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Selling on Farm or on the Market: What Kind of Arbitrage for Smallholders' Farmers in South-Kivu, Democratic Republic of Congo?

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Abstract

This paper focuses on the different variables that could explain farmers' choices between on farm and off farm sales and the counterfactual gains of each one. The endogenous switching regression model is used to analyze data collected in the South Kivu Province (DR Congo). The results show that the likelihood of selling on the market depends positively on the plot size, the location of the market, market frequency… and negatively on the distance to farm. The average gain of a randomly selected household among the sample of farmers selling on the farm is lower than selling on the market and inversely.

Keywords: intermediaries, market participation, cartel, transaction costs.

1. Introduction

The decision to sell on farm or on the market is an important issue in rural areas that has attracted quite some attention in the literature (Fafchamps and Hill, 2005; Shilpi and Umali-Deininger, 2007; Vakis et al., 2003). This paper identifies empirically the incentives underlying this decision for a sample of South Kivu farmers, in order to outline policy measures likely to improve market participation. A comparison between the value of sales on the market and those obtained if the same farmers would have sold on farm, and vice and versa, sheds a quantitative light on transaction costs in an environment where they are pervasive. Studies on the market participation of rural households already existed several decades ago. Many authors (Bellemare and Barrett, 2006; Boughton et al., 2007; Goetz, 1992; Jagwe and Machethe, 2011; Kandiero and Randa, 2004; Lapar et al., 2003; Mather et al., 2011; Obare et al., 2003; Oduro and Osei-Akoto, 2008) have tackled this question with various methods and, sometimes, with divergent results according to the location and/or the type of products.

The size of the local market in particular, the type of the marketed goods (perishable or not) and the quasi inexistence of infrastructures can affect the producer's decision to sell on the market or on farm (Obare et al., 2003; Shilpi and Umali-Deninger, 2007). The distance constitutes obviously, an important handicap for farmers' participation on the markets (Fischer and Qaim, 2012; Jagwe et al., 2009). When markets are too far away, the sale on farm will be privileged. The quantity produced plays also an important role in creating incentives for the farmers to sell on farm or on the market (Birachi et al., 2011; Fafchamps and Hill, 2005). Many rural areas of the developing countries are indeed far away from the marketing centers of their products.

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So, the intermediaries especially salesmen, play a key role in connecting cities to the countryside and among rural areas themselves. Still, associations of intermediaries give them some market power compared to the producers who, on their side, compete on the market. Increased farmer participation to the market is a key step to fight against rural poverty (Barrett, 2008; Gani and Adeoti, 2011; Lopes, 2010; Olwande and Mathenge, 2012; Siziba et al., 2011). To achieve this challenge of poverty reduction and to improve the living conditions in rural areas, a series of transformations from subsistence agriculture to market oriented agriculture is necessary. The results of the studies on markets participation for corn, breeding livestock, vegetables, fruits and dairy products show that poor households have significantly lower volumes of production due to small plot sizes and lower participation rate on the markets compared to the non-poor ones (Gani and Adeoti, 2011; Lapar et al., 2003; Rios et al., 2008). Poor farmers adopt less new technologies like fertilizers and improved seeds; are less educated, do not have enough productive and/or financial capital and have only a weak access to credit institution. All these combined effects limit production capacities, profits and thus investment of the farmer and exclude real possibilities of taking part at the market (Back et al., 2003; Fischer and Qaim, 2012; Gani and Adeoti, 2011; Lopes, 2010; Olwande and Mathenge, 2012).

In order to achieve its objectives, this paper takes as a methodological starting point the papers by Fafchamps and Hill (2005); Shilpi and Umali-Deininger (2007); Vakis et al. (2003). These studies use either the tobit or the conditional maximum likelihood or the conditional logit for the data analysis. Contrary to those methodologies, the Endogenous Switching Regression Model is used in order to determine the average net gain of the sale on farm/on the market and the average net gain that a random farmer would obtain if he takes an alternative decision in each one of these two cases. By using an instrument, the two stages method avoids the bias resulting from an endogenous variable. The switching regression makes possible to correct the selection bias and to identify the impact of the exogenous variables on the endogenous which is a dummy variable. In other words, the impact of the independent variables (X) is theoretically different according to whether the peasant sells on farm or on market. This method consequently calculates counterfactuals and presents the results allowing the choice of such strategy rather than another.

Our contribution to the literature consists in two points. First, a special attention is given to the analysis of the sale on the market on the net gains received by the farmers and which will be compared with those that they would have received from the sale on farm; and vice and versa. None of these previous studies allows to get such results. It enables to have an empirical base on the modeling of the markets problems in the South-Kivu and how to decide on the selling place in the context of high transaction costs. Second, some specific findings on intermediation give interesting results which are not treated in the existing literature, to the best of our knowledge. The remaining of the chapter is organized in the following way: the second section presents the data resulting from our investigations, the third one describes the methods and tools used and the fourth section presents the results and their discussion. Finally, the conclusion summarizes the results and draws the possible implications for agricultural policies.

2. Data and Descriptive Statistics

Our empirical study is based on a personal survey which took place in 2011 in four territories of South Kivu: Kabare, Kalehe, Idjwi and Uvira. The stratified sampling in three stages was drawn within each territory. Initially, the territory was divided into collectivities. In the second time, the collectivities were subdivided in communities ('groupements') and those in villages. In the last stage, a random sample of 586 producers' households was drawn within 30 villages by respecting the criterion of location relative to the market.

