Transaction costs, information technologies, and the choice of marketplace amongst farmers in northern Ghana

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Abstract

Relatively little evidence is available on the importance of information and the role of Information Communication Technologies (mobiles and radios) in key aspects of marketing behaviours of developing country farmers. We included the concept of proportional and fixed transactions costs within a household framework to investigate market participation decisions of farm households with a marketable surplus of food crops. Differently to previous studies, we also modelled the behaviour of farm gate buyers. We use a novel dataset from Ghanaian farmers, which contains detailed information for individual selling transaction that is seldom available in other household surveys. We found that larger transactions occur at the farmgate, where farmgate buyers are prepared to pay a premium price because of lower fixed transaction costs they incur. The knowledge of market information has a contrasting effect on the decision of the marketplace. In some cases, farmers use the information on prices in specific marketplaces to travel farther, in other cases they sell their commodity in closer market where they may strengthening their bargaining power. Finally we only found weak evidence on the impact of using mobile phones in reducing searching costs and attract farm gate buyers.

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I. Introduction

Relatively little empirical research has been devoted to the role of transaction costs in developing countries given their potential importance in marketing decision. This is surprising since rural markets are often imperfect and transactions costs can be so high that farmers are unable participate in markets, and therefore the market is said to be missing (de Janvry et al.; 1991). In the past twenty years governments and aid agencies have recognized the importance of developing agricultural markets investing in infrastructure and favouring policies to improve market participation of small-scale farmers. Moreover a large part of the trade in agricultural commodities in Sub-Saharan Africa takes place within social networks and depend on personal relationships. Therefore, one of the challenges faced by policy makers has been to bring about a shift from personal exchanges to impersonal ones in order to widen the trade network. From the other side, farm households have adapted a number of strategies in order to be able to participate in markets or expand the trade network, such as creating and participating in cooperatives where costs and risks associated with transactions are minimized (Fafchamps; 2004). In an environment where transport infrastructure is often inefficient, a major obstacle to market participation is the scarcity of information between the actors. The recent massive adoption of Information Communication Technologies (namely, mobile phones and radios) in rural areas of Sub-Saharan Africa can potentially enhance the flow of information with direct benefits for farmers' welfare. Better information can improve farmers bargaining position, reducing searching costs, and give them the choice to travel to farther markets if prices there are higher. Moreover, farmers can have better allocation of production factors and be more informed on the optimum timing of sales.

In this paper we focus on the determinants that drive the farm household's decision of the marketplace. Specifically, we first investigate why some transactions occur at farmgate and others at the marketplace. That will require modelling not only the farmers marketing behaviours, but also the role of itinerant farmgate buyers. Farmgate buyers are an important figure in the economic system of many developing countries. Their role is to travel to farmgate, buy the commodity and re-selling in markets farther from the production regions where they have a larger profit. Often, they may buy after harvest, and store the product until prices at the market rise. However, small-scale farmers may decide to travel to the market if farmgate buyers are not available or if they expect larger profit from a sale. In this case, they may have different marketplace to choose from. What drive the decision to sell at a closer market or travel at a further market is the second objective of this study. Understanding how transactions are driven in developing countries is a relevant contribution in order to support economic inclusion of remote farm households and ulti-

mately increase their welfare. Market participation is important to economic growth and poverty reduction in rural areas in two ways. On the one hand, because it allows farmers to focus on the production of those goods in which they are skilled, and to trade the surplus for other goods and services they desire but for which they do not hold comparative advantage in production. On the other hand, it allows larger scale production, decrease of fixed production costs, and use of technology which all together leads at more rapid total factor productivity growth.

The current study encompasses two strands of research on market participation in agricultural markets: the first comprises studies devoted to investigating the role of transactions costs in market transactions; the second is a more recent strand that looks at the impact of Information Communication Technologies (ICTs) in developing countries, focusing mainly on the use of mobile phones and radios.

In the first strand most of the studies investigate transactions costs that serve as barriers to farmers in entering a market first, and consequently influence the quantities they trade. Seminal work on this field was by Goetz (1992) which investigated the market behaviour of Senegal grain farmers. Thereafter major contributions came from Key et al. (2000) and Bellemare and Barrett (2006). Using a different analytical method, they introduced the distinction between proportional and fixed transaction costs. Proportional transactions costs are transaction costs that vary with the quantity traded. Often they are associated with the unit transport cost or the time needed to sell. Fixed transaction costs are independent of the quantity traded and they include cost of seeking information on prices or monitoring costs. Only a few studies on transactions costs investigate their impact on market behaviour at household level. Vakis et al. (2003) included the distinction of fixed and proportional transactions costs in a household framework to study the marketing decision of Peruvian potato farmers. Fafchamps and Hill (2005) investigated why many Ugandan coffee growers did not sell their product at the marketplace but instead wait for an itinerant farmgate buyer, resulting in lower profits. More recently Shilpi and Umali-Deininger (2008) studied how market facilities influence marketing decision of farmers in the Indian state of Tamil Nadu. An important obstacle that has limited empirical research on market behaviour is the volatile nature of transactions costs which is not easily quantified and very often not captured, or only partially, in surveys.

