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Do transaction costs influence smallholder rubber farmers' choice of selling outlets? Evidence from Liberia

Francis F.B. Mulbah, Cecilia Ritho and John Mburu

ABSTRACT

This article determines the effect of transaction costs and socio-economic factors on smallholder natural rubber farmers' decisions to sell at the farm gate to itinerant traders or in the alternative markets in Liberia. Cross-sectional data were collected from 200 smallholder natural rubber farmers through multistage sampling. The results indicate that transaction costs and socio-economic variables significantly influenced the choice of selling outlets. The study recommends that policy could aim at establishing market support services in the form of market information systems and affordable means of transportation to enhance access to up-to-date market information on trading partners and prices.

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Introduction

Natural rubber is one of the vital cash crops that has sustained economies in some developing countries, particularly Liberia, Ivory Coast, Laos PDR and Nigeria, in terms of job creation, better livelihoods, foreign exchange earnings, and improved food and nutrition security (Manivong and Cramb 2008). It helps with government policy on stabilising shifting cultivation where forests are under threat. More than 20 million households, mostly smallholders, depend on natural rubber cultivation as a primary source of income (Nwachukwu et al. 2014).

Natural rubber is the most important agricultural export commodity in Liberia and a source of income for many rural dwellers. The sector is dominated by small and medium farms that cover more than 5% of the agricultural land (GoL 2013). According to Tyson (2017), from 2003 to 2010, natural rubber accounted for about 85% of total export earnings. Liberia was ranked the fourteenth highest producer of natural rubber in the world and second in Africa, with a total output of 60,000 metric tonnes per year in 2015 (Daly, Bamber, and Gereffi 2017). Despite the contributions of natural rubber to export earnings and livelihoods, there are still low income and high poverty rates among the farmers. About 58% of rural smallholder natural rubber farmers in Liberia live below the poverty line of US\$1.90 per day (World Bank 2018).

In order for Liberia to meet Sustainable Development Goal 8 (SDG 8), focusing on “sustainable economic growth and full productive employment”, there is a need to increase the production and commercialisation of natural rubber to enhance farmers' incomes and foreign exchange earnings. In Lao PDR and other natural rubber-producing countries in Asia, smallholders mostly sell at the farm gate and through cooperatives, spot markets, processors, and international markets (Manivong 2007; Southavilay 2016). However, in Liberia, smallholder natural rubber farmers sell to processors, cooperatives, spot markets and at the farm gate. The selling outlets depend on the latex processing method used, distance to the market, and access to market information. The selling of natural rubber at the farm gate and spot market requires less quality control compared to selling to processors that require a specific quality of natural rubber (Manivong 2007). In this study, the

choices of selling outlets are grouped into two categories: farm gate and alternative markets. Alternative markets are cooperatives, spot markets and processors.

Most of the natural rubber produced in Liberia by smallholder farmers is sold at the farm gate to itinerant traders because farmers are unable to access higher price markets due to the low quality of natural rubber produced (cup lump rubber), poor road network, limited information on potential buyers, and long distances from farms to markets increasing transportation costs (Southavilay 2016). Most of these factors constitute what are termed transaction costs. Transaction costs are costs related to the act of exchanging ownership rights of economic assets, which in this case, is natural rubber (Ortmann and King 2007a). They include the costs of organising, bargaining, buying and selling, information search costs for products, and the costs of ensuring contracts are obeyed and enforced. Poor road conditions and long distances to markets translate into high transaction costs, which force farmers to sell at low farm-gate prices, reducing their income and entrenching them in the vicious cycle of poverty.