The following table describes the variables used and their principal statistics.

Table 1: Variable description[3]

Variables	Description	Mean	St.dev.
Plot size	Average total plot size in hectare	.85	.81
Age	Age of the head of household	35.73	12.87
Gender	1 if the household is male headed	.42	.49
Marital status	1 if the head of the household is married and 0 otherwise	.77	.42
Household size	Number of household members	7.45	3.19
Distance to the farm	Distance to from the household to farms (in minutes)	41.85	63.69
Distance to the market	Distance from household to markets (in minutes)	48.44	56.75
Market frequency	Market frequency	2.1	1.2
Unsolds	1 if the household had unsold and 0 otherwise	.70	.46
Perishable products	1 if the household sell perishable products and 0 otherwise	.36	.48
Road	1 if the household is near the road and 0 otherwise	.1	.3
Market location	1 if the market is located near the loader gates and 0 otherwise	.67	.47
Selling on the market	1 if the household sell on the market and 0 otherwise	.75	.43
Transaction costs	Costs incurred by the household for commercialization	17083.19	34784.85
Net sales revenues	The effective amount received by farmers after sales	228191.2	275779.1

Source: own computation based on our household survey in Kalehe, Idjwi, Kabare and Ruzizi Plain

The average plot size is very limited, 0.85ha whereas the household size is large, approximately 7 persons. Most of the households, 58 per cent, are headed by women. In South Kivu, women play an important role for the marketing of the agricultural products. Even in the households headed by men, the women and the children are the ones dealing primarily with the transport and the sale of the products on the market. The surveyed population is essentially young, the average age being 36 years. This is due to the high natality rate but also to the low life expectancy resulting from the persistent difficulties of the health system to provide adequate care. Moreover, the farmers marry early. Our data set indicates that 77 per cent of the farmers in the sample are married. The early marriage is also at the base of the very large size of the rural households in the South-Kivu. Our data show that 75 per cent of the households sell on the market but obtain very limited gains (212.7$ us) compared to those selling on farm (275.3$ us). These are small farmers who, because of the distance to the markets, prefer selling on the market rather than on farm in order to have a higher price. Non-monetary transaction costs, like the time spent waiting for the customer at the market and market risks (perishability, theft…) constitute other important aspects constraining the willingness to sell on the market.

The average distance from the households to fields and markets is respectively of forty-two and forty-eight minutes. Having fields far away, those who are the most distant from the markets are surprisingly more numerous to sell on them than those who are closer and sell mostly on farm. This is to some extent a paradox, knowing that prices decrease as one moves away from the markets and in contrast to the existing literature since distance, despite its related costs, does not appear here to be an obstacle per se. Furthermore, 70 per cent of surveyed households have unsold goods. Once the product harvested and brought to the market, the farmer is subjected to many risks in particular about the negotiated price and the possibility of theft. Whereas when the products are still at the farm, the farmers are selling their products but sometimes might not find purchasers.

The market opening frequency is, on average, two days a week. Farmers producing perishable products feel that a market frequency opening of two days a week is insufficient. The perishability of the products strongly decreases the gains for the farmers if they are further away from the loading places of the products (roads, harbor…).

[3]Figures on transaction costs and total revenues are expressed in Congolese francs.

The distance to reach the agricultural access roads is one of the reasons which encourage the farmers to sell on farm. Only 10 per cent of the surveyed households have an easy access to these roads. This is the reason why the intermediary is always a key agent for the marketing of the agricultural products in South-Kivu, being the commercial connection between rural areas but also between rural and urban centers.

3. Methods and Tools for Analysis

According to the problem of selection bias due not only to sample selection and self-selection, the traditional models such as the logit and probit cannot be used for the estimation. The theoretical model of Maddala (1983) with complements brought by Greene (2002) and by Cameron and Trivedi (2005) is used to deal with this problem. Let us note by S, the farmers' decision to sell. The first stage of the selection process, the decision about the location of sale, depends on the relative gains of participating to the market process. It is a dummy variable that we write as follows:

$$S_i = 1 \text{ if } \gamma_{11} + \sum_{j=2}^{m} \gamma_j Q_{ji} + \delta_{1i} \succ 0 \quad (1)$$

$$S_i = 0 \text{ if } \gamma_{12} + \sum_{j=2}^{m} \gamma_j Q_{ji} + \delta_{2i} \leq 0 \quad (2)$$

Where Q_{ji} is a vector of factors j influencing the decision to sell on the market by the household i, γ_j is a vector of unknown parameters, δ_i is an error term of mean 0 and variance σ^2. The two equations determine the decision of selling on the market or on the farm. The second stage consists of defining the regression equation where the explanatory variables X can include some of the Q variables. A sufficient condition of identification is that at least one variable of the set Q is not also in the set X (Cameron and Trivedi, 2005; Maddala, 1983).

