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Spillovers from off-farm self-employment opportunities in rural Niger

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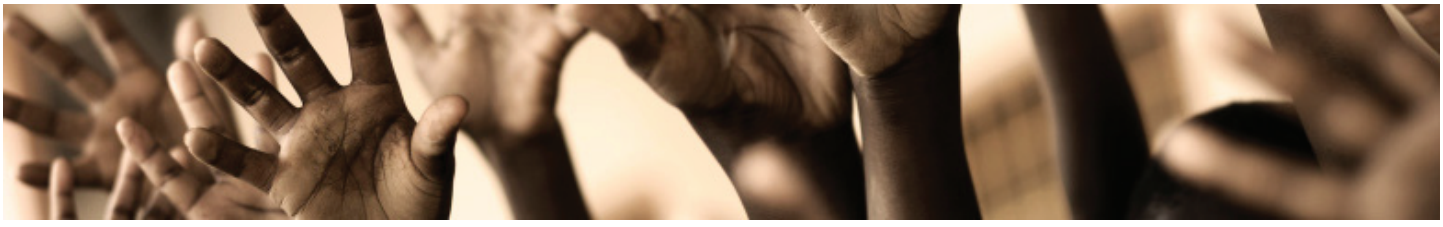

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Spillovers from off-farm self-employment opportunities in rural Niger

Abstract

Agricultural households in Niger face constraints that may hinder agricultural production and threaten food security. A rural exodus is also resulting from a lack of formal and decent wage employment. The way to enhance agricultural production and improve food security while at the same time increase employment is still an important policy question in rural Niger. This study assesses the effects of off-farm self-employment opportunities on expenditures for agricultural inputs and on food security using the potential outcome framework for treatment effects. The study finds that farm and non-farm related factors determine off-farm self-employment opportunities in rural Niger. Also, participation in self-employment increases agricultural expenditures on purchased inputs and hired labour but decreases the propensity to hire labour. Self-employment opportunities favour food accessibility without having any additional effect on food availability and food utilisation. The results confirm that the policy of promoting the non-farm sector can be harmonious with the development of the agricultural sector. There is a scope to increase or create favourable conditions for the development of the non-farm sector in rural Niger.

JEL: D13; O15; Q12.
Keywords: Agricultural household, Off-farm self-employment, Food insecurity, Niger.

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I. Introduction

In Niger more than half of the population lives in the rural area and depends on agriculture. The sector is the main economic activity in peri-urban and rural Niger and represented an average of 40% of GDP of the country over 2006 to 2014. Yet, farm households still face constraints in terms of climate changes and agricultural factors that may hinder agricultural production and threaten food security. Food insecurity is a recurrent and agriculture-related issue in Niger (de Sardan, 2007). A study of the World Food Program reports that 47.7% of the population was affected by food insecurity in 2010 (Ali, 2012). Another nationally representative survey, conducted in November 2011 by the National Institute of Statistics (INS) on the vulnerability of households to insecurity, indicated that 34.9% of households surveyed were food insecure. Moreover, 23.1% of households surveyed were classified as "at risk", i.e., could fall into a situation of food insecurity before the next harvest (INS-NIGER, 2013). Farm households generally have high consumption of grains and other agricultural products generated at the end of the crop year. Thus, any period of drastic decline in agricultural production and pronounced grain deficit is followed by food insecurity, malnutrition and a deterioration of living conditions of the population (RNDH, 2009).

One of the causes of vulnerability often put forward is the lack of diversification of revenues of farm households and their concentration on agricultural production. A potential alternative in risk management strategies of a large numbers of rural households is thus their involvement in the rural non-farm economy. As an important route out of poverty, there is a new interest in promoting the development of the rural non-farm economy as a source of growth in agricultural-based countries (IFAD, 2011).

This concern, along with the objectives of the support of sustainable agricultural development and food security, are manifested in the recent initiative 3N implemented by the government of Niger. The initiative 3N named "Nigeriens Nourishing Nigeriens", focuses on creating conditions conducive to dealing with all risks to food and nutritional security and to ensuring that the agricultural sector is the vehicle for social transformation and economic growth (IMF Country Report, 2013).

In Niger there is a lack of formal and decent wage employment in agricultural zones resulting in a rural exodus, mainly of young people. However, low-skilled off-farm self-employment[1] continues to be the most accessible off-farm opportunities for households. In the recent and nationally representative ECVMA-2011 data we use in this study, more than 50% of farm households involve in some off-farm non-salaried employment and this will be more likely in the future as a result of the farm household's livelihoods strategy to diversify income sources. The main challenge for policy interventions is thus to promote this type of off-farm employment while at the same time enhancing agricultural production and improving food security. Whether

[1] Self-employment/entrepreneurship activities of individual household members in rural areas.

there are conflicting objectives, in which case the promotion of the non-farm sector may compromise the performance of the farm sector, is still an important policy question.

In this study, we ask whether increasing self-employment opportunities is beneficial (or not) for agricultural households in Niger. This is a question on the nature of the relation between the farm and non-farm sectors in the country. As farm households become more diversified by becoming involved in the non-farm sector, market imperfections may cause interdependencies between farm and off-farm activities and may lead to spillover effects. According to the literature on the linkage between farm and off-farm activities, labour market imperfections may cause the linkages to be negative whereas credit market imperfections may cause them to be positive. Off-farm activities are viewed as an important source of cash income, which can potentially improve farm productivity if it is used for farm input purchases or longer-term capital investment purposes (Reardon et al., 1994). There is also the argument that negative externalities might, however, result from the expansion of off-farm activities through labour transfers out of farming (McNally, 2002; Gedikoglu et al., 2011). The promotion of non-farm activities can attract the agricultural labour force and even generate unemployment if the cost of waiting and seeking for non-farm working opportunities is lower than the loss in income by remaining in the agricultural sector. In such a case, policy interventions in rural Niger derived from models that consider farm and off-farm decisions as independent may be misleading.

Our research objectives are twofold. We use the potential outcome framework to (1) analyse factors that determine farm households' decisions to be involved in self-employment activities and then (2) analyse the average treatment effects of that decision on farm households' agricultural decisions - expenditures on inputs used and on hired labour - and on food security. As we document in the next section, many studies in a similar context of market imperfections as found in Niger have stressed the importance of understanding the constraints faced by the rural non-farm sector and the related implications. Yet, there is little knowledge on the determinants of low-skilled off-farm employment and the nature of the linkage between the farm and the non-farm sectors resulting from the increasing of such non-salary wage work. We find complementary effects between farm and non-farm sectors, suggesting that the application of employment policies in the rural areas of Niger may be expected to encourage agricultural investments and reduce food insecurity.

II. Literature review

For a long time, policy interventions in many developing countries have been differently and disproportionally implemented in rural and urban areas. Traditionally, in many cases employment policy draws more attention in urban zones while agricultural policy is the main concern in rural areas (Ruben and Van den Berg, 2001). The role that the rural non-farm sector may play is now gaining in importance thanks to the emergence of off-farm activities observed in rural areas. The non-farm sector is increasingly perceived as having a potential ton absorb a growing rural labour force and in slowing rural exodus (Haggblade et al., 1989; Lanjouw and Lanjouw, 2001). The common argument is that the promotion of the rural non-farm economy is

not only limited to the above mentioned potential outcomes, but could also be a support for the agricultural sector. However, there is uncertainty on what policies can be introduced to make non-farm income opportunities available for broad removal of rural poverty (Holden et al., 2004).

Especially in rural areas where the farm sector also has potential, it is suggested that policies intended for the rural non-farm sector should also consider their impact on the farm sector. The literature on the relation between farm and off-farm activities has stressed the importance of understanding the nature of this linkage when introducing or elaborating such policies in agricultural areas (Davis et al., 2002). Expenditures linkages are reported as largely existent in developing countries where market imperfections are highly likely.

Two forms of expenditures linkages emerge in general from the literature. The first is investment linkages. The positive argument is related to the view that off-farm activities are important source of cash income, which can potentially improve farm productivity if used for farm input purchases or longer-term capital investments purposes (Reardon et al., 1994). Some studies on developing countries show that off-farm income contributes to alleviating capital and credit constraints, providing the necessary cash for farm expenses (Davis et al., 2002). For example, Savadogo et al. (1994) provide evidence from Burkina Faso that off-farm income has an indirect positive effect on farm productivity through its effect on technology adoption of an expensive package of animal traction equipment. Maertens (2009) finds that earnings from agro industrial employment opportunities in Senegal are partially invested in the family farm, resulting in larger farm sizes and higher farm expenditures. Oseni and Winters (2009) show that wage employment and self-employment play a role in inducing spending in hired labour and inorganic fertilizers in Nigeria. The effect is zone-specific and also depends on the type of crops. Evidence in developing countries other than Africa is not different. Focusing on the experience of Vietnam, Stampini and Davis (2008) conclude that the allocation of household labour between agriculture and other activities outside of agriculture, such as wage or self-employment, affects farming choices. When a family engages in non-agricultural labour, it spends on average 21% more on seeds, 26% more on hired labour, and 35% more on market expenditures on livestock inputs than if the family worked exclusively on its own farm. The efficiency and productivity-enhancing effect of the development of the rural non-farm sector is another finding from the literature (Ruben and Van Der Berg, 2001; Woldehanna, 2000; Anriquez and Daidone, 2010).

The positive investment linkage is balanced by the argument pointing out the fact that negative externalities might result from the expansion of off-farm activities. It occurs through the existence of factors that are shared across farm and off-farm activities (Ravallion, 2003). Family labour allocation between farm and off-farm activities is one case highlighted in the literature. For example, it is argued that increasing off-farm employment opportunities may contribute to labour transfers out of farming and to a reduction in the time available for farm management (McNally, 2002; Gedikoglu et al., 2011). This might lead to a reduction of the adoption of time-intensive farming techniques (Phimister and Roberts, 2006), farming inefficiency (Goodwin and Mishra, 2004) and farm production and productivity loss (Low, 1981).