Transaction costs can be categorised into fixed and variable costs. Fixed transaction costs do not vary with the volume of commodities traded in the market, but rather the frequency of trade (Osebeyo and Aye 2014). These costs serve as decision-making tools for smallholder participation in the market. Fixed transaction costs comprise: (a) costs of looking for potential buyers; (b) negotiations and bargaining costs; and (c) the cost of monitoring and supervising contracts, especially when commodities are exchanged for credit (Key, Sadoulet, and De Janvry 2000). Variable transaction costs vary with the volume of each unit of a commodity traded in the market, and also serve as decision-making tools for farmers to sell at the farm gate or alternative markets and the volume to be transported to the market. These costs include transportation costs to the market, the time taken to transport commodities to the market, and storage fees (Key, Sadoulet, and De Janvry 2000; Jagwe and Machethe 2011). Excluding production costs, these transaction costs determined the actual price farmers receive from selling their commodity. According to Ortmann and King (2007b), high transaction costs resulting from poor infrastructure such as telecommunication, road and farmers' support services (credit, extension, and information) serve as a major determinant of the level of farm income in sub-Saharan Africa (SSA).

Different programmes, including the Smallholder Tree Crop Revitalization Support Project (STCRSP), have been introduced by policymakers to improve production and road conditions in order to reduce transaction costs and increase the commercialisation of smallholder farmers in Liberia. However, the programme has not yielded much gain as the commercialisation rate is still low at 55% among cash crop farmers (GoL 2017). Therefore, there is a need to identify other means of minimising the high transaction costs faced by smallholder natural rubber farmers to increase the rate of commercialisation. Collective action has been seen as one such means (Markelova et al. 2009). Through collective action, farmers can satisfy stringent marketing requirements, which if undertaken individually require high transaction costs.

In order to increase the level of commercialised rubber production in Liberia, there is a need to improve the potential of smallholder farmers to produce a marketable surplus and reduce transaction costs that serve as a major barrier to accessing high price markets. Improving the livelihoods of smallholder rubber farmers in Liberia through commercialisation calls for understanding factors influencing farmers' choice of selling outlets.

Previous studies (Fafchamps and Hill 2005; Jagwe and Machethe 2011; Shiimi, Taljaard, and Jordaan 2012; Kuma et al. 2013; Abu, Issahaku, and Nkegbe 2016) determined factors influencing farmers' choice of marketing outlets. These studies found that the choice of marketing outlets depends on access to market information, membership of a farming group and ownership of transport means. Similarly, Woldie and Nuppenau (2009) and Maina, Lagat, and Mutai (2015) examined the role of transaction costs in determining smallholder market participation and choice of selling outlets. They found that household size and monitoring and enforcement costs of contracts determined the choice of selling outlets and extent of market participation.

However, these studies focused on the effect of transaction costs on food crops, while the current study focuses on non-food crops. While transaction costs and other factors have proven to be major constraints to food crop farmers' access to improved market, there is limited empirical evidence that the same is true for non-food crops, specifically natural rubber. One exception is Randela, Alemu, and Groenewald (2008), who found that transaction costs and other related factors determined market participation of smallholder cotton farmers in South Africa. There remains a dearth of knowledge about factors that constrain smallholder natural rubber farmers from accessing high-price markets. This has resulted in little effort being made to reduce transaction costs in natural rubber marketing. This article attempts to address this knowledge gap.

This study differs from previous studies in that Liberia experienced 14 years of crisis that destroyed the productive and commercial sectors, resulting in poor infrastructure development, specifically roads and telecommunication. Previous transaction cost studies were conducted in countries with more developed agriculture infrastructures, support services, and with differing laws. Given this, the findings of these studies may not apply to Liberia because transaction costs vary from one country to another, and from one enterprise to another.

Natural rubber a unique crop because it is bulky, has 55–60% water content, and harvesting is for at least 120 days per year, indicating that it requires a ready market and the frequency of transactions is high (Jayanthi and Sankaranarayanan 2005; Manivong 2007).

The rest of the paper is organised as follows. The next section presents the theoretical background and the characteristics of natural rubber. The third section presents the analytical framework, description of the variables used in the empirical model, and study areas and sampling design. The results and discussion provide a descriptive analysis of the data and the results of the logit model. The final section concludes and provides policy recommendations.

