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Selling at the Farm-Gate or Travelling to Market*

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Abstract

Using detailed survey data from Uganda, this paper examines coffee producers sell to itinerant traders or directly to markets, where they can get a higher price but must incur a transport cost. We find that selling to the market is more likely when the quantity sold is large and the market close by. Wealthy farmers are less likely to sell to the market, possibly because the shadow value of their time is higher. But if they have a large quantity of coffee for sale, they are more likely to sell it to the market. They are also more likely to travel to a distant market. These findings are consistent with their better ability to pay for public transportation.

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1 Introduction

This paper examines one critical dimension of producer prices that has seldom been studied in poor countries, namely the decision to sell at the farm-gate. Farmers' decision whether to sell at the farm-gate or to transport their produce to the market has received little attention in the literature. This is surprising given a long-standing interest in transactions costs and how they affect farmers' crop choices (e.g. de Janvry, Fafchamps & Sadoulet 1991, Key, Sadoulet & de Janvry 2000). The paper fills this gap in the literature by showing that transactions costs also affect the choice of form of sale and hence the price received by farmers.

Research in the US (e.g. Fu, J & Fletcher 1988, Fletcher & Terza 1986, Edelman, Schmiesing & Olsen 1990) and Australia (McLeay & Zwart 1998) has shown that farmer characteristics influence the farmer's choice of sale mechanism. But little if anything has been written on the choice of sale mechanism by farmers in poor countries. Yet the livelihood of many poor farmers the world over depends on the sale of agricultural commodities for export. The price growers receive for these commodities has major implications regarding poverty alleviation. Farmers typically have the choice between selling their output at the farm gate or transporting their output to the nearest market. Selling at the farm gate is more convenient since farmers do not have to incur the cost and trouble of carrying their crop to the market, often located many miles away. But it is less remunerative.

We examine how small coffee farmers sell their output. We begin by constructing a simple model of the decision to sell at the farm gate or travel to the market. The focus of the model is on the relationship between wealth and farm-gate sales. We begin by assuming away public transportation. The model predicts that because poor farmers have a lower opportunity cost of time, they prefer to walk to the market in order to fetch a higher price for their crop. We then allow for public transportation and assume that the rich can better afford to pay for public transportation. In this case, that the relationship between wealth and the decision to sell at the farm-gate gets reversed, as wealthier farmers can better afford to pay for public transportation.

Model predictions are tested using original survey data collected by the authors in four regions of Uganda. Our findings are by and large consistent with model predictions. First, we find that the likelihood of selling to the market increases with the quantity sold and the proximity to the market. The relationship between wealth and market sales is found to be non-linear: poorer and wealthier farmers are more likely to sell to the market while farmers of intermediate wealth sell at the farm-gate. This non-linearity goes away once we include an interaction term between wealth and quantity sold: wealthy farmers are less likely to sell to the market, possibly because the shadow value of their time is higher. But if they have a large quantity of coffee for sale, they are more likely to sell it to the market. They are also more likely to travel to a distant market. These findings are consistent with their better ability to pay for public transportation.

More has been written on similar choices made by consumers, i.e., whether to buy from a nearby convenience or micro-retail outlet or to travel to a larger store. Research has shown that poor consumers are more likely to use convenience stores and to buy from micro-retail outlets. As a result, they typically pay more for consumption goods. This propensity to purchase from convenience stores for the sake of proximity is further reflected in the prevalence of convenience stores relative to supermarkets in low-income areas. For the US, evidence can for instance be found in the works of Goodman (1968), Alcaly & Klevorick (1971), and Bureau of Labour Statistics (1966). Caraher, Dixon, Lang & Carr-Hill (1998), Wrigley, Warm, Margetts & Whelan (2002), and Whelan, Wrigley, Warm & Cannings (2002) provide more recent but similar evidence in the UK. Even at low income, an increase in wealth raises the premium consumers are willing to pay for convenience, with poor but slightly better off consumers preferring to use convenience stores (Whelan et al. 2002). Rao (2000) provides similar evidence for India. The findings presented here are similar in many respects, except that they apply to selling instead of buying.

The paper is organized as follows. Section 2 presents the conceptual framework underlying our testing strategy. Section 3 describes the survey on which the paper is based and introduces the data. Econometric analysis is presented in Section 4.

2 Conceptual framework

When deciding whether to sell at the farm-gate or to travel to the nearest agricultural market, a farmer must choose between receiving a lower price up front, or receiving a higher price but incurring a transaction cost. Formally, let the farm-gate and market prices be written p^f and p^m respectively, with $p^f \leq p^m$. The cost incurred by the farmer to transport his coffee to the market is denoted c. The farmer chooses to transport coffee to the market if:

$$p^f < p^m - c \tag{1}$$

Let the difference between the two be written $D \equiv p^m - c - p^f$. Forces that raise D make it more likely that the farmer transport his coffee to the market.

Itinerant traders who buy from the farm-gate also have to incur transport and search costs m. With free entry in itinerant trading, competition ensures that:

$$p^f = p^m - m \tag{2}$$

We therefore have $D = m - c$, with sale at the farm gate if $m < c$ or $D < 0$ and sale to the market if $D > 0$.