The second form of expenditures linkages is the consumption linkages. Only few studies directly relate the development of the non-farm sector in rural areas with household consumption or the inherent aspect that is food security. However as far as rural agriculture development is concerned, the link is established. For example, Ruben and Van den Berg (2001) analyse the consumption effects of non-farm employment by regressing the caloric intake adequacy ratio on household income sources in Honduras. They find that a 10% increase in non-farm income leads to a 0.3% improvement in food adequacy. The adoption of agricultural technologies is found to make farming households more food secure in many developing countries. Studies show that using improved seeds and inorganic fertilizers have positive effects on different definitions of food security (Asfaw et al., 2012; Kassie et al., 2014; Shiferaw et al., 2014).

The creation of the linkages between the farm and the non-farm sectors in rural zones also flows from the emergence, the development and the type of off-farm activities. Policy recommendations derived from many studies on the determinants of non-farm activities are then formulated to address constraints or entry barriers of rural households' participation in these activities. Because of these barriers, relatively wealthy farm households may dominate the most lucrative rural non-farm activities as is found, for example, in the Tigray region of northern Ethiopia (Woldenhanna and Oskam, 2001). Access to some public assets and private assets are advocated as supports to help rural households to increase their self-employment (Escobal, 2001).

Certain off-farm activities, notably self-employment, may require necessary inputs such as skill and capital. For example, education is reported to be relevant in accessing better remunerating off-farm employment in Mexico (de Janvry and Sadoulet, 2001; Yunez-Naude and Taylor, 2001). It is also found that self-employment in rural China shares many features of a productive small-business sector found in developed countries (Mohapatra et al., 2007). In testing the credit rationing hypotheses on business start-ups in Rwanda, Ali et al. (2014) find that being credit constrained reduces the scope for non-farm self-employment by 6.3 percentage points. Infrastructure and location are other related impediments to the development of self-employment opportunities as revealed in the literature. Households located in remote areas, for example in northern Ethiopia and in central Nepal, are less likely to participate in low-skilled off-farm labour markets (Bhatta and Årethun, 2013; Ghimire et al., 2014). In neighbourhoods in Honduras where opportunities for self-employment are not necessarily located close to urban centres, these activities are reported to be importantly dependent on access to infrastructure such as important roads and proximity to tourist areas (Isgut, 2006).

Nagler and Naude (2014) provide evidence of determinants of non-farm entrepreneurship in six Sub-Saharan Africans countries over the period 2005 to 2013. Important determinants as found by the authors are push factors related to the risk of farming under imperfect and missing markets for credit and insurance. Access to credit, household wealth and education are reported as drivers for business opportunities. These results differ by country, revealing the contextual aspect of non-farm entrepreneurship in rural Africa. In the case of Niger, Nagler and Naude (2014) find that annual net household income significantly increases the likelihood of a household operating a non-farm enterprise. Liquidity constraints thus seem to hinder

entrepreneurial activities in rural and urban Niger. However there is no evidence of the effect of the riskiness of farming as push factors. The authors find that households experiencing food shortages are less likely to operate a non-farm household enterprise in rural areas. Also, neither unexpected prices changes of inputs/outputs nor geographical (natural) shocks affect rural or urban entrepreneurship in Niger.

We add to the literature in this way. First, in the context of Niger, we are not aware of any evidence about the existence and/or nature of any linkages between the farm and the non-farm sectors, induced by an increase in off-farm self-employment. We use the same database as Nagler and Naude (2014). However, we restrict our analysis to the factors which determine the decision to be involved in off-farm self-employment activities, and only among agricultural households. Using the sample of all households in the database, Nagler and Naude (2014) do not find any farm-related factors impacting the likelihood of a household operating a non-farm enterprise, thereby putting into question the existence of any linkage between the farm and the non-farm sectors. We argue that the effect of the riskiness of farming as push factors is more likely within agricultural households that are accustomed to facing several farm constraints. As such, we account for both the farm and non-farm decisions of agricultural households by modelling such decisions simultaneously.

Second, as highlighted above, the literature that relate the development of the non-farm sector with household consumption and food security in particular is rare. Several studies limit food security issues to agricultural decisions, ignoring the social implications that may come from the transformation of the non-farm sector. Contrary to the previous studies, we examine both the investment linkages and the consumption linkages, using different definitions of food security. As such, we account for agricultural as well as social policy implications that may come from the development of the non-farm sector. Policy actors may be interested to know whether the promotion of off-farm self-employment results in less (more) productive and efficient use of farm resources and decreases (increases) food security. This information could be exploited to develop complementary employment programs by stimulating factors which contribute to a positive linkage between the farm and non-farm sectors and which remove constraints to self-employment opportunities which hinder the development of such linkage.

III. Data and descriptive statistics

We use the data from the survey *Enquête Nationale sur les Conditions de Vie des Ménages et l'Agriculture de 2011* (ECVMA-2011), available online from the World Bank site. Data were collected during July-September 2011 and November 2011-January 2012 by the National Institute of Statistics (INS-Niger). The original sample includes approximately 3,968 households and is nationally representative in both urban and rural areas in all the 8 regions of Niger. The sample was chosen through a random two-stage process and was stratified by four ecological zones - urban, agricultural, agro-pastoral and pastoral.

3.1. Defining treatment and outcome variables

We consider the sample of the agricultural households that were involved in any farming or livestock activity during the 12 months prior to the survey. All these households derive their income from agricultural activities but some of them also complement the income with off-farm activities. They diversified into different off-farm activities, having one or more members involved either in salaried work, non-salaried work or both types of off-farm employment. Of particular interest in our study is the distinction between households whose members are off-farm self-employed workers and households with any member who is an off-farm self-employed worker.[2] The final data we use - after all missing data are removed - is a sample of 1,942 agricultural households, 63.34% of which have at least one member involved in off-farm self-employment, irrespective of any other off-farm employment.[3] In this study, the agricultural households with off-farm self-employment activities are defined as participant households. Non-participant households are thus agricultural households, those with any member engaged in an off-farm self-employment activity during the 12 months prior to the survey.

The required data on socio-demographic characteristics and on different types of activities of households, to estimate outcomes such as agricultural expenses and food security indicators, are also available in the survey. The first outcome of interest of agricultural inputs is the expenditures on purchased inputs used (seeds, fertilizers and phytosanitary products) and for other costs (transport, electricity, water, taxes, etc.). The second agricultural outcome of interest is the expenditures on hired labour. Several agricultural households did not hire labour in our sample. As such, we also consider an additional binary outcome indicating whether the households hire labour or not.

The ECVMA-2011 data include the appropriate information to estimate a set of relevant indicators of the food insecurity. Mainly, we use five indicators to define food insecurity. The two first indicators use the definition of *food accessibility*: the (per capita) food consumption energy kilocalories (kcal) and the food expenditures expressed in adult equivalent terms. The data on food consumption energy kilocalories are calculated by INS-Niger using consumption information from ECVMA-2011 data (see INS-NIGER, 2013, p. 28). Using these data we calculate a third indicator, namely the propensity of the household to fall into food insecurity. This is a dummy variable equal one if the food consumption energy kcal of the household is below the national level of 2200 kcal. The fourth indicator we consider uses the definition of *food availability*, where the food gap is defined as the number of months the household faces a situation where it did not have sufficient food for the entire household during the 12 months

[2] The survey manual defines a *self-employed worker* as a person who works alone or only with the help of family and apprentices, and without salaried workers. It defines an *employer* as a person whose production unit (enterprise) employs at least one salaried worker. *Employers* and *self-employed workers* are described as *independent workers*. The terminology of *self-employed worker* we use in this study is equivalent to "*independent worker*".

[3] 22.81% of households in the sample have at least one (agricultural or non-agricultural) salaried worker.

prior to the survey. The last indicator uses the definition of *food utilization*, i.e. diet diversity: the number of food groups consumed by the household in the 7 days prior to the survey.[4]

3.2. Agricultural households, farm and off-farm sectors in Niger

The descriptive statistics reported in Table 1 indicate that participant households seem relatively more endowed in human capital compared to non-participants. However significant differences are only observed in some cases. Participant households have a significantly higher number of household members, including more workers but also more dependents. They are also more likely to be male-headed household with more highly educated members. Non-participant households have access to more land but have less livestock units and a lower non-agricultural wealth index than participant households.

Table 1: Agricultural households' characteristics

	Total sample (1942)		Non-participants (712)		Participants (1230)		
	Mean	SD	Mean	SD	Mean	SD	Mean-comparison test
Agricultural inputs							
Input expenses for cropping (1,000 FCFA)	29.307	172.061	27.117	191.62	30.549	159.692	
Expenditures on hired labour (1,000 FCFA)	18.376	57.546	12.903	48.656	21.481	61.978	***
Family labuor used for cropping (pers-days)	176.613	221.112	161.914	175.844	184.952	243.097	
Food security indicators							
Per capita food consumption (energy kcal)	2459.794	1174.552	2602.377	1247.261	2379.259	1124.184	***
Per capita food expenditures (1,000 FCFA)	273.2726	108.848	269.551	103.397	275.405	111.912	
Propensity to fall into food in security	33%		32%		34%		
Food gap (months)	2.129	2.373	2.21	2.445	2.083	2.327	
Dietary diversity	8.086	1.856	7.979	1.799	8.146	1.888	
Human capital							
Size of household	6.781	3.507	6.277	3.204	7.066	3.638	***
Age of household head	44.228	14.572	43.279	14.811	44.766	14.412	**
Number of labourers	2.916	1.506	2.758	1.315	3.005	1.593	***
Dependency ratio of dependents to labourers	1.434	.944	1.364	.942	1.473	.945	*
Female-headed household	7.40%		8.40%		6.90%		

[4] Food availability, food accessibility and food utilization are three interlinked dimensions of the food and nutrition status of a household. Food availability is a measure of the amount of food physically available for households. Household-level food accessibility is realized when a household has the opportunity to obtain sufficient food quantity and quality. Food utilization includes, in addition to the quantity of food, the quality of the diet. Food accessibility is a necessary but not a sufficient condition to ensure an adequate food and nutrition status, while the realization of food availability is a necessary but not sufficient condition for the realization of food access (see Pieters et al., 2013).