Theoretical background

This study is based on transaction costs theory in the New Institutional Economics (NIE). The theory argues that market exchange, for example, the exchange of agricultural commodities, is not costless (Coase 1937). Neo-classical economists assumed that information is costless and perfect without uncertainty, but transaction costs economics relaxed some of the non-realistic assumptions of neo-classical economics such as complete information, zero transaction costs, and full rationality (Kherallah and Kirsten 2001). Transaction costs economics maintains that every transaction is associated with costs such as search costs, negotiation costs, and the costs of monitoring an agreement to ascertain that its terms are satisfied, hence gathering information is not free. For instance, in the selling of natural rubber, there are adverse selection and moral hazard problems caused by information asymmetry between producers and consumers (Hernandez-Espallardo, Arcas-Lario, and Tantius 2009).

NIE hypothesised that institutions such as collective action and social capital are transaction costs minimising arrangements that may evolve with changes in the nature and source of information costs, and can help overcome the information asymmetry problems (Williamson 2007). In the absence of formal institutions that modulate transaction costs, farmers face high transaction costs to obtain information about trading partners and to monitor and enforce contracts. Perfect information reduces the problem of moral hazard and adverse selection since farmers are knowledgeable about trading partners. According to North (2000), institutions that reduce transaction costs are essential to the functioning of economies, and also the role of state actors is vital in enforcing contracts and reducing the transaction costs of market exchange. Moreover, Kherallah and Kirsten (2001) noted that the institutions of a country such as the legal system, political institutions and communication and road infrastructure policies, determine its economic performance. However, Nkhori (2006) argues that it is not suitable to create formal institutions to reduce transaction costs without an enabling political environment to sustain the appropriate institution.

Asset specificity

This is a situation where an asset has a single or limited use outside the enterprise where it was purchased. Specific assets are investments farmers made for a particular enterprise, and the costs of these assets are considered sunk costs (Liang 2009). There are different forms of asset specificity, but the two most important forms are physical and human specificity. Physical asset specificities are equipment or machinery that produce output particular to a specific agricultural enterprise like natural rubber, while human asset specificity involves the accumulation of skills and expertise that are specific to an agricultural enterprise (Hajderllari, Karantininis, and Chaddad 2014). The skills or knowledge acquired may have no or less value in alternative uses. According to Kydd and Dorward (2004), asset specificity in SSA is mainly caused by thin markets for an asset. Some of the specific assets in SSA would not be considered as specific assets in economies with well-developed markets that allow redistribution.

Natural rubber is asset specific because it has a limited number of buyers, and the skills and assets used in production, such as the tapping of natural rubber, platform balance and chemical balance, cannot be used in another enterprise. The high asset specificity exposes smallholder farmers to high transaction costs because the refusal of a buyer to buy at a better price forces the farmer to negotiate or search for another buyer, thus increasing their search and negotiation costs (Williamson 2007).

Materials and methods

Institutional and socio-economic conditions influence a household's selling decisions, while the supply of agricultural commodities depends on variable transaction costs such as the transportation cost of goods to the market, time taken to transport goods to the market, and storage fees. The choice of household selling outlets can be modelled between two options: sell at the farm gate or alternative markets. The dependent variable is discrete and binary, hence a binary logit model is employed to determine such influence.

$$Y_i \begin{cases} 1 & \text{if a farmer sells at farm-gate} \\ 0 & \text{if a farmer sells at alternative markets} \end{cases} \quad (1)$$

The logistic regression model used a cumulative logistic distribution function. The model has some limitations, the assumptions of linearity, normality, and homoscedasticity are not satisfied. The model does not represent dissimilarities in tastes that cannot be related to observed characteristics of the farmer (Train 2002; Dell'Olio et al. 2018). Despite the limitations of the logit model, it has two practical advantages over the probit model: the cumulative distribution function of the logit model is not difficult, and the inverse linear transformation of the logit model is directly interpretable as log-odds (Klieštík, Kočíšová, and Mišanková 2015). Therefore, the logit model was preferred for this study. Previous empirical studies have used the logit model alone or with two-stage models to determine household decisions. For instance, Osebeyo and Aye (2014) employed the logit model in their study of factors influencing the choice of marketing outlets for tomato farmers in Nigeria. Randela, Alemu, and Groenewald (2008) used a logit model to estimate factors increasing smallholder cotton farmers' market participation in South Africa.