To empirically test the model, let M denote the decision on how to sell, with $M = 1$ if the farmer sells directly to the market, and $M = 0$ if the farmer sells at the farm-gate. This decision depends on the latent variable $D^* = D + u$ where u is an error term. We have $M = 1$ if $D^* > 0$ and $M = 0$ otherwise. Factors that raise D thus make farmers more likely to sell to the market.

We now examine the effect of distance from the market d on m and c. We assume that m increases with distance: $m(d)$ with $m' > 0$. The transaction cost c incurred by the farmer also increases with distance. For farmers walking small quantities of coffee to the market, the cost is basically the shadow cost of their time w. Since walking travel time is more or less proportional to distance d, the unit transport cost to the farmer can be approximated as:

$$c = \frac{\alpha d w}{q^{\sigma}} \tag{3}$$

with $\sigma \leq 1$ and where α is the time required to travel one unit of distance. As long as the quantity is small enough that only one trip is required, the walking cost does not depend on the quantity transported. In this case, the unit shadow cost is inversely proportional to the quantity sold q and $\sigma = 1$. More generally, transport cost may increase with quantity. If transport time increases more than proportionally with quantity, the farmer's *unit* transport cost increases with quantity and $\sigma < 0$.

It follows immediately that:

$$\frac{\partial D}{\partial q} = \sigma \frac{\alpha d w}{q^{\sigma+1}} \gtrless 0 \text{ if } \sigma \gtrless 0 \tag{4}$$

Prediction 1: Farmers are more likely to travel to market if the quantity sold is large provided that the farmer's *unit* transport cost does not increase with quantity, i.e., that $\sigma > 0$.

In our study area, traders travel by motorbike while many farmers walk or cycle. It is therefore reasonable to assume that traders' transport cost increase less rapidly with distance than that of farmers, i.e., that $m'(d) < \alpha w/q^\sigma$ beyond a minimum distance d_m. We thus have:

$$\frac{\partial D}{\partial d} = m' - \frac{\alpha w}{q^\sigma} < 0 \text{ for } d > d_m \tag{5}$$

Prediction 2: Farmers located near the market walk their crop to the market while farmers located further away sell at the farm-gate to itinerant buyers. We also see that:

$$\frac{\partial D}{\partial \alpha} = -\frac{dw}{q^\sigma} < 0$$

Prediction 3: To the extent that owning a bicycle reduces α, by increasing the speed at which a farmer can travel, it also increases D and thus the likelihood of travelling to the market.

So far we have assumed that w is constant across farmers. This assumption is reasonable if markets are perfect. With imperfect markets, however, the shadow cost of labor varies across farmers. In this case, we expect wealthier farmers to have a higher shadow cost of leisure – in part because they have more productive capital and in part because their income is higher and leisure is a normal good. Consequently, we have $w = w(y)$ with $w' > 0$ where y denotes wealth. It immediately follows that:

$$\frac{\partial D}{\partial y} = -\frac{\alpha d w'}{q^\sigma} < 0 \tag{6}$$

Prediction 4: Wealthier farmers are less likely to sell to the market and more likely to indulge in the convenience of farm-gate sale.

Wealth also affects the slope of the effect that d and q have on D:

$$\frac{\partial^2 D}{\partial d \partial y} = -\frac{\alpha w'}{q^\sigma} < 0 \tag{7}$$

$$\frac{\partial^2 D}{\partial q \partial y} = \sigma \frac{\alpha d w'}{q^{\sigma+1}} \gtrless 0 \text{ if } \sigma \gtrless 0 \tag{8}$$

Prediction 5: Equation (7) implies that, as distance increases, wealthy farmers are less likely to sell to the market than poor farmers. *Prediction 6:* Equation (8) means that, provided that $\sigma > 0$, wealthy farmers are more likely to sell to the market as quantity sold increases.

Public transportation can be added to the model as follows. Suppose that the farmer can hire private transport for a lumpsum price td/q^{γ} which depends on distance and quantity transported.[1] The farmer hires private transport if

$$\frac{\alpha w(y)d}{q^{\sigma}} > \frac{td}{q^{\gamma}}$$

where γ is a parameter representing how the unit cost of public transportation varies with quantity. Given that public transport is motorized while farmers are not, it is reasonable to assume that $\gamma \geq \sigma$ and that $\gamma > 0$. With this amendment, the farmer sells at the farm gate if:

$$D = m(d) - \frac{d}{q} \min\left(\alpha w(y) q^{1-\sigma}, t q^{1-\gamma}\right) > 0 \tag{9}$$

Prediction 1 ($\frac{\partial D}{\partial q} \gtreqless 0$ if $\sigma \gtreqless 0$) is changed in an important way by the presence of public transport. Let $\widehat{q}$ be the quantity at which the farmer is indifferent between public transport and own transport, i.e., at which $\alpha w(y) \widehat{q}^{\gamma-\sigma} = t$. Then for all $q > \widehat{q}$, the farmer chooses public transport. In this case, for all for $q > \widehat{q}$ we have $\frac{\partial D}{\partial q} > 0$ even if $\sigma < 0$. With public transport available, all farmers are more likely to hire public transportation to carry a large enough quantity of coffee to the market. Other predictions are basically unchanged. We still have prediction 2 as before, i.e., $\frac{\partial D}{\partial d} < 0$. But predictions 3 ($\frac{\partial D}{\partial \alpha} < 0$) and 4 ($\frac{\partial D}{\partial y} < 0$) hold only up to the point at which $\alpha w(y) \widehat{q}^{1-\sigma} = t$. Letting $\widehat{y}$ be defined as the level of income at which $\alpha w(\widehat{y}) q^{\gamma-\sigma} = t$, we see that farmers with $y > \widehat{y}$ use public transportation and for them

[1] In practice, farmers hitch a ride on a mini-bus or pick-up truck with a bag of coffee.

