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Proportional Transaction Costs in Rice Marketing: Estimation and Distribution by Institutional Arrangement

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Agricultural commercialisation is emerging as an important option for achieving agricultural development and reducing poverty in developing countries, but it faces many barriers, including high proportional transaction costs, which lower the efficiency of agricultural marketing system, and yet its measurement remained a challenge and its distribution under different institutional arrangement is not widely explored. Therefore, this paper estimated proportional transaction costs in rice marketing and assessed how they are distributed among the institutional arrangements of contract, personalised arrangement and spot market. The paper adopted a quantitative methodology based on data collected from Northern Uganda. Proportional transaction cost was then estimated using transport model and its distribution was also assessed using t-statistics. Generally, the estimation found that low proportional transaction costs are incurred by rice producers in Northern Uganda, mainly because of subsidisation of transport cost by rice millers. However, these costs were noted to be much lower under contract institutional arrangement than under spot market and personalised arrangement. Therefore, these findings reveal useful information about rice milling as one of the points along the rice value chains that policy intervention for improving market access of rice producers can be made, and confirm the importance of contract farming in reducing transaction cost and enhancing access to market.

Keywords: Marketing, proportional transaction cost, estimation, distribution

Introduction

Transforming agriculture from subsistence to market-oriented (Commercialised) ventures is widely considered the most appropriate and effective pathway for realising agricultural growth and reducing poverty in developing countries. Agricultural growth reduces poverty directly by raising farmer incomes, but raising these incomes is almost impossible without agricultural commercialisation, which is achieved through participation in markets (Ratnadiwakara, De Silva & Soysa, 2008, p.3; Makhura, Kirsten & Delgado, 2001). Agricultural commercialization transforms farm households' goals from 'self-sufficiency' toward profit-making and income-generating (Pingali, Khwaja & Meijer 2005, p. 4). However, agricultural commercialisation is hampered by a number of factors, including high transaction costs.

Transaction costs are costs incurred during market exchange, and they can be proportional or fixed transaction costs. Proportional costs vary with quantity of products being transacted while fixed transaction costs are invariant to or independent of quantity of products being transacted (Azam, Imai & Gaiha, 2012, p. 7; Key, Sadoulet & de Janvry 2000, p. 245; Martuscelli, 2012, p. 2). Proportional transaction costs play important roles in agricultural marketing. They influence participation in the agricultural market; agricultural supply response; the choice of channels and institutional arrangements for marketing and; customers' satisfaction. Proportional transaction costs increase the effective price paid by a buyer and reduce the effective price received by a seller, thus lowering quantity of products or inputs supplied to the market and creating a price band between the two prices, which generates heterogeneity in market participation, namely net buying, net selling and self-sufficiency regimes (Key et al., 2000, p. 245 & 247; Martuscelli, 2012, p. 2). According to Martuscelli (2012, p. 7), the choice of these regimes is contingent upon comparing the utility obtained in the different regimes for a particular commodity.

The utility obtained in different regimes and thus the decision on whether to take part [in] the market depends on a comparison between the shadow price of those goods with the buying and selling market prices. If the shadow price is higher than the buying price then the household will maximize its utility level by being a net-buyer. If the household shadow price is below the market selling price then the household will be better off as a net-seller. Finally, if the shadow price [falls] within the band non-participation is the utility maximizing strategy for the household (Martuscelli, 2012, p. 7).

Therefore, transaction costs partly explain why some farmers participate in the market while others prefer self-sufficiency. However, self-sufficiency may need to be interpreted in the context of a par-

ticular commodity only. Proportional transaction costs are also a key factor in the choice of channels and institutional arrangements for marketing. If the cost of using a particular marketing channel or institutional arrangement exceeds its benefit, producer households get discouraged to sell under that channel or arrangement, they instead go for other options that maximise their utility (Jari & Fraser, 2009, p. 1132). Thus, proportional transaction costs affect the level of utility a producer household derives from a channel and an institutional arrangements for marketing.

Proportional transaction costs reduce customers' satisfaction. Since they increase the effective price paid by consumers, they reduce their utility. Reduced utility of customers spurs a great concern to the government as it may trigger protest from the electorate against unaffordable food prices (Crawford, 1997, p. 301). Therefore, proportional transaction cost raises not only market concerns, but also political issues. It reduces the efficiency of the marketing system, be it from the perspectives of farmers, consumers or the government.

Although proportional transaction costs are widely known to determine the efficiency of agricultural marketing system, they are generally not directly observed, despite the fact that some factors affecting them are observed. This poses measurement challenge. At the same time, how these costs are distributed among different institutional arrangements is not well understood. On that note therefore, this paper estimated the proportional transaction costs in rice marketing and assessed how they are distributed among the institutional arrangements of contract, personalised arrangement and spot market. Estimation and assessing distribution of proportional transaction costs facilitate the assessment of the efficiency of the marketing process, identification of policy intervention and institutional arrangements that ease barriers to market participation. The paper also contributes to the academic literatures regarding estimation and distribution of proportional transaction costs.

