Market participation of smallholders and the role of the upstream segment: evidence from Guinea

CAMARA, Alhassane

International Food Policy Research Institute, Cheikh Anta Diop University

April 2017

Market participation of smallholders and the role of the upstream segment: Evidence from Guinea

Alhassane CAMARA[1]

April 2017, Dakar

JEL: Q12, Q13, Q18

Abstract:

Despite theoretical advances in analyses on smallholder participation, little attention is paid to the marketing of staple food grains and the role of upstream segment. In this study, we argue that participation does not depend only on a well-functioning output market, but also on efficient and low-costs production factors. In this context, transaction costs in output market are part of total costs including those in factors markets. Therefore, the decision whether to participate or not in output market, is based on the effective margin associated to participation. Using survey data from the cereal sub-sector in Guinea, results indicate that market price of food grains must sufficiently overweight unit production costs to motivate smallholders to be market-oriented, otherwise they would prefer to meet their own consumption needs. Access to transportation equipment, adoption of technology and adherence to farmers' organizations are determinant when promoting market participation.

[1] International Food Policy Research Institute, West and Central Africa Office; Cheikh Anta Diop University, Dakar Senegal
Email: papalhas@gmail.com; a.camara@cgiar.org; Titre 3396 lot 2, Almadies, Dakar, Senegal; BP: 24063

Introduction

The transformation of agriculture through switching from low productivity (semi-subsistence agriculture) to high productivity (market-oriented agriculture) formed a major topic of development and agricultural economics for many years (Barrett 2008). The argument is that the shift of semi-subsistence agriculture toward market orientation[2] can significantly boost the income and increase the welfare of smallholder farmers as well as contribute to economic growth and poverty alleviation. (Zhou & al., 2013)

However, in Sub-Saharan Africa, semi-subsistence agriculture remains high; around 90% of the agricultural output is produced by semi-subsistence farming (Torero, 2011)[3]; revealing that most of African smallholders produce more staple food grains to meet firstly their own consumption and then put the rest on markets. In the literature, factors limiting smallholder market participation have been discussed for a long time, but there are still some gaps that justify further researches to hone understanding about smallholders' motivation to be market-oriented. In a coherent theoretical framework, the pioneer work by Goetz (1992) has pointed out that transaction costs such as transportation costs, search costs associated with access to market, and smallholders assets[4]endowment, are factors influencing market participation. Recent empirical studies (Azam & al. 2012; Martey & al. 2012; Mmbando & al. 2015) supported Goetz's findings in different contexts[5]. However, Jaleta & al. (2009) brought attention to the fact that smallholder market participation requires not only perfect output markets but also efficient and low-cost factor markets that can capture the true opportunity costs of inputs. In this vein, Winter-Nelson & Temu (2005), by studying input markets, have shown that constraints[6] linked to access to fertilizer markets may raise transaction costs that can differ from those prevailing in output markets; what may jeopardize intensification process and mitigate marketed supply. Based on that result, Alene & al. (2008) mentioned that Goetz (1992) and a few previous studies (Key & al.,2000; Vakis & al.,2003) have overlooked the role of market production shifters – fertilizers for example – in generating marketable surplus when analyzing market participation of smallholders.

---

[2] As mentioned by Jaleta et al. (2009), market participation does not focus only on cash crop production but also includes production and marketing of staple food. The reason is that in some circumstances, imperfections in markets can prevent a full specialization in cash crop.

[3] Cited by Aragie & McDonald (2014).

[4] Such as land, machinery and transport equipment.

[5] Goetz (1992) for Senegal, Azam and al (2012) for Cambodia, Mmbando and al (2015) for Tanzania. This is a non-exhaustive list of studies based on seminal work by Goetz (1992).

[6] In the Tanzanian context, authors found that constraints related to access to fertilizer markets located in towns, while farmers are in remote villages, imply different travel costs for inputs and outputs (Winter-Nelson and Temu, 2005).

In addition to production shifters markets like fertilizers, and improved seeds, transaction costs may appear in rural labor markets that can raise labor costs at farms level, and then mitigate production of marketable surplus. In fact, recent literature on developing countries has pointed out that large proportion of agricultural households hire external labor[7] even when they rely heavily on unpaid family labor and suffer from imperfections in rural labor market (Dillon & Barrett 2014; Bedemo & al., 2013; Kaur 2012). Furthermore, within developing countries, one of the features of rural labor markets is the lack of institutional framework which permits the establishment of formal enforceable contracts based on information on both smallholders and workers. Theoretically, the lack of information on workers may create two problems: (i) the productivity of diverse workers is not observable with certainty (adverse selection), (ii) work effort is not completely observable, verifiable (moral hazard), (DeSilva, & al., 2006). In terms of implications, adverse selection leads to recruiting costs (search, screening) while moral hazard can lead to monitoring costs (supervision) or to paying efficiency wages to guarantee great efficiency at work. For example, Kaur (2012) explained empirically a downward nominal wage rigidity in agricultural labor market by pointing out the presence of efficiency wages; and (DeSilva, & al., 2006) showed the existence of supervision costs measured by opportunity costs of time of family members in charge of monitoring hired labor at work.