Following McFadden (1973) the probability that individual i sells at the farm gate can be modelled as:

$$\text{prob} [y_{ij} = 1] = \frac{\exp \theta' X_i}{1 + \exp \theta' X_i} = \Lambda(\theta' X_i) \quad (2)$$

where; i = Individual farmer; j = Choice of selling outlets (1 = farm gate, 0 = alternative markets); X = A vector of explanatory variables such as market distance travel and other socio-economic conditions; θ = The parameter to be estimated; Λ = Logistic distribution function.

The unobservable error term ε of the logit model is assumed to follow a logistic probability distribution whose cumulative density distribution function (F) is specified as:

$$F'(\theta'X_i) = \Lambda(\theta'X_i)[1 - \Lambda(\theta'X_i)] \quad (3)$$

Where; F' represents the cumulative distribution function of the logistic distribution (Λ). The rest of the variables are defined in equation 2.

The probability of individual i selling at the farm gate can be empirically estimated as:

$$P_r[Y_i = 1] = X_i\theta_i + \varepsilon_i \quad (4)$$

Y_i is the decision made by individual households, whether to sell at the farm gate or alternative markets, θ is the parameter to be estimated, and ε_i is the unobserved error term of farmers. The parameter estimates of the logit model provide only the direction of the effect of the explanatory variables on the dependent variable, but they do not represent the real magnitude of change (Demeke and Haji 2014). Marginal effects were estimated to measure the magnitude of the effect of the explanatory variables on the predicted probability of household's choice of selling outlets, which is to sell at the farm gate or alternative markets (Anderson and Newell 2003).

$$\theta_m = \left[\frac{\partial(\theta_t X_t + \varepsilon_t)}{\partial \theta_t X_t} \right] \beta_t \text{ Marginal effects for continuous} \quad (5)$$

explanatory variables

$$\theta_m = P_r[Y_{i=1}] - P_r[Y_{i=0}] \text{ Marginal effects for dummy variables.} \quad (6)$$

Where m is the marginal effect, the rest of the variables are defined in equation 2

Description of variables used in the empirical model

Several factors influence smallholder natural rubber farmers' choice of selling outlets. These include socio-economic, institutional and transaction costs factors. The independent variables capturing transaction costs include access to market information, time taken to find buyers, distance to the nearest local market, and ownership of transport means. The independent variables capturing the socio-economic and institutional factors hypothesised to influence the choice of selling outlets include farm size, gender, and household size, access to extension services, training in natural rubber production and marketing, and group membership. These variables were used to estimate the predicted probability of the dependent variable. Table 1 describes the independent variables hypothesised to influence households' choice of selling outlets.

The choice of the independent variables is based on previous empirical studies on factors influencing market participation and choice of marketing outlets used by farmers. On the socio-economic factors, Randela, Alemu, and Groenewald (2008), Jagwe, Machethe, and Ouma (2010), and Jagwe and Machethe (2011) show that group membership, household size, and farm size positively correlate with the likelihood of selling at alternative markets. Group membership brings about a reduction in transaction costs through collective marketing. With group membership, farmers can receive information about prices through calls or text messages that improve their bargaining power while trading.