The second research strand on which this study stands looks at the impact of the recent diffusion in developing countries of ICTs which has rekindled research on the role of transactions costs. Jensen's pioneering work (2007) showed that the adoption of mobile phones amongst fishermen in the Indian state of Kerala was associated with a reduction of price dispersion and waste of fish caught. Goyal (2010) demonstrated that the diffusion of computer terminal sharing market information in Central India brought an increase of 1.6%

in the wholesale prices compared to areas where no comprehensive information diffusion systems were in place. Aker (2010) and Aker and Fafchamps (2010) analysed the impact of mobile phones in Nigerien agricultural markets. They found that the advent of mobile phones reduced price dispersion of grains between markets by at least 6.5 percent. Moreover, producer prices of perishable crops were affected more than that of storable crops. No evidences on the difference on farmgate prices were found, differently from the findings of Svensson and Yanagizawa (2009) who found that radio adoption did increase farmgate prices in Uganda.

This study, therefore, attempts to contribute to the branch of studies on transaction costs that focus on market behaviour of small farmers in developing countries and at the same time it makes wide use of data on the adoption and usage of ICTs to explore how these tools are used in marketing decisions. We used a novel dataset that contains very detailed information on 314 selling transactions of grains made by 197 small-scale farmers of northern Ghana. The rich dataset allows us to explore aspects of transaction costs that often have not been taken into account in previous microeconomics studies, such as the real use of ICTs to seek marketing information, the source of price information, or the knowledge of prices in different markets and the trust amongst agents. The remainder of the paper is as follow: after the theoretical framework, the empirical models are introduced. The description of the data is followed by a section discussing the potential endogeneity in the model. The results are then discussed, and a final section concludes.

II. Conceptual Frameworks

Starting point of the theoretical framework is the model developed by Vakis et al. (2003) where fixed and proportional transactions costs are embedded in the outputs part of the household model. We expanded it to include the behaviour of the itinerant farmgate buyers that bring to analyse the decision of marketplaces by farm households.

The total marketable surplus of a farm household $q^{'}$ is defined as the difference between the total production (Q) and the own consumption (c)

$$q^{'} = Q - c.$$

We assume that the marketable surplus is traded in a variable number of transactions of q_i quantity such that

$$q^{'} = \sum_{i=1}^{I} q_i \qquad where \;\; i = 1, ..., I.$$

For the sake of simplicity, hereinafter i identifies the transaction and the household.

Each rural household decides where to sell the marketable surplus q_i based on three factors: the amount of proportional (TC^p) and fixed (TC^f) transaction costs associated to the transaction, and the expected price ($p_j^{'}$) in market j.

Proportional transaction costs faced by the farm household for selling in market j (TC_{ij}^p) increase as the quantity traded increases. They depend on the distance to the market (d_{ij}), the means of transport (t_{ij}), the number of trips required (n_{ij}), the time required to sell the products in market j (r_{ij}), and other household-specific characteristics (z_{ij}^p), such as the quality of the road. The function can then be expressed as:

$$TC_{ij}^p = TC^p(d_{ij}, t_{ij}, n_{ij}, r_{ij}, z_{ij}^p). \tag{1}$$

Unlike the proportional transaction costs, the fixed transaction costs are independent of the quantity sold. Selling on the market j is associated with fix costs specific for each household (z_{ij}^f) that can include cost of searching for buyers and obtaining information on prices in different markets. Fixed transaction costs faced by the i farm household for selling in the market j (TC_{ij}^f) are given by:

$$TC_{ij}^f = TC^f(z_{ij}^f). \tag{2}$$

Finally, in its marketing decision the i household considers the expected price to be received in the market j ($p_{ij}^{'}$). The price will depend on the information on prices they have in the j market ($\bar{p_j}$), and the positive or negative mark-up (B) which depends on the quantity sold (q_i), the quality of the product (w), and the household ability and experience to bargain (z_i^b). The price function can then be shown as:

$$p_{ij}^{'} = \bar{p_j} \pm B(q_i, w_i, z_i^b). \tag{3}$$

The i farm household will then simultaneously choose to sell the quantity q_i in the market j which maximises revenue and gives the highest potential profit (Π) amongst all the markets $k = 1, ..., K$. That can be written as:

$$j \ : \ \max_k \left\{ \Pi_{ik} = q_i \cdot \left[\bar{p_k} \pm B(q_i, w_i, z_i^b) - TC_{ik}^p(d_{ik}, t_{ik}, n_{ik}, r_{ik}, z_{ik}^p) \right] - TC_{ik}^f(z_{ik}^f) \right\}. \tag{4}$$

Likewise, transaction costs affects also the buyers behaviour. When farmgate buyers (g) are in the market looking for potential crops to buy, their decisions on where to buy is based on the same factors and constraints the farm households have but in reverse: the transaction costs increase the prices they need to pay (1, 2, and 3). Therefore, the buyer's

choice of the marketplace j will depend on where the costs (C) are minimized:

$$j \; : \; \min_{k} \left\{ C_{gk} = q_g \cdot \left[\bar{p_k} \pm B(q_g, w_g, z_g^b) + TC_{gk}^p(d_{gk}, t_{gk}, n_{gk}, r_{gk}, z_{gk}^p) \right] + TC_{gk}^f(z_{gk}^f) \right\}. \quad (5)$$

From Equations 4 and 5 we build the decision model of selling at farmgate or at the markets, and in the latter case how the marketplace is determined. The remainder of the theoretical section will cover each of them.