In this research, we analyze the participation of smallholders in staple food grains market in Guinea Republic while stressing on the role of factor markets. Unlike previous studies, we argue that market participation does not rely only on well-functioning output market (downstream), but also on low-costs production factors[8] (upstream). Indeed, in some circumstances, smallholders may get access to purchased inputs like fertilizers, seeds or other chemicals and hired labor at higher costs due to transaction costs[9]. In this context, transaction costs in output market are part of total costs including those in factor markets. Therefore, the decision (ex-ante) whether to participate or not in output market, is based on the expected effective gain[10] associated to participation. More specifically, the rational behavior is that market price of food grains must sufficiently overweight unit production costs to motivate smallholders to be market-oriented, otherwise they would prefer to meet their own

[7] Agricultural households' demand for external labor may be motivated by the lack of family labor supply during a peak season (Kaur 2012) or during production stages requiring labor intensively such as weeding or plant preparation (Parker & al., , 2009)Recently, Dillon & Barrett (2014) showed that in Niger, Malawi and Uganda, more than 40% of farm households hire labor.
[8] (Jaleta & al., 2009)
[9] In some other cases, they cannot get access to input market because of higher transaction costs or missing markets.
[10] Spread between market price of food grains and unit-production costs.

consumption[11] needs. In other words, if the food market is unfavorable or if there is food shortage, farmers can sell or consume their own production. (Handschuch et al. 2015). This hypothesis is plausible and relevant to be tested since stylized facts revealed that in Guinea, (i) local input market (fertilizers, improved seeds and other chemical products) is very tight and when producers get access to inputs they incur transactions costs due to transportation costs and isolation of production zones[12];.. (USAID, 2006, 2015)

Although the Ebola Virus Disease (EVD) crisis[13] (started in 2013 and ended in 2015) raised constraints in farming activities through reducing labor force[14] and raising costs to reach markets, the agricultural sector, and particularly the cereal subsector in Guinea faces longstanding constraints that limit productivity and prevent farmers from benefiting from market opportunities offered by the growing population –urbanization. In fact, agriculture in Guinea is dominated by small farmers using traditional systems (low mechanization, low use of fertilizers and improved seeds) based essentially on rainfall.

About 80% of the labor force is in agriculture[15] while the sector is estimated to produce 12% of GDP. Agricultural production is broadly driven by cereals- a production of 3.3 million tons over 2.8 million hectares. The cereal sub-sector is mainly led by rice and maize productions that represent respectively 58.1% and 20.4% of cereal production and 57.8% and 18.9% of land affected to cereal crops[16]. Recent literature on value chains in the main cereal-producing regions, revealed that about 84% of rice farmers reported using no fertilizer and 69% do not apply crop protection inputs; only 0.2% use improved seeds. On the other hand, only 2% of maize farmers reported using fertilizer. Almost all harvesting and threshing is done manually, which requires more labor. (USAID, 2015)

Aware of such situation, the government is striving to promote the development of cereals value chains with focus on rice, through implementing programs and projects that emphasize the enhancement of the productivity of farms and the commercialization of agricultural commodities.

---

[11] Cereals (particularly rice) are important in consumption habits in Guinea. It's also been revealed that Guinean consumers prefer and are willing to pay a price premium for domestically produced rice. (USAID, 2015).

[12] In general, inputs are imported from foreign countries by private firms (individual or societies), projects or government in collaboration with development partners; and most of input sales outlets are based in Conakry and other urban areas away from production zones where the quality of roads is bad. Another explanation of higher costs of inputs in Guinea is linked to fluctuation and continuing depreciation of the local currency. (USAID, 2006)

[13] . In the short term, the Ebola crisis In Guinea leads to 12,000 jobs lost in the transport sector and over 40,000 jobs in the potato sector (USAID, 2015).

[14] According to the WHO (December, 2015), in Guinea 2,536 deaths have been recorded and 3,804 have been declared.: http://apps.who.int/ebola/current-situation/ebola-situation-report-23-december-2015

[15] Agriculture only includes crop culture and hunting activities.

[16] Annual statistics reported by National office for statistics in 2013 and 2014: http://www.stat-guinee.org/index.php/documents-publies/annuaire-stat

In this context, an empirical investigation on better understanding of participation of smallholders in food grains markets would be useful to design strategies enhancing the development of economically important value chains and would be also a notable contribution to literature.

The paper is organized as follows: section 1 overviews the literature on market participation analysis, section 2 presents the theoretical model, empirical specification and data, and section 3 presents results and concluding remarks.

Literature review

For many years, analyses on smallholders' market participation have drawn researchers' attention both in developed and developing countries. The literature on this topic is shifting from analyses that focus on transaction costs in output markets toward those including transactions costs both in input and output markets. But there are still gaps that justify further researches to hone understanding about smallholder motivation to be market-oriented.

From the pioneer work by Goetz (1992) till recent years, literature on this topic has highlighted the role of transaction costs in the choice of market regimes (net sellers, net buyers or autarky). Two large categories of transactions costs were highlighted (Vakis & al.,2003; Key & al.,2000): proportional (PTC) and fixed transaction costs (FTC). Proportional transaction costs depend on transacted volume. They include transportation costs and time spent to deliver output to the market. Thus, they reduce price effectively received when selling output. On the other hand, fixed transaction costs are invariant to the volume of the transaction. They include information, negotiation and monitoring costs. Information costs are related to aspects such as searching for potential buyers and/or better price. Negotiation costs rely on time spent to bargain output price or wage, reach an agreement and decide for payment. Monitoring costs arise to enforce conditions of contract or exchange.