This paper is organised into four sections. Other than Introduction, the paper comprises theoretical framework, research methodology, results and discussions as well as a conclusion. The theoretical framework explains the major components of proportional transaction cost, namely: costs of product losses; product preparation, packaging and handling costs; transport costs as well as storage and processing costs. Research methodology describes the analytical framework of the paper, model specification, study area, sampling and data collection techniques and how the data was analysed. Result and discussion section presents and discusses results of removing outliers, assessing distribution of key model variables, measuring multicollinearity, testing for variable omission and heteroskedasticity, estimating and selecting transport models as well as the results of estimating proportional transaction cost and assessing its distribution.

Market transaction costs are costs of participating in or using the market (Yustika, 2005, p. 3; Ratnadiwakara et al., 2008, p. 4). They comprise fixed and proportional transaction costs. While proportional transaction costs vary with quantity of products being transacted, fixed transaction costs are invariant to quantity of products being transacted (Azam et al., 2012, p. 7; Key et al., 2000, p. 245; Martuscelli, 2012, p. 2; Vakis, Sadoulet & de Janvry 2003, p. 2). Fixed transaction costs include three major cost categories, namely: '(1) the costs of preparing contract (search and information costs), (2) the costs of concluding contracts (costs of bargaining and decision making, and (3) the costs of monitoring and enforcing the contractual obligations' which are generally unobservable (Ratnadiwakara et al., 2008, p. 5; Yustika, 2005, p. 3; Key et al., 2000, p. 245). For Key et al. (2000, p. 245 and 246), proportional transaction costs include per-unit costs of accessing markets and it is associated with marketing costs and imperfect information. However, imperfect information is also part and partial of fixed transaction costs. This makes Key's conceptualisation of proportional transaction costs blurred. For that matter, proportional transaction costs are considered synonymous with marketing costs in this paper.

Marketing costs include all expenses incurred in organising and carrying out the marketing processes or the charges made for any marketing activity (Smith, 1992, p. 8). They are incurred whenever commodities move from the farm to the final market, irrespective of whether they are moved by farmers, intermediaries, cooperatives, marketing boards, wholesalers, retailers or exporters. Marketing cost comprises product losses and costs of product preparation, handling, packaging, transport, storage, processing and so on.

Cost of Product Losses

Product losses often occur during production, post-harvest handling and at different stages of marketing, namely transport, storage or processing. These loses normally arise either because of overproduction by farmers; poor harvesting and improper primary processing techniques as well as bad handling on the farm; delays, poor packaging and handling, constant shaking on bumpy roads, exposure to rain and sun during transit; poor storage conditions and handling at selling points and; faulty weighing and processing machines as well as defects in their use (Smith, 1992, p. 16; Crawford, 1997, p. 309). These losses can be in terms of quantity or quality. Crawford (1997, p. 310) noted that quality losses manifest themselves when farmers or traders have to sell part of their consignment at prices lower than the rest, and he attributes them to deterioration during the period when products are being sold and

when there is expectation that they will deteriorate before another opportunity to sell them. For Smith (1992, p. 16), the level of product losses depends on a particular product, handling and storage technology. Handling and storage technology are key factors affecting product losses in developing countries, like Uganda, where storage technologies are rudimentary and prone to contamination and infections; and where crop drying are done on bare ground and they are packed and transported using materials and means and under conditions that increase losses.

Like other marketing costs, measuring product losses poses a serious challenge. Yet, accurate measurement of these losses provides information about the efficiency of the marketing system and its omission gives an inaccurate assessment of marketing cost and, thus profit margin. Although measuring cost of product losses is challenging, the methodology proposed by Smith is becoming famous. The methodology establishes how much of the raw material is necessary to purchase in order to supply the consumer with 1 kg of the reference product and it uses the ratio between these two amounts of product as a conversion factor to express all costs and margins in terms of 1 kg of the final product (Crawford, 1997, p. 309). However, Crawford, (1997, p. 309) argued that by-products are not part of the reference product and therefore, have to be excluded from calculations of the marketing costs attached to the reference product'. This may be true if the by-products have no alternative uses from which money can be earned.

This methodology was developed for use in the context of processed products, but it is also applicable in other contexts, making it very resourceful in setting prices and recovering costs (Crawford, 1997, p. 310). The usefulness of this methodology is undeniable, but its accuracy is yet to be improved.

Product Preparation, Packaging and Handling Costs

Product preparation includes operations such as cleaning, sorting and grading of produce, which are performed by households, exchanged or hired labour or a combination of them (Wandschneider & Yen, 2006, p. 23). Expenses on labour used in these tasks are product preparation costs. However, product losses may still be incurred although these preparation activities are not conducted. For example, lack of sorting and grading reduces product quality, leading to lower product prices. When these operations are completed, products are ready for packaging.

Packaging facilitates handling and transportation; protects the produce from losses such as bruises and spillage and others; it also aids dividing produce into convenient units for sale and makes them attractive to consumers (Crawford, 1997, p. 313). Therefore, avoiding or minimising packaging costs may increase marketing costs instead of reducing it. Packaging costs constitutes expenses on packaging materials and labour. These materials vary in types and costs and their choice may depend on the market, product and its market value. Packaging for supermarkets may need to meet specific requirements compared to those products destined for other markets like retail shop, open market stalls and many others. Cereals are mostly packed in gunny bags, meanwhile vegetables are mostly packed in boxes. Products with low market value tend to be packaged using cheaper materials and the reverse is true for products with high market value.