The household *i* decides to sell on farm if his utility derived from the sale on farm is higher than that of the market sale. The decision to sell on the market or not is determined by the respective potential gains. The more the market gains increase, the more households will be inclined to sell on the market. Taking into account the fact that the surveyed households produce several goods, the following function determines the value of the entire production. More precisely, the sales net from transaction costs are considered. The equations determining those sales are given as follows:

$$\text{Regime 1: } Y_{1i} = \beta_{11} + \sum_{j=2}^{m} \beta_j X_{ji} + \eta_{1i} \text{ if } S_i = 1 \quad (3)$$

$$\text{Regime 2: } Y_{2i} = \beta_{12} + \sum_{j=2}^{m} \beta_j X_{ji} + \eta_{2i} \text{ if } S_i = 0 \quad (4)$$

Where Y_{1i} is the net sales of household *i* in the group of those who sell on the market and Y_{2i} is the net sales of household *i* belonging to the group who sell on farm. *X* is the vector of factors including the main characteristics of the households (age and gender of the head of household, location…). The selection bias comes from the fact that estimating these equations by Ordinary Least Squares gives estimators that are not consistent (Cameron and Trivedi, 2005; Maddala, 1983). If the household sell on the market, we observe Y_{1i} and $S_i=1$. In this case, Y_{2i} is missing because he cannot make the two decisions at the same time. Inversely, if the household decides to sell his product on farm, we observe Y_{2i}; Y_{1i} is missing. So, the covariance between the error terms δ_{1i}, δ_{2i} and η_{1i}, η_{2i}, can be observed but not the one between η_{1i} and η_{2i}.

The probability that a peasant sells on farm or on the market is not necessarily independent of the expected net sales that he would have at one place compared to the other because of the selection bias (self-selection problem). The choice made by the farmers for a given place can be explained by the observed characteristics and also by random factors. These same factors determine also the outcome from sales on farm or on the market. The error terms in the equations of the place of sale are correlated with those of the equations of the outcome.

For the peasant to participate as a net seller on the market, he will look for the maximum possible expected gain. Mathematically, the problem is formalized as follows:

$$E\left(Y_i \middle| S_i^* \succ 0\right) = E\left(Y_i \middle| \delta_{1i} \succ -\gamma_1 - \sum_{j=2}^{m} \gamma_j Q_{ji}\right) = E\left(\beta_{11} + \sum_{j=2}^{m} \beta_j X_{ji} + \eta_{1i} \middle| \delta_{1i} \succ -\gamma_1 - \sum_{j=2}^{m} \gamma_j Q_{ji}\right) (5)$$

By applying the normal theorem of moments of a truncated bivariate distribution as illustrated in Greene (2002), the error terms η and δ have a normal bivariate distribution of mean 0 and standard deviation σ_n, σ_δ and of correlation level ρ. It follows that:

$$E\left(Y_i \middle| S_i \succ a\right) = \mu_y + \rho \sigma_y \lambda (6)$$

By applying this formula to the second part of the equation (6):

$$E\left(\eta_{1i} \middle| \delta_{1i} \succ -\gamma_1 - \sum_{j=2}^{m} \gamma_j Q_{ji}\right) = \rho \sigma_\eta \lambda(\gamma_\delta) (7)$$

Knowing that $\rho = \sigma_{\delta\eta} \Big/ \sigma_\delta \sigma_\eta$ and that $\lambda = \dfrac{f\left(\dfrac{\gamma_1 + \sum_{j=2}^{m} \gamma_j Q_{ji}}{\sigma_\delta}\right)}{F\left(\dfrac{\gamma_1 + \sum_{j=2}^{m} \gamma_j Q_{ji}}{\sigma_\delta}\right)}$ (8)

To find λ (the inverse mills ratio), the probability law is used because a truncation has to be imposed on our distribution. The estimation of the probability of selling on the market is determined by truncating the distribution of Y towards the lower part as follows:

$$P\left(S_i^* \succ 0\right) = P\left(\beta_1 + \sum_{j=2}^{m} \beta_j X_{ji} + \delta_1 \succ 0\right) = P\left(\delta_1 \succ -\beta_1 - \sum_{j=2}^{m} \beta_j X_{ji}\right) (9)$$

If the error term δ_1 is normally distributed with mean 0 and variance σ^2, dividing the two members of the equation above by σ makes the error term normally distributed with mean 0 and variance 1. This gives:

$$P\left(\frac{\delta_1}{\sigma} \succ \frac{-\gamma_1 - \sum_{j=2}^{m} \gamma_j Q_{ji}}{\sigma}\right) = f\left(\frac{-\gamma_1 - \sum_{j=2}^{m} \gamma_j Q_{ji}}{\sigma}\right) (10)$$

By reference to the Density of a Truncated Random Variable theorem of Greene (2002):

$$f\left(x \middle| x \succ a\right) = \frac{f(x)}{prob(x \succ a)} \text{ With } prob(x \succ a) = 1 - \Phi\left(\frac{a - \mu}{\sigma}\right) (11)$$

Equation (10) above may also be written as f(x), a density function. Knowing relation (11),

we have: $\lambda_{1i} = \dfrac{\phi(.)}{[\Phi(.)]}$ (12)

By replacing each term by its value in our equation (6) gives:

$$E\left(Y_i \middle| S=1\right)=E\left(Y_i \middle| S^* \succ 0\right)=\mu_y+\frac{\sigma_{\delta_1\eta_1}}{\sigma_{\delta_1}}\frac{\phi(.)}{[\Phi(.)]} \quad (13)$$