A. Selling at the farmgate or at the market

Farm households can sell at the farmgate (in case a farmgate buyer is available) or decide to transport their products to the m-th market. Due to the presence of transaction costs faced by the farmgate buyer, the price per unit sold at the farmgate (p^f) is equal or less than the price at the market (p^m)

$$p^f \leq p^m. \quad (6)$$

Let W be the net revenue (revenues less transaction costs) at the farmgate and X net revenue at the market. Introducing to the Equation 6 the fixed and proportional transaction costs at the farmgate (TC^{ff}, TC^{pf}) and market (TC^{fm}, TC^{pm}), the expected price at farm gate ($p_i^{f'} = \bar{p}_i^f \pm B(q_i, w_i, z_i^b)$) and at the market ($p_i^{m'} = \bar{p_i}^m \pm B(q_i, w_i, z_i^b)$), the farmers decide the marketplace based on the relationship

$$\underbrace{\left[\left(q_i \cdot p_i^{f'}\right) - TC_i^{pf}\right] - TC_i^{ff}}_{W} \; \lesseqgtr \; \underbrace{\left[\left(q_i \cdot p_i^{m'}\right) - TC_i^{pm}\right] - TC_i^{fm}}_{X},$$

in which farmers selling at the farmgate incur in lower costs of locating a buyers ($TC_{ij}^{ff} \leq TC_{ij}^{fm}$) and lower transport costs ($TC_{ij}^{pf} \leq TC_{ij}^{pm}$) compared to selling at the market.

From the point of view of the farmgate buyers, let Y be the net cost of buying a commodity at the farmgate, and Z at the marketplace. If we include in the 6 the expected price at farmgate ($p_g^{f'} = \bar{p_g}^f \pm B(q_g, w_g, z_g^b)$) and market ($p_g^{m'} = \bar{p_g}^m \pm B(q_g, w_g, z_g^b)$), the choice between travelling to look for a farmgate seller or buying at the market is based on:

$$\underbrace{\left[\left(q_i \cdot p_g^{f'}\right) + TC_g^{pf}\right] + TC_g^{ff}}_{Y} \; \lesseqgtr \; \underbrace{\left[\left(q_i \cdot p_g^{m'}\right) + TC_g^{pm}\right] + TC_g^{fm}}_{Z},$$

in which looking for a sellers at farmgate requires more time ($TC_g^{ff} \geq TC_g^{fm}$) and increase the transport cost ($TC_g^{pf} \geq TC_g^{pm}$). As in Fafchamps and Hill (2005), we assume perfect competition between farmgate buyers and free entry in the itinerant trading. However,

with the distinction between fixed and proportional transaction costs we allow some traders costs to decrease with the quantity traded. There will be a sale at farmgate or marketplace based on the following relationships:

$$\begin{array}{l} W \geq X\,,\, Y \leq Z \;\Rightarrow\; sale\ at\ farmgate \\ W \leq X\,,\, Y \geq Z \;\Rightarrow\; sale\ at\ market \\ W \geq X\,,\, Y \geq Z \;\Rightarrow\; sale\ at\ market \\ W \leq X\,,\, Y \leq Z \;\Rightarrow\; sale\ at\ market \end{array} \quad . \tag{7}$$

The first two cases are straightforward and maximize seller's profit and minimize buyer's costs. In the third case although the farmer would prefer selling at farmgate ($W > X$), farmgate buyers are not available and ultimately, due to the need for cash and perishability of crops, it will be necessary to transport the product to the market. In the last case, the farmer knows that higher profits can be obtained by selling at the market ($W < X$) and so will be willing to travel there. The buyer will not find products to buy at farmgate which would have minimized costs ($Y < Z$), and as a consequence is forced to buy at the market.

B. Choosing the marketplace

Let consider the case in which a household decides to sell at the market. In which market should the household sell? We can expand Equation 6, introducing an additional market, n, with potentially better infrastructure and more buyers than market m and located farther away from the farm household ($d^m < d^n$), where the potential price (p^n) is higher or equal to p^m

$$p^m \leq p^n \leq \ldots \leq p^{n+k} \qquad (m < n;\ k = 1, \ldots, K). \tag{8}$$

In case no farmgate buyers are available or the seller think it can get better prices bringing the commodity to a marketplace, the farm household will face the following trade off

$$\begin{aligned} \left[\left(q_i \cdot p^{m'}\right) - TC_i^{pm}\right] - TC_i^{fm} \lesseqgtr \left[\left(q_i \cdot p^{n'}\right) - TC_i^{pn}\right] - TC_i^{fn} \lesseqgtr \ldots \\ \lesseqgtr \left[\left(q_i \cdot p^{(n+k)'}\right) - TC_i^{p(n+k)}\right] - TC_i^{f(n+k)}, \end{aligned}$$

where $TC_i^{pm} \leq TC_i^{pn}$ and $TC_i^{fm} \leq TC_i^{fn}$. The decision to travel to the more distant market will then depend on the different magnitudes of proportional and fixed transactions costs, and the accuracy of the price information. Specifically, let

$$D = \left\{\left[\left(q_i \cdot p^{m'}\right) - TC_i^{pm}\right] - TC_i^{fm}\right\} - \left\{\left[\left(q_i \cdot p^{n'}\right) - TC_i^{pn}\right] - TC_i^{fn}\right\} \tag{9}$$

being the difference in net revenues from selling in market m and selling in market n; the farmer will decide to travel to the m market if $D > 0$, otherwise the sale will take place at the n marketplace.