Every stage in the marketing chain involves packing and unpacking; loading and off-loading; putting produce into store and ferrying them out of it. Costs incurred in these activities are especially high when the market is served by many intermediaries and the commodities are not sorted, cleaned or packed in standard weight and materials by farmers. Therefore, traders who buy from farmers need to perform more operations to meet quality and other requirements imposed by or expected from their customers. Each individual handling cost is often small, but the total cost of all handling activities conducted in the whole marketing chain is considerable.

Transport Costs

Once agricultural products are packaged, they are transported to their different destinations. Transport costs constitute a significant component of marketing costs, especially where commodities are transported over long distances, road conditions are poor and when only small quantities of produce can be transported at one time (Smith, 1992, p. 13). Transport cost depends on the distance between the farm and the market, the quality of the roads, and the local availability of transport (Wandschneider & Yen, 2006, p. 23). Generally, transport cost is proportional to the distance travelled. When road quality is poor and transport means are not readily accessible, transport costs tend to be higher and the reverse are also true for good road quality and accessibility to transport means.

Measuring transport costs can be easy when farmers or traders hire or pay for the services of private transporters, as they can be determined from the payment they make to transporters (Crawford, 1997, p. 315; Smith, 1992, p. 15). Otherwise, transport costs are often less obvious in cases where farmers and traders use own transport means for ferrying their produce to the market (Crawford, 1997, p. 315; Smith, 1992, p. 15). This is especially true to African farmers who have poor record keeping culture. Therefore, there is need to use proxies for these costs.

Storage and Processing Costs

Storage and processing are ones of the key marketing functions, and costs incurred in performing these functions contribute significantly to marketing costs. Produce are stored to extend the period of their availability to consumers, but storage may not be viable unless it offers benefits that cover storage cost and an incentive of taking risk that a loss may result (Crawford, 1997, p. 317). Storage may instead increase produce losses, when it is done in places where no protection against moisture, dirts, direct sunshine and rodents are ensured. Processing adds value to agricultural produce, but it needs to be done when it is financially viable.

Storage costs are associated with the physical operation of the stores; the maintenance of the product quality while it is in store; loss of quality and quantity while the produce is in store and the financial cost to the owner or the produce while it is in store (Crawford, 1997, p. 317). Opportunities costs of storing produce may be very high among poor farmers who need to sell their produce early to pay school fees or meet other obligations. Processing costs consist of product losses and by-products (Crawford, 1997, p. 319). Processing costs are a function of the efficiency of the processing organisation, processing facility's throughput and frequency of its operation as well as the organisation's costs. Sometimes, produce processing equipment in developing countries are faulty, and they result into high product losses, in terms of spillage, low milling ration, breakage and other forms of losses.

Research Methodology

Analytical Framework

While Ratnadiwakara et al. (2008, p. 5) consider proportional transaction costs observable, Key et al. (2000, p. 247), Vakis et al. (2003, p. 4) and Bahta and Bauer (2012, p. 3527) assert that these costs are unobservable. Key et al. (2000, p. 247) contend that many transportation and marketing costs are either unobservable or cannot be easily recorded in a survey. Bahta and Bauer (2012, p. 3527) also argued that under circumstances, where transaction costs are so high that they prevent market exchanges from taking place, these costs remain hidden because transactions from which they can be observed have not occurred. This is often the case, where farmers have no access to transport and communication services—basically intermediaries— so that there would be no paid out costs to observe. In such cases, farmers tend to transport their products themselves using their assets and time (Bahta &Bauer, 2012, p. 3527). However, measuring farmers' time spent selling their crops in the market as well as transportation and time costs for farmers who transport their crops themselves is very difficult (Key et al., 2012, p. 247). Costs are paid out in some cases, but they remain unobservable because farmers maintain poor or no records regarding these transactions. Therefore, researchers need to indirectly measure proportional transaction costs. One of the indirect approaches used so far is the expression of proportion transaction cost as a function of observable exogenous characteristics that affect these costs when selling (Key et al., 200, p. 247).

Bahta and Bauer, (2012, p. 3527) and Key et al. (2000, p. 253) used distance to nearest town, ownership of transport equipment, road condition to the nearest town, membership in the farm organizations or groups and cooperation with white commercial farmers as exogenous variables for proportional transaction costs in their studies. The longer the distance to markets, which are mainly located in urban areas, the higher is the transport cost. When the road condition is poor, many farmers may not use it, and those who use it incur higher costs; namely high transport costs and longer time taken to reach the market. Ownership of assets—especially transports and communication equipment— reduces proportional transaction costs. However, the high fixed cost associated with using own transport means may result into high transport cost when they are underutilised (Smith, 1992, p. 14). Membership to farmer organisation or group also reduces proportional transaction costs, especially when they market their produce collectively. Cooperation with commercial farmers increases access to market information and facilitates product transport (Bahta & Bauer, 2012, p. 3527).

Model Specification

Proportional transaction cost was estimated from the transport cost model, following the methodology employed by Vakis et al. (2003, P. 4) in estimating transactions costs from observed behaviour in Peru. Transport cost was model as a function of distance to market and main road (D), road condition (C), whether farmers mill rice before selling (P), own motorcycle (M), own bicycle (B). It is mathematically expressed as follows: $Y = f(D, C, P, M, B)$.