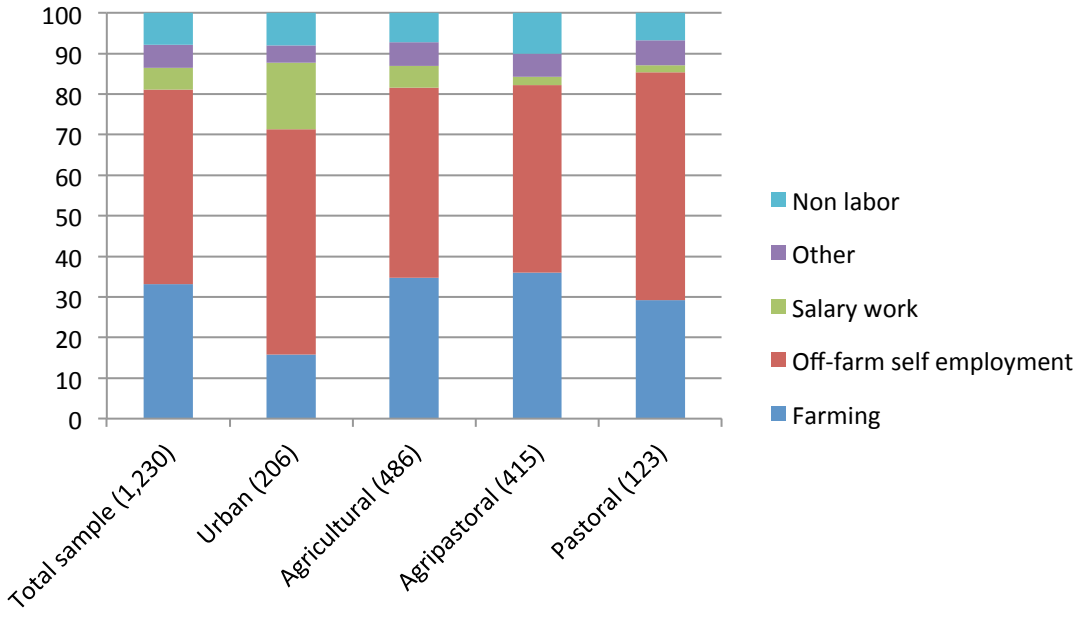
Years of education of the household head	1.381	3.635	1.492	4.080	1.318	3.347	
Highest household education	3.066	4.667	2.774	4.781	3.233	4.596	
Physical capital							
Farm size (ha)	6.458	11.084	6.841	14.086	6.241	8.891	
Per capita landholdings (ha)	1.945	3.387	2.122	3.744	1.844	3.156	
Units of livestock	3.172	6.629	3.055	7.199	3.238	6.276	
(Household non-agricultural) wealth index	-0.968	1.304	-1.071	1.343	-0.909	1.276	***

Notes: the wealth index is measured as the first principal component of indicators of household asset variables such as vehicles, home characteristics, furniture, and household appliances (see Filmer and Pritchett, 2001). The dependency ratio of dependents to labourers is measured as the number of household members aged 15 or below or above 80, divided by the number of household members aged between 15 and 80.
Significant mean differences are indicated with *** p<0.01, ** p<0.05, * p<0.10.
Source: Authors' calculations using ECVMA-2011 data.

The first part of the table 1 shows that participant households are those who have spent more on agricultural input and on food. They are also those who faced a reduced number of months of food gaps but consumed less energy (kcal) compared to non-participant households. However, the relative difference in terms of input expenditures and food security may be attributable not only to the participation of agricultural households in off-farm self-employment. As the second part of Table 1 shows, differences in observable household characteristics need to be accounted for when analysing the implications of participating in off-farm self-employment.

Off-farm self-employment activities constitute an important source of revenue for a large part of agricultural households in our sample. These activities are mostly individual non-agricultural enterprises - extraction, manufacturing, trading and services - operating in various locations such as professional premises, fixed or mobile location on a public road, in the dwelling, or street peddler. The contribution of income from off-farm self-employment activities to total income is manifest in the sample of participant agricultural households (Figure 1). The share of income from this off-farm non-salaried work remains high even through zones with different agricultural production potential ranging from 46.23% in agro pastoral zones to 56.03% in pastoral zones. This suggests that the development of off-farm self-employment activities is not only an urban (peri-urban) phenomenon. Clearly, off-farm self-employment activities have become the most important source of revenue in the agricultural zones after farming. This may reflect a quest for financial resources off the farm, induced in part by the need to finance agricultural activities. Anecdotal evidence from Oxfam Niger that we visited suggests that this is probable in rural zones.

Figure 1: Percentage of total income from different sources, by agro ecological zones (participant households)



Agriculture in Niger is mainly rain-fed and takes place between June and September. Only 14.01% of agricultural households in our sample cultivated any crop during the dry season (contre-season). Yet, during the rainy season, agricultural households grew a varied number of staple crops and cash crops using pure (monoculture) or mixed (intercropping) farming methods. About thirty-seven crops were cultivated. Less than 12% of all agricultural households grew at most one product and less than 70% cultivated at most five products. The relative number of products cultivated has an important implication in terms of the financing of agricultural expenses, the time for the management of the farm household production and food security. Data from the survey do not explicitly record much information that could allow us to assess whether agricultural households have experienced poorly functioning labour and credit markets in the regions of study. However, data from the agriculture questionnaire shows that the majority of the farm households finance their agricultural expenses using mostly a channel other than a form of credit.

Table 2: Credit accessibility for agricultural expenses

Input categories	Total sample (1942)		Non-participants (712)		Participants (1230)	
	Number that incurred costs	% that used credit	Number That incurred costs	% That used credit	Number that incurred costs	% that used credit
Fertilizer	468	9.40	143	11.19	325	8.62
Phytosanitary products	207	6.76	74	10.81	133	4.51
Seeds	1,169	8.38	424	7.31	745	8.99
Machinery	1,015	4.73	356	3.37	659	5.46

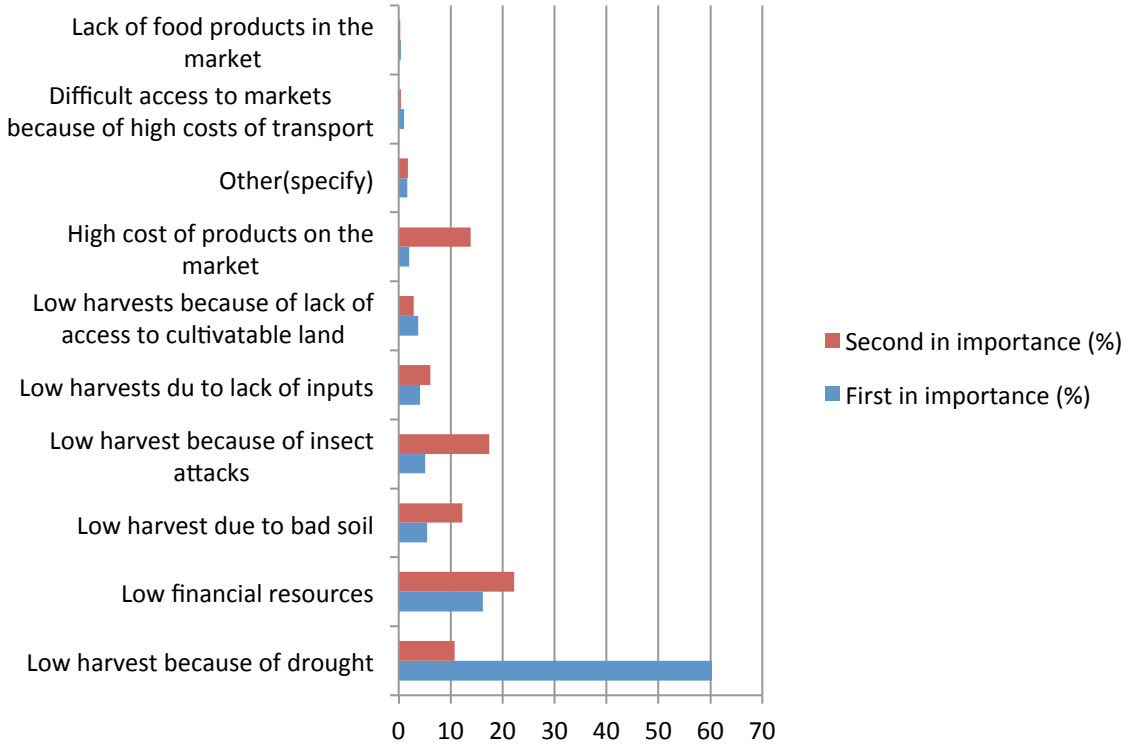
Source: Authors' calculations using ECVMA-2011 data.

In Table 2, we report the number of agricultural households that purchased some agricultural inputs or incurred other agricultural related costs and the percentage of these households that financed the expenses by any form of credit. A distinction is also made between those who participate in off-farm self-employment and non-participants. The figures show that at least 60% (745/1230) of participant households undertook some form of agricultural expenses.[5] In the few cases that credit is used, participant households depend less on this form of financing for certain types of inputs but rely more on credit for relatively necessary investment such as seeds and fixed costs. It is reported from the questionnaire that farming households finance the majority of the cost using cash, suggesting that self-financing is likely within households.

One recurrent issue in Niger of interest in this study is food insecurity. The implication in terms of food security of the nature of the linkage between the farm and off-farm sectors is evidenced in our data. In Figure 2 we report the causes of food insecurity indicated by 1077 agricultural households that faced a situation where they did not have sufficient food for the entire household during the 12 months prior to the survey. Small harvests and low financial resources are the main causes of food insecurity reported by farming households. In addition, leaving aside the other natural causes - drought, bad soil and insect attacks - leading to low crops, around 10% of food insecure households indicated the lack of inputs as the reason for a small harvest. These statistics suggest that food security is obviously related to agriculture and household income. As long as there exists a linkage between the farm and off-farm sectors in agricultural zones in Niger, food security is likely to be affected by the nature of this linkage.

[5] Some households faced other input costs without spending on seeds.

Figure 2 : Farm households' reported causes of food insecurity



IV. Methodology

We rely on the framework of a potential outcome model (POM) for treatment effect (see StataCorp, 2013).