Goetz (1992) constructed a switching model to analyze Senegalese smallholder participation in coarse grain market. The rationale behind his analysis is that smallholders face two decisions. Firstly, they must decide whether to participate[17] or not and, secondly, they must determine quantities to be sold or bought[18]. The hypothesis is that factors influencing sales are the same that affect the decision of whether to participate or not, but the opposite is not true since the second stage of decision can only be affected by proportional transaction costs. In other words, determinants of sales are a sub-set of those affecting participation decision. Empirically, Goetz used a probit model to identify determinants of market participation and he estimated supply and demand functions using OLS regression, conditional on regimes of market participation. As main results, he showed that better market information has positive and significant effect on the probability of being a seller, and the access to technology increases sales.

[17] As seller, buyer or autarkic.
[18] Intensity of participation.

Following Goetz (1992), Key & al.(2000) developed a structural model where producers can be net sellers, net buyers, or prefer to stay out of market (autarky). The choice of regimes of market participation is based on comparison of expected utilities in each regime. The innovation brought by authors is about separating effects of proportional transaction costs from those of fixed transaction costs when estimating a structural model. Using data from the corn sector in Mexico[19], estimation results indicated that transaction costs are determinants of smallholders' participation.

Using the same theoretical framework as Goetz (1992) but extended by Key & al.(2000), Ouma & al. (2010) investigated determinants of smallholder's participation[20] in the banana market both in Rwanda and Burundi. The methodology is based on a two-step procedure by Heckman (1979). Findings showed that market participation decision and sales are influenced negatively by transaction costs associated with transportation and market information costs. The price seemed to provide a significant incentive to supply banana in these areas.

Olwande & al. (2015) aimed at (i) understanding drivers of smallholders' entry in maize, kale and milk markets and (ii) analyzing and comparing factors influencing sales by commodities. The theoretical model is inspired by that from Key and al.(2000) but updated within the context of Southern Africa by Barrett (2008). The core framework describes an agricultural household relying on its own production and purchased goods, and maximizing utility function under income constraint coming from sales and off-farm activities. Using the Double Hurdle Model (DHM) by Cragg (1971) without overlooking unobserved heterogeneity, the authors found that household's physical resource endowments[21] and reliable rainfall are determinants of smallholders' participation in maize, kale and milk markets in Kenya.

Burke & al. (2015) proposed an innovative approach in modelling market participation decision. The rationale behind their method is that traditional Double Hurdle Models (DHM) based on a two-stage procedure and utilized in previous studies considers producers of a specific commodity. According to the authors, it would be relevant to know how policies enhancing market participation of producers of a specific commodity may encourage non-producers to become producers and then sellers; yet the DHM overlooks such question. To fill this gap, Burke & al. (2015) introduced the Triple Hurdle Model (THM) where (i) the decision whether to produce or not is determined using a probit model, (ii) the decision to be net seller

[19] Data collected in a national survey conducted in 1994 by the Mexican Ministry of Agrarian Reform.
[20] Here market participation includes decision to participate or not and sales conditional on participation.
[21] Land, transport and irrigation equipment, technology.

or net buyer or autarkic is determined through an ordered probit model and (iii) the volume of participation is a lognormal function. Applying their model to dairy market in Kenya, the authors found that rural electrification, training, and improved grazing practices enhance market participation of dairy producers.

Martey & al. (2012) analyzed market participation and sales among maize and cassava farmers in Ghana. Unlike earlier studies, the authors analyze market participation empirically using Household Commercialization Index (HCI)[22]. Owing to the large number of zeros in sales data, a Tobit model has been applied to estimate sales equation. Results showed that transaction costs related to market access and extension services are key determinants of sales.

Unlike studies presented above, there are authors that highlighted the role of transactions costs in input markets when analyzing participation of smallholders in output markets.

Winter-Nelson & Temu (2005) argue that imperfections in fertilizer markets can limit the participation of smallholders in output market. The rationale behind their analysis is that in some contexts, transactions costs in fertilizer markets may raise and can even be higher than those in output markets; it results in low use of fertilizer, which mitigates the production of marketable surplus. Using data from Tanzanian coffee growers and estimating a sample selection model, results mainly indicated that output prices affect positively input purchases and that travel costs in input and output markets have distinct effects on input usage.

In Kenya, Alene & al. (2008) studied smallholders' participation in output and input (fertilizer) markets in maize sector. Following Key & al.(2000), the contribution of authors is about analyzing effects of transaction costs both on marketed supply and fertilizer use in the same theoretical framework. The argument is that constraints associated to access to production shifters such as fertilizer may jeopardize maize production and mitigate marketable surplus production. Using Heckman (1979) selection model, results indicated that transaction costs have negative effects on market participation and sales. High costs related to transportation or access to market information lead to low use of fertilizer and limited participation in maize market.