Table 1: Hypothesised Relationship with Transport Costs

Variable	Variable Description	Expected Effects on transport Cost
D	Distance to the main road (Km).	+
C	Road condition (Poor=1, otherwise=0).	+
P	Mill rice before selling=1, otherwise=0.	-
M	Own motorcycle=1, otherwise=0.	-
B	Own bicycle=1, otherwise=0.	-

Study Area

This paper is based on a survey research conducted in Acholiland in Northern Uganda, specifically in the districts of Amuru, Gulu and Nwoya and in the sub counties (divisions) of Bungatira, Purongo, Amuru, Lamogi and Pabbo as illustrated in figure 1 below.

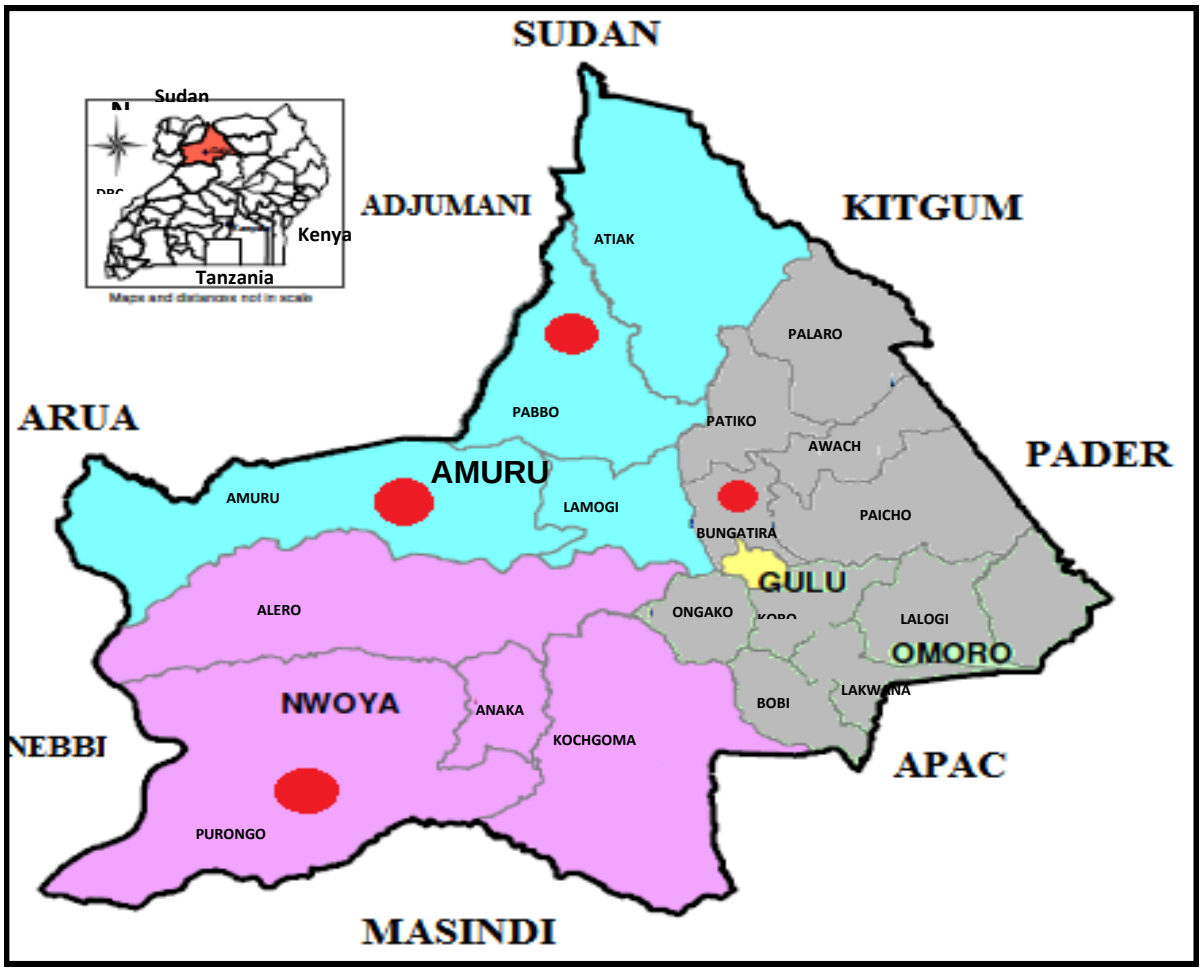

Figure 1: A Combined Map of Amuru, Gulu and Nwoya Districts Showing Study Areas

The Acholi, part of the luo-speaking ethnic group widely believed to have originated from Bahr el Ghazal in southern Sudan, are found in North-Central Uganda, where they have lived for quite many centuries. Traditionally, Acholi had well-organised social and political institutions, rich cuisine and a wide range of livelihood strategies.

Acholi are organized into clans headed by chiefs ('Rwot'), who dispense traditional justice and link the living and their great ancestors. The Acholi highly cherished communal values and these values are reflected in their habits, activities and ceremonies, which are often communally organized and done. For example, land was communally owned, but it was allocated and managed by a grandfather or clan leader who provides plots to each male family member according to need and the perceived ability to use the land (Mabikke, 2011, pp. 9; Adoko and Levine, 2004, pp. 5). It was also collectively tilted under 'rotational and 'prestation' labour exchange systems (Wairimu, 2015, pp. 5). Under rotational labour exchange, a group of community members tilt their member's garden in turn according to the schedule determined by either a secret ballot system or local arrangement. While for prestation labour exchange system, a community member would request for labour inputs from fellow members to assist in carrying out a particular activity and the recipient of labour normally prepare foods and entertain the providers of labour with beer in return for their help.