$\frac{\partial D}{\partial y} = \frac{\partial D}{\partial \alpha} = 0$.

In the presence of cash constraints, poor farmers may not be able to afford public transportation. If this is the case, Proposition 1 remains applicable to them over the entire range of quantity. This raises one interesting possibility regarding the joint effect of q and y on D whenever $\sigma < 0$. In this case, we have a negative relationship between q and D for poor farmers – i.e., poor farmers are less likely to sell to market if the quantity is large because they cannot afford to take the coffee to market by public transport and it is to costly for them to carry the coffee on their own. In contrast, we have a positive relationship between q and D for wealthy farmers – at least over a large range of values. This is because wealthy farmers are much more likely to use public transportation which, given our assumptions, is always cheaper than relying on itinerant traders if the quantity sold is large enough.

Before taking the model to the data, it is important to recognize that other factors may affect the relationship between wealth and D. We briefly consider two of them here: consumption trips to the market; and fear of impulse purchases. Consumption trips can affect farmer behavior as follows. Until now we have assumed that the farmer visits the market exclusively to sell coffee. This need not be the case: the farmer may also visit the market for shopping purposes, in which case the marginal cost of selling coffee to the market is zero (since the farmer can take the coffee along when travelling to the market). The immediately corollary is that farmers who visit the market more frequently for consumption purposes are also more likely to sell their coffee there. Let $N = 1$ denote a consumption trip to the market. We now have:

$$\Pr(M = 1) = \Pr(N = 1|y) + \Pr(N = 0|y) \Pr(mq > d \min\left(\alpha w(y) q^{1-\sigma}, t q^{1-\gamma}\right)|y) \tag{10}$$

If the number of consumption trips increases with income, the first term $\Pr(N = 1|y)$ increases with income – and hence $\Pr(N = 0|y)$ decreases with income. We know that $\Pr(mq >$

$d \min \left(\alpha w(y) q^{1-\sigma}, t q^{1-\gamma}\right)$ falls with income – up to the point where $y = \widehat{y}$. This means therefore that, as income increases, the first term in equation (10) increases while the second falls before tapering off. A strong enough first terms therefore eventually dominates for large enough wealth. This generates an inverse U-shape relationship between sale to market and wealth: initially negative but eventually positive when the first term dominates.

One last factor worth discussing is the possibility that poor farmers fear impulse purchases. When poor farmers walk to the market to sell their coffee, they may find themselves tempted to spend the cash they just received. In particular, they may not trust themselves *not* to spend the money on frivolous expenditures – especially alcohol consumption. It is reasonable to expect poor farmers to worry more about impulse purchases than rich farmers because, for them, the marginal utility cost of foregone money is larger. For this reason, they may prefer to sell their coffee at the farm-gate where opportunities for spending money are more limited and family needs less easy to forget.[2] This effect operates in a direction opposite to the opportunity cost of time argument that underlies prediction 4. If strong enough, the fear-of-impulse-purchase motive could generate a positive relationship between wealth and sale to market. The purpose of the rest of this paper is to test all the above predictions.

3 The data

We now proceed to test this model with data on 300 Ugandan growers of Robusta coffee. Ugandan coffee producers are typically smallholders, with less than 2 hectares of cultivated land. The average size of a smallholding is about 0.19 hectares (APSEC 1999). Although the bimodal pattern of rainfall Uganda receives allows for coffee harvesting throughout the year, there are two

[2] Many forms of saving by the poor, such as Roscas and susu collectors (Aryeetey & Steel 1994), can be understood as self-disciplining devices. The obligation to set aside a given amount each day or week shelters savings from temptation.

main harvest seasons: October to March, concentrated in the months of November to January; and May to August, concentrated in the months of June and July. The West of the country experiences its main harvest between May and August, with a fly crop from October to March, whilst the central and Eastern regions experience their main harvest from October to March, with a fly crop earlier in the year. Farmers harvest coffee cherries and dry them. The majority of Ugandan producers sell their coffee in the form of dry cherries locally known as *kiboko*. These cherries are then milled by middlemen who buy the coffee from farmers. Milling involves separating the cherry from its husk, a process that yields what is called Fair Average Quality coffee cherries, known as FAQ coffee. This coffee is then sorted and exported to be roasted in the coffee houses in Europe and elsewhere.

The data were collected by a team from the Uganda Bureau of Statistics (UBOS) in collaboration with the Centre for the Study of African Economies at Oxford University. Funding for the survey was provided by the World Bank. The purpose of the survey was to look at the effect of commodity price fluctuations on producers and at the potential for risk management schemes. The data were collected at the beginning of 2003 and include information on the farmers' production decisions and coffee sales for the previous calendar year in addition to household characteristics and risk preferences. Data were collected in four districts producing most of Robusta coffee in Uganda: Mukono, Luwero and Masaka in the central region, and Bushenyi in the western region. These four districts combined account for about 50 percent of all Robusta coffee produced in Uganda.