However, these authors may overlook part of transactions costs in upstream segment as they focus mainly on fertilizer markets while transactions costs may exist in other factor markets (credit, labor for example), since the recent literature in developing countries highlights the

[22] The index measures the extent to which household crop production is oriented toward the market.

recurrence of imperfections in those markets (Dillon & Barrett, 2014; Ali, & al., 2014; Kaur 2012).

Theoretical model and empirical specification

Theoretical Model

In this study, we start with an extension of the Goetz (1992) model by Alene & al. (2008). The theoretical model is a simple static agricultural household model that overlooks some aspects of household decision, particularly the role of risk and intra-annual credit constraints. However, we invoke non-separability[23] hypothesis owing to the existence of multiple imperfections in markets.

Let's assume that the rational representative agricultural household produces one commodity. At the beginning of the agricultural season, it makes its plan (ex-ante) about production, sales, consumption and input purchases (fertilizer, labor, and other tradable factors) following market information (output price, wages, fertilizer price,). As both input and output markets suffer from imperfections, the prices in those markets include transactions costs[24]. Then, the objective of the household is to maximize a utility function (1) of net revenue under production technology constraint (2).

$$U = U\left(p_q Q - cX - wL\right) \qquad (1)$$

$$F\left(Q, X, L, Z\right) = 0 \qquad (2)$$

Where p_q is farmer's specific output price; this price is (i) heterogeneous among smallholders and (ii) determined endogenously by observed market price (p_{mq}) and proportional transaction costs per unity of output (φ_q^v) (Olwande & al. , 2015):

$$p_q = p_{mq} - \varphi_q^v$$

Let's consider φ_{mq}^f as fixed transaction costs at entry in output markets, φ_{mf}^f is fixed transaction costs at entry in factor markets.

Q is the volume of output[25], X_i is the volume of input and c is the unit input costs and may include transactions costs in input market, L_i is the volume of hired labor, w_i is the unit cost of

[23] In the non-separable model, household production decisions are influenced by its consumption behavior (preferences, demographic characteristics…). In the opposite, a model is said to be separable when production decisions are completely independent from consumption decisions. The household first maximizes the profit and then uses generated profit as a component of income to set its demand for commodities. In this particular case, the model is said to be recursive.

[24] In output market, transactions costs such as travel costs diminish the price while in factor market they raise price paid by farmer.

[25] Or value of output

labor and also may include transactions costs due to imperfection in labor market, and Z is a vector of household characteristics that include (non-tradable factors like land, family labor, geographical status…). Output is described by a well-behaved production such that $\partial Q/\partial X_i > 0$ and $\frac{\partial^2 Q}{\partial^2 X_i} < 0$. Marketed surplus Q^s is assumed to be equal total output (Q) less output consumed (Q^c) (Goetz , 1992): $Q^s = Q - Q^c$.

The utility function can be written as:

$$U = U\left(p_{mq}Q^c + \left(p_{mq} - \varphi_q^v\right)Q^s - cX - wL - \varphi_{mq}^f(m_q) - \varphi_{mf}^f(m_f)\right)$$
$$m_q = \begin{cases} 1 \text{ if } Q^s > 0 \\ 0 \text{ otherwise} \end{cases} \quad (3)$$

Following Goetz (1992) and Alene & al. (2008), the first order conditions of the maximization of the utility function under constraint (2) will yield reduced forms of the system of input demand (fertilizer, hired labor, other tradable factors) and output production and market supply. Usually, output supply and input demand are jointly estimated, Sadoulet & de Janvry (1995) have showed that it is possible to focus on output market participation in presence of transaction costs without dealing with all the system[26]. It results in the following of marketed supply[27], conditional on participation in output market:

$$m_q = f_1\left(p_{mq}, c, w, \varphi_q^v, \varphi_{mq}^f, \varphi_{mf}^f, Z\right) \quad (4) \quad \text{Participation}$$
$$Q^s = f_2\left(p_{mq}, c, w, \varphi_q^v, Z\right) \quad (5) \quad \text{Sales}$$

Rewriting

$$m_q = f_1\left(mg_q, \varphi_{mq}^f, \varphi_{mf}^f, Z\right) \quad (6)$$
$$Q^s = f_2\left(mg_q, Z\right) \quad (7)$$

with $mg_q = \frac{p_{mq} - c - \varphi_q^v}{w}$,

mg_q expected margin per unit of output

[26] The distinguishing feature of agricultural household decision is that in presence of imperfections (transaction costs) in markets, production, sales, consumption and input purchases depend on household characteristics; therefore non-separability decisions can be tested if output supply is influenced by household characteristics, which also affects consumption decision, production decision.

[27] Here we derive participation and sales in output market as it is of interest. However, one may be interested in participation in both input and labor markets; if so, the same approach can be used.

Thus, market participation[28] can be understood as discrete comparisons of expected utilities and it will be determined by (i) expected margin per unit of output and (ii) by household characteristics.

Empirical specification

In empirical literature review, two approaches are often used to estimate two-stage decision processes. Basically, the main difference between these methods is due to the treatment of zeros in data on sales for nontrivial fraction of smallholders. The first, Heckman (1979) selection model, is based on the assumption that zeros come from unobserved data due to non-random sample from survey, non-response in survey or sample attrition. The second, Double Hurdle model (DHM) (Cragg, 1971) considers zeros as observed data since they can reflect rational decisions of smallholders to stay out of the markets owing to multiple factors preventing access to market such as insufficient expected net gain from selling. Following our theoretical framework, we assume that the DHM is suited to analyze market participation of smallholders.