4.1. The potential outcome framework

We assume that every agricultural household potentially has an opportunity to undertake an off-farm self-employment activity. The POM or the counterfactual model implies that:

$$Y_i = (1 - D_i)Y_{0i} + D_i Y_{1i} \quad (1)$$

$$Y_i = Y_{1i} \quad \text{if } D_i = 1 \quad (2)$$

$$Y_i = Y_{0i} \quad \text{if } D_i = 0 \quad (3)$$

where D_i is the (binary) treatment variable indicating the decision of an agricultural household (*i*) to additionally work off the farm or not, i.e. the household's participation in a self-employment

activity. The outcome variable Y_i (the response of) for every household is only observed in one state of the treatment and then takes either the value Y_{1i} or Y_{0i}.

We are interested in two treatment effects that are usually used in the impact evaluation literature. The first is the average treatment effect among agricultural households which are actually involved in an off-farm self-employment activity. This is the average effect of the treatment on the treated (ATT):

$$ATT = E(Y_{1i} - Y_{0i} \,|D_i = 1) \tag{4}$$

The second treatment effect is the average treatment effect among agricultural households that were not involved in an off-farm self-employment activity. This is the average effect of the treatment on the untreated (ATU):

$$ATU = E(Y_{1i} - Y_{0i} \,|D_i = 0) \tag{5}$$

Many econometric models were developed to assess the treatment effect or to perform impact evaluations. Of course, each specification is appropriate for a type of data, as well as the raised econometric aspects. A common aspect to be taken into account is the correction of selection bias and where the treated units are in general not randomly selected. The other problem can be related to the limited number of available covariates to explain the outcome or program choice. Further, if the non-observed factors jointly influence the treatment selection and the outcome, we may have also an endogeneity problem.

The treatment effects are calculated trough the estimation of the explicit form of the POM:

$$Y_{1i} = X_i'\beta_1 + \varepsilon_{i1} \quad \text{if } D_i = 1 \tag{6}$$

$$Y_{0i} = X_i'\beta_0 + \varepsilon_{i0} \quad \text{if } D_i = 0 \tag{7}$$

with the treatment model:

$$D_i = \begin{cases} 1 & \text{if } D_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \tag{8}$$

$$D_i^* = Z_i'\alpha + u_i \tag{9}$$

with X_i and Z_i being vectors of explanatory variables. α, β_0 and $\beta_1$are coefficient vectors to be estimated and used for the estimation of the ATT and the ATU. ε_{i0}, ε_{i1} and u_i are unobservable error terms that are not related to either X_i or Z_i with the following covariance matrix:

$$\Delta = \begin{pmatrix} \sigma_u^2 & \sigma_{1u} & \sigma_{0u} \\ \sigma_{1u} & \sigma_{\epsilon 1}^2 & . \\ \sigma_{0u} & . & \sigma_{\epsilon 0}^2 \end{pmatrix} \tag{10}$$

such that : $\text{var}(u_i) = \sigma_u^2$; $\text{var}(\varepsilon_{1,i}) = \sigma_{\varepsilon 1}^2$; $\text{var}(\varepsilon_{0,i}) = \sigma_{\varepsilon 0}^2$; $\text{cov}(u_i, \varepsilon_{1,i}) = \sigma_{1u}$ and $\text{cov}(u_i, \varepsilon_{0,i}) = \sigma_{0u}$.

Equation (08) implies that an agricultural household participates in off-farm self-employment activities under the condition that the difference – the latent variable D_i^* - between the marginal net benefits of being involved in that activity and not being involved is positive (see Alene and Manyong, 2007). The estimation of the vector of parameters α allows answering the first research question. The ATT and the ATU, i.e. the differential impact of participating or not in an off-farm self-employment activity (second research question), can be calculated through equations (06) and (07).

A set of parametric and non-parametric methods have been developed in the literature to estimate equations (06) to (09). However, the pertinence of the different methods depends on the conditional independence (CI) assumption, also known as unconfoundedness or selection-on-observables, that restricts the dependence between the treatment model and the potential outcomes, i.e. $\sigma_{1u} = \sigma_{0u} = 0$. In other words, this assumption considers the nonexistence of the endogeneity problem as long as all observable (covariates) variables are controlled for. In our case, it is unlikely to rely on the assumption that, conditional on covariates X, the decision of a agricultural household to additionally work off the farm is independent of the potential outcomes. This would ignore the assumption of interdependency of household decisions that may lead to endogeneity problem.[6]

The decision to participate in an off-farm employment activity in rural Niger is likely to be non-random. We consider that off-farm self-employment decisions and other household decisions related to agriculture and food security are made simultaneously. For example, some unobserved household characteristics such as entrepreneurial ability can influence both agricultural decisions and off-farm activities (Pfeiffer et al., 2009). More motivated households might also combine farm and off-farm activities while more constrained households might decide to engage more in off-farm activities such as self-employment. In such a case, unobserved factors in the error terms ε_i are correlated with those affecting the decision (involvement in self-employment) process, i.e. u_i. Ignoring the selection problem would lead to biased estimated coefficients and then biased treatment effects. We use different estimations to account for precise specifications of the joint dependence among the unobservable factors and depending on the nature of the outcomes.

4.2. Estimation methods for continuous outcomes

For the continuous outcome we use first the endogenous switching regression (ESR) approach that deals with the specific correlation structure between the unobservable factors affecting the treatment and the unobservable factors affecting the potential outcomes.[7] Endogenous treatment effect models such as the Heckit Model or the Instrumental Variables (IV) approach

[6] In fact we account for the argument of interdependencies or jointness between farm households activities that is specific to many developing countries.

[7] The ES model has been used in a similar context of farm household decisions such as adaptation to climate change and adoption to a new crop in Ethiopia (Negash and Swinnen, 2012; Di Falco et al., 2011), under technology adoption decisions in northern Nigeria (Alene and Manyong, 2007) or participation in supermarket channels in Kenya (Rao and Qaim, 2011).

do the same. However these approach do not account for the fact that there may be interactions between the decision to be involved in self-employment and the observabled explanatory variables X_i in the outcome models.

We estimate the ESR model by the full information maximum likelihood (FIML) method using the *movestay* Stata command (see Lokshin and Sajaia, 2004). Endogeneity is modelled through the correlation between the error terms ε_i and u_i ($\rho 1$ and $\rho 0$) that are assumed to have a trivariate normal distribution, with a mean vector zero and the covariance matrix Δ (We normalize σ_u^2 to be equal to 1). Evidence of endogenous switching is found if $\sigma_{1u} \neq 0$ or $\sigma_{0u} \neq 0$ or if either of the correlation coefficients are statistically different from zero.[8]

From the estimation of the ESR model, we calculate the actual expected outcomes observed in the sample:

$$E(Y_{1i}|D_i = 1) \text{ and } E(Y_{0i}|D_i = 0);$$

and the respective counterfactual expected outcomes:

$$E(Y_{0i}|D_i = 1) \text{ and } E(Y_{1i}|D_i = 0).$$

We then derive from (4) and (5), following the literature:

$$ATT = E(Y_{1i}|D_i = 1) - E(Y_{0i}|D_i = 1) = X_{1i}(\beta_1 - \beta_0) + (\sigma_{1u} - \sigma_{0u})\lambda_{1i} \quad (11)$$

$$ATU = E(Y_{1i}|D_i = 0) - E(Y_{0i}|D_i = 0) = X_{0i}(\beta_1 - \beta_0) + (\sigma_{1u} - \sigma_{0u})\lambda_{0i} \quad (12)$$

where λ_{1i} and λ_{0i} are the Inverse Mills Ratios (IMRs) evaluated at $Z\alpha$.

In a second estimation, we use the endogenous treatment-regression model (ETR) that is a specific endogenous treatment effects model (see StataCorp, 2013). The ETR model is nested into the ESR model by using a constrained normal distribution of the covariance matrix Δ to model the deviation from the CI assumption. Maddala (1983) describes the ETR model as a constrained endogenous-switching model. The version of the ETR model we estimate accounts for a possible selection bias but imposes a homogenous selectivity effect while the ESR model assumes a differential selectivity effect (different coefficients of the IMRs and of the σ_{iu}, *i*=0,1). We use the *etregress* Stata command to estimate the average treatment effects as defined in (4) and (5) by full maximum likelihood.[9]

[8] $\rho 1 = \sigma_{1u} / \sigma_u \sigma_1$ and $\rho 0 = \sigma_{0u} / \sigma_u \sigma_0$.

[9] Contrarily to the case of the ETR model, the estimation of the average treatment effects from the ESR model involves a long calculation process. Because of lack of convergence - the outcome variables are indeed right-skewed - we transform the continuous outcome variables into their logarithms form before estimating the ESR model. The expected outcomes obtained are then transformed into their exponential form before calculating the ATT and the ATU from the equations (11) and (12) using the mean estimation method.

4.3. Estimation methods for binary outcomes

When the outcome is binary the POM (6) and (7) become:

$$Y_{1i}^{*} = X_i'\beta_1 + \varepsilon_{i1} \quad \text{and} \quad Y_{1i} = I(Y_{1i}^{*} > 0) \tag{13}$$

$$Y_{0i}^{*} = X_i'\beta_0 + \varepsilon_{i0} \quad \text{and} \quad Y_{0i} = I(Y_{0i}^{*} > 0) \tag{14}$$

with Y_{1i}^{*} and Y_{0i}^{*} as the latent variables that determine the observed binary outcomes Y_{1i} and Y_{0i}. *I* is a criterion function as defined in equation (8) and equation (9). As in the case of a continuous outcome, we rely on the ESR approach that estimates the binary selection and the binary outcome by FIML under the assumption of joint normality of the error terms in the selection and outcome. We use the switch_probit Stata command to estimate the expected effect of the treatment on agricultural households, with observed characteristics *X*, who participated in an off farm self-employment activity (TT):

$$TT(x) = Pr(Y_{1i} = 1 | D_i = 1,\ X = x) - Pr(Y_{0i} = 1 | D_i = 1,\ X = x) \tag{15}$$

We also estimate the expected effect of the treatment on agricultural households with observed characteristics *x* who did not participate in an off-farm self-employment activity (TU):

$$TU(x) = Pr(Y_{1i} = 1 | D_i = 0,\ X = x) - Pr(Y_{0i} = 1 | D_i = 0,\ X = x) \tag{16}$$

The ATT and ATU are then the respective average of TT(x) and TU(x) for the corresponding subgroups of the agricultural households.