The survey built on a national household survey conducted in 1999/2000, which was used to identify coffee farmers. A random sample was drawn from coffee producing households in the 1999/2000 survey. They were revisited in early 2003 and asked many of the original survey questions through face-to-face interviews. The Uganda Bureau of Statistics (UBOS), the data collection body responsible for the 1999/2000 survey, also conducted the 2003 survey. An advantage of this approach was that members of personnel, including enumerators, who had been involved in the 2000 survey also became involved in conducting the 2003 survey. Researchers were trained and the questionnaires tested before the survey commenced. Editing of questionnaires was done before research assistants and supervisors left the field. This allowed corrections to be made carefully and accurately, and respondents to be revisited where clarification was needed. In two of the survey districts (Masaka and Bushenyi) qualitative questions were also asked to the respondents to allow triangulation of results from the more quantitative questions of the main survey.

UBOS conveyed upon the survey a sense of legitimacy which allowed the enumerators to receive cooperation from the respondents in nearly all cases. Introduction letters stating the purpose of data to be collected were given to the district administrative officers concerned and the data collection team worked entirely with the local council leaders in those selected villages within sub-counties and towns. These both reduced the problem of non-cooperation and suspicion among the respondents. In only one instance did the respondent refuse to cooperate.

As the period between the baseline and the follow up survey was relatively short, there was little attrition resulting from dead and migrated households. Most households were still in existence within the village and it was relatively easy to trace them. Some farmers identified as coffee producers on the basis of their response to the 1999/2000 survey were no longer farming coffee. In these cases data were still collected but only the relevant sections of the questionnaire were completed.

Detailed data on coffee sales were collected by asking the farmer to describe his latest coffee sale transaction: where the coffee was sold, who to, how much was sold, at what price and other aspects of the transaction. Once details on the last coffee transaction were complete, the farmer was asked to recall the transaction made before that and if possible the one before that, collecting what could be remembered. In some cases the farmer only made one transaction in the year, or could only recall the details of the latest transaction. In this case only one transaction was recorded for that farmer. More than half of the surveyed farmers were able to give information on their two or three most recent transactions.

Table 1 describes the kind of information on coffee transactions collected in the survey. Reported values are based on 409 observations. We find that 15% of sales transactions take place at the market; other transactions are at the farm-gate. The average transaction is for 118 Kg. This average hides a lot of variation, however: the median transaction size is a much lower 43 Kg per transaction, a quantity that can be carried by hand or bicycle. We see that, among farmers selling at the market, the distance travelled is short and a little less than half of them use public transportation.

The table also reports values for various household characteristics such as the wealth and age of the farmer and the number of trees harvested. Wealth is measured as the value of all non-land wealth of the household (including the value of buildings). Robusta coffee growers tend to be older farmers, reflecting a waning interest in coffee among younger farmers. The number of trees harvested may appear high to the uninformed reader, but farmers count as trees all off-shoots from their original planted tree. Off-shoots typically form clumps of 5 to 15 'trees' bunched up together. Coffee is generally interspersed with food crops.

4 Empirical results

We now test the various model predictions presented in Section 2. We begin regressing non-parametrically the decision M to sell to the market on wealth. The reason is that we suspect this relationship to be non-linear and we need to know what shape this non-linearity takes in

Variable	Unit	Median	Mean
Characteristics of coffee sale:			
Quantity sold	kilo of FAQ equivalent	43.20	
Price at which sale made	US$ / kilo of FAQ equivalent	0.29	
Distance from coffee market	miles	6.25	
Sale at market	1 = sale at market		15%
If sale made at market:			
Distance travelled	miles	1.25	
Public transport used	1 = public transport used		46%
Public transport spending	US$	1.31	
Characteristics of farmer:			
Wealth	US$	592.63	
Bicycle	1 = household owns a bike		51%
Other transport	1 = owns bike and other transport		11%
Age of farmer	years	50	
No. of trees harvested	number	100	
Location and seasonal dummies:			
Masaka	1 = Masaka		20%
Mukono /Kayunga	1 = Mukono / Kayunga		21%
Bushenyi	1 = Bushenyi		29%
Luwero	1 = Luwero		30%
Season	1 = high season		51%

Table 1: Descriptive Statistics

the data. Results are presented in Figure 1a. We observe a positive relationship between wealth and selling to market, which a priori contradicts to Prediction 4 but is a prima facie consistent with the other factors discussed at the end of Section 2 – namely, credit constraints for public transportation, consumption visits, and fear of impulse purchases by the poor.

Survey respondents also reported, for each coffee sale, the distance between the farm and the actual point of sale. Thus, for instance, if a farm-gate sale in practice took place half a kilometer from the farm, the distance was recorded as half a kilometer. Because distance is a continuous variable, this measure is potentially more informative. A non-parametric regression of this variable on wealth is shown in Figure 1b. Here we observe an inverse U-shape relationship between wealth and distance travelled: it is the poorest and wealthiest farmers who travel the furthest to sell their coffee. This finding is consistent with $\sigma < 0$ but credit constraints in accessing public transportation (or consumption visits and fear of impulse purchases).

