shows OLS results and those of quantile regression technique are highlighted in Columns [2], [3] and [4].

Findings reveal that young workers engaged in farm self-employment earn higher wages than their counterparts involved in farm wage employment (the base category). In addition, youth participating in non-farm sector as self-employed and wage workers earn 33.68 per cent and 51.8 per cent, respectively, more than those in farm wage employment. In line with the descriptive statistics presented above, it is also noted here that rural youth workers involved in non-farm sector earn higher wages than their counterparts employed in farm sector. Quantile regression estimates indicate that this pattern increases along the income distribution. In fact, relative to youth in farm wage employment, youth engaged in non-farm self-employment get an income premium of 27,76 per cent in the first quartile, while the premium ranges from 39.93 per cent at the second quartile to 44.68 per cent at the third quartile. The income gap between the two sectors may be due to lower productivity in the farm sector compared to the non-farm one. This is likely because there are fewer skilled young workers (i.e young educated workers) in the farm-sector.

Results also show that large income differences exist between young men and women in rural Senegal. Young women earn on average 66,8 per cent less than young men. In addition, female youth earnings are lower than male youth earnings for all reported quantiles. The gender income gap may, to some extent, be explained by differences in level of education. As mentioned above, young rural men are more educated than young rural women and, according to human capital theory (Schultz 1961a, 1961b; Becker 1964; Mincer 1974), more educated individuals are better paid in the labor market.

[5] Estimation results are available upon request.

**Table 3.** Determinants of rural youth income using OLS and Quantile Regressions methods

| | OLS [1] | | 25th [2] | | 50th [3] | | 75th [4] | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | Coefficient | P>\|t\| | Coefficient | P>\|t\| | Coefficient | P>\|t\| | Coefficient | P>\|t\| |
| ***Employment sector*** | | | | | | | | |
| Farm self-employment | -0.433*** | 0.001 | -0.441*** | 0.002 | -0.319*** | 0.000 | -0.302 | 0.129 |
| Non-farm wage employment | 0.518*** | 0.000 | 0.560*** | 0.001 | 0.673*** | 0.000 | 0.562*** | 0.005 |
| Non-farm self-employment | 0.337** | 0.022 | 0.278* | 0.072 | 0.399*** | 0.000 | 0.447** | 0.025 |
| ***Individual characteristics*** | | | | | | | | |
| Education | | | | | | | | |
| Primary | 0.139* | 0.079 | 0.118 | 0.245 | 0.0334 | 0.673 | 0.166* | 0.051 |
| Secondary | -0.150 | 0.159 | -0.316** | 0.014 | 0.00210 | 0.986 | 0.176 | 0.194 |
| Tertiary | 0.854*** | 0.000 | 1.276*** | 0.000 | 1.274*** | 0.000 | 0.845*** | 0.001 |
| Gender | | | | | | | | |
| Female | -0.668*** | 0.000 | -0.655*** | 0.000 | -0.598*** | 0.000 | -0.626*** | 0.000 |
| General Experience | | | | | | | | |
| Age | 0.0434*** | 0.000 | 0.0318*** | 0.002 | 0.0318*** | 0.000 | 0.0411*** | 0.000 |
| ***Household characteristics*** | | | | | | | | |
| Household size | -0.0130*** | 0.000 | -0.0170*** | 0.002 | -0.0141*** | 0.000 | -0.0168*** | 0.000 |
| Economic dependency ratio | -0.0287 | 0.467 | 0.0168 | 0.725 | 0.0239 | 0.522 | -0.0511 | 0.134 |
| Farm household (=1) | 0.313 | 0.106 | -0.0715 | 0.870 | 0.222 | 0.531 | 0.746 | 0.139 |
| Farmland size | 6.43e-08 | 0.171 | 6.83e-08 | 0.998 | 1.17e-08 | 1.000 | 7.70e-08 | 0.999 |
| ***Community characteristics*** | | | | | | | | |
| Access to all-weather roads (=1) | 0.0227 | 0.820 | -0.0356 | 0.754 | 0.0590 | 0.476 | -0.0145 | 0.894 |
| Access to food markets (=1) | 0.212** | 0.028 | -0.0205 | 0.874 | 0.142* | 0.082 | 0.288** | 0.013 |
| Constant | 9.600*** | 0.000 | 8.989*** | 0.000 | 9.631*** | 0.000 | 10.19*** | 0.000 |
| Number of observations | 2400 | | 2400 | | 2400 | | 2400 | |
| R2 (OLS) and Pseudo R2(Quantile regression) | 0.257 | | 0.126 | | 0.1470 | | 0.1605 | |