III. Empirical Models

We proceed to derive the empirical models that estimate the determinants of Equations 7 and 9. Initially in the selling process, each farm household faces a binary decision on where to sell its marketable crops; we demonstrated that price at the market can be higher, as well as transaction costs. Sellers can choose between the utilities deriving from selling at the farmgate (U_0) or at the market (U_1) which are functions of the household consumption (C) and leisure (L):

$$\begin{cases} U_0 = f\left(C_0 + L_0\right) \\ U_1 = f\left(C_1 + L_1\right) \end{cases} \tag{10}$$

where U_0 and U_1 are deterministic components of utility.[1] The observed outcome (y_1) is defined by

$$y_1 = \begin{cases} 1 \; if \; U_0 > U_1 \\ 0 \; otherwise \end{cases} . \tag{11}$$

From Equation 7, we can get the probability that a seller sells at the market as

$$Pr\left[y_1 = 1\right] = Pr\left(\left[(q \cdot p^{m'} - TC^{pm}) - TC^{fm}\right] > \left[(q \cdot p^{f'} - TC^{pf}) - TC^{ff}\right] \mid x, q, h\right) = \Phi(x, q, h),$$

where Φ is the standard normal cumulative distribution function which characterizes the probit model.

Farmers that decide to sell at the market face a choice on which marketplace travel to. More distant markets may have better infrastructure, more buyers, and potentially higher profits; reasons that can urge households to transport their product to be sold there (Shilpi and Umali-Deininger; 2008). However, that would increase proportional transactions costs and possible information on prices may be not reliable adding uncertainty and risk to the transaction. Because of its administration units, in northern Ghana small-scale farmers can choose to sell their products (ordered from the closer to the farther away market) at the community market, in the district capital, or at the regional market.[2] The households

[1] We used a random utility model since within the household framework the presence of transactions costs break down the profit maximization concept (Equation 4) (de Janvry and Sadoulet; 2006).

[2] In this case, Equation 8 from the theoretical framework is expanded to accommodate three markets ($k = 1$).

that decide to sell at the market will compare the utility of selling in each outlet, which is

$$\begin{cases} U_0 = f\,(C_0 + L_0) \\ U_1 = f\,(C_1 + L_1) \\ U_2 = f\,(C_2 + L_2) \end{cases}, \tag{12}$$

where U_0 represents the return of utility from a sale at the community market, U_1 at the market in the district capital, and U_2 at the market situated in the capital region or farther.[3] The relationships between the latent variable and the observed outlet of the sale (y_2) is given by

$$y_2 = z \qquad if\ \alpha_{z-1} \leq y_2^* \leq \alpha_z \qquad for\ z = 0,\ 1,\ 2,$$

where the *alphas* are the cut-points or threshold, $\alpha_0 = \infty$ and $\alpha_3 = -\infty$. The observed outcome by the ordered model is

$$y_2 = \begin{cases} 0 \Rightarrow sale\ at\ the\ community\ market & if\ \ U_0 > U_1,\ U_0 > U_2 \\ 1 \Rightarrow sale\ at\ the\ district\ market & if\ \ U_1 > U_0,\ U_1 > U_2 \\ 2 \Rightarrow sale\ at\ the\ regional\ market & if\ \ U_2 > U_0,\ U_2 > U_1 \end{cases};$$

and the probability for each outcome

$$\begin{aligned} Pr(y_2 = 1 \mid x, q, h) &= \Phi(\alpha_1 - x'\beta) \\ Pr(y_2 = 2 \mid x, q, h) &= \Phi(\alpha_2 - x'\beta) - \Phi(\alpha_1 - x'\beta)\ , \\ Pr(y_2 = 3 \mid x, q, h) &= \Phi(\alpha_2 - x'\beta) \end{aligned}$$

where the standard normal cumulative distribution function (Φ) characterizes the ordered probit model.

IV. The Data

Probably one of the most interesting aspects of the data is the availability of detailed information for individual selling transaction that is seldom available in other household surveys. The data include the extension of market information available for each seller, the use of ICTs as a marketing tool, and the characteristics of the sale (place, transport

[3]Instead of modelling as an ordered model, in some situation a truncated model of the distance travelled by the sellers to reach the sale point could be used (see Fafchamps and Hill; 2005). However, since in our case the distance travelled to reach a market varies by district and region, a similar approach would have been not informative (e.g. the distance to reach a district market in the region A could have been the same distance needed to reach a community district in the region B).

means and costs, duration, and how much the buyer was trusted). We collected primary data in northern Ghana on all sale transactions of 447 households in the agricultural season 2008-2009. We used multi-stage sampling, where we selected three districts in the northern regions of Ghana (Lawra in Upper West, Bongo in Upper East and Bunkpurugu-Yunyoo in Northern region), and within each district five communities were selected and thirty random households surveyed in each community.