The univariate results presented in Figures 1a and 1b may be misleading because they do not control for quantity and distance. We therefore turn to multivariate analysis. Results are presented in Table 2 by increasing order of complexity. In the first model, we include only two regressors – distance between the farm and the nearest coffee market, and a dummy which takes value one is the household owns a bicycle. Both distance and bike ownership are shown to have the sign predicted by the model.

We then introduce the quantity sold. Logit regression results are reported in Table 2. In all cases, robust standard errors are reported that allow for household-level clustering.[3] The quantity sold is potentially endogenous to the transaction choice, for instance if itinerant traders cannot buy more than they can carry on their motorbike. It is also conceivable that itinerant traders incite farmers to sell small quantities before they have finished harvesting. Farmers indeed harvest their trees sequentially and dry their coffee as it is harvested. For these reasons, we need to instrument quantity sold. We do so using as instrument the number of coffee trees harvested by the farmer over the entire year. There is no reason to suspect the number of trees harvested to affect the form of sale except through their effect on quantity sold. All instrumenting regressions are presented in Appendix. The instrument is strongly significant with a t-statistic of 12.81. The R^2 of the instrumenting regression is 0.39, suggesting that it is unlikely to suffer from overfitting.

Results with instrumented quantity are presented in the second column of Table 2. Since the dependent variable is dichotomous, we use the Smith-Blundell approach to instrumentation and include the predicted residuals from the instrumenting regressions in the regression. This generates a test of endogeneity as a by-product, which suggests that endogeneity is not a problem.

[3] In case of multiple observations per household. Unfortunately, households do not change their transaction mode sufficiently often to enable us to use fixed effects.

	First	Second	Third	Fourth	Fifth
log(distance to market)	-0.289	-0.214	-0.224	-0.240	-2.071
	(0.156*)	(0.158)	(0.163)	(0.154)	(0.599***)
Bike dummy	0.986	0.434	0.564	0.586	0.548
	(0.421**)	(0.479)	(0.584)	(0.587)	(0.576)
log(quantity sold)		0.851	0.717	-2.790	-2.806
		(0.348**)	(0.369*)	(0.975***)	(1.019***)
residual for quantity sold		-0.459	-0.353	2.497	2.178
		(0.370)	(0.429)	(1.149**)	(1.244*)
log(wealth)			-1.180	-2.297	-2.784
			(0.705**)	(0.762***)	(0.860***)
square of log(wealth)			0.089		
			(0.051**)		
log(quantity sold)*log(wealth)				0.536	0.535
				(0.157***)	(0.163***)
residual for quantity*wealth				-0.426	-0.374
				(0.177**)	(0.189**)
log(distance)*log(wealth)					0.276
					(0.092***)
Region and season dummies					
Masaka	0.023	-0.532	-0.564	-0.898	-0.792
	(0.464)	(0.539)	(0.522)	(0.570)	(0.558)
Mukono/Kayunga	-0.981	-1.019	-1.145	-1.174	-1.217
	(0.544*)	(0.550*)	(0.593*)	(0.618*)	(0.619**)
Bushenyi	-1.047	-1.273	-1.135	-1.012	-1.036
	(0.586*)	(0.596**)	(0.595*)	(0.601*)	(0.614*)
Season dummy	-0.210	-0.414	-0.366	-0.373	-0.386
	(0.288)	(0.292)	(0.298)	(0.311)	(0.316)
constant	-1.463	-4.413	-0.260	10.738	14.163
	(0.567***)	(1.434***)	(2.952)	(4.310**)	(4.917***)

Table 2: Probit results for decision to sell at the market

Results show that, as predicted by the model when $\sigma > 0$, quantity sold raises the likelihood of direct sale to the market. Once we control for quantity, distance and the bike dummy keep the same sign but are not longer significant.

We then introduce wealth as additional regressor. Because both the model and the non-parametric analysis makes us suspect the presence of an inverse U-shape relationship between wealth and sale to the market, we include a square term as well. Both terms are significant.[4] To

[4] We also experimented with partial non-parametric regression. Results are very similar to those reported in Table 2 and are omitted here for the sake of space.

facilitate interpretation, we visualize the combined effect of wealth in Figure 1c, which confirms the presence of a U-shape relationship.

Next we introduce an interaction term between quantity and wealth. When we do so, the square wealth term becomes non-significant and is dropped from the regression. Because quantity sold is potentially endogenous, we need to instrument the cross-term. We do so using the interaction between wealth and number of trees harvested as instrument. Results are presented in the fourth column. We find that once we include the cross-term, quantity itself becomes strongly negative while the interaction term is strongly positive. We visualize the combined effect in Figure 2a. We see that poor farmers become *less* likely to sell to the market when the quantity sold increases while rich farmers become *more* likely to sell to the market when quantity rises. This finding is consistent with the version of our model where $\sigma < 0$ (unit cost of own transport rises with quantity), public transportation is available, and because of cash constraints the poor cannot finance transport.