Let suppose that $\frac{\sigma_{\delta_1\eta_1}}{\sigma_{\delta_1}}=\sigma_{1\delta}$, then, $E\left(Y_i \middle| S=1\right)=E\left(Y_i \middle| S^* \succ 0\right)=\mu_{y_{1i}}+\sigma_{1\delta}\frac{\phi(.)}{[\Phi(.)]}$ (14)

By the same way, the expected gain of regime 2 can be determined as follows:

$$E\left(Y_i \middle| S_i^* \le 0\right)=E\left(Y_i \middle| \delta_{2i} \le -\gamma_2-\sum_{j=2}^{m}\gamma_j Q_{ji}\right)= E\left(\beta_{12}+\sum_{j=2}^{m}\beta_j X_{ji}+\eta_{1i} \middle| \delta_{2i} \le -\gamma_2-\sum_{j=2}^{m}\gamma_j Q_{ji}\right) \quad (15)$$

Imposing a truncation of our distribution above, we determine the probability:

$$P\left(S_i^* \le 0\right)=P\left(\gamma_2+\sum_{j=2}^{m}\gamma_j Q_{ji}+\delta_2 \le 0\right)=P\left(\delta_2 \le -\gamma_2-\sum_{j=2}^{m}\gamma_j Q_{ji}\right) \quad (16)$$

Then:

$$E\left(Y_i \middle| S=0\right)=E\left(Y_i \middle| S^* \le 0\right)=\mu_{y_{2i}}-\sigma_{2\delta}\frac{\phi(.)}{[1-\Phi(.)]} \quad (17)$$

If the covariance between the error terms is statistically significant, then selling on the market or on farm and the income gained by the farmers will be correlated. This implies an endogeneity problem and the null assumption of the absence of a selection bias will be rejected. It is also important to estimate the expected values of the dependent variables for the alternative choice that is the average gain of those who sell on the market and the counterfactual expected outcomes and inversely.

What are our expectations about the sign of the various relations in the model? A positive relationship is expected between the following independent variables and selling on the market: market frequency, intermediary index, perishability of the products and unsold commodities. For the others, distance to the market, distance to the farm, a negative relationship with selling on the market is expected. Other variables like roads, market location, marital status and plot size are expected to influence positively the likelihood of market participation. The gender is expected to influence negatively the household market participation because women are the key agents of agricultural commercialization in South Kivu and so, household headed by them will be likely to participate more in the market.

The effect of age is ambiguous, young farmer can transport himself his products compare to the old ones. On the other hand, old farmers have many resources (land, household labor) and consequently are more likely to participate in the market. Let us confront those expectations with the actual results.

4. Results and Discussion

Tables 2 to 5 present our regression results. We will start by a discussion of the global indicators (table 2) and then turn to the selection equation (table 3) and the outcome equations (tables 4 and 5). These tables have five columns corresponding to the different choices of control variables. The probability for a household of selling on farm or on the market is determined by several characteristics specific to the household but also to the environment in which he lives. The household size, the characteristics of the head of household (age, sex, and marital status), the distance to the market, access to the road and the field, the location of the markets are the main determinants.

The Wald test is significant at 1 per cent, rejecting the independence between the specified equations as described in the table below.

Table 2: Global indicators

	(1)	(2)	(3)	(4)	(5)
σ_0	1.258966**	1.24731***	1.249537***	1.142372	1.080508
	(.087468)	(.0953494)	(.1063867)	(.0931387)	(.0894426)
σ_1	1.120837*	1.116982***	1.117645**	1.09734**	1.00981
	(.0674047)	(.0440863)	(.0624489)	(.0398577)	(.0443122)
ρ_0	-.864110***	-.8493188***	-.8486337***	-.655137***	-.773123***
	(.0707355)	(.070737)	(.1000278)	(.1639235)	(.1134588)
ρ_1	-.7768107*	-.7790865***	-.7799628***	-.792133***	-.594245***
	(.2307882)	(.0936591)	(.1194657)	(.0840599)	(.1611607)
Wald test	40.05***	67.68***	35.52***	64.99***	62.29***
Log likelihood	-869.24	-867.87741	-869.22277	-869.52507	-834.16329
N	500	500	500	500	500

Bootstrapped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In our case, it indicates that the null assumption of the absence of correlation between the error term of the place of sale and that of the net gains can be rejected. The net gains in a given selling place depend on the decision to sell on this place. Thus, the endogenous switching regression model corrects this bias. The correlation coefficient between the error term of the equation of the sale on farm and the one of the sale on the market equation is negatively significant respectively with the thresholds of 5 and 1 per cent. The two categories of sales are thus not affected in the same way by the unobservable characteristics governing the choice of the household (Goetz, 1992). The negative sign of the correlation coefficient in the two equations indicates that, for the farmers who sell on farm, the net gains resulting from the sale on the market would be higher than what they would have obtained while selling on farm. For those who sell on the market on the other hand, it indicates that they would have a lower net gain than the one obtained while having sold on farm. This means that farmers selling on market/on farm have unobserved characteristics that allow them to earn more/less than the average farmers selling on market or on farm (Lee, 1978; Maddala, 1983; Van der Gaag and Vijverberg, 1988).

The following table describes results about the decision to participate on the market by rural households in South Kivu.