Sigei et al. (2015), Maina, Lagat, and Mutai (2015) and Abu, Issahaku, and Nkegbe (2016) show a positive influence of the gender of the household, and access to extension services on the likelihood of selling at alternative markets. Male-headed households are more likely to access distant selling outlets because they have better negotiation skills and are wealthier and have more resources than their female counterparts, allowing them to own vehicles and more productive assets (Jagwe and Machethe 2011). Training in latex production enables farmers to access high-value markets that require quality (Zaw and Myint 2016). Additionally, training in agronomic practices and the

Table 1. Description of socio-economic, institutional and transaction costs variables hypothesised to influence household's choice of selling outlets.

Variable	Description	Measurement of variables	Hypothesised sign
Dependent variable			
Choice of selling outlet	A binary variable indicating the decision to sell at farm-gate or alternative markets	Dummy (1 = farm-gate, 0 = otherwise)	
Independent variables			
<i>Socio-economic and institutional variables</i>			
<i>Socio-economic variables</i>			
Gender	Gender of the household head (farmer)	Dummy: (1 = male, 0 = female)	+
Household size	Number of people dependent on the household head for food	Continuous	-
Farm size	Size of land cultivated for natural rubber	Dummy (1 = 0–10) acres, 0 = >10 acres	-
<i>Institutional variables</i>			
Access to extension service	Household access to extension services from 2017 to 2018	Dummy (1 = Yes, 0 = No)	-
Training	Access to training on natural rubber production and marketing from 2017 to 2018	Dummy (1 = Yes, 0 = No)	-
Group membership	Member of a farmers' group or organisation	Dummy (1 = Yes, 0 = No)	-
<i>Transaction costs variables</i>			
Access to market information	Household have access to market information	Dummy (1 = Yes, 0 = No)	-
Time taken to find buyer	Number of hours taken to search for buyers for natural rubber	Dummy (1 = <8 h, 0 = >8 h)	+/-
Distance to nearest market	Average distance to the nearest local market	Kilometres	+
Ownership of transport means	Ownership of bicycle, motorbike, and vehicle	Dummy (1 = Yes, 0 = No)	-

use of improved seed increases productivity. This helps farmers to access markets that require a large quantity of produce. Hence, it is hypothesised to influence farmers' decision to sell at the farm gate negatively. In terms of transaction costs variables, Osebeyo and Aye (2014), Fafchamps and Hill (2005), Key, Sadoulet, and De Janvry (2000), and Sigei et al. (2015) show a positive relationship between distance from the farm to the market and probability of selling at the farm gate, while ownership of transport means had a negative influence on the probability of selling at the farm gate. Similarly, an increase in information search duration has been associated with a decrease in the quantity of agricultural products sold, whereas access to market information has been reported to reduce farm-gate sales (Randela, Alemu, and Groenewald 2008; Osebeyo and Aye 2014). Access to information enables farmers to make an informed decision on the choice of marketing outlets and quantity to supply to the market.

Study area and sampling design

Margibi County was purposively selected as it is the major area for rubber production in Liberia, and it has the largest industrial natural rubber plantation (Firestone Natural Rubber Company) in the world. It has four districts – Kakata, Gibi, Firestone, and Mambah-kaba – and a total population of 209,923 (GoL 2011). The climate is hot and humid, with an annual temperature of 80°F and an average annual rainfall of 510 cm. The soil is sandy clay loam and has many nutrients. The main cash crops are natural rubber (52%), followed by plantain and bananas (34%), sugarcane and pineapples (14%), palm nuts (14%), and cacao (10%). The primary livelihood activities in Margibi County are natural rubber and charcoal production. The county has an approximated land area of 2866.67 square miles, and 6.4% is used by natural rubber plantations (GoL 2012). In total, 88,704 people live in Kakata district and 14,250 in Gibi district (GoL 2011).

A multi-stage random sampling procedure was used to sample smallholder natural rubber farmers in Kakata and Gibi districts. In the first stage, Kakata and Gibi were purposively selected because they have a large number of smallholder rubber farmers (GoL 2011). In the second stage, out of 22 villages in Kakata and 70 in Gibi, 15 and 52 villages were purposively selected, respectively. This was done in accordance with the number of registered farmers in the districts according to the Ministry of Agriculture, and the maturity of the farms for harvesting. In the final stage, a list of 530 households in the selected villages was obtained from the office of the county agricultural coordinator. From this, respondents were randomly selected for interviews.