For this analysis we focus on the marketing of grains (maize, sorghum/millet, rice) and legumes (cowpea and groundnut), which are the main food crops in the region. Due to their common characteristics including non perishability, transaction costs for marketing these crops are likely to be similar which enables market transactions in these crops comparable. Out of the full sample, we used a sub-sample of 314 selling transactions made by 197 households and treated them as a cross-sectional dataset.[4] Descriptive statistics of the household characteristics and the sales are respectively reported in Tables 1 and 2 On average, the head of households is over 50 years old with just two years of formal education. Most of them are male, however in Ghanaian rural markets the spouses have a relevant role in leading market transactions. On average each household made two transactions which involved slightly less than 400 kilograms of commodity. The majority of the transactions are made at the market (83%), to which farm households travelled around 10 kilometres, with an average of more than two trips per transaction.[5] Out of all the transactions incurred at the market, 68 percent were made in the community market, 26 percent in the district market, and the remains in the regional capital. For a given product, the mark-up price, defined as the difference between the price received and the average price at community level (net of transport cost), varies on average from a loss of GH¢ 0.42 to a gain of GH¢ 0.44 (per Kg).[6] One fourth of the transactions are bargained by the spouse alone; we would have expected a higher percent since in Ghana women are traditionally more active in the market than men. Trust is an important component in market transactions that derives from a history of successful exchanges. In the sample, most of the transactions occurred in a situation where seller positively trusted the buyer. In most of the transactions, sellers knew in advance the price at the point of sale (60%). On average, sellers at the time of the sale had price information on more than one market. Thirty-three percent of the transactions used mobile phones to retrieve market information, compared to 16 percent that listened to the radio for market information and 38 percent that gained market information discussing

[4]As a consequence, all the models are estimated clustering the standard errors at the household level.

[5]Note that not all the farmgate sales are physically made at the farmgate (i.e. the seller did not incur in any transport cost). In some cases (26 percent of the farmgate sales), farmers had to transport their products to a point where a farmgate buyer collected the commodity (on average they travelled 450 meters).

[6]In 16 cases the commodity traded was unique in the community. As a consequence, the mark-up price is computed based on the average price at district level.

with the informant (what we call "word of mouth"). In case of mobile phones, information was transmitted via voice in the great majority of cases (98%). The main sources of market information were the neighbours (61%), followed by the extension officers (46%). The average wealth, computed as the value of all the non-land belongings of the household, was GH¢ 1219.65, equivalent to GBP 553.83 or US$ 863.15.[7]

V. Correction for Potential Endogeneity in the Models

In market theory, quantity and price of commodity can thought to be endogenous to the place of sale.

We begin testing the endogeneity hypothesis of the quantity traded since, for example, farmers may decide to sell small quantities at farmgate or closer markets, and larger quantities in distant markets (or *vice versa*). We tested both models whether the quantity traded is indeed endogenous (Durbin-Wu-Hausman test), check that the instrument chosen is not weak (5% distortion from Wald test based on Stock and Yogo significance levels), and in case jointly estimated the model and the instrumental regression. As in Fafchamps and Hill (2005) and Shilpi and Umali-Deininger (2008), as instruments we chose land characteristics of the crop sold: we have no reason to think that the plot size has an effect on the marketing decisions (Table 3). In the choice of selling at farmgate or marketplace we rejected the hypothesis of exogeneity of the quantity traded ($\rho = 0.07$) and the chosen instrument proved to be strong (F=33.29, $\rho = 0.00$, Stock and Yogo=16.38). In case of modelling which marketplace sellers choose to travel to, we accepted the exogeneity of the quantity traded ($\rho = 0.82$). We then concluded that the quantity sold is indeed endogenous in the choice between selling at the farmgate or at the market, but it is not between the choices of different marketplaces.

The rural market participations in Northern Ghana suggest that the price received in a transaction may not be endogenous in the decision on where to sell the marketable surplus. Farm households in the region are atomistic in nature, and they tend to sell only the marketable surplus of grain they may have. A common behaviour is also participation in the market in order to achieving a fixed level of income to meet other needs. Once the target level of income is reached, they may decide to consume the remaining part of the own production. That would suggest that the single behaviour of a household would not affect the market, since the quantity sold by each household is not large enough to be though it could change the market equilibria. We empirically tested our field observation estimating a supply equation of the quantity traded as in Renkow et al. (2004). If prices

[7]The average exchange rate in 2009 stood at GH¢ 2.202 and GH¢ 1.413 respectively to GB £1 and US $1.

are endogenous, we would expect the quantity traded to increase as prices increases. Table 4 shows the estimation of the supply equation where the quantity traded is not significant. Farm households are not able to adjust the production or the quantity allocated for own consumption in order to be able to sell more crops. They could be said to be "price takers". As a further robustness check, we estimated the same model for each single crop (the dummies of crops in the supply equation may not completely capture the role of each crop), and the results confirm the previous model (not shown for brevity).

VI. Results

A. Selling at the farmgate or at the market

Coefficients and marginal effects of the probit model are reported in Table 5. A significant factor that drives the market relationship between farmers and the itinerant farm gate buyer is the quantity traded. Farm gate buyers travelling from community to community looking for crops to buy have high fixed transaction costs: bargaining and monitoring costs can be very high. As a consequence, to make more profitable their work they look for sellers that put into the market larger quantities. An increases of 10 percent of product sold increases the probability the sale incurs at the farmgate by 0.02. It is worth to highlight how different crops traded in different countries have different effect on the marketing decision. The quantity traded has an opposite effect on market transactions amongst small scale farmers in Ghana to the findings of coffee growers in Uganda (Fafchamps and Hill; 2005). In that case, sellers of larger quantities were more likely to sell at the market instead of waiting for a farmgate buyer. Ghanaian farm gate buyers are prepared to reward the sellers of larger quantities. Farmers that sold at the farm gate on average are better off than the ones that travelled to the market to sale the commodity. The prices per unit at the market are higher that at farmgate, however the amount of transaction costs that the farmer has to incur does not make it more profitable. Moreover, the competition amongst sellers at farmgate is lower — most of the farmers tend to sell just the marketable surplus that comes in smaller quantities — and farm gate buyers pay a premium to the sellers, which anyway would be lower than the fixed transaction costs they would have if the transaction would have been with more sellers. A strong relationship possibly joins farm gate buyer and farmers, and the latter have significantly higher trust on the formers compare to the buyer at the marketplace.