The fifth column introduces another interaction term between wealth and distance. Prediction 5 says that, in the absence of public transportation, this interaction term should have a negative sign. When public transportation is available and the poor cannot afford it, however, the prediction is reversed: as distance increases it becomes more attractive to transport to the market using public transportation. To the extent that only the wealthy can afford to do so, we expect a positive sign on the interaction term. This is indeed the result we obtain.

To check the robustness of our results, we redo the analysis using instead actual distance travelled as dependent variable. Because distance travelled is censored at 0, we estimate the model using tobit. Results are presented in Table 3. The combined effect of wealth and quantity sold on distance travelled is visualized in Figure 2b. All our earlier findings are confirmed.

Results are by and large consistent with model predictions. The version of the model that

	First	Second	Third	Fourth	Fifth
log(distance to market)	-0.341	-0.117	-0.258	-0.169	-2.290
	(0.161**)	(0.155)	(0.155*)	(0.153)	(0.780***)
Bike dummy	1.462	0.354	0.834	0.777	0.734
	(0.398***)	(0.422)	(0.416**)	(0.404*)	(0.405*)
log(quantity sold)		1.433	1.721	-1.927	-2.136
		(0.230***)	(0.399***)	(0.892**)	(0.934**)
residual for quantity		-0.755	-1.021	2.244	2.544
		(0.343**)	(0.428**)	(1.111**)	(1.173**)
log(wealth)			-2.089	-3.097	-3.904
			(0.565***)	(0.660***)	(0.895***)
square of log(wealth)			0.119		
			(0.045**)		
log(quantity sold)*log(wealth)				0.574	0.614
				(0.136***)	(0.147***)
residual for quantity*wealth				-0.497	-0.552
				(0.162***)	(0.176***)
log(distance)*log(wealth)					0.325
					(0.122***)
Region and season dummies					
Masaka	2.254	1.448	0.794	0.466	0.549
	(0.505***)	(0.482***)	(0.507)	(0.524)	(0.516)
Mukono / Kayunga	0.185	0.236	-0.024	-0.003	-0.066
	(0.553)	(0.518)	(0.514)	(0.507)	(0.509)
Bushenyi	-0.282	-0.874	-0.956	-1.028	-0.965
	(0.541)	(0.522*)	(0.527*)	(0.518**)	(0.517*)
Season dummy	-0.611	-0.721	-0.789	-0.698	-0.799
	(0.406)	(0.382*)	(0.388**)	(0.377*)	(0.380**)
constant	-4.934	-9.907	-2.539	8.454	13.683
	(0.711***)	(1.302***)	(2.266)	(3.840**)	(5.275***)
σ	3.224	2.979	2.908	2.865	2.867
	(0.225)	(0.206)	(0.201)	(0.199)	(0.199)

Table 3: Tobit results for distance travelled to sell coffee

best fits the data is one in which unit costs on own travel increase with quantity ($\sigma < 0$), hence explaining why poor farmers switch to farm-gate sales as they sell more coffee. The simplest version of the model predicts that wealthy households are more likely to sell at the farm gate because they value the convenience itinerant traders offer. We find some evidence of this at low wealth levels. But for wealthier households, the relationship between wealth and sale to the market is positive. This finding can be accounted for by the combination of availability of public transportation and the presence of cash constraints explaining why poor households do not resort to public transportation.

To investigate these issues further, we examine whether wealthier farmers are indeed more likely to use public transportation to sell their coffee. Results are omitted here to save space. The dependent variable is a dummy variable that equals one if the farmer reported spending money for transport. Given that only 33 farmers reported transport expenditures, results should be taken with a grain of salt as it is possible that some farmers used public transportation but failed to recall how much they spent on transport. In spite of this shortcoming, we find that the likelihood of reported use of public transport increases with quantity sold (second column) and with wealth (third column).[5] Results regarding interaction terms are unchanged as well. We take this as evidence that our earlier interpretation is consistent with the data.

5 Conclusion

Using household data from Uganda, we have examined farmers' choice to sell at the farm-gate. We first constructed a simple model of farmers' choice of form of sale. We showed that, when farmers must walk coffee to the market, wealthier farmers are predicted to resort to farm-gate sales, especially if the distance is far or the quantity sold is large. When we introduce cash

[5] In this case the wealth squared term is not significant and is ignored from the regression.

constraints and public transportation as an additional option, predictions get reversed in the sense that wealthy farmers are more likely to sell to the market.

We then tested these predictions using original survey data collected by the authors in four regions of Uganda. We find that the likelihood of selling to the market increases with the quantity sold and the proximity to the market, as predicted by the simple model. The relationship between wealth and market sales is found to be non-linear: poorer and wealthier farmers are more likely to sell to the market while farmers of intermediate wealth sell at the farm-gate. This non-linearity goes away once we include an interaction term between wealth and quantity sold: wealthy farmers are less likely to sell to the market, possibly because the shadow value of their time is higher. But if they have a large quantity of coffee for sale, they are more likely to sell it to the market. They are also more likely to travel to a distant market. We take these findings as consistent with our more general model in which wealthy farmers are better able to pay for public transportation.