Following Garcia (2013), in Hurdle model, the single mechanism that determines the choice whether to participate or not (y>0 Vs y=0) can be different from that influencing sales. This can be summarized in two steps as follows:

Decision of participation: the smallholder decides to sell or not a positive quantity (Y^*)

$$P \begin{cases} =1 & \text{if } Y^*>0 \text{ or } (mg^*_q>s) \\ =0 & \text{if } Y^*=0 \text{ or } (mg^*_q <= s) \end{cases} \qquad (12)$$

$Y^* = E_i\phi + \mu$; Y^* = inobserved sales ; mg^*_q =inobserved margin, s =inobserved threshold

P potential seller or not, P is not observed

Choice of quantity: then it decides the optimal amount to buy

$$Y_i \begin{cases} = X_i\theta+\varepsilon_i & \text{if } P=1 \\ =0 & \text{otherwise or (if } P=0) \end{cases} \qquad (13)$$

Y observed quantity

With

$$u_i \approx N(0,1);\ \varepsilon_i \approx N(0,\sigma^2)\ ;\ corr(u_i, \varepsilon_i)=\rho$$

[28] As we will focus on cereals that are produced by all producers, we do not analyze producers decision.

Where Z and X are vectors of explanatory variables affecting decision of participation and sales respectively; $Y_i$is the observed quantity (or sales) sold by smallholder and is a dependent variable continuous over positive values. The model can be reduced as:

$$Y_i \begin{cases} = X_i\theta+\varepsilon_i \quad \text{if min } \left(X_i\theta+\varepsilon_i, Z_i\phi+\mu>0\right) \\ = 0 \quad \text{otherwise} \end{cases} \tag{14}$$

$$\begin{pmatrix} \epsilon_i \\ u_i \end{pmatrix} \sim N(0,\Sigma),\ \Sigma = \begin{pmatrix} 1 & \sigma_{12} \\ \sigma_{12} & \sigma \end{pmatrix}$$

The log likelihood function for the DHM can be defined and the Maximum Likelihood Estimator (MLE) is used to estimate θ, ϕ and σ where σ=var(ϵ) and the restriction is that v$ar(u)$=1 in order to allow the model to be identified. (See Garcia, 2013)

Past empirical studies mentioned that measurement of transaction costs poses many difficulties owing to the fact that they include variables that are not easily observables in a survey (Key & al., 2000); Alene & al., 2008). However, Vakis & al. (2003) argued that their measurement can be approached using variables related to characteristics of market actors. In this study, we consider proxies of transaction costs such as distance to food market, ownership of transport equipment (motorcycle, bicycle, and car), ownership of communication assets -telephones -. (Alene & al. 2008)

Distance to market is supposed to increase travelling time and transportation costs and then reduce market participation and sales. Ownership of transport equipment is assumed to enhance market participation at both levels since it helps owner gather information when selling; it also facilitates transportation of products from farms to markets. Access to communication assets (telephone) is expected to improve market participation by reducing search costs when seeking buyers.

Other factors that are susceptible to influence market participation are, adherence to farmers' organizations, off-farm income (including salary, income of breeding), composition of household (ratios of dependents, male and off-farm employees in households), adoption of technology in farming activities (utilization of fertilizers), percentage of hired labor in farm labor, share of cereals purchases in household consumption and agro-ecological characteristics.

Finally, our main explanatory variable is the expected margin per unit of output that is supposed to influence positively the participation of smallholders in market. We expect that the higher this relative price is, the more smallholders are market-oriented.

Data

The data used in this research come from the national household survey (ELEP[29] 2012) conducted by the "Institut National de la Statistique" in Guinea. The data had been collected between February and April 2012 and a two-stage stratified random sampling was used to get finally 3,996 urban households and 3,575 rural households. Information on households covered a set of domains including Education, Wealth, Poverty status, Housing, Employment, on-farm activities, income sources, etc…. In addition, the dataset includes prices collected at local levels (outlets).

We focus our analysis on rural areas [30] since most of the agricultural activities are carried on in the rural context[31]. Constraints due to data structure[32] impose to emphasize cereal[33] producers who represent about 96% of farmers. The survey also contains data on commodities market prices collected at village level (local markets).

Table 1 presents statistics of sample. The absolute market price does not seem to be a motivating factor of being market-oriented while the expected margin per unit of output[34] does. In fact, average observed market price that non-sellers face is higher than that of sellers, while the average expected margin per unit of output is higher for participants than for non-participants. This difference result from disparities in factors costs (input costs[35], labor costs) between groups.

Non-sellers seem to have less transactions costs than sellers. Indeed, percentages of households owning transportation and communication equipment are higher among non-sellers than in the group of sellers. The first group is closer (6.92 km) to the nearest food market than the second one (7.81 km).