As expected, selling at the farmgate reduce proportional transaction costs for farmers since the distance travelled is less than travelling to the market. Given that buyers will come to farmgate, sales take place in shorter time than the case a seller wait at the market

for potential buyers. Moreover, any additional selling transaction made by the household increases the likelihood that the sales take place at the marketplace by 0.06. Farmers may save on transport costs bunching different crops to be sold at the market. However, farmgate buyers are not prepared to travel to remote areas far from the markets and incur in higher proportional transaction costs. As a consequence, remote farm households are more likely to travel to market.

Broader information pushes farmers to sell at the market. On the one hand, we can expect that higher unit prices at the market convince farm households to invest in transport costs, although we found that they would be better off at selling at farmgate. On the other hand, farmers trading smaller quantities already know that unlikely a farmgate buyer is willing to buy from them, and therefore broader information on prices at different market allow them to choose the best options. Any information on prices in additional markets increases the likelihood a household sells at the market by 0.08. Similarly, if a farmer seeks market information from an extension officers is more likely to sell at the market. Finally, we found a significant, although weak, evidence on the impact of using mobile phones in marketing. The two-ways communication technology does not only allow to receive updated price information but also to interact with the informant and possibly negotiate a sales at the phone. As a consequence, it reduces fixed transaction costs for both the seller and the farm gate buyer, and it increases by 0.12 the likelihood the sales takes place at the farmgate.

B. Choosing the marketplace

In case no farmgate buyers are available, or expected prices are higher at the marketplace, the sellers face the decision on which marketplace travel to. To recall, three are the options available: households can decide to sell their products at the market in the community, at the district capital, or at the regional capital or farther (i.e. other regional markets).[8] The model estimations are reported in Table 6.

As expected, households with a bicycle are able to travel to farther markets, decreasing the probability to sell at the community by 0.50, and with a substantial increase in the likelihood of selling at the district market (0.39). Consistent with the theoretical model, the number of trips to the market significantly decreases with the distance: if sellers can travel to more distance markets, they will minimize the number of trips and save on transport costs (or the shadow cost of their time in case they walk or cycle to the

[8]Since in this case we are modelling only the transactions processed at the market (262 out of 316 transactions), it could be argued that a selectivity issue is in place. As a robustness check, we jointly run the initial probit modelling the choice to sell at farmgate or at the market with the ordered probit on the marketplace choices and the ρ (the correlation parameter between the first and second stage) is highly insignificant (p =0.938). We then conclude that the selection is due to observable factors.

market). Sellers listen on the radio to market information are more likely to sell at the closer market. Possibly farmers who are more informed on prices in distant market may try to use that information in the bargaining process to obtain higher prices. If the sources of information are the extension agents sellers are more likely to travel to farther away market.[9] It appears that the trust on extension officers convinces farmers to invest more in proportional transaction costs in pursuit of potentially greater profit. Sellers that know in advance the price at a farther away market are more like to travel there, increasing by 0.09 and 0.19 respectively the likelihood to sell at the district and regional capital markets. Knowing the price allow to estimate the potential profit of a sale. The trust in the buyer is also an important factor that pushes farmers to travel farther; higher trust in the buyer reduce screening costs and the risk of default. Disagreements on the quality of the product are more likely to happen at community markets: farmers that are aware the quality of the crop is below the average may decide not to incur in higher proportional transaction costs and sell the product in closer marketplaces. We then find evidence that wealthier farm households are not prepared to spend much time and resources to travel at the regional market and preferring the district market. Probably they value more their leisure time than travelling to farther markets where they can get higher profit. Although the sign of the coefficients of the quantity sold and the mark-up prices are consistent with the theoretical model, they are not significant in the model. Possibly the transaction costs embedded into the selling price greatly vary at households level and they are is not captured in the choice of the marketplace.

C. Marketplace and price received

We have shown that the expected price is an important factor for farmers in the choice of marketplace. From the estimations, we had evidence that selling a farmgate is significantly more profitable than travel to the market, however we did not capture the price dynamics amongst different market. To have a better understanding on how price received vary amongst marketplaces, we regress nonparametrically the choice of marketplace with the price received (Figure 1). In the graph any value above zero means that the transaction was more profitable than the average sale of the same crop within the community (net of transport costs and in GH¢ / Kg.). We confirm our finding that sales are farmgate are more profitable, but consistent with the theoretical framework we also find that transactions at the regional markets are more profitable than other markets. However, as expected farther

[9]From the previous model it could be argued that extension officers may be more likely to visit remote areas where transactions costs for farmgate buyers are too high, and therefore farmers are forced to transport their products to the market. If so, they would decide to sell at the closer market. Instead, here we found evidence that information from extension officers pushes sellers to travel at farther away markets.