This paper leaves some important questions unanswered. It is surprising, for instance, that individual farmers do not bunch up their sales to reduce transport costs and reap a higher price. Perhaps they need the money quick and cannot afford to wait. Alternatively, it is possible that they already bunch up sales but quantities remain too small to justify travelling to the market. To increase quantities, farmers could sell jointly, with one farmer travelling to the market carrying the quantities sold by several neighbors. It is possible that farmers do not trust each other enough to do this: with coffee prices changing all the time, it would only be too easy for the travelling farmer to defraud his neighbors. An alternative would be for a rich farmers to purchase coffee from his neighbors in order to sell it to the nearest market. This does not appear to be taking place in our study area. It is unclear why. More research is needed to answer these questions.

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Dependent variable: log(quantity sold)	Second	Third	Fourth	Fifth
log(distance to market)	-0.160	-0.074	-0.063	0.479
	(0.043***)	(0.044*)	(0.043*)	(0.167***)
Bike dummy	0.301	0.141	0.131	0.117
	(0.100***)	(0.102)	(0.101)	(0.101)
log(wealth)		-0.201	-0.98	0.616
		(0.169)	(0.169)	(0.126***)
square of log(wealth)		0.033	0.062	
		(0.013***)	(0.015***)	
log(distance)*log(wealth)				0.325
				(0.122***)
Masaka	0.091	0.202	0.266	0.259
	(0.131)	(0.130)	(0.129)	(0.130**)
Mukono / Kayunga	-0.065	-0.037	-0.017	0.023
	(0.135)	(0.131)	(0.128)	(0.130)
Bushenyi	0.666	0.624	0.629	0.594
	(0.128***)	(0.123***)	(0.121***)	(0.122***)
Season dummy	0.194	0.243	0.260	0.254
	(0.104*)	(0.101**)	(0.100***)	(0.100**)
log(number of trees)	0.445	0.363	0.949	0.663
	(0.035***)	(0.036***)	(0.159***)	(0.141***)
log(number of trees)*log(wealth)			-0.090	-0.044
			(0.024***)	(0.021**)
constant	1.727	1.829	-0.085	-2.105
	(0.223***)	(0.604***)	(0.781)	(0.849**)

Table 4: Instrumenting regression results for log(quantity sold)

Dependent variable: log(quantity sold)*log(wealth)	Fourth	Fifth
log(distance to market)	-0.566	6.066
	(0.295*)	(1.148***)
Bike dummy	0.950	0.796
	(0.684)	(0.694)
log(wealth)	-0.98	6.601
	(0.169)	(0.869***)
square of log(wealth)	0.062	
	(0.015***)	
log(distance)*log(wealth)		-1.034
		(0.169***)
Masaka	1.812	1.712
	(0.880**)	(0.895*)
Mukono / Kayunga	-0.416	0.058
	(0.878)	(0.891)
Bushenyi	4.139	3.711
	(0.828***)	(0.842***)
Season dummy	1.445	1.389
	(0.679**)	(0.689**)
log(number of trees)	4.243	0.900
	(1.083***)	(0.972)
log(number of trees)*log(wealth)	-0.316	0.223
	(0.162**)	(0.142*)
constant	-4.987	-29.337
	(5.321)	(5.831***)

Table 5: Instrumenting regression results for log(quantity sold)*log(wealth)