Although most Acholi people are Christians, traditional belief in ancestral spirits and guardians are still evident, although weakening.

Huts provided for housing needs and granary served food storage purpose in Acholiland. Huts have grass thatched roofs, with walls mudded and floors well-leveled and smeared with black river soils and cow dungs. Foods are mainly dried on rocks and well-swept bare grounds in the compound or in the bush and then stored in granaries, made up of well-knitted reeds or bamboo.

The Acholi diet is dominated by grain legumes and green leafy vegetables, flavoured by roasted or raw-pounded simsim (sesame) and peanut, but with occasional meat servings. The sauces are normally served with sweet potatoes, cassava, staple dough ('Kwon') made from maize, sorghum, millet and cassava flours or a mixture of them. Frying food with oil was rare, but it is becoming common. Rice and Irish potatoes were later introduced into Acholi diet and they were mainly served with meat and eaten a lot on big days such as Christmas, Independence Day and others.

Food in Acholi was not only a requirement for a healthy and well-functioning person, but it played key social roles. Foods and drinks were and still central in prestation labour exchange system, whereby they are served to providers of labour in return for assistance rendered in carrying out a particular activity. Foods and drinks were offered to ancestral spirits and gods to appease them. Food was not sold, but stored in granaries to avoid famine during adverse weather conditions and it was always given to other community members with limited food stock. However, the roles played by food today are changing. Almost every food crop has become a commodity. Although they are produced in small scale, parts of them are always sold to generate income for paying schools fees, medical bills, meeting other social obligations and acquiring other commodities that are not locally produced, but have become important for livelihoods and meeting other needs of the community. Foods destined for the markets are often carried on the heads, bicycle and sometimes on motorcycle and by trucks.

Traditionally, the Acholi practiced mixed subsistence farming. They rear cattle, goats, sheep and poultry and grow sorghum, millet, cassava, sweat potatoes, maize, simsim, ground nuts (peanuts), beans, peas, green vegetables and other savannah crops. Hunting, using net, spears and other tools often in the past, but seldom now supplement farming. Cotton, Tobacco and rice were introduced by the colonial government and Indian traders as cash crops, although other crops of commercial values have also emerged today. Acholi traded with their neighbouring communities in petty commodities, basically on barter system. However, conventional commercial activities were conducted by the Indian traders and few local merchants.

Although farming in Acholiland is still predominantly subsistence, many middle-scale and few large-scale commercial farmers are emerging in the sub-region. Acholiland is becoming one of the destinations for agricultural investment because of land availability and the slowly changing land tenure system from communal to private ownership. This increasing trend in land individualization in Acholiland has also been noted by Mercy Corps (2011, pp. 5) in her study of Uganda Conflict and Market Assessment – Acholiland. From this study Mercy Corps noted that 'cash sales of land have increased in frequency since the end of the war'. However, this progress is meeting resistance and spurring land conflicts in the sub-region. This conflict often arises when an investor acquires land in a dubious or non-transparent manner without full consent of the community (Mercy Corps, 2011, pp. 5). The sub-region is not only a destination for agricultural investment, but procurement of a number of commodities. This commodity sourcing takes place in the spot market, under contract arrangement and through processors and other intermediaries based on commission. Thus, farming in Acholiland is undergoing slow, but visible transformation partly because of the changing traditional institutions and external influence.

One of the commodities being sourced from Acholiland is rice. Rice was introduced in Northern Uganda in the 1950s, and it became very popular by the 1980s, mainly as a cash crop. However, rice production and trade had been interrupted by 20 years of conflict in the region because farmers were displaced into internally displaced persons (IDP) camps, and insecurity limited access to their land and the markets (Emerging Market Group, 2008, pp. 1). A study conducted in the region by International Alert in 2008 reveals that 81% of the households stopped cultivation during the insurgency, and they had to rely on relief supply; businesses in trading centres were looted by rebels; vehicles were ambushed, and the risks associated with moving to and from the region further isolated it (International Alert, 2008, pp.15). This made agricultural production and trade extremely difficult, risky and subsequently low. However, the relative peace that prevailed after the agreement to stop hostilities in 2006, resulted into movement of Internally Displaced Persons from camps to transit sites and their original homes, intensifying land conflicts, but also increasing influx of economic recovery programmes, and revitalizing the rice production and trade (MAAIF, 2009, pp.7; International Alert, 2008, pp.16; Emerging Market Group, 2008, pp.1). Since a few years, the crop and the region are regaining their glories (International Alert, 2008, pp.16; Emerging Market Group, 2008, pp. 1).

The three districts and four sub counties of Acholiland were chosen because they are among the main rice producing areas in Northern Uganda, and it is where a lot of rice processing takes place and high volume of rice trading with other parts of the country and Southern Sudan is transacted. Out of the 20 districts in Northern Uganda, these three districts account for 48 percent of rice produced in the region (UBOS, 2011, pp.154). Rice milling takes place mainly in Gulu town and Pabbo along the highway leading to South Sudan, but also to a lesser extent in other trading centres (Emerging Markets Group, 2008, pp.26). Mills serve as rice marketing centres, where urban traders buy rice and sell to buyers from Kampala, other districts and South Sudan markets (Emerging Markets Group, 2008, pp.26).