Notes: P>|t| are P-valuues. Asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Source : Authors

We also find that education contributes to better wages. In fact, rural youth whith primary education (with tertiary education) earn 13.94 per cent (85.41 per cent) higher income than their uneducated counterparts. The coefficient associated with secondary education is throughout insignificant, except in the low end of the income distribution, where rural youth with complete secondary education earn 31.59 per cent less than those with no education. This suggests that rural youth workers whith complete secondary education do not have good labor market connections that allow them to convert their skills into higher incomes. In addition, rural youth workers with primary education are being paid comparatively more in the upper income quantiles than in the lower ones. Thus, the richest youth ($75^{th}$ quantile) with primary education appear to benefit more from social networks than the poorest youth ($25^{th}$ quantile). Unlike the primary and secondary levels, the tertiary level significantly increases rural youth income at all quantiles. However, it is worth noting that the returns to education for rural youth workers with tertiary education decrease with the income level: they are highest in the lowest quantile of income and lowest in the highest income quantile.

Results reveal that general experience (proxied by age) is also an important determinant of rural youth income (Table 3 above). On average, a one point increase in general experience increases rural youth income by 4.34 per cent, controlling for other characteristics. Moreover, experience appears to have significant effect on income across quantiles. The estimated return to an additional year of experience is 3.18 per cent for rural youth in the fisrt quartile, and 3.17 per cent and 4.11 per cent among rural youth in the second and third quartile of the income distribution. Hence, the returns to experience is higher at the upper quartile than at the lower quartiles. This finding suggests that experience is inequality-increasing because it increases rather than reduces income differences betwenn low- and high- income rural youth.

**Impact of diversification strategies on rural youth income**

In previous sections we have investigated the main determinants of rural youth participation in farm and non-farm activities and the income they derive from these activities. In this present section, we assess the extent to which diversification strategies can impact rural youth income. To this end, we start with the PSM method.

Before analyzing the estimation results for the average treatment effect on the treated (ATT) of the outcome variable, we first estimated the propensity socre using a logit regression[6] in which we included the same set of covariates used in the participation equations. We also checked matching quality based on balancing property, the distribution of propensity scores before and after matching, as well as on the common support of comparaison[7].

Three matching methods have been used: nearest neighbour matching, radius caliper matching and Kernel-based matching. The results are presented in Table 4 below.

Our analysis reveals that, regardless of the method used, diversification strategies have a positive and significant impact on rural youth income and the results are statistically significant at the 1-per cent level. In fact, diversification strategies increase monthly rural youth income with a magnitude ranging from 17 per cent to 20 per cent. This indicates that income for rural youth who diversified is significantly higher than that of the non-diversified.

[6] The results are not discussed here since we conducted similar analys in the participation equations. Results are available from the authors upon request.

[7] The results of these exercises are available upon request.

**Table 4.** Impact of diversification strategies on rural youth income using PSM method[a]

| | Decision stage | | | |
|---|---|---|---|---|
| | To diversify | Not to diversify | Treatment effect | T-stat |
| Method 1: Nearest neighbour matching | 10.22 | 10.05 | ATT= 0.17*** | 5.2 |
| | | | *(0.0323)* | |
| Method 2: Radius caliper matching | 10.22 | 10.04 | ATT= 0.18*** | 5.97 |
| | | | *(0.0297)* | |
| Method 3: Kernel based matching | 10.22 | 10.02 | ATT= 0.20*** | 6.56 |
| | | | *(0.0296)* | |

Notes: [a] the outcome variable is the log of monthly income. Asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Standard Errors in parenthesis. Source : Authors

The PSM cannot provide consistent estimation of causal effects in the presence of selection bias due to unobservable factors. Given this limitation and to check the robustness of our PSM results as well, we apply the endogenous switching regression (ESR) model. One of the main advantages of ESR model is that it can control both for observed and unobserved characteristics of rural youth.