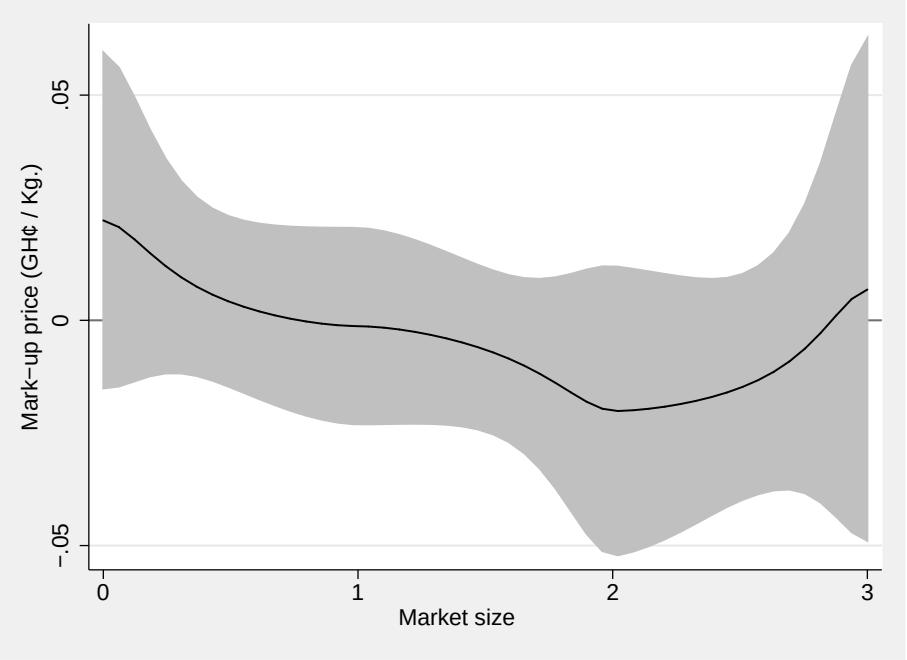

Figure 1: Kernel regression with 95% confidence interval on the mark-up price and the marketplace (farmgate (0), community market (1), district market (2), regional market (3)).

a farmers travel to sell the commodity, larger the price bands are. Information then becomes critical for farmers to empower the bargain power or choice the optimal time for a sale and therefore take advantage in situations where profits and losses can be large.

VII. Conclusion

We explored some aspects of the household market participation behaviour in developing countries that so far has not received much attention in the literature. Nevertheless marketing decisions are strategic for small-scale farmers and they can have a remarkable impact on the welfare of the households. This was possible thanks to a novel dataset containing detailed information on selling transactions of grains made by farmers from northern Ghana and their use of ICTs as marketing tool.

We had evidence that larger transactions occur at the farmgate, where farmgate buyers are prepared to pay a premium price because of lower fixed transaction costs. This finding supports the creation of cooperative where farmers pull marketable crop to be sold in a larger transaction and have larger bargaining power. Such marketing cooperative are not active in the study area, and a possible explaining may lie on the heterogeneity quality of crops which would not allow to aggregate different crops or by the fact that farmers may not trust each other enough to do this (Fafchamps; 2004). Possibly, more incentives

and law enforcement need to be in place to favourite the creation and participation in cooperatives. The knowledge of market information has a contrasting effect on the decision of the marketplace. In same cases, farmers use the information on prices in specific marketplaces to travel farther, in other cases they seem to sell their commodity in closer market. Possibly they may try to use that information in the bargaining process to obtain higher prices. Extension services have an active role in pushing farmers to trade in larger markets, possibly aiming for better prices. Finally, we found weak evidence of the use of mobile phone to reduce searching costs and attract farm gate buyers.

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Table 1: Descriptive statistics: regional and crop dummies, and household characteristics

Variable	Unit	Mean	Std. Dev.	Min	Max
Household Characteristics					
Male household head		0.94	0.24	0	1
Household head age	Years	51.27	14.58	24	95
Adult in the household (15-64)	Number	4.43	2.02	1	12
Household head education	Years	2.22	4.22	0	20
Household head experience of farming	Years	27.02	15.65	2	74
Inputs	GH¢	289.77	283.77	1.33	2015.21
Households wealth	GH¢	1219.65	1558.08	7.4	8995.29
Regional and crop dummies					
North region		0.43	0.50	0	1
Upper West region		0.48	0.50	0	1
Maize		0.24	0.43	0	1
Sorghum/Millet		0.17	0.37	0	1
Rice		0.12	0.33	0	1
Cowpea		0.09	0.28	0	1
Groundnut unshelled		0.24	0.43	0	1

In case of dummy variable, the unit is not specified.

Table 2: Descriptive statistics: proportional and fixed transaction costs, instruments

Variable	Unit	Mean	Std. Dev.	Min	Max
Proportional Transaction Costs					
Transactions per household	Number	2.29	1.36	1	6
Travels to the market	Number	2.30	2.05	0	11
Time needed to sell the product	0=Less than one hour	0.82	0.77	0	3
	1=Between 1 to 3 hours				
	2=More than 3 hours				
	3=Did not sell the same day				
Ownership of bicycle		0.86	0.34	0	1
Distance to the local market	Meters	3590.60	2449.97	50	9000
Fixed Transaction Costs					
Spouse alone bargained the transaction		0.28	0.45	0	1
Trust on the buyer	1=Very little	3.38	1.65	1	5
	2=Little				
	3=Neutral				
	4=Much				
	5=Very much				
Disagreement on product quality		0.09	0.29	0	1
Market price sale known in advance		0.60	0.49	0	1
Markets prices known	Number	1.15	0.61	0	3
Receiving market information via mobile phone		0.33	0.47	0	1
Receiving market information via radio		0.16	0.37	0	1
Receiving market information via “word of mouth”		0.38	0.49	0	1
Receiving market information s from neighbours		0.61	0.49	0	1
Receiving market information from extension agents		0.46	0.50	0	1
Quantity traded, prices and selling locations					
Quantity sold	Kilograms (log)	5.43	1.06	2.08	8.16
Sale at the market		0.83	0.37	0	1
Market chosen (*n=262*)	0=Community market	0.38	0.60	0	2
	1=District market				
	2=Regional market				
Distance travelled to marketplace	Meters	9570.70	42912.01	0.00	450000.00
Mark-up price (net of transport costs)	GH¢	-0.001	0.14	-0.42	0.44
Instrument variable					
Size plot	Hectares	0.67	0.47	0.08	3

In case of dummy variable, the unit is not specified.