A total of 200 respondents were sampled and interviewed. The sample size was distributed across the two districts using probability proportionate to size. Data were collected on socio-economic, institutional and transaction costs factors. Six households were dropped during the analysis due to incomplete data. Therefore, 194 households were included in the analysis.

Results and discussion

Characteristics of household by choice of selling outlets

To compare the socio-economic and institutional characteristics of the sample household by choice of selling outlets (at the farm gate or alternative markets), the study employed a two-sample t-test and proportion test to check for significant differences between the two groups of farmers. The results show significant differences between the two groups (Table 2).

The average natural rubber production for farmers selling at alternative markets was significantly higher than farm-gate sellers. This is attributed to the fact that market sellers have bigger farms compared to their farm-gate counterparts. The average household size for farmers selling at alternative markets was more than farm-gate sellers suggesting less family labour available for farm-gate sellers to produce enough quantity in bulk that can be sold in high-price markets.

The average distance to the market for alternative market sellers was significantly higher compared to farmers selling at the farm gate. A likely explanation is that farm-gate sellers do not meet the minimum quantity required to sell to the market, hence, they are constrained to sell to traders. For instance, the Firestone Natural Rubber Company requires a minimum of 500 kg for purchase. Moreover, alternative market sellers owned more transport means that could help in accessing

Table 2. Socio-economic and farm characteristics of sample household by choice of selling outlets.

Variables	Farm-gate sellers (n = 64)	Alternative markets (n = 130)	t-ratio	Significant differences (P-value)
	Means			
Household size (continuous)	7	8	2.18	0.03**
Monthly output of natural rubber (kg) continuous	425.47	647.96	3.45	0.00***
Transaction costs				
Distance to the nearest market (km)	7.40	27.70	8.58	0.00***
Socio-economic and institutional variables	Percentage of household		z-ratio	(P-value)
Gender of the household head (Male)	88	89	0.19	0.84
Group membership	45.31	52.31	0.92	0.36
Access to extension services (Yes)	10.94	1.54	-2.93	0.00**
Training in natural rubber production and marketing (Yes)	7.8	16.90	1.72	0.08***
Farm size (1 = 0–10 acres)	50	37.70	-1.63	0.10*
Transaction costs				
Access to market information (Yes)	46.88	57.69	1.42	0.15
Time taken to find buyer (1 = <8 h)	62.50	47.69	-1.94	0.05**
Ownership of transport means (Yes)	5	17	2.39	0.02***

Notes: ***, ** and * imply significance at 1%, 5% and 10% respectively.

Source: Survey data (2018).

distant markets. Surprisingly, farm-gate sellers had more access to extension services compared to their alternative markets' counterparts.

Empirical results and discussion

The marginal effects of the binary logit model are presented in Table 3. The model fitted the data well since the wald $\chi^2(10) = 49.41$ and a Prob $> \chi^2 = 0.000$, meaning that all the independent variables taking together statistically and significantly explained the variation in the probability of smallholder natural rubber choice of selling outlets in Kakata and Gibi districts. The results indicate that the proxies for transaction costs variables (distance to the nearest market, ownership of transport means, time taken to find buyers, and access to market information) as well as some socio-economic factors (household size and access to extension services) significantly influenced households' choice of selling outlets.

Preferably in literature, large households represent labour resources available to assist with farming activities. A unit increase in household size reduced the likelihood of selling at the farm gate by 2%. In other words, an additional household member increased the likelihood of selling at alternative markets by 2%. A tenable explanation is that larger household size is an indication of more family labour available to produce bulk quantities of natural rubber to access distant markets with a high price and markets that demand a particular quantity. This result corroborates the findings of Kadigi (2013), who found that an increase in household size reduced the probability of dairy farmers in Tanzania selling their milk at the farm gate.