Our model contains the same set of covariates used so far in our regressions. However, we added two more variables in the selection equation for identification purposes. More specifically, we included two dummy variables for community level shocks which capture whether rural youth live in community affected by a decline in soil fertility, and by a frequently erratic agricultural production, respectively[8]. It is likely that rural youth belonging to communities exposed to both types of agro-climatic shocks tend to invest more in non-farm activities and, hence, are more likely to adopt diversification strategies. In fact, agro-climatic shocks are considred as one of the major causes of diversification (e.g. Barrett *et al.* 2001; Deshingkar 2004; Haggblade *et al.* 2007; Kilic *et al.* 2009; Shittu 2014; Corral & Radchenko 2017). The selected two variables are believed to impact on rural youth income via their effects on diversification and not directly, and thus satisfy the exclusion criteria of being included as instruments.

Results from the endogenous switching regression model estimated with the full information maximum likelihood are reported in Table 5 below[9]. The first column presents the estimated coefficients of selection equation (6) on adopting diversification strategies or not. The second and third columns report the outcome equation (the log of monthly income) for rural youth that did and did not diversify their activities, i.e. under (Eq.7) and (Eq.6) regimes, recpectively.

[8] A community is considered to be exposed to these shocks only if it is affected just a little, a lot or in a very extreme way.

[9] We estimated the endogenous switching regression model in STATA using the movestay command developed by Lokshin and Sajaia (2004).

**Table 5.** Full information maximum likelihood estimates of the switching regression model

| | Diversification decision (1/0) | | Income: diversified youth | | Income: non-diversified youth | |
|---|---|---|---|---|---|---|
| VARIABLES | Coefficient | P>\|z\| | Coefficient | P>\|z\| | Coefficient | P>\|z\| |
| ***Individual characteristics*** | | | | | | |
| Education | | | | | | |
| Primary | 0.0639** | 0.018 | 0.0342 | 0.606 | 0.164*** | 0.000 |
| Secondary | 0.160*** | 0.000 | 0.441*** | 0.000 | 0.516*** | 0.000 |
| Tertiary | 0.262*** | 0.000 | 1.140*** | 0.000 | 1.552*** | 0.000 |
| Gender | | | | | | |
| Female | -0.389*** | 0.000 | -0.576*** | 0.000 | -0.505*** | 0.000 |
| General Experience | | | | | | |
| Age | 0.0201*** | 0.000 | -0.00108 | 0.850 | 0.0241*** | 0.000 |
| ***Household characteristics*** | | | | | | |
| Household size | -0.00959*** | 0.000 | 0.00555 | 0.215 | -0.00265*** | 0.001 |
| Economic dependency ratio | 0.0569*** | 0.000 | -0.0862** | 0.018 | -0.0545*** | 0.000 |
| Farm household (=1) | 0.598*** | 0.000 | -1.318*** | 0.000 | -0.871*** | 0.000 |
| ***Community characteristics*** | | | | | | |
| Access to all-weather roads (=1) | 0.0403 | 0.323 | 0.107 | 0.237 | -0.0173 | 0.451 |
| Access to food markets (=1) | 0.00636 | 0.867 | 0.0518 | 0.563 | -0.0436** | 0.048 |
| ***Agro-climatic shocks*** | | | | | | |
| Erratic agricultural production (=1) | 0.0886*** | 0.000 | | | | |
| Diminishing soil fertility(=1) | -0.00276 | 0.910 | | | | |
| Constant | -2.448*** | 0.000 | 13.08*** | 0.000 | 10.06*** | 0.000 |
| $\sigma_{\varepsilon_2}, \sigma_{\varepsilon_1}$ | | | $1.446^{****}$ | 0.000 | $1.048^{****}$ | 0.000 |
| $\rho_2, \rho_1$ | | | $-.601^{****}$ | 0.000 | $.0730^{****}$ | 0.000 |
| Wald test for independent Equations $\chi^2$ | | | | | $26.72^{****}$ | 0.000 |
| Number of observations | 38708 | | 38708 | | 38708 | |

Notes: P>|z| are P-valuues. Asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Source : Authors

At the bottom of Table 5, the estimates of the coefficients of correlation ($\rho_1, \rho_2$) between the error terms of the selection equation and outcome equations are provided, respectively. The estimated coefficients of correlation are statistically significant. This result suggests that observed and unobserved factors influence both youth decision to diversify and their income level. The significance of the coefficient of correlation between the diversification equation and the income function of rural youth who did diversify ($\rho_2$) indicates that self-selection occurred in the adoption of diversification strategies. In addition, the likelihood ratio test for joint

independence of the three equations is statistically significant at 1 per cent pointing out dependence between the equations. This supports our assumption that diversification is endogenous and justifies the use of ESR model.