4.4. Estimation methods for count outcomes

For the periodic count outcomes we use the Poisson regression with endogenous treatment effects (PETR) to estimate equations (6) to (9). The PETR is a nonlinear potential outcome model; it is a form of the ETR model that allows for a nonlinear (count) outcome. Terza (1998) categorized the PETR as an endogenous switching model. The form of the POM (6) and (7) that nests the PETR is:

$$E(Y_{1i} | X_{i,}\ \epsilon_i) = \exp(X_i'\beta_1 + \varepsilon_{i1}) \quad \text{if } D_i = 1 \tag{17}$$

$$E(Y_{0i} | X_{i,}\ \epsilon_i) = \exp(X_i'\beta_0 + \varepsilon_{i0}) \quad \text{if } D_i = 0 \tag{18}$$

We use the *etpoisson* Stata command to estimate the average treatment effects as defined in (4) and (5) by full maximum likelihood.

4.5. Exclusion restriction and variable used for all estimation

Although no exclusion restrictions are needed to identify the switch model - because of the nonlinearities of the selection model - we include in vector Z_i some variables which do not

belong to the vector X_i to make the estimates more robust. We define in Table A1 in the Appendix the explanatory variables used in the econometric analysis.

Two types of instruments are considered. We use the household distance to the capital of the department of residence and the size of household[10] as a first type of instrumental variables. Location and the size of the household are found to be important for informal enterprises in developing countries. They may operate from inside the household premises in order to reduce fixed production costs or in order to combine family life with business activities (Amin, 2010). About 98% of the non-agricultural enterprises in the ECVMA-2011 data we use are individual and informal family micro enterprises with 44.43% of them operating in the dwelling. It is thus reasonable to argue that households living near to the capital of the department of residence or those with more family labour are likely to undertake an off-farm self-employment activity because of a reduction in operating costs or because of high potential business opportunities in the capital of the department. These instruments are correlated with participation in off-farm self-employment activities.

The second type of instruments is a set of self-reported dummy variables indicating whether the household experienced idiosyncratic shocks, price shocks and geographic shocks over the 12 months prior to the survey. It has been shown that being subject to these shocks is associated with operating a non-farm enterprise in developing countries (Nagler and Naudé, 2014). We find that these shocks are jointly significantly correlated to the participation in off-farm self-employment activities in our sample. All the instruments we use are exogenous by definition. It is assumed that they are not directly related to agricultural activities and food security other than through the decision to participate in off-farm self-employment activities.[11]

The vector X includes observable covariates which might affect household decision making, namely factors that influence either the relative return and risk of agricultural production or food security and factors that determine the capacity or the motivation of farm households to participate in non-farm activities (de Janvry et al., 2005; Oseni and Winters, 2009; Ruben and Van den Berg, 2001). These variables are human capital endowments - the size of the household, the age and the gender of the household head and the number of years of schooling for the household member with the highest education - and social capital - whether the household head belongs to the main ethnic group (Haoussa). Agricultural landholdings, livestock, household non-agricultural wealth index, non-labour income and whether a bank or a microfinance institution exists in the community, are additional factors controlling for household access to resources. Other accessibility variables - whether there is an agricultural cooperative in the community, whether there is a system of traditional assistance among the farmers in the community and whether common transport passes through the community - that may influence

[10] The size of household is used as instrument only in the regressions with the agriculture expenditures as outcome variables.

[11] In the context of our study, this is plausible (for the second type of instruments) if the participation in off-farm self-employment activities is viewed as a livelihood strategy to cope with shocks. In addition, some explanatory variables used as accessibility variables - which could mitigate the potential direct effect of distance on outcome variables - are already controlled for in the regressions. We nevertheless recognize that it may be difficult to find valid instruments, giventhat variables often used as instruments are more likely to directly affect outcomes variables.

both the outcomes and the decision of the households to participate in off-farm self-employment activities, are controlled for. Dummies for agro ecological zones and for regions are also included in X to account for environmental or geographic conditions.

V. Results and discussion

In what follows, we present and discuss regressions results for the selection equation (objective 1) along with the differential impact of participating, i.e. the treatment effects (objective 2). Because of the different structures of the models used, the differences induced in the outcome variables, the estimated coefficients of the selection equations to be interpreted, are not uniform. However, it is reassuring to note that the estimation results from each selection equation are not systematically different in general. Also, given that the estimation of the treatment effects depend on these estimations methods, in the following section we first discuss some results from these methods.

5.1. Estimations diagnosis

We report in the last part of the tables A2 to A6 in the Appendix, estimates for the correlation coefficients between the error term of the selection equation and the error term of the outcome equations. We also report the likelihood ratio test for joint independence of these equations. Two observations are highlighted. First, the ETR results indicate that self-selection may be an issue for all the continuous outcomes variables, as indicated by the significance of the correlation coefficients (Table A3). The correlation coefficients obtained from the ESR corroborate the same either for $\rho 1$ or $\rho 0$ for all the continuous outcomes variables[12] (Tables A2 and A4). They have the same negative sign implying that $\sigma_{1u} < 0$ and $\sigma_{0u} < 0$. The results suggest that participant agricultural households have higher agricultural expenses, higher food energy (kcal) consumption and higher food consumption expenditures than they would have if they did not participate in an off-farm employment activity. However, they tend not to do better than the population average for households with a self-employed member. In fact, households who participate are below average in terms of agricultural and food consumption expenditures and food energy (kcal) consumption in both treatment levels, but they do better when involved in an off-farm employment activity. Non-participant agricultural households are above average in terms of agricultural and food consumption expenses and food energy (kcal) consumption in both treatment levels, but would do better if involved in an off-farm employment activity (see Trost, 1981; Fuglie and Bosch, 1995).

Second, irrespective of the self-selection issue, the likelihood ratio test shows that the selection equation and the agricultural expenditures equations are statistically and significantly jointly determined (Table A2 and A3). The evidence of dependence between the equations is proof of

[12] $\rho 0$ are significant at a 20% significance level for the agricultural expenses outcome variables.

additional endogeneity. It is also an indication that the hypothesis of interdependency between the farm and off-farm sectors is justified in our sample. The presence of further endogeneity in equations involving the continuous indicators of food insecurity is not evident throughout the ESR model (Table A4). The likelihood ratio test statistic does reject the null for joint independence of the selection equation and the food energy (kcal) consumption equations, only in the ETR model (Table A3). In general, endogeneity is likely in the estimations involving the continuous outcomes, the binary outcomes (Table A5) and the count outcomes (Table A6). In most of the cases it comes from either self-selection or other sources as revealed by the joint dependence of the equations, and we would do better to take this into account. The few exceptions of absence of endogeneity are the cases of some indicators of food insecurity where the correlation coefficients are only significant between the 15% and the 25% significance level and particularly the case of the food gap equations (Table A6).

5.2. Factors determining off-farm self-employment activities

We report in Table 3 the probit estimation results of the agricultural household decision to participate in an off-farm self-employment activity. Both the independent and the jointly estimated probit coefficients - the selection equations - are reported. Table 3 shows that factors influencing the household decision to participate in off-farm self-employment are: the size of the household, education, the ethnicity of the household head, land size, non-agricultural assets, non-labour income, the existence of a financial institution in the community, the availability of common transport through the village, the household distance to the capital of the department of residence, price shocks and geographic shocks.

Table 3: Probit models for determinants of participation in off-farm self-employment activities

	Independent probit	Jointly estimated probit							
		With continuous outcome				With binary outcome		With count outcome	
	Participation 1/0	Log (Exp_input)	Log (Exp_hired labor)	Log (pcFood_ Cons_ kcal)	Log (pcFood_ Cons_ exp)	Propensity to hire labor	Propensity to fail into food insecurity (<2200 kcal)	Food gap	Dietary diversity
Female headed	-0.115	-0.063	-0.289	-0.120	-0.078	-0.132	-0.075	-0.120	-0.101
Age of head	0.003	0.003	0.001	0.003	0.003	0.002	0.004	0.003	0.003
Size of household	0.045***	0.054***	0.051***	0.036***	0.047***	0.054***	0.045***	0.045***	0.040***
Education	-0.016*	-0.015*	-0.014	-0.017*	-0.015	-0.017**	-0.017*	-0.016*	-0.009
Haoussa	0.395***	0.350***	0.477***	0.337***	0.394***	0.426***	0.402***	0.391***	0.286***
Landless	-0.065	-0.082	-0.009	-0.034	-0.021	-0.051	-0.065	-0.062	-0.180
Land size (ha)	-0.006	-0.008*	-0.006	-0.006*	-0.006	-0.006*	-0.006	-0.006*	-0.005
Livestock	-0.003	-0.008	-0.002	-0.005	-0.002	-0.003	-0.005	-0.003	-0.002
Wealth index	0.101**	0.097**	0.062	0.128***	0.095**	0.108***	0.121***	0.100**	0.091**
Log (non-labour income)	0.015**	0.013*	0.015	0.008	0.014*	0.019***	0.011	0.015**	0.013*
Finance institution	-0.391***	-0.407***	-0.598***	-0.471***	-0.353**	-0.391***	-0.452***	-0.391***	-0.776***
Agri cooperative	-0.024	-0.028	-0.150	-0.021	-0.026	-0.029	-0.002	-0.025	-0.010
Assistance_trad	0.016	0.035	0.047	-0.060	-0.017	0.022	-0.012	0.015	-0.225***
Transport	-0.198**	-0.131*	-0.084	-0.093	-0.178**	-0.186**	-0.161*	-0.196**	-0.189**
Cereal bank	-0.163**	-0.117	-0.196*	-0.087	-0.140*	-0.172**	-0.155*	-0.159*	-0.083
Sharecropper	0.144	0.123	0.087	0.068	0.145	0.149*	0.116	0.142	0.015
Distance	-0.007***	-0.004***	-0.007***	-0.004**	-0.007***	-0.004***	-0.007***	-0.007***	-0.004***
Idio_shock	0.023	0.003	0.070	0.106	0.080	-0.098	0.084	0.006	-0.036
Prices_shock	0.154*	0.058	0.148	0.043	0.131	0.185***	0.122	0.138	0.156*
Geo_shock	-0.157**	-0.128**	-0.343***	-0.166**	-0.189**	-0.112**	-0.154*	-0.185	-0.156**
Constant	0.650**	0.393	1.152***	0.607**	0.654**	0.434	0.589*	0.659**	0.473**
Pseudo R2	0.1197								
Observations	1,942	1,942	1,121	1,835	1,890	1,942	1,835	1,942	1,942

Notes: agro ecological zones dummies and region dummies are included in the regressions. Survey weights included.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.