The likelihood of selling at the farm gate increased by 48% as a household received extension services. This result differs from previous studies' findings. This implies that the extension services provided in the study areas are mostly oriented towards other agricultural activities than marketing, hence, farmers received more information about increasing the production of natural rubber than marketing it. Additional discussions with farmers revealed that the extension services provided are mainly oriented toward curbing natural rubber disease and the tapping of latex. Similarly, Alemu, Abrha, and Teklu (2011), who studied determinants of vegetable marketing outlets in Ethiopia, found that access to extension negatively influenced market participation.

Access to market information is a proxy for fixed transaction costs. The more information smallholder natural rubber farmers have on marketing, the less transaction costs they incur for searching and waiting for potential buyers and storage fees. Access to market information reduced the probability of selling at farm gate by 11%. This indicates that households receiving marketing information

Table 3. Determinants of household choice of selling outlets using logit model.

Dependent variable: household choice of selling outlet (1 = farm-gate, 0 = alternative markets)	Coefficient	Robust std. error	Marginal effect (dy/dx)
Gender (1 = male, 0 = female)	0.485	0.088	0.063
Household size (continuous)	-0.146	0.008	-0.019 **
Access to extension (1 = yes, 0 = no)	3.714	0.155	0.483***
Training in latex production (1 = yes, 0 = no)	-0.935	0.083	-0.121
Group membership (1 = yes, 0 = no)	-0.156	0.063	-0.020
Farm size (1 = 0–10 acres, 0 = 10 > acres)	-0.351	0.054	-0.046
Transaction costs variables			
Access to market information (1 = yes, 0 = no)	-0.836	0.052	-0.109**
Time taken to find buyers (1 = < 8 h, 0 = >8)	0.867	0.053	0.113**
Distance to the nearest market (km)	-0.084	0.001	-0.011***
Ownership of transport means	-1.516	0.104	-0.197*
Log Likelihood: -78.82			
Pseudo R^2 : 0.36			
Prob > χ^2 : 0.000			
LR $\chi^2(10)$ 49.41			

Notes: ***, **, and * imply significance levels at 1, 5 and 10%, respectively.

Source: Survey data (2018).

are more likely to access high-value alternative markets compared to those that do not receive information. Access to market information enables farmers to analyse the market situation and information about prices and the proportion of natural rubber to supply to the market. Further, it reduces the risk of oversupplying commodities to the market that results in accepting a lower price. The result concurs with Osebeyo and Aye (2014), who found that access to market information increased smallholder farmers' market participation in Nigeria.

Time taken to find buyers is another proxy for fixed transaction costs. Taking less than 8 hours to find a buyer for natural rubber increased the probability of selling at the farm gate by 11%. This is ascribed to the distance from farm to market and the quantity of natural rubber. Mostly, farmers look at quantity and transportation costs in accessing the market. If the quantity is small and the transportation costs are almost equivalent to the price the natural rubber will be sold at, farmers opt to sell at the farm gate where buyers are available.

The distance to the nearest local market is a proxy for variable transaction costs. A kilometre increase in the distance from the nearest local market to the farm reduced the probability of selling at the farm gate by 11%. This means that a household closer to the market is more likely to sell at farm gate compared to households distant from the market. A reasonable explanation is that farm-gate sellers have lower yields that restrict them from accessing alternative markets while they are closer. Further, there are fewer quality restrictions in selling at the farm gate than in alternative markets to processors who require a specific quality. This result is similar to Randela, Alemu, and Groenewald (2008), who reported that a unit increase in distance increased the market participation of cotton farmers in South Africa.

Owning transport means is another proxy for fixed transaction costs. Ownership of any transport means reduced the probability of a household selling at the farm gate by 20%. This implies that households that owned a bicycle, motorbike or vehicle are more likely to sell at alternative markets. Ownership of transport means helps lower transaction costs in accessing markets and increases the quantity of natural rubber