Furthermore, non-sellers have more off-farm workers in the household than sellers. In fact, the first group has relatively more off farm income and higher percentage of off-farm employees than the second one. The share of cereal purchase in household consumption is higher (14%)

[29] Enquête Légère sur l'Evaluation de la Pauvreté
[30] After dropping missing data, we get a sample of 3,491 rural households.
[31] In the dataset, around 78% of farmers live in rural areas.
[32] In the dataset, the productions are available for groups of commodities such as cereals, tubers and roots, legumes, industrial culture and fruits and vegetables. Furthermore, data on inputs (labor, fertilizer, seeds, etc…) are not decomposed into activities.
[33] Here cereals include rice,maize, fonio, millet and sorghum; however, it must be noted that cereal producers also produce other crops such as fruits and vegetables, tubers and roots and some industrial cultures; as we will see later, for this group of farmers, cereal production represents more than half of total output.
[34] Price net of unit factors costs.
[35] As they are not participants, non-sellers can use off farm income coming from breeding or other paid work (in services,) by household members.

among non-sellers compared to that of the second group (12%). This may show the difference in the contribution of cereal consumption in household welfare between these two groups.

Table 1 Descriptive statistics

Variables	Description of variables	Non-Sellers	Sellers	All	diff	
		mean	*mean*	*mean*		
Rprix_kg	market price of cereals ('000 LC per kg)	6.47	6.42	6.44	-0.05	***
unitcost	Input cost per unity of output ('000 LC per kg)	0.18	0.16	0.17	-0.02	
Va_outp	Value added per unit of output ('000 LC per kg)	6.29	6.26	6.28	-0.03	
Lab_outp	Labor costs per unit of output ('000 LC per kg)	0.69	0.46	0.58	-0.23	
Ginc_outp	Gross margin per unit of output ('000 LC per kg)	5.60	5.80	5.69	0.19	
Pemp	Share of off- farm workers in Household	0.06	0.04	0.05	-0.02	***
Pdepen	Share of children (<=5 years) and the elderly (> 59 years) in Household	0.28	0.28	0.28	0.00	
Pmen	Share of Men in household (>18 & <=59)	0.15	0.17	0.16	0.02	***
Dfert	1 if Household uses fertilizer, 0 otherwise	0.19	0.18	0.18	-0.01	
Dfarm	1 if Household is member of a farm organization, 0 otherwise	0.40	0.55	0.47	0.15	***
Prod_cer	Production of Cereals (tons)	1.15	1.37	1.25	0.22	**
Inc_oth.ag	Income from other agri. commodities sales (millions LC)	0.95	1.06	1.00	0.10	
Inc.off.farm	Off-farm income (millions LC)	1.95	1.49	1.74	-0.45	**
Inc_Elev	Income of breeding (millions LC)	0.28	0.23	0.26	-0.05	
Sup_cer	Land allocated to food grains	2.20	2.16	2.19	-0.04	
Transp	1 if Household owns at least 1 transportation equipment	0.37	0.33	0.36	-0.04	**
Telep	1 if Household owns at least 1 mobile phone	0.35	0.30	0.32	-0.05	***
Phlab	Share of hired labor in total labor employed in farming	0.27	0.40	0.33	0.13	***
Dist	Distance from market (km)	6.92	7.81	7.34	0.89	***
Shar_cer.purch	Share of cereals purchases in household consumption	0.14	0.12	0.13	-0.02	***
Boke	1 if household resides in the region of Boke	0.12	0.12	0.12	0.00	
Faranah	1 if household resides in the region of Faranah	0.06	0.17	0.11	0.10	***
Kankan	1 if household resides in the region of Kankan	0.20	0.06	0.14	-0.14	***
Kindia	1 if household resides in the region of Kindia	0.10	0.22	0.16	0.12	***
Labe	1 if household resides in the region of Labe	0.19	0.09	0.14	-0.10	***
Mamou	1 if household resides in the region of Mamou	0.14	0.07	0.11	-0.07	***
Nzerekore	1 if household resides in the region of Nzerekore	0.18	0.28	0.23	0.09	***
Observation		1,535	1,347	2,882		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results

In this section, we present firstly results on participation analysis and then, secondly, margins effects are presented.

- ***Participation and sales***

Estimation results of DHM using Maximum Likelihood Estimator (see Garcia, 2013) are presented in Table 1. Estimations have been made without overlooking potential heterogeneity issues. The model showed greater significance as illustrated by log likelihood value and lower Mean Absolute Errors (MAE).