The likelihood of participating in off-farm self-employment increases as the size of the household increases. This is probably attributed to the availability of surplus labour in the house that could push some members of households to work off the farm in order to complement income. This result is consistent with that is found by previous studies in other countries (Nagler and Naude, 2014). Agricultural households having an educated member with low years of schooling are more likely to be involved in an off-farm self-employment activity. Since we define participant household as those having at least one member involved in off-farm self-employment, it is expected that the more the members are educated the higher the probability of participation in the wage labour market (Yunez-Naude and Taylor, 2001) and the less is the household's participation in low-skilled self-employment. This is consistent with the literature that schooling increases the likelihood of non-farm wage employment comparatively more than self-employment (Beyene, 2008).

The ethnicity variable is positive and significantly related to the household's decision to participate in off-farm self-employment activities, consistent with previous studies (Yamaguchi, 2010; Zhang and Zhao, 2015). Belonging to a social network or having social relations seems important and a good motivation for the development of off-farm businesses in Niger, as it is more likely to be found among the Haoussa ethnicity. Another motivation or push factor inducing households to look for a remunerative activity off the farm is the availability of land. Holding less agricultural land increases the household's probability of participating in off farm employment, although the effect is significant at the 10% level.

Farm households with more non-labour income and more non-agricultural assets are more likely to undertake a self-employment activity off the farm. The result is in line with previous studies which found, for example, that financial constraint is an impediment for non-farm self-employment (Escobal, 2001; Ali et al., 2014). However, the existence of a financial institution in the community seems to negatively impact on the probability of participating in businesses activities. This result may indicate that there are some negative factors inherent to banks or microfinance institutions within the community that could possibly discourage agricultural households from additionally diversifying their activity off the farm. One anecdotal explanation comes from religion. Nigeriens are mostly Muslim, and marabouts (Islamic holy man) prohibit interest, which deters people. Directly available and costless financial resources such as nonlabour income may then lessen the burden encountered by farm households when looking for credit and thus motivate them more to start off-farm activities. It could also be argued that off-farm self-employment opportunities do not increase in communities with banks or microfinance institutions because agricultural households are able to directly finance their agricultural expenditures through these institutions, and so they do not need to work off the farm.

Self-employment opportunities are higher in communities without a cereal bank and in villages where no common transport passes through. This may suggest a livelihood behaviour of some agricultural households in these seemly isolated communities or villages. It may also reflect businesses opportunities for them to sell for those who are not able to diversify and not able to travel so far. Farm households residing far from the capital of the department are less likely to diversify into off-farm employment activities, as is also found in previous studies (Bhatta and

Årethun, 2013; Ghimire et al., 2014). Location or the proximity of the households to the capital thus seems an important factor influencing their decision to participate, as it may be a favourable opening for business opportunities.

Households negatively affected by unexpected changes of prices of food, inputs and outputs are more pushed to look for additional business activities off the farm while those negatively affected by geographic shocks such as natural disasters are less likely to undertake an off-farm activity. Nagler and Naude (2014) do not find any evidence of the effect of prices shocks and geographical shocks using the same database. We explain the difference in results as due to the fact that we use a sample of agricultural households who are more likely to deal with unfavourable agricultural production environments (Mathenge and Tschirley, 2015). Our result may reflect the fact that farm households view the possibility of participating in additional off-farm business as a livelihood strategy to cope with specific shocks, as is found in other studies (Demeke and Zeller, 2012). However, they might be less able to adopt the same strategy under difficult-to-insure aggregate shocks such as floods, droughts or pests. In the following, we examine the implication of the participation decision on the different outcome variables - our second research question.

5.3. Treatment effects from off-farm self-employment

We analyse the average treatment effects as derived from the ESR (probit), the ETR (continuous) and the PETR (count) models. We report in Table 4 and Table 5 the treatment effects respectively for the agricultural expenditures and for food insecurity indicators. Table A7 in the Appendix includes results of the average treatment effects from the ESR for the continuous outcomes. We first discuss the estimates from the continuous outcomes given that two different estimations methods are used for these outcomes. There is a difference, in the estimated treatment effects in terms of magnitude, between the ESR and the ETR. The average treatment effect on the treated (ATT) and the average treatment effect on the untreated (ATU) from the ESR (Table A7) are always lower than those estimated with the ETR (Table 4) except for agricultural input expenditures. The difference between the treatment effects calculated with the ESR and the ETR are also noticeable in terms of the direction of the impact, particularly for the continuous indicators of food insecurity (Table 5 and Table A7).

Contrary to the case of the ETR, the treatment effects from the ESR are derived using the equations (11) and (12). These treatment effects may be thus sensitive to either (a) the estimated coefficients of the outcome equations for participant households and non-participants, (b) the estimated covariance terms and (c) the Inverse Mills Ratios (IMRs) which are also evaluated at $Z\alpha$ (see tables A2 and A3). The full information maximum likelihood (FIML) method we used corrects for inefficiency relative to the ML estimation. However, it has been shown that FIML parameter estimates are usually somewhat more biased when the model is mis-specified (West, 1986, p. 369). This could be an additional explanation for the difference between the treatment effects obtained from the ESR and the ETR. We recall that the ETR model we estimate is described as a constrained endogenous switching model that imposes

homogenous selectivity between participants and non-participants. Thus, in order to check whether that assumption holds - i.e. whether the estimation of the ETR is more justified than that of the ESR - we perform a joint Wald test of a cross-equation constraint on the estimated correlation coefficients ($\mathrm{Ho}: \rho 1 = \rho 0$) and the estimated covariance terms ($\mathrm{Ho}: \sigma_{0u} = \sigma_{1u}$), after the estimation of the ESR. The tests show that the estimated correlation coefficients and the estimated covariance terms are not statistically and significantly different between participants and non-participants in all the continuous outcomes equations, except for the agricultural input expenditures equations (Table A2 and Table A4 in the Appendix). For all the reasons highlighted above we can thus rely confidently on at least the estimated treatment effects from the ETR.[13]

Now let's analyse the implications of the decision to participate in off-farm self-employment in terms of agricultural expenditures. Table 4 shows that agricultural households which participate in an off-farm self-employment activity would have spent about 32028 FCFA[14] less on non-labour agricultural inputs if they had not participated. The ATU estimates shows that farm households who did not participate would have spent about 28907 FCFA more on non-labour agricultural inputs if they had participated. We observe the same trend concerning the second type of crop expenditures, spending on hired labour. Farm households who actually participated in off-farm self-employment would have spent on average about 26191 FCFA less on hired labour, if they had not participated. Likewise, the ATU shows that farm households who did not participate in off-farm self-employment would have spent about 28344 FCFA more on hired labour if they had participated.

Table 4: Average treatment effects: Agricultural expenses

Estimation methods	Treatment effects	Outcome variables					
		Agricultural input expenditures		Expenditure on hired labour		Propensity to hire labour	
ETR (continuous) / ESR (probit)	ATT	32,027.570	*	26,190.96	***	-0.390	***
		(16,560.33)		(9,313.354)		(0.006)	
	ATU	28,906.570	**	28,344.09	***	-0.476	***
		(13,846.910)		(7,954.896)		(0.009)	

Notes: ATT is the average effect of the treatment on the treated and ATU is the average effect of the treatment on the untreated. The average treatment effects are derived from tables A3 and A5 in the Appendix, using the Endogenous Treatment-Regression (ETR) for the continuous outcomes and the Endogenous Switching Regression (ESR) for the binary outcome.
Standard errors in parentheses.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.
Source: Authors' calculations using ECVMA-2011 data.

[13] Also, it is worth noting that our calculation of the treatment effects from the ESR model, involving logarithmic and exponential terms, may be another reason for the difference in the estimated treatment effects in terms of magnitude.

[14] The Franc de la Communauté Financière Africaine (FCFA) is the local currency with a fixed exchange rate to the Euro; 655.957 FCFA = 1 Euro.

The results from the ESR probit in Table 4 indicate that the treatment effects for the propensity to spend on hired labour are significantly negative. Participant households have about a 39% lower probability to spend on hired labour compared with the counterfactual case of not participating. Those who actually did not undertake any off farm self-employment activity would also have about a 48% lower probability to spend on hired labour in the case that they did participate in that activity. Our results are similar to previous studies that have used different estimations methods and have found a positive effect of participation in non-farm activities on the use of inputs (Oseni and Winters, 2009; Stampini and Davis, 2009).

Particularly in this study, in the case of the specific type of input that is non-family labour, we consider both the estimated average treatments effects for the expenditure on hired labour - that indicates the effects of intensity in use of that input - and the estimated average treatment effects in terms of the probability to use that input. Accordingly, the estimated ATT and ATU for non-family labour reported in the two last columns of the Table 4 suggest that, on average, agricultural households decrease their propensity to hire labour when diversifying into an off-farm self-employment activity but participants who still need non-family labour further increase their expenditures on hiring labour. An alternative explanation is that, for some agricultural households, there is a trade-off in terms of the type of agricultural expenditure to make when considering getting involved in off-farm self-employment activities. The cash income from off-farm self-employment activities may have the effect of relaxing the liquidity constraint. The alleviation of this constraint may thus induce these farm households to reallocate the available resource by spending more in purchased inputs and by reducing the number of labourer hired on farm or the hours of labour hired.