Sample and Sampling Techniques

A sample population of one hundred fifty one (151) farm households was drawn. The respondents were selected using stratified sampling. The study area was divided into strata using geographical criteria. These strata comprise sub counties of Bungatira, Purongo Amuru, Lamogi and Pabbo. Up to 28 respondents were sampled from Bungatira, 45 from Purongo 14 from Amuru, 32 from Lamogi and 31 from Pabbo. Sampling within each stratum was conducted by interviewing the third household in the direction randomly chosen. This was enough further apart given the sparse nature of rural population. The survey was conducted in every selected village once to avoid interactions among respondents. This sampling technique was chosen because it ensures obtaining a representative sample and allows analysis for separate sample and it generates more variations required in statistical analysis.

Data and Data Collection Techniques

Data was entirely collected from primary source and information related to the market, institutional arrangements, rice output and quantity sold, transaction costs, social capital, asset endowment of the targeted households, characteristics of rice producers and traders and other variables were captured.

The data was collected using a structured questionnaire administered through personal interviews. A questionnaire was first drafted and pre-tested using four respondents and thereafter, it was adjusted accordingly and administered.

Data Analysis

Data collected was subjected to statistical treatment in STATA. These statistical operations comprised generation of box-plots and histograms to remove outliers and assess the distribution of key variables. Descriptive statistics were also generated to provide a summary of the data. Based on the distribution of the endogenous variable, possible models were estimated, and they were compared in order to choose the model that fits the data better. The model was then tested for variable omission and heteroskedasticity before the appropriate estimation remedy was used.

Results and Discussions

Removal of Outliers and Assessment of Variable Distribution

Using box plots, all outliers were removed from the data as can be seen in figure 2 and the distribution of transport cost per unit quantity of rice sold was assessed by plotting a histogram presented in figure 3. Both box plot and histogram revealed that transport cost per unit quantity of rice sold is not normally distributed. It is rather left-censored.

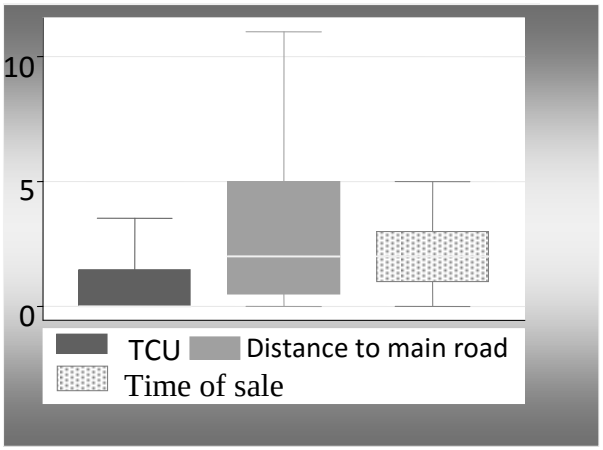

Figure 2: Box Plot

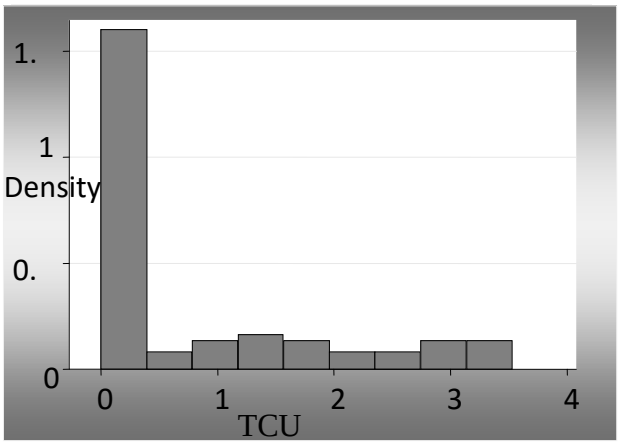

Figure 3: Histogram for TCU

This observation suggests that the ordinary least square estimation would generate biased and inconsistent estimates.

Descriptive Statistics

These statistics were generated for both quantitative and qualitative variables.

Table 2: Quantitative Variables

Variable	#Obs.	Mean	STD	Skewness	Kurtosis
Transport cost per unit (UGX/Kg)	94	0.743	1.113	1.226	3.079
Distance to main road	94	2.670	2.483	1.286	4.599
Time of Sales	94	2	1.333	0.653	2.619

According to table 2, the average transport cost is about UGX 0.74 per kg or UGX 60 per bag, but transport costs incurred by the majority of rice producers are above average. This is quite low compared to market rate. This is mainly attributed to the fact that rice farmers get free or low-cost transport service from buyers and rice millers. The same table also shows that most rice farmers are located about 2.5 km away from the main road. As noted from table 3, the problem of far location is worsen by poor road conditions. Most of them sell their rice 2 months after harvest. This period is too short for farmers to scoop attractive price for their rice.