Table 3: Selection Equation

	(1)	(2)	(3)	(4)	(5)
Gender	.1328664	.1345388	.1194439	.0858659	.251063
	(.1948563)	(.1740005)	(.1653789)	(.1757184)	(.1723292)
Age		-.0680192			-.0897631
		(.2179944)			(.1583275)
Distance to farm	-.18446***	-.19064***	-.18644***	-.18233***	-.20407***
	(.0546615)	(.0433128)	(.0442574)	(.0601966)	(.047772)
Distance to market	1.18917***	1.17492***	1.13826***	.457809***	1.27149***
	(.3113344)	(.2022471)	(.2373975)	(.060387)	(.2122009)
Household size	-.0713828	-.0701575	-.1013751	-.0764128	.0507883
	(.2095518)	(.2090958)	(.2148559)	(.237879)	(.1946418)
Marital status	-.3781119	-.3764009	-.186268	-.2442006	-.3440289*
	(.2748272)	(.2527152)	(.1934916)	(.2355231)	(.2007098)
Distance to market^2	-.14232*	-.13729***	-.13184***		-.15435***
	(.0561182)	(.0358647)	(.0381125)		(.0368446)
Intermediary	.1688516			-.720117	
	(.3804357)			(.6908552)	
Plot size	.5131601**		.4962733**	.379674**	
	(.2260599)		(.1966125)	(.1923409)	
Intermediary*plot size		.139504***			-.0673371
		(.0524836)			(.0635109)
Market location	.4248363*	.4463527**	.4539258**	.6177366**	.555581***
	(.2417778)	(.1924234)	(.1952665)	(.2426248)	(.1723198)
Perishable	.3011358	.3225265*	.2997435*	.2768428**	.3775335*
	(.2112363)	(.1837945)	(.178612)	(.1120814)	(.2043765)
Unsolds	.592184***	.620742***	.608951***	.621482***	.693635***
	(.1405297)	(.1357081)	(.1153051)	(.1871159)	(.1655635)
Market frequency	.6775992*	.6837274	.6978492	.7614069**	.821978***
	(.3705067)	(.4156562)	(.4294871)	(.3356303)	(.2891422)
Road		-.1764945	-.159164	-.171362	-.1695763
		(.4069044)	(.3007218)	(.2811277)	(.2655852)
Kalehe	1.481743	.933232***	1.04719***		1.22212***
	(.9540501)	(.3506144)	(.3559541)		(.3094284)
Idjwi	.3799351	-.2411053	-.1970622	-1.7670***	-.1297869
	(.8236532)	(.3589542)	(.3334291)	(.2616644)	(.3074729)
Plaine de la Ruzizi	.7202228			-2.117819*	
	(.4538118)			(1.214136)	
Kabare		-.79453***	-.82999***	-3.09966**	-.95433***
		(.2828952)	(.257392)	(1.551687)	(.2939352)
Constant	-3.3600***	-1.95295	-2.31723**	1.99955	-2.2984***
	(.9522333)	(1.311269)	(1.014364)	(2.473179)	(.8639647)

Bootstrapped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The variable distance from the house to the market is significantly positive; meaning a stronger market participation of the households as the distance increases. The same result is in Jagwe and Machethe (2011). This result is contrary to our expectation and with Bardhan et al. (2012); Komarek (2010); Osebeyo and Aye (2014). In South Kivu, the most distant households from the markets count primarily on 'free' family labor to transport their agricultural products to the market. It is clearly an opportunity cost for them if available alternative productive activities exist. But it is considered less important ('cheap labor') compared to the lower gains from selling on farm. In addition to the costs related argument, there is also the incidence of the large price differential according to the location which makes households preferring the sale on the market under the average threshold of 50 minutes of transport time.

For the households who decide to take part in the market in spite of the distance, the opportunity costs related to time for reaching the market, for waiting before selling the products given the customers searching times, are low according to their 'subjective' evaluation compared to a household close by the market but not selling on it. The variable distance to the farm is negatively significant indicating that, the more distant the household to the farm, the fewer farmers sell products in the markets.

An increasing distance to the market influences negatively the sales on the market. The square of the distance is negatively significant at 1 per cent. The more the households are isolated; the lower is the probability of arriving in time at the market and of finding good conditions of sale, and the smaller the motivation to sell at the market. Even if initially the households are considering as low the opportunity cost of going to the market, a continued increase of these costs drives them to sell on farm. This result confirms former studies (Bardhan et al., 2012; Fafchamps and Hill, 2005; Fischer and Qaim, 2012; Shilpi and Umali- Deininger, 2007). The closer a market is from the loader gates, roads and harbor, the higher the probability that a household will sell on the market because he will benefit from a greater demand for its products and of more of transport possibilities compared to more remote markets.

The variable marital status has a negative and significant effect on the probability of selling on the market (column (5) in the table above). This is contrary to our expectation. This could be explained by the fact that the market plays also a social role and thus is a meeting place especially for the single people providing for social and interpersonal exchanges whereas married persons must take care of children and of other tasks at home. This argument is speculative though, since the significance of the coefficient is weak.