Table 2 :Estimation results

		Participation	Intensity
Transp	1 if Household owns at least 1 transportation equipment	-0.0106 (-0.17)	0.291*** (3.53)
Telep	1 if Household owns at least 1 mobile phone	-0.0498 (-0.73)	
Dist	Distance to market (km)	0.376 (1.22)	0.000581 (0.00)
Dfert	1 if Household uses fertilizer, 0 otherwise	0.117 (1.59)	0.315*** (3.39)
Pemp	Off-farm workers Household (share)	-0.742** (-3.08)	-0.276 (-0.77)
Pdepen	Children (<=5 years) and elderly persons (> 59) in Household (share)	0.135 (0.88)	0.0929 (0.44)
Pmen	Adult Men in household (>18 & <=59) (share)	0.454* (2.14)	0.302 (1.01)
Phl	Share of hired labor in farming labor	0.326* (2.38)	0.352 (1.96)
Dfarm	1 if Household is member of a farmer organization, 0 otherwise	0.0968 (1.63)	0.292*** (3.73)
Ln.Inc_oth.ag	Log of other agri. commodities sales (LC)	0.0332*** (7.89)	-0.000428 (-0.06)
Ln.Inc_Elev	Log of income from livestock (LC)	0.00613 (1.11)	-0.0151* (-2.12)
Ln.Inc_offFarm	Log of off-farm income (LC)	-0.00539 (-1.29)	0.00423 (0.70)
Ln.rval	Log of margin	0.162** (3.22)	0.0958 (1.37)
Ln.rval_sq	Square of Log of margin	-0.00803** (-3.23)	-0.00538 (-1.56)
Shar_cer.purch	Share of cereals purchases in household consumption	-0.940*** (-4.28)	-1.982*** (-5.63)
Boke	1 if household resides in region Boke	0.638*** (5.16)	-0.0928 (-0.45)
Faranah	1 if household resides in region Faranah	1.110*** (9.21)	-0.137 (-0.57)
Kindia	1 if household resides in region Kindia	1.144*** (9.90)	-0.300 (-1.23)
Labe	1 if household resides in region Labe	0.338** (2.84)	-1.530*** (-6.93)
Mamou	1 if household resides in region Mamou	0.343** (2.73)	-0.747*** (-3.79)
Nzerekore	1 if household resides in region Nzerekore	0.653*** (5.94)	-0.252 (-1.24)
_cons		-1.084*** (-7.18)	13.48*** (33.36)
N	*Observations*	*2882*	
Log of likelihood		*-1311306.8*	
MAE	*Mean of Absolute Error*	*0.42*	*7.22*

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As expected, the participation of smallholders in the market is positively determined by the margin. In fact, this result reveals that, under given conditions in cereal markets, the price must sufficiently overweight unit production costs to motivate smallholders to be market-oriented.

This result is interesting and supports the fact that if the market price of staple food is unfavorable, then smallholders would consume their own production. (Handschuch et al. 2015).

The socio-demographic characteristics of households also exert influence over the decision of participation of smallholders in the market. Results indicate that the higher the number of off-farm workers in household, the lower the likelihood to sale; and the number of adult men (>18 & <=59) in the household and the number of hired labor in farm labor affect positively the decision to be seller. Furthermore, access to off-farm income (livestock) increases the probability of being market oriented. In fact, off-farm income is an additional resource that can be used to purchase production shifters.

Adoption of technology, adherence to farm organizations and access to transportation equipment influence positively sales, conditional on participation in market. In fact, the utilization of fertilizers (adoption of technology) enhances farm productivity leading to an increase to marketable surplus; furthermore, farmer organizations (i) generally focus on building marketing and negotiation skills of members, and (ii) they can also play the intermediation role to help members in meeting potential buyers;

Smallholders with higher share of cereal purchase in household consumption are less likely to be cereal sellers and even if they participate in market, their sales are relatively less important.

- ***Margin effects***

Estimations of margin effects[36] are presented in the Table below. Results indicate that an increase of 1% in expected margin per unit of output increases the probability of being participant by 0.05 percentage points. Conditional on participation, access to transportation equipment, access to production shifters like fertilizer, and adherence to farm organizations, increase sales by 29.1%, 31.4% and 29.2% respectively.

Table: Estimation of margin effects and elasticity of sales

	Participation		Intensity	
	Coef	Robust-SE	Coef	Robust-SE
Transp	-0.004	0.021	0.291***	0.082
Dfert	0.04	0.025	0.314***	0.092
Dfarm	0.03	0.020	0.292***	0.078
Ln.rval	0.05***	0.017	0.152	0.069

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[36] See Garcia (2013) for more details on margin effects in DHM.

Conclusion

Despite the theoretical advances in analyses on smallholder market participation, little attention is paid to the role of factor market. In this study, we argue that market participation does not depend only on well-functioning output market (downstream), but also on efficient and low-costs production factors (upstream). In some circumstances, smallholders may get access to purchased inputs like fertilizers, improved seeds or other chemicals and hired labor with higher costs due to transaction costs. In this context, transaction costs in output markets are part of total costs including those in input markets. Therefore, the decision whether to participate or not in output market is partly based on the margin associated to participation. More specifically, the rational behavior is that market price of food grains must sufficiently overweight unit production costs to motivate smallholders to be market-oriented, otherwise they would prefer to meet their own consumption needs. Recent stylized facts in Guinea show that input markets (fertilizers, improved seeds) are tight and suffer from imperfections (transportation costs, low supply). Using Guinean national survey data, results indicate that participation of smallholders in cereal market is influenced by state of both output and input markets. More specifically, they showed that expected margin is one of the main determining factors influencing market participation positively. This in line with the view that if the price of staple food is unfavorable, then smallholders would consume their own production. Access to transportation equipment, adoption of technology and adherence to farmers' organizations are also instruments to promote market participation by smallholders.

As recommendations, this research like previous studies, supports policies enhancing transportation infrastructures in rural areas to reduce transaction costs and improve access to market. However, it supports also actions focusing on factor market (upstream) (i) that facilitate access to production shifters like fertilizer at lower costs; (ii) that organize (formalize) rural labor market through the establishment of an institutional framework which promotes the creation of formal enforceable contracts including wages based on workers' productivity.