Table 5: Average treatment effects: Food insecurity indicators

Outcome variables	Treatment effects	Estimation methods		
		ETR (continuous)	ESR (probit)	PETR (count)
Per capita food consumption (energy kcal)	ATT	335.741 *		
		(179.094)		
	ATU	355.1602 **		
		(168.4081)		
Propensity to fail into food insecurity (<2200 kcal)	ATT		-0.011 ***	
			(0.003)	
	ATU		-0.307 ***	
			(0.006)	
Per capita food expenditures adult equivalent	ATT	32,143.86		
		(24,191.59)		
	ATU	29,513.33		
		(22,838.28)		

Food gap	ATT	-0.61
		(2.031)
	ATU	-0.63
		(1.209)
Dietary diversity	ATT	0.037
		(0.124)
	ATU	-0.01
		(0.113)

Notes: ATT is the average effect of the treatment on the treated and ATU is the average effect of the treatment on the untreated. The average treatment effects are derived from tables A3, A5 and A6 in the Appendix, using the Endogenous Treatment-Regression (ETR) for the continuous outcomes, the Endogenous Switching Regression (ESR) for the binary outcome and the Poisson regression with Endogenous Treatment Effects (PETR) for the count outcomes. Standard errors in parentheses.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.
Source: Authors' calculations using ECVMA-2011 data.

The implications of participation in off-farm self-employment in terms of food security are analysed. Table 5 shows the treatment effects for the five indicators used in this study. The expected food energy (kcal) consumed by participant households is higher than what would be consumed if not participating. Also, non-participant households would have consumed more food energy (kcal) had they participated in an off-farm self-employment activity. Indeed, the average treatment effects for the per capita food consumption (kcal) of the participant and the non-participants households are significantly positive with the ETR. The result suggests that participation significantly increases food consumption by an average of 336 kcal for every member in participant households. A non-participant household member would have consumed on average about 355 more kcal of food if they had participated. It is important to note that while the food consumption (kcal) of participants and non-participants increases with respect to the counterfactual cases, it does not mean that all agricultural households who consume more kcal are eventually food secure. We check this by analyzing the results from the probit ESR.

The average treatment effects from the probit outcomes (ESR probit) show that every member in participant households have on average about 1% higher probability of consuming more than 2200 kcal of food - the national level of food insecurity - compared with the counterfactual case of not participating. Every member of an agricultural household who did not actually undertake any off-farm self-employment activity would have on average about a 31% higher probability of consume more than 2200 kcal had they participated in that activity. Hence, even if participation in off-farm self-employment increases per capita food consumption energy kilocalories, it reduces food insecurity by only 1%.

We are not able to draw a conclusive outcome with regard to the results concerning per capita food expenditures and the two count outcomes of food insecurity. Participation in off-farm self-

employment on average increases per capita food expenditures. However, both the average treatment effects (with the ETR) are positive but not statistically significant. On average, participation decreases the number of months with a food gap and increases diet diversity, but the average effects are small and not statistically significant. While these effects seem to be zero on average, it may be the case that there are some sub-groups of agricultural households for which the effects are statistically significant. Our results are in line with the general conclusion of previous studies that off-farm income increases food security, nevertheless in different ways (Babatunde and Qaim, 2010; Owusu et al., 2011; Mishra et al., 2015).

VI. Conclusions and policy implications

Like many agricultural-based countries, Niger is characterized by a context of scarce resources, imperfect factors markets, food insecurity and unemployment. Particularly in rural areas, farm households face constraint in terms of inputs and climate change that may hinder agricultural production and threaten food security. A rural exodus also results from a lack of formal and decent wage employment. The way to enhance agricultural production and improve food security while at the same time increasing employment is still an important policy question in rural Niger. This concern is reflected in the new interest of the government through the initiative 3N called "Nigeriens Nourishing Nigeriens". The initiative focuses on creating conditions conducive to dealing with all risks to food and nutrition security and to ensuring that the agricultural sector is the vehicle for social transformation and economic growth.

In this study, we have used a trend observed in rural Niger to analyze whether and how the development of the rural non-farm economy, i.e. the promotion of non-agricultural rural employment, would not conflict with the objectives of other agricultural or food security policies. Low-skilled self-employment is evolving in Niger and continues to be the most accessible off-farm opportunity for rural households. This is likely to be more the case in the future as a result of the rural farm households' livelihood strategy to diversify income sources. We have examined whether and how increasing self-employment opportunities in rural Niger benefit the agricultural sector and contribute to food security in rural Niger. We have provided more understanding on the causes and consequences of off-farm self-employment opportunities in rural areas to inform policy.

We have found that farm-related factors such as price changes of inputs and outputs and constraints relating to land size and cereal banks are push factors for off-farm self-employment opportunities in rural Niger, revealing the existence of a linkage between the farm and non-farm sectors. Other drivers for off-farm self-employment opportunities found are social relations, finance and proximity. Credit constraints, infrastructure and location are thus entry barriers for agricultural households' participation in off-farm self-employment in Niger.

With regard to the consequences of off-farm self-employment opportunities, we have found that participation in off-farm self-employment activities on average increases agricultural expenditures on purchased inputs. Agricultural households decrease their propensity to hire labour when diversifying into an off-farm self-employment activity but participants who still

need that input further increase their expenditures on it. Involvement in self-employment activities decreases food insecurity but only through an increase in food consumption (kcal). Off-farm self-employment opportunities thus favour food accessibility without having any additional effect on food availability and food utilisation as measured by the number of months of food gaps and diet diversity.

This result suggests that positive linkages between the farm and non farm sectors are likely in rural Niger. There is thus scope to increase or create favourable conditions for the development of the non-farm sector in rural Niger. Initiatives for the promotion of rural entrepreneurship should be encouraged as we have found that non-participant agricultural households are above average in terms of agricultural and food consumption expenditures and food energy (kcal) consumption, in both treatment levels, and would do better to be involved in an off-farm employment activity. Financial and infrastructure constraints that are entry barriers to agricultural households' participation in off-farm self-employment in Niger should be taken into account by the National Employment Promotion Agency. As non-farm self-employment activities in rural Niger are predominantly low-skilled, policies to increase the level of technology and the skills of rural dwellers through training programs, for example, may also be beneficial to the rural non-farm sector. This is because there could be increased productivity effects in this non-farm economy, better agricultural linkages and indeed, stronger structural transformation of the economy.

In addition, any program to promote off-farm self-employment in rural areas in Niger should be combined at least partly with agricultural and social protection policies, as off-farm self-employment opportunities benefit the agricultural sector and food security. This may be a rural alternative and cost effective strategy of alleviating agricultural constraints and also reducing food insecurity. The Ministry of Agriculture, the National Employment Promotion Agency and the Ministry of Population, Promotion of Women and Child Protection each has its own policy strategy. Yet, they may develop and implement complementary programs intended for agricultural households and in synergy with the recent initiative 3N that seeks to reduce food insecurity through agricultural investments - such as partial or total subsidies of inputs and equipment -, revolving credit and a warehouse receipt system for small producers. For instance, the warehouse receipt system should receive more attention as this system is intended, among others, to ease access to credit for farming households to undertake income generating activities whose profits should be used in the purchase of agricultural inputs.

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Appendix

Table A 1: Definition of the variables

Explanatory variables	
Size of household	Number of household members
Female headed	Gender of household head
Age of head	Age of household head
Education	Years of schooling of the member of household with the highest education
Haoussa	Dummy if household belongs to Haoussa ethnicity=1; 0 otherwise
Landless	Dummy if household has not owned any land =1; 0 otherwise
Land size (ha)	Total landholdings (ha)
Wealth index	First principal component of indicators of household asset variables (vehicles, home characteristics, furniture, and household appliances)
Livestock	Tropical Livestock Units TLU (1 TLU equals 1 cow/horse, 0.8 donkeys and 0.2 sheep/goat)
Log (non-labour income)	Log of income from non-employment work and transfer
Finance institution	A bank/microfinance institution exists in the community=1; 0 otherwise
Agri cooperative	An agricultural cooperative exists in this village =1; 0 otherwise
Assistance_trad	There is a system of traditional assistance among the farmers in the community =1; 0 otherwise
Transport	Common transport pass through the village =1; 0 otherwise
Cereal bank	A cereal bank exists in the community =1; 0 otherwise
Share cropper	There are sharecroppers in the village =1; 0 otherwise
Exclusion restrictions	
Distance	Household distance in kilometers to Capital of Department of Residence
Idio_shock	Household negatively affected by idiosyncratic shocks: illness, death of a family member, or loss of employment =1; 0 otherwise
Prices_shock	Household negatively affected by price shocks: unexpected prices changes of food prices, input and output prices =1; 0 otherwise
Geo_shock	Household negatively affected by geographical shocks: natural disasters such as floods, droughts, or pests =1; 0 otherwise

Table A 2: Estimated coefficients from Endogenous Switching Regression (ESR): agricultural expenses

	Log (Exp_input)			Log (Exp_hired labor)		
	Participation 1/0	Participant households	Non-participant households	Participation 1/0	Participant households	Non-participant households
Female headed	0.095	-0.586	-1.569***	-0.288	-0.167	-0.134
Age of head	0.003	-0.022	0.006	0.001	0.003	0.014***
Education	-0.007	0.048	-0.033	-0.014	0.045***	0.009
Haoussa	0.294**	-0.605	0.217	0.478***	-0.164	-0.459
Landless	-0.136	0.621	-0.160	-0.009	0.389	0.046
Land size (ha)	-0.006	0.033***	-0.023*	-0.006	0.020***	0.009**
Livestock	0.003	0.044	-0.059**	-0.002	0.060***	0.020***
Wealth index	0.109	-0.114	0.394***	0.062	0.208***	0.225***
Log (non-labour income)	0.012	-0.055	-0.034	0.015	-0.014	0.006
Finance institution	-0.492*	1.123**	0.184	-0.600***	0.042	0.174
Agri cooperative	-0.006	0.472	-0.220	-0.150	-0.073	0.293
Assistance_trad	0.040	-0.684**	-0.238	0.046	0.084	-0.253
Transport	-0.092	-0.593**	-0.870***	-0.085	0.117	0.204
Cereal bank	-0.108	0.172	0.775***	-0.194*	0.177	0.250
Sharecropper	0.064	0.290	0.849***	0.087	0.052	-0.254
Distance	-0.003***			-0.007***		
Idio_shock	0.026			0.067		
Prices_shock	0.023			0.146		
Geo_shock	-0.067			-0.341***		
Size of household	0.035			0.051***		
Constant	0.373	13.827***	10.515***	1.158***	10.239***	8.091***
Observations	1,942	1,942	1,942	1,121	1,121	1,121
sigma (□)		3.768***	2.787***		1.361***	1.359***
□j		-0.980***	-0.233		-0.609**	-0.584
LR ratio test of indep. eqns. (khi2)			4.83**			3.27*
Prob > chi2			0.028			
Log pseudolikelihood			-4979207.7			-2105098.3
Wald chi2			160.65***			159.74***
Test (Ho: □1 = □0 and □$_{0u}$ = □$_{1u}$)						
Wald chi2			35.91***			0.03
Prob > chi2			0.00			0.99

Notes: Agro ecological zones dummies and region dummies are included in the regressions. Survey weights included.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.