Table 3: Qualitative Variables

Variable	#Observations	Frequency	Percentage
Mill rice before selling=1, otherwise=0	94	70	74.5
Own Bicycle=1, otherwise=0	94	73	77.7
Own motorcycle=1, otherwise=0	94	14	14.9
Road condition=1, otherwise=0	94	21	22.3
Institutional arrangements			
Contract	94	29	30.9
Personalized arrangement	94	28	29.8
Spot Market	94	37	39.4

Majority of farmers mill their rice before selling. This is probably because rice buying and selling take place at the rice milling plants and rice mills are many, with some even installed at remote locations. However, these mills do not grade rice and some of them are in poor mechanical conditions, leading to frequent break downs and high milling losses. Most of the rice farmers own bicycle, but few of them have motorcycles. A bicycle carries limited amount of rice over a longer distance, leaving motorcycle and motor vehicles as the only viable means of transporting rice to the mills and mar-

kets. Rice marketing takes place under the institutional arrangements of contract, personalized arrangement and spot market. Although marketing under contract arrangement reduces transaction risks and improves access to market, rice marketing in Northern Uganda takes place predominantly under spot market as can be seen in table 3 above.

Table 4: Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
Time of Sales	1.24	0.804
Distance to main road	1.17	0.857
Own Bicycle=1, otherwise=0	1.15	0.870
Road condition=1, otherwise=0	1.12	0.893
Own motorcycle=1, otherwise=0	1.09	0.918
Mill rice before selling=1, otherwise=0	1.09	0.919
Mean	1.14	

Table 4 shows that all variance inflation factors are less that the critical level of 4 and their reciprocal are greater than 0.5. This suggests that the level of multicollinearity is low and as such the model is insignificantly affected by multicollinearity problem**.**

Table 5: Test for Variable Omission and Heteroskedasticity

Test	Hypothesis	Chi2/F	
Ramsey RESET Test	Ho: Model has no omitted variables	F(3,84):	0.52
Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity	Ho: Constant variance	F(3,83):	6.81***

Table 5 suggests we cannot reject the null hypothesis that the model has no omitted variables. Therefore, endogeneity bias is reduced. However, the same table shows that we cannot accept the null hypothesis of constant variance. This suggests the presence of heteroskedasticity problem. Therefore, robust regression was employed to reduce this problem.

Transport Model Estimation and Selection

Transport cost model was estimated as a function of distance to main road, whether a rice producer mill rice before selling, own bicycle, own motorcycle or not and whether the road condition is bad or good. The model was generated with both Tobit and ordinary least square (OLS) regressions. However, the two models were compared to select the one that better fits the data. As can be seen from table 6, Tobit model has lower values of Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) than the OLS models. This suggests that Tobit model fits the data better. Hence, the subsequent discussion of the transport cost model is centered on Tobit model.

Table 6: Tobit and OLS Model Estimates

Variable	Tobit Estimates	OLS Estimates
Distance to main road	-.088	-.053
	(0.11)	(.050)
Time of Sales	0.324**	0.147
	(0.166)	(.097)
Mill rice before selling=1, otherwise=0	-2.636***	-1.196***
	(0.414)	(0.266)
Own Bicycle=1, otherwise=0	0.527	.070
	(0.667)	(0.277)
Own motorcycle=1, otherwise=0	-1.708***	-0.539***
	(0.557)	(0.188)
Road condition=1, otherwise=0	1.176**	0.368
	(0.533)	(0.305)
Constant (Intercept)	0.486	1.424***
	(0.716)	(0.354)
F(6,88)	14.63***	11.03***
Number of Observations	94	94
Akaike's Information Criterion (AIC)	196.765	252.364
Bayesian Information Criterion (BIC)	217.111	270.167

Model Explanation

Although transport cost model was estimated as a function of distance to main road, whether a rice producer mill rice before selling, own bicycle, own motorcycle or not and whether the road condition is bad or good, table 6 shows that only time of sale, milling rice before selling, ownership of motorcycle and road condition significantly affect transport cost.

Delaying rice sale by one month leads to an increase in transport cost by about 40 cent and UGX 30 for every kilogram and bag of rice transported respectively. This may be attributed to low supply of transport services. As time passes by, farmers tend to sell most of their rice and the declining volume of rice results into low demand for transport services and subsequently low supply. The scarcity of transport services raises their costs. Infrequent transport services have been blamed for inefficient agricultural marketing, where the transporting and marketing unit costs are high (Hine & Ellis, 2001, p. 2). Although storing commodity until its price has risen is advisable, the high transport costs incurred as a result of scarce transport services may considerably reduce benefits accruing to farmers storing their commodity for longer time. Therefore, farmers' decision of when to sell their rice need to take into consideration both the prevailing and future market price as well as transport costs they are likely to incur.

Milling rice before selling is associated with a reduction in transport cost. As shown in table 6, milling rice before selling is associated with a reduction in transport of UGX 2.636 and 211 for every kilogram and bag of rice transported respectively. This appears to be the case because some rice millers provide free transport services to rice producers, others refund transport costs incurred by rice producers, while others contribute 50% of the total transport cost to be incurred by rice producers. Therefore, rice millers in Northern Uganda play a significant role in improving market access of rice producers. Any policy intervention geared towards improving market access of rice producers can be implemented by either subsidizing rice millers or channelling subsidies to rice producers through rice millers.