When products are perishable, the households' likelihood of taking part to the market is higher. However, the significance of this effect is not always robust. The perishability of the product is indeed a major incentive for selling on the market. If the product is mature and harvest is imminent, selling on the market increases the probability of finding a buyer the same day. This result makes more precise the decision about the place of sale when a crop is perishable. It shows that farmers have better benefits if selling on the market where they can try to negotiate good prices rather than being price takers as suggested by Jagwe and Machethe (2011).

If the households have unsold goods, their probability of selling them on the market increase. In all the territories covered by our investigations, the farmers have declared that the main advantage of the market sale is the importance of the demand coming from the intermediaries and the consumers, the probability of getting rid of the entire product being higher than when selling on farm. This is in contrast with the single "more isolated" demand by an intermediary at the farm.

An increase in market frequency increases the likelihood of market participation for a household. In spite of the fact that agricultural trades are constrained by production cycles, even during the harvest period, the markets are not regular. The increase in market frequencies would help to reduce the problems of adequate conservation infrastructures, of theft in storage facilities (if they exist!). However, the significance of this effect is not always robust. The plot size variable has a positive and significant effect on households' market participation as seller. The households who exploit larger pieces of land have the capacity to produce and sell more on the market than those endowed with a small plot size. This result confirms that of Bahta and Bauer (2012); Jagwe (2011) and Ouma et al. (2010).

In addition, the household's proxy for wealth makes it also easier to support markets transaction costs. This effect is measured by the interaction between variables intermediary and plot size. Precisely, this variable is considered as a proxy of the wealth effect on market participation. A larger plot size for farmers turning to salesmen increases their likelihood of participation to the market compared to those who sell directly to consumers. This result shows that only rich farmers will be able to catch markets opportunities given transaction costs incurred. This result is contrary to that obtained by Shilpi and Umali-Deininger (2007).

The negative and statistically significant coefficients are obtained for the geographical location in various territories: Idjwi, Ruzizi Plain and Kabare (see column (4), for more details). This can be due to many reasons like low production, lack of infrastructures (the case of Kabare and Idjwi) and high transaction costs especially due to barriers in the Ruzizi plain. All these factors reduce the probability of selling on the market by households located in these territories. In the columns (2) and (3) of the same table, the likelihood of selling on the market for farmers located in Kalehe increases because cassava harvests are spread all along the entire year with small quantities sold progressively.

After analyzing the main results from the selection equation, we now present the determinants of selling on farm or on the market respectively in tables 4 and 5 below.

Table 4: Logarithm of sales on farm

	(1)	(2)	(3)	(4)	(5)
Gender	.40737*	.39326**	.41386**	.39971**	.3329105*
	(.22215)	(.16431)	(.16024)	(.17690)	(.1912535)
Age	.26407*	.28702	.29366**	.30542***	.3454643**
	(.14177)	(.18674)	(.14164)	(.11246)	(.1703266)
Distance to farm	.25878***	.25655***	.24884***	.24256***	.215055***
	(.06708)	(.05996)	(.06686)	(.08609)	(.056299)
Distance to market	-.42299***	-.41214***	-.4062***	-.27979***	-.318217***
	(.08137)	(.08628)	(.09167)	(.10609)	(.0857033)
Household size	-.01006	-.02105	.0833	.12225	-.1070827
	(.26222)	(.24486)	(.26196)	(.296493)	(.2302279)
Marital status	.43204	.42641			.3650385
	(.31436)	(.34911)			(.2509232)
Intermediary				.24329	
				(.19368)	
Road			-.04569	-.03022	-.1165925
			(.3966)	(.37604)	(.3421038)
Plot size					1.16595***
					(.2252742)
Constant	9.7316***	-.02124	9.8053***	8.9569***	9.25161***
	(.76676)	(.33889)	(.74302)	(.67735)	(.7613946)

Bootstrapped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Logarithm of sales on the market

	(1)	(2)	(3)	(4)	(5)
Gender	.52432***	.51719***	.53489***	.525866***	.422061***
	(.1048617)	(.1274566)	(.1142096)	(.0869674)	(.1082314)
Age	-.1057313	-.0772521	-.0917101	-.1294434*	-.081367
	(.0975057)	(.0854471)	(.0924152)	(.0748011)	(.1009278)
Distance to farm	.072076**	.07597***	.074629**	.0643279**	.081416***
	(.0323309)	(.0285157)	(.0331115)	(.0327403)	(.0294444)
Distance to market	-.15103***	-.14941***	-.14462***	-.17427***	-.0771607
	(.0552697)	(.0498731)	(.0453736)	(.0399645)	(.048199)
Household size	.1815841	.1728304	.1987814	.2040823	.1317901
	(.2024563)	(.1432256)	(.159844)	(.1947389)	(.1282003)
Marital status	.1504516	.1649616			.0178136
	(.1193874)	(.1253318)			(.1229848)
Intermediary				.265159***	
				(.074437)	
Road			.3217533*	.2296976	.3021597*
			(.1753375)	(.1415679)	(.1624695)
Plot size					.958497***
					(.130256)
Constant	11.925***	.3381653*	11.888***	11.2878***	11.2129***
	(.5367222)	(.1826154)	(.4540659)	(.5939051)	(.4400495)

Bootstrapped standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The gender variable is significantly positive on the sales whatever their location. This is different from our initial expectation. The household being headed by a man increases sales at the market by 52 per cent compared to 40 per cent for sales at the farm. In rural areas, households headed by men are larger in size than those headed by women. Our investigations show that the correlation between the gender and household size is positive.