We focus more on the discussion of the estimated impact of adoption of diversification strategies on rural youth income, which is the main purpose of this section[10]. Table 6 below presents the expected monthly income of rural youth under the actual and counterfactual conditions.

**Table 6.** Conditional Expectations, Treatment and Heterogeneity Effects[a].

| | Decision stage | | |
|---|---|---|---|
| | To diversify | Not to diversify | Treatment effect |
| Rural youth that diversified | ***(a)*** 10.05 | ***(c)*** 9.86 | ATT= 0.19*** |
| | *( 0.0208)* | *(0.0161)* | *( 0.0074)* |
| Rural youth that did not diversified | ***(d)*** 11.75 | ***(b)***9.57 | ATU= 2.18*** |
| | *(0.0053)* | *(0.0042)* | *(0 .0015)* |
| Heterogeneity effects | BH1 = -1.7 | BH2 = 0.29 | TH= -1.99 |

Notes: [a] the outcome variable is the log of monthly income. Asterisks ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Standard Errors in parenthesis. Source : Authors

A simple comparison shows that the group of rural youth that diversified their activities earn, on average, 48 per cent more than their counterparts that did not diversify (cells (a) and (b)). However, the observed differences in the average monthly income between the two groups can be misleading simply because it does not take into account the unobserved factors that may have affected rural youth income. The last column of Table 6 presents the average treatment effect on the treated (ATT) and the average effect of the treatment on the untreated (ATU). The results indicate that the average monthly income of diversified youth is statistically higher than had they not been diversified their activities. Diversification strategies on average result in a 19 per cent increase in income. This result is consistent with that of propensity score matching which assumes that diversification decision is based on observable characteristics only. Similarly, if the group of rural youth that did not diversify had diversified, the mean effect would be an increase in monthly income of 218 per cent. Findings also reveal that the transitional heterogeneity effect is negative, that is, rural youth that did not diversify would have earned higher income than those rural youth that diversified in the counterfactual case.

## 5. Conclusion and policy implications

Using data from the second national poverty monitoring survey, this study provides new evidence on youth labor market outcomes in rural Senegal. To this end, we followed a four-step econometric approach. First, we used logit model to identify main constraints that limit rural youth particiation in farm and non-farm activities. Second, we estimated the participation equations simultaneously to take into account the pull and push factors. Third, we applied the ordinary least squares method and quantile regression techniques to estimate the revenues generated from farm and non-farm activities. Fourth, we made use of impact evaluation techniques, namely the propensity score matching method and endogenous switching regression model, to assess the impact of diversification strategies on rural youth income. The results reveal that rural youth face multiple constraints keeping them from participating in farm

[10] The two stages results are not discussed here since it is not the primary objective of this section and their analysis follows the same analogy as those conducted in previous sections. The results are available from the authors upon request.

and non-farm activities. On the one hand, young people with less work experience, those living in large households with low economy dependency ratio, as well as young female workers are less likely to engage in rural farm activities. One the other hand, we find that young people without access to infrastructure services such as access to all-weather roads and to food markets, those with low levels of education and experience, and young women tend to participate less in rural non-farm sector. The results also show that rural youth participating in non-farm activities earn higher income than their counterparts involved in farm activities and the income gap between the two sectors increases across the conditional income distribution. Furthermore, findings indicate that diversification has a positive and significant impact on rural youth income. Indeed, diversification strategies increase rural youth income by about 19 per cent whereas for non-diversified youth, the average income would have been increased by about 218 per cent had they diversified.

Based on these findings, the policy challange is to lift constraints that rural youth encounter and make the diversification strategies successful. In this respect, policy-makers and donors interested in improving rural youth outcomes should:

- ✓ Adopte a comprehensive vision of rural economy in that there are strong synergies between the farm and non-farm sectors.
- ✓ Implement policies that will help in increasing rural youth human capital. The education level of rural youth is low and those with primary and tertiary education have been found to earn relatively more than their non-educated peers.
- ✓ Increase investments in rural infrastructure. In fact, the lack of infrastructure services, such as access to all-weather roads and to food markets, is associated with lower employment opportunities and income for rural youth. Thus, it is essential that policymakers assist in improving the access to basic infrastructure services so that youth can benefit from the expansion of rural activities.

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