Owning motorcycle has a negative effect on transport cost. Owning a motorcycle is associated with reduction of UGX 1.708 and 137 for every kilogram and bag of rice transported respectively. Rice producers with motorcycles use them for ferrying rice to the mill. However, this may be possible only for farm households nearer to the mills and with smaller quantity of rice. Even though rice producers may use their motorcycle, they incur costs on repair and maintenance, fuels and other costs that may be difficult to measure.

Road condition is positively related to transport cost. As Table 6 shows, when the road condition is poor, transport cost increases by UGX 1.176 and 94 for every kilogram and bag of rice transported respectively. This observation agrees with finding of a study conducted in Tanzania, which found that in the stretch of over 50 km distance, an increase in road roughness by 50 percent would raise truck charges by 16 percent and that of pickup charges by nearly 200 percent (Hine & Ellis, 2001, p. 3). Poor road conditions affect transport costs by influencing the supply of transport services. When road condition is poor, transporters are discouraged to use that road. The few of them, who remain in that route, tend to monopolise and charge high transport cost. As Hine and Ellis (2001, p. 8) noted, poor road condition results into inadequate transport services. Subsequently, the scarce transport services raise transport charges. At times transporters are not discouraged to use roads under poor conditions, but the high fuel, repair and maintenance costs they incur along such roads drive them to raise transport cost.

Estimation and Distribution of Proportional Transaction Costs

Based on the estimated transport model, proportional transaction cost was predicted. As Table 7 shows, the average proportional transaction cost is about negative 0.5, with the majority of transport costs incurred being above the average transport cost. The negative and low value of proportional transaction is mainly attributed to subsidization of transport cost by the rice millers.

Table 7: Summary of Proportional Transaction Cost Estimate

Statistics	Statistics
Observation	94
Mean	-0.456
Standard Deviation	1.678
Skewness	0.417
Kurtosis	2.111

How the proportional transaction costs are distributed among the different institutional arrangements for rice marketing was also assessed. As presented in table 8, proportional transaction costs incurred under the spot market and personalized arrangement are significantly lower than those incurred under contract arrangement.

Table 8: Comparison of Mean Proportional Transaction Costs under different Institutional Arrangements for Rice Marketing

Mean Comparison	1st Mean	2nd Mean	Mean Diff.	95% C.I	T-value	Ha: diff = 0 Pr(|T| > |t|)
Spot Market vs. Personalized Arrangement	.023	-0.185	0.207	(-0.652,1.067)	0.482	0.631
Spot Market vs. Contract Arrangement	.023	-1.620	1.643	(1.032,2.253)	5.378	.000
Personalized vs. Contract Arrangement	-0.185	-1.620	1.435	(0.580,2.291)	3.362	.001

The lower proportional transaction incurred under contractual arrangement is attributed to the fact that rice selling under this arrangement is always done after milling and as noted before, millers provide free transport services to rice producers, while others contribute 50% of the total transport cost to be incurred by rice producers. As table 9 shows all (100 percent of) rice sold under contract arrangement are milled before selling compared to only 61 percent and 65 percent under personalized and spot market respectively.

Table 9: Institutional Arrangement and Rice Milling

Institutional Arrangement	Sell Rice without Milling	Mill Rice Before Selling	Total
Contract	0	29 (100%)	29
Personalized Arrangement	11	17 (61%)	28
Spot Market	13	24 (65%)	37
Total	24	70	94

This observation agrees with the general literature on the role of contractual arrangement in enhancing agricultural development. As Prowse (2011, p. 22) noted, contract farming improves marketing efficiency and stimulates the broader commercialisation of smallholder farming. It reduces transaction cost; hence, it facilitates entry of small holder farmers into the market, deepens their market participation and it increases net gains they derived from the market.

Conclusion

Proportional transaction cost was predicted from the transport model, following methods applied by Vakis et al. (2003) in estimating transactions costs from observed behaviour in Peru. Their model estimated transport cost as a function of distance and time to market as well as their squares and a location dummy, but this paper never used time to market because it is mainly unobservable. However, time of selling commodity emerged as one of the key variables in transport model estimated in this paper. Although the paper made an extensive review of product losses and other key components of proportional transaction costs, it never incorporated them in the model. This is a weakness the model shares with earlier similar models developed, which may need to be addressed in subsequent research and papers.

Otherwise, the estimated transport cost model shows that time of sale and poor road condition tend to raise transport cost, but owning a motor cycle and milling rice before selling are associated with lower transport cost. However, milling seems to reduce transport cost, where miller subsidise transport cost.

Regarding distribution of proportional transaction costs, it is thinly distributed among farmers engaged in contract farming compared to their counterparts under personalised arrangement and in the spot market. This is consistent with the general literature on contract farming and transaction cost.

In general, these findings suggest that (1) estimation of proportional transaction cost needs more research attentions; (2) rice milling is one of the points along rice value chains that policy intervention for improving market access of rice producers can be made and; (3) that relatively well-off rice producers tend to incur lower proportional transaction cost, since they are the ones who afford buying motorcycle. The poor counterparts may resort to bicycles and other means, which are associated with high proportional transaction costs. These findings also point to the fact that storing produce may not be taken for granted, since time of

sale is positively related to transport cost. Finally, they confirm the importance of good road conditions and contract farming in reducing transaction cost and enhancing access to market.

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