So, household headed by men are likely to have more family labor and to have more gains from sales than those headed by women.

On the other hand, households headed by women being less endowed in resources, they have lower incomes and favor the self-subsistence strategy compared to those headed by men being more oriented towards a marketing strategy (Jagwe et al., 2009). The age of the household head is also significant for sales on farm but not for sales on the market. The households headed by the elderly sell more on farm than on the market. The elderly are confronted with the inexistence of adequate transport infrastructures. Selling on the market is for them costly and complicated according to market location. For the young farmer, the transport cost is easier to bear, but this factor cannot be influential if they do not produce enough to sell on the market. This variable may be considered as a proxy of wealth by considering that the probability of having more lands, household labor and access to other resources increases with the age. The correlation between age and land tenure being positive, this imply that household headed by elderly are landowners contrary to younger ones. Thus, the older the head of household, the higher is the probability of having accumulated resources compared to a household headed by a young person. This result supports the argument according to which the households having more resources tend to sell more on farm than on the market (Fafchamps and Hill, 2005).

The distance between the household and the farm has an expected positive and significant impact on the sales. The households, distant from their fields and selling on farm, are getting higher net gains of 26 per cent compared to those in the same situation but selling on the market (only 7 per cent**)**.

In other words, the distance to the field increases the sale on farm and consequently, the probability for a given household to sell on the market decreases. Indeed, the data analysis shows that 24 per cent of the surveyed households are located at more than one hour from their respective farms.

On the other hand, the further away household is from the market, the lower are its net sales. They will decrease by 42 per cent for those who sell on farm compared to only 15 per cent for the farmers who sell on market. The longer the distance, the higher the transaction costs and, consequently, the more significant is the fall of the net prices received (Ouma et al., 2010). This diminution is even larger for the farmers selling on farm because of the required sequence of salesmen.

The road access is significantly positive. Household localized near a road increases the net gains from their sales on the market by 32 per cent. The same result was confirmed by the study of Bahta and Bauer (2012) in South Africa who found that having the access to a road increases the sales of 58 per cent. This result shows the advantage of the location near the agricultural access roads.

Finally, we close this section by an extensive discussion on intermediation. This variable has a positive and statistically significant effect for the sales on the market. In other words, the sales for those who sell on the market by referring to a salesman increase by 27 per cent compared to those selling to consumers directly. Salesmen compete more on the market than in the dispersed farms in the villages. Even if the salesman is in a position to exert market power, the quantity sold is controlled by the farmer (Gaspart and Platteau, 2001). If prices are low, the latter offers less on the market or turn to other salesmen. All salesmen anticipate this and this mechanism ensures some degree of competition on the market. On contrary, the dispersion of the salesmen in the village gives to each one the capacity to offer a monopoly price on farm.

In fact, association of intermediaries exists in order to limit this form of competition. They are likely to set cartel prices on the markets. Within an intermediaries' cartel, sanctions exist in the event of deviation from the standards by some members. Still, on the market, the buyer's prices are easier to compare for every seller. This may induce some intermediaries to break the rules (the association fix the ceiling price to buy goods in rural areas) and buy at a price slightly higher than the one fixed by the association. Individual cartel members have always an incentive to break-up the agreement in order to gain more profits by proposing a higher price than the cartel price, in exchange of bigger quantities. The farmers, bringing their products to the market might benefit from this possible weakness of the cartel and might gain more than selling on farm. This result provides an empirical proof of the possible instability of price collusive cartels on agricultural markets. This topic was the subject of several theoretical studies in particular (d' Aspremont et al., 1983; d'Aspremont and Gabszewicz, 1986; Donsimoni et al., 1986; Lambertini, 1996; Prokop, 2009).

The respect of the cartel standards is observed for those who buy on farm because of the weak bargaining power of the farmers. The dispersion of the fields in many villages, weak demand and the transportation costs borne by the intermediary contribute to such weakness. The intermediaries have a way of coordinating the transactions among the villages by attributing exclusive rights to individual members on:

1. Geographical areas: The intermediaries allocate among themselves different territories for the purchase of the agricultural products. Such a behavior is in some sense rational to minimize transport costs and to preserve market power. Within each territory, they allocate among themselves the different communities. The farmers are taking on themselves the transport of cash crops to markets. For those who sell on farm, the urban intermediary can get the product thanks to a rural intermediary or, in extreme case; he/she organizes him/herself for getting the products on the farms.

2. Products to be bought: They organize themselves in association by products that they predominantly want to buy in the rural areas. This creates some homogeneity between intermediaries according to products which can be a source of cartel instability mainly in terms of price rules (Prokop, 2009). This is in some sense rational to limit competition between buyers for the same product to keep a strong bargaining power when facing the farmers.

It should be noted that, if an intermediary wants to buy the cassava and the palm oil, for example, he must affiliate himself to the two associations at the same time and pay the contributions for both. Constraints are of course stronger in this case than when the intermediary affiliates himself only to one association.

Finally, the comparison of gains received by peasants according to selling place is important now. The following table describes the net gains for selling on the market and the counterfactual ones for a randomly selected household.