Table 3: Instrument variable (IV): Quantity sold (log) on plot size (ha)

	Coefficient	S.E
Size plot (ha)	0.705***	0.111
Constant	4.960***	0.108
R^2	0.10	
F statistics	40.58***	

***, **, *, stand for values statistically significant at 0.01, 0.05, 0.1 levels respectively. Standard errors clustered at household level.

Table 4: Supply Equation

Variable	Price/Kg	Std. Err.
Quantity traded	-0.66e-7	0.14e-5
Household size	0.008	0.005
Education	-0.001	0.002
Farm size	-0.022*	0.011
Farming experience	-0.001**	0.001
Inputs	0.82e-5*	0.44e-5
Constant	0.870***	0.050
R^2	0.56	
F statistics	30.13***	

Standard errors are clustered at household level. Significance at the 10%, 5%, and 1% levels are indicated by one, two, and three asterisks, respectively. The model includes but is not shown regional and crop dummies.

Table 5: Selling at the farmgate (0) or at the market (1)

	Coefficient	Std. Err.	M.E.
Quantity sold (IV)	-0.629**	0.250	-0.108
Wealth	0.11e-4	0.71e-5	0.19e-4
Mark-up price	-1.355**	0.674	-0.232
Proportional transaction costs			
Number of transactions	0.370**	0.152	0.063
Distance to the market	0.16e-4***	0.52e-5	0.27e-4
Bike ownership	0.329	0.320	0.066
Time to sell	0.534***	0.170	0.092
Fixed transaction costs			
Bargain spouse	-0.403	0.263	-0.077
Trust on buyer	-0.375**	0.147	-0.064
Disagreement on quality	0.360	0.340	0.051
Price market sale known	-0.137	0.312	-0.023
Markets prices known	0.466*	0.271	0.080
Receiving market information via mobile phone	-0.642*	0.374	-0.127
Receiving market information via radio	-0.104	0.495	-0.019
Receiving market information via "word of mouth"	-0.479	0.376	-0.089
Receiving market information from neighbours	-0.164	0.309	-0.027
Receiving market information from extension agents	0.791***	0.258	0.132
Constant	1.657	1.685	
Log pseudolikelihood	-466.30		
Wald χ^2	144.23***		
Overall correct prediction (%)	81.21		

Significance at the 10%, 5%, and 1% levels are indicated by one, two, and three asterisks, respectively. Standard errors clustered at household level. The model includes but is not shown regional and crop dummies, and household characteristics.

Table 6: Choosing the marketplace: community (C), district (D), or regional market (R)

	Coefficient	Std. Err.	M.E. (C)	M.E. (D)	M.E. (R)
Quantity sold	0.091	0.149	-0.017	0.004	0.014
Wealth	-0.17-4*	0.94e-5	0.32e-4	0.67e-7	-0.26e-4
Mark-up price	0.022	0.673	-0.004	0.001	0.003
Proportional transaction costs					
Number of transactions	-0.131	0.106	0.025	-0.005	-0.020
Distance travelled to marketplace	0.34e-4***	0.78e-5	-0.66e-4	0.14e-4	0.52e-4
Number travels to the market	-0.293***	0.091	0.056	-0.011	-0.044
Bike ownership	1.586***	0.532	-0.497	0.389	0.108
Time to sell	0.271	0.191	-0.052	0.011	0.041
Fixed transaction costs					
Bargain spouse	-0.412	0.324	0.088	-0.034	-0.055
Trust on buyer	0.498**	0.205	-0.095	0.020	0.075
Disagreement on quality	-1.467**	0.582	0.458	-0.357	-0.101
Price market sale known	1.333***	0.414	-0.284	0.091	0.194
Markets prices known	0.027	0.222	-0.005	0.001	0.004
Receiving market information via mobile phone	-0.306	0.402	0.062	-0.018	-0.044
Receiving market information via radio	-1.242**	0.495	0.347	-0.234	-0.113
Receiving market information via “word of mouth”	-0.937*	0.504	0.208	-0.085	-0.123
Receiving market information from neighbours	-0.462	0.365	0.082	-0.007	-0.076
Receiving market information from extension agents	0.858**	0.364	-0.165	0.031	0.134
α_1	5.791***	1.535			
α_2	8.399***	1.621			
Pseudo R^2	0.52				
Log pseudolikelihood	-98.81				
Likelihood ratio χ^2	70.65***				
Overall correct prediction (%)	83.97				

Significance at the 10%, 5%, and 1% levels are indicated by one, two, and three asterisks, respectively. Standard errors clustered at household level. The model includes but is not shown regional and crop dummies, and household characteristics.