Table A 3: Estimated coefficients from Endogenous treatment-regression (ETR): Continuous outcomes

	Agricultural expenses				Indicators of food insecurity			
	Log (Exp_input)		Log (Exp_hired labor)		Log (pcFood_cons_kcal)		Log (pcFood_cons_exp)	
	Participant households	**Non-participant households**	**Participant households**	**Non-Participant households**	**Participant households**	**Non-participant households**	**Participant households**	**Non-participant households**
Female headed	-0.886*	-1.478**	-0.172	-0.131	-0.028	-0.038	0.024	-0.03
Age of head	-0.018**	-0.002	0.003	0.014***	0.002	0.002	-0.001	0.001
Size of household					-0.051***	-0.064***	-0.024***	-0.020***
Education	0.043*	-0.021	0.045***	0.009	0.001	-0.001	-0.005	0.001
Haoussa	-0.379	-0.198	-0.159	-0.462**	-0.071	-0.032	0.019	-0.034
Landless	0.567	0.05	0.388	0.047	0.003	-0.093	-0.072	0.014
Land size (ha)	0.036***	-0.022	0.020***	0.009**	0.004**	0.001	0.001	0
Livestock	0.031*	-0.053*	0.060***	0.020***	0.012***	0.007**	0.012***	0.005*
Wealth index	-0.077	0.242	0.209***	0.224***	-0.002	-0.007	0.088***	0.116***
Log (non-labour income)	-0.042**	-0.057**	-0.014	0.006	-0.001	-0.008	0.002	-0.005
Finance institution	1.002***	0.68	0.033	0.178	0.129	0.236**	0.152***	0.112*
Agri cooperative	0.438	-0.25	-0.076	0.293	-0.042	0.095	-0.029	0.051
Assistance_trad	-0.692***	-0.343	0.084	-0.253	0.051	0.052	-0.066*	0.014
Transport	-0.629***	-0.811**	0.116	0.204	-0.014	-0.034	-0.012	0.025
Cereal bank	0.03	0.923***	0.174	0.251	-0.047	0.029	0.013	0.05
Sharecropper	0.398*	0.778**	0.054	-0.255	-0.100*	-0.113*	-0.066*	-0.017
Constant	13.576***	8.842***	10.232***	8.079***	8.288***	7.299***	13.125***	12.238***
Observations	1,942	1,942	1,121	1,121	1,835	1,835	1,890	1,890
sigma (□)		3.386***		1.357***		0.601***		0.382***
□j		-0.771***		-0.593***		-0.820***		-0.384*
LR ratio test of indep. eqns. (khi2)		132.71***		18.19***		13.8***		2.69
Log pseudolikelihood		-5078618.2		-2105120		-1981497.4		-1633716.4
Wald chi2 test		13921.66***		55246.4***		328694.83***		2154988.89***

Notes: Agro ecological zones dummies and region dummies are included in the regressions. Survey weights included.Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.

Table A 4: **Estimated coefficients from Endogenous Switching Regression (ESR): continuous indicators of food insecurity**

	Log (pcFood_cons_kcal)			Log (pcFood_cons_exp)		
	Participation 1/0	**Participant households**	**Non-participant households**	**Participation 1/0**	**Participant households**	**Non-participant households**
Female headed	-0.117	-0.017	-0.078	-0.064	0.032	-0.034
Age of head	0.002	0.001	0.003*	0.002	-0.001	0.001
Size of household	0.033***	-0.053***	-0.055***	0.046***	-0.027***	-0.017**
Education	-0.016	0.002	-0.006	-0.014	-0.004	0
Haoussa	0.325***	-0.099	0.064	0.391***	-0.006	-0.005
Landless	-0.07	0.013	-0.133	-0.017	-0.06	0.005
Land size (ha)	-0.007**	0.005**	-0.001	-0.006	0.002	0
Livestock	-0.005	0.012***	0.005	-0.002	0.012***	0.005
Wealth index	0.127***	-0.01	0.038	0.094**	0.080***	0.125***
Log (non-labour income)	0.009	-0.002	-0.005	0.014*	0.001	-0.004
Finance institution	-0.479***	0.167	0.105	-0.355**	0.187***	0.084
Agri cooperative	0.006	-0.038	0.101	-0.040	-0.024	0.049
Assistance_trad	-0.042	0.051	0.033	-0.028	-0.063	0.008
Transport	-0.118	-0.006	-0.065	-0.169*	-0.004	0.017
Cereal bank	-0.094	-0.033	0.004	-0.126	0.021	0.043
Sharecropper	0.048	-0.109*	-0.110*	0.154	-0.076*	-0.007
Distance	-0.005**			-0.007***		
Idio_shock	0.089			0.129		
Prices_shock	0.073			0.114		
Geo_shock	-0.094			-0.151*		
Constant	0.725**	8.358***	7.754***	0.667**	13.204***	12.347***
Observations	1,835	1,835	1,835	1,890	1,890	1,890
sigma (□)		0.655***	0.436***		0.422***	0.353***
□j		-0.927***	-0.123		-0.659*	-0.088
LR ratio test of indep. eqns. (khi2)			2.69			1.71
Log pseudolikelihood			-1955249.6			-1630148.5
Wald chi2 test			117.41***			200.23
Test (Ho: $\square 1 = \square 0$ and $\square_{0u} = \square_{1u}$)						
Wald chi2			2.08			1.24
Prob > chi2			0.35			0.54

Notes: Agro ecological zones dummies and region dummies are included in the regressions. Survey weights included.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.

Table A 5: Estimated coefficients from Endogenous Switching Regression (ESR): Binary outcomes

	Propensity to hire labour (1/0)		Propensity to fall into food insecurity (<2200 kcal) (1/0)	
	Participant households	Non-participant households	Participant households	Non-participant households
Female headed	-0.082	0.132	0.240	0.266
Age of head	0.006**	0.006**	-0.002	-0.002
Size of household			0.116***	0.126***
Education	-0.019**	-0.025**	0.013	0.015
Haoussa	0.119	0.064	0.093	-0.186
Landless	0.111	-0.295	0.010	0.430
Land size (ha)	0.014**	0.004	-0.009*	0.003
Livestock	0.013	0.028**	-0.031***	-0.020
Wealth index	0.290***	0.327***	-0.073	-0.105
Log (non-labour income)	0.018**	0.016**	0.002	0.008
Finance institution	-0.621***	-0.291*	-0.330*	-0.290
Agri cooperative	-0.030	0.127	0.061	-0.270
Assistance_trad	0.048	-0.085	-0.064	-0.217
Transport	0.046	-0.095	-0.077	0.099
Cereal bank	-0.002	-0.003	0.095	0.039
Sharecropper	0.039	0.092	0.329***	0.207
Constant	0.710*	2.200***	-1.643***	-0.550
Observations	1,942	1,942	1,835	1,835
□j	0.915***	1***	0.595***	0.066
LR ratio test of indep. eqns. (khi2)		10.04***		2.64
Log pseudolikelihood		-1978714.4		-1902384.6

Notes: Agro ecological zones dummies and region dummies are included in the regressions. Survey weights included.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.

Table A 6: Estimated coefficients from Poisson regression with endogenous treatment effects (PETR): Count outcomes

	Food gap		Diet diversity	
	Participant households	Non-participant households	Participant households	Non-participant households
Female headed	0.217	-0.148	-0.007	-0.052
Age of head	-0.004	-0.002	-0.001**	0
Size of household	0.037**	0.025	-0.002	0.002
Education	0	-0.038**	0	0.001
Haoussa	-0.243*	0.037	0.096***	0.060***

Landless	-0.173	0.047	0.019	0.025
Land size (ha)	-0.005	-0.006	0	0
Livestock	-0.003	-0.004	0.007***	0.004***
Wealth index	-0.285***	-0.123	0.021***	0.020*
Log (non-labour income)	0.005	0.016	0.002	-0.001
Finance institution	0.093	-0.055	0.013	0.059**
Agri cooperative	-0.144	-0.292*	-0.003	-0.017
Assistance_trad	-0.017	0.325*	-0.040**	-0.039
Transport	0.052	-0.167	0.055***	0.009
Cereal bank	-0.015	-0.068	0.019	-0.003
Sharecropper	0.156	-0.122	-0.044***	0.004
Constant	-0.708	-0.024	2.162***	2.061***
Observations	1,942	1,942	1,942	1,942
sigma (□)		0.900***		0.001
□j		0.163		0.885***
LR ratio test of indep. eqns. (khi2)		0.12		32.17***
Log pseudolikelihood		-4254307.7		-4658968.5
Wald chi2 test		302.13***		177163.69***

Notes: Agro ecological zones dummies and region dummies are included in the regressions. Survey weights included.
Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.

Table A 7: Average treatment effects from the endogenous switching regression (ESR) model: Continuous outcomes

Estimation methods	Treatment effects	Outcome variables			
		Agricultural input expenditures	Expenditures on hired labour	Per capita food consumption (energy kcal)	Per capita food expenditures adult equivalent
ESR (continuous)	ATT	97.454	13706.46 ***	-97.760 ***	9724.922 ***
		(435.431)	(3404.084)	(11.268)	(1120.165)
	ATU	41133.55 **	13953.03 **	-84.538 *	-4710.266 *
		(17387.74)	(6112.732)	(51.031)	(2533.401)

Notes: ATT is the average effect of the treatment on the treated and ATU is the average effect of the treatment on the untreated. The average treatment effects are derived from tables A2 and A4 in the Appendix, using the Endogenous Switching Regression (ESR) for the continuous variables.
Standard errors in parentheses. Significant level are indicated with *** p<0.01, ** p<0.05, * p<0.10.
Source: Authors' calculations using ECVMA-2011 data.