References

Alene, A.D.; Manyong, V.D.M., Omanyac, G., Mignouna, H.D., Bokanga, M.& Odhiambod, G. (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. Food Policy, 33(4), 318–328.

Ali, D.A., Deininger, K. & Duponchel, M. (2014). Credit Constraints and Agricultural Productivity: Evidence from Rural Rwanda. Journal of Development Studies, 50(5), 649–665.

Aragie, E.A. & McDonald, S. (2014). Semi-subsistence Farm Households and Their Implications for Policy Response. 17th Annual Conference on Global Economic Analysis, Dakar, Senegal.

Azam, M.S., Imai, K. & Gaiha, R. (2012). Agricultural Supply Response and Smallholders Market Participation: the Case of Cambodia. Discussion Paper.

Barrett, C.B. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. Food Policy, 33(4), 299–317.

Bedemo, A., Getnet, K. & Kassa, B. (2013). Determinants of Household Demand for and Supply of Farm Labour in Rural Ethiopia. Australian Journal of Labour Economics, 16(3), 351–367.

Burke, W.J., Myers, R.J. & Jayne, T.S. (2015). A triple-hurdl emodel of production and market participation in Kenya's dairy market. American Journal of Agricultural Economics, 97 (4): 1227-1246.

Cragg, J.G. (1971). Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. Econometrica, 39(5), 829–844.

DeSilva, S., Evenson, R.E. & Kimhi, A., (2006). Labor supervision and institutional conditions: Evidence from Bicol rice farms. American Journal of Agricultural Economics, 88(4) 851–865.

Dillon, B. & Barrett, C.B. (2014). Agricultural factor markets in Sub-Saharan Africa: an updated view with formal tests for market failure. Food Policy, 1–39.

Goetz, S.J. (1992). A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa. American Journal of Agricultural Economics, 74(2), 444–452

Garcıa, B. (2013) Implementation of a double-hurdle model. The Stata Journal 13(4), 776–794.

Handschuch, C. et al. (2015). Traditional Food Crop Marketing in Sub-Saharan Africa: Does Gender Matter ? The Journal of Development Studies ISSN: 0022-0388 (Print) 1743-9140

Heckman, J. (1979). Sample Specification Bias as a Selection Error. Econometrica, 47(1), 153–162.

Jaleta, M., Berhanu, G. & Hoekstra, D. a (2009). Smallholder commercialization: processes, determinants and impact. International Livestock Research Institute, Discussion paper (18),

Kaur, S. (2012). Nominal Wage Rigidity in Village Labor Markets. Columbia University Working Paper,

Key, N., Sadoulet, E. & Janvry, A. De (2000). Transactions costs and agricultural household supply response. American Journal of Agricultural Economics, 82(2), 245–259.

Martey, E., Al-Hassan, R.M. & Kuwornu, J.K.M. (2012). Commercialization of smallholder agriculture in Ghana: A Tobit regression analysis. African Journal of Agricultural Research, 7(14), 2131–2141.

Mmbando, F.E., Wale, E.Z. & Baiyegunhi, L.J.S. (2015). Determinants of smallholder farmers' participation in maize and pigeonpea markets in Tanzania. Agrekon, 54 (1), 96-119

Olwande, J. Smale, M., Mathenge, M.K., Place, F.& Mithöfer, D. (2015). Agricultural marketing by smallholders in Kenya: A comparison of maize, kale and dairy. Food Policy, 52, 22–32.

Ouma, E. John Jagwe, J., Obare, G. & Abele, S. (2010). Determinants of smallholder farmers' participation in banana markets in Central Africa: The role of transaction costs. Agricultural Economics, 41(2), 111–122.

Parker, D.C., Jacobsen, K.H. & Komwa, M.K. (2009). A qualitative study of the impact of HIV/AIDS on agricultural households in southeastern Uganda. International Journal of Environmental Research and Public Health, 6(8), 2113–2138.

Sadoulet, E. & Janvry, A.D. (1995). Quantitative Development Policy Analysis. The Johns Hopkins University Press, Baltimore and London.

Torero, M. (2011). A framework for linking small farmers to markets. Paper presented at the IFAD Conference on New Directions for Smallholder Agriculture. International Fund for Agricultural Development. Italy. 24-25 January 2011. Rome, IFAD HQ.

United States Agency for International Development (2015). "Guinea Value Chain Analysis." Leveraging Economic opportunities, Report #22.

United States Agency for International Development (2006). Situation et perspectives des intrants agricoles en Guinée : Phase 1.

Vakis, R., Sadoulet, E. & Janvry, A. De (2003). Measuring Transactions Costs from Observed Behavior: Market Choices in Peru. California, University. Department of Agricultural and Resource Economics, working paper

Winter-Nelson, A. & Temu, A. (2005). Impacts of prices and transactions costs on input usage in a liberalizing economy: Evidence from Tanzanian coffee growers. Agricultural Economics, 33(3), 243–253.

Zhou, S., Minde, I.J. & Mtigwe, B. (2013). Smallholder agricultural commercialization for income growth and poverty alleviation in southern Africa: A review. African Journal of Agricultural Research 8(22), 2599-2608.