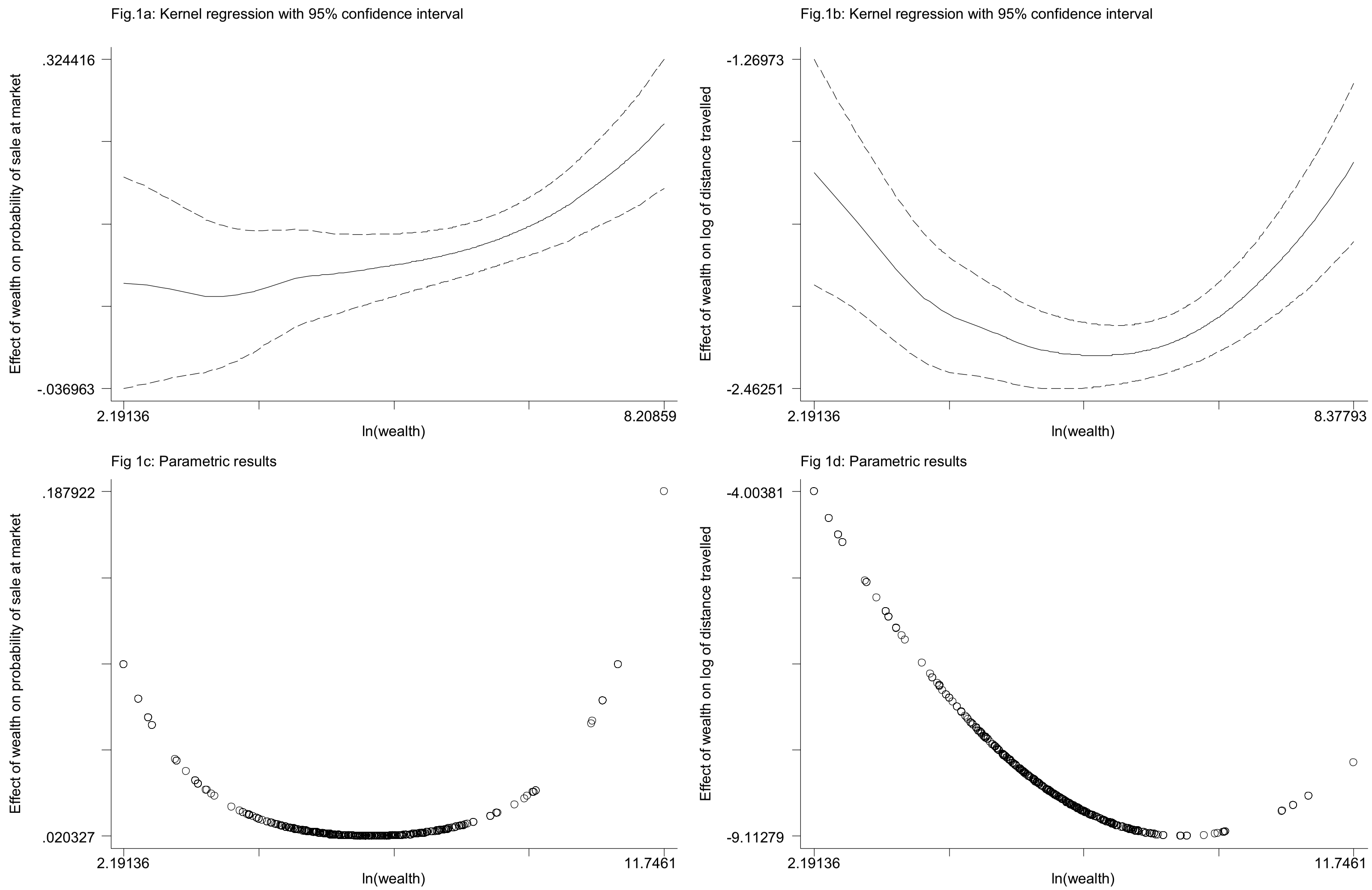

Figure 1: Effect of wealth on the probability of sale at the market and the distance travelled to make the sale. Top graphs result from non-parametric estimation, bottom graphs result from a parametric quadratic approach.

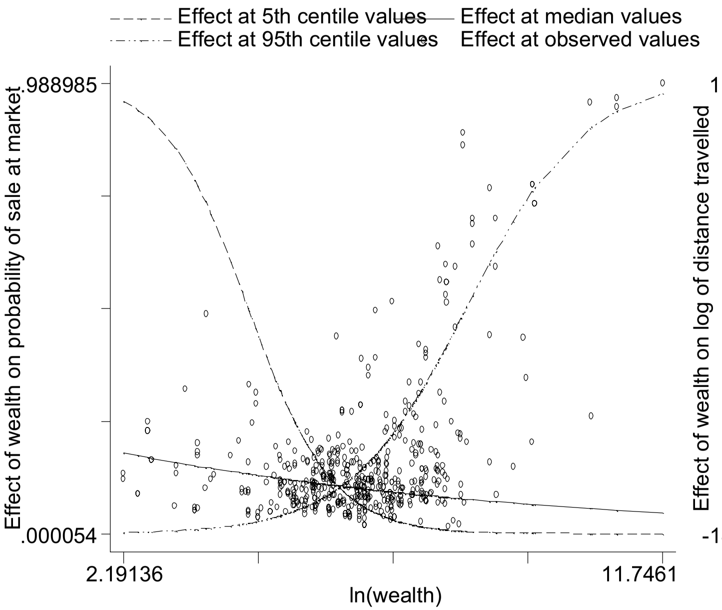

Fig.2a

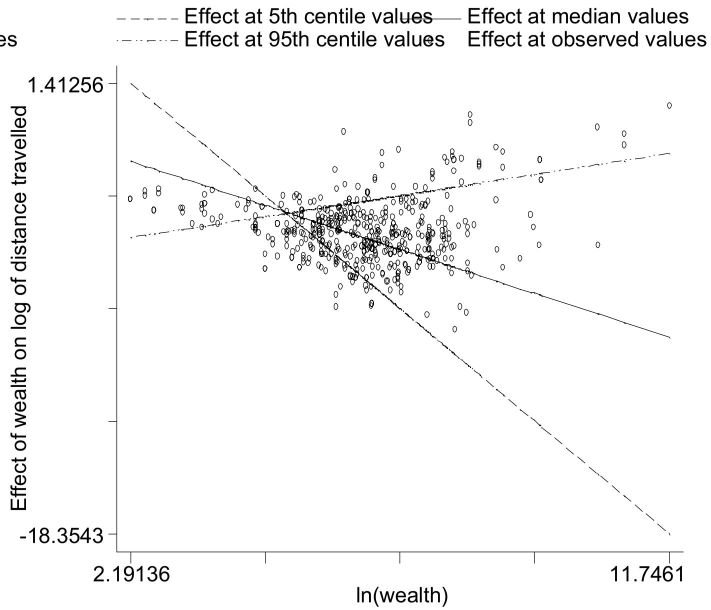

Fig.2b

Figure 2: Effect of wealth on probability of sale at market and on distance travelled to sell coffee for values of quantity and distance at the 5th, 50th and 95th percentile and for observed vaues of quantity and distance as denoted (for a farmer without a bike in Luwero district selling during the coffee season).