Table 6: Farmers' gains by selling on farm or on the market (in US $)

Category	Net gains		Counterfactual gains		(a)-(c)	(b)-(d)
	$E(Y_{1i}\|S=1)_{(a)}$	$E(Y_{2i}\|S=0)_{(b)}$	$E(Y_{1i}\|S=0)_{(c)}$	$E(Y_{2i}\|S=1)_{(d)}$		
All	73.86	273.76	10.94	396.33	62.9***	-122.6***
Large	126.75	392.38	27.45	573.77	99.3***	-181.4***
Small	73.13	100.71	16.32	213.20	56.8***	-112.5***

Statistical significance at the 1%, ***, 5%, ** and 10%, *

For a randomly selected household among the sample of farmers selling on the market, our results show that he gains on average 73.86, 126.75 and 73.13 respectively for the pooled, big and small farmers sample; whereas by selling on farm, he would have gained only 10.94, 27.45 and 16.32 for the same three categories. Moreover, a household selected randomly among the sample of farmers selling on farm gains on average 273.76, 392.38 and 100.71 for the pooled, big and small farmers sample, the counterfactual gains for this household being 396.33, 573.77 and 213.2. This means that the household having sold on the market would have gained more on the market than having sold on farm.

By comparing the expected gains for those selling on farm/market and the gains they would have obtained if they had made the alternative decision, the expected gain of selling on the market can be seen to be higher than that of selling on farm. In other words, the expected effect of selling on the market for a given household selected randomly among those actually selling on the market is, respectively of 62.93, 99.31 and 56.81 for the pooled, big and small farmers. On the other hand, the expected gain of selling on farm, for the farmers who actually sell on farm, is lower than what they would obtain while selling on the market. Thus, by selling at the farm instead of selling on the market for a given household selected randomly in the sample of those selling on farm implies gain losses of 122.57 for the pooled, 181.39 for the big farmers and 112.49 for small ones. The correlation coefficient between the counterfactual and transaction costs is positive but not significant. It means that there are some information (like risk premium, opportunity costs of time…) which are missing in our estimation of transaction costs because we took only monetary costs.

Because of the lack of sufficient resources and the very low prices on farm than on the market, the participation to the market as net sellers constitutes an important way to improve the living conditions of the poor households. But, our results show that the difference between the marginal gains between their effective net gains and the counterfactual ones for the farmers who sell on farm and the same marginal gains for those selling on the market is negative. Despite this result, farmers who sell on farm continue to do so because their characteristics are such that selling on farm is more profitable for them. The converse is true for those who sell on the market. Each of them make an optimal choice according to his own characteristics. But these characteristics can be modified by some external factors not included in the model like the opportunity cost of time and the risk premium. For example, given that a big share of production is sold on farm, an improvement of communication infrastructures, thereby a reduction of the opportunity cost of time could induce farmers actually selling on farm to sell from now on the market. Moreover, if the premium risks to sell on the market increases, it will be more costly to those who actually sell on the market to keep doing so. Selling on farm might become more beneficial. The participation effect for small farmers who sell on farm is greater than that of big ones. Small farmers gain 52.76 per cent more by selling on the market in contrast to the big farmers who gain only 31.61 per cent. Such a result shows that market participation will be beneficial to all but more for small farmers than big ones. Small farmers are losing more by selling on farm because they do not produce enough and because the prices on farm are lower than on the market.

For big farmers, although prices on farm are low, they benefit from the large quantities that they can sell. Our study shows that if the marketing of surplus production is facilitated for the farmers of Kabare, Idjwi, Kalehe and the Ruzizi Plain, households would be able to get more gains than that they currently have. On the other side, those who already sell on the market will lose if ever they must sell on farm. In spite of the high transaction costs to which the farmers must face for the commercialization of their products, selling on the market pays for a household randomly selected in the sample whatever its category, large or small, because of the higher expected gain of doing so compared to selling on farm.

5. Conclusion

This paper has presented the analysis of the net effective gains from sales by the households compared to the potential gains which they would have if they are switching from one type of sale to another. The high transaction costs that the farmers must currently support to sell at the market explain why most of the sales carried out by the farmers are made on farm. Knowing those problems and the absence of consistent support to the agricultural sector, which strategy farmers have to adopt in the future?

Our results showed that the difference between the expected gain and the counterfactual one of those who sell on the market is higher than that of those who sell on farm. Selling on farm is giving fewer gains than if the households would sell on the market. In spite of the distance and its related costs, the farmers keep selling on the market in order to benefit from the surplus gains due to the positive price differential which increases with the distance but up to a certain point. This result is contrary to what can be found in the previous literature. But there are however limits to this. If the distance to market is doubled, then households will prefer selling on farm. In this case, the transaction cost effect overrides the price differential effect to such an extent that the household prefers selling on farm. The significant market participation of remote households can be due to the fact that remoteness deprives them from useful price information, number of potential customers and other market characteristics.

Selling on the market, despite the many transaction costs, is the best way to improve rural gains, everything else being equal. But, it is not in general sufficient because of the market exiguity and the low market frequency per week. Market frequency is a strong incentive to market participation. However, before proposing a policy to increase the markets frequency (as well as the number of markets within the territory), it is initially necessary to allow farmers to produce more in order to have a marketable surplus. A considerable effort must also be made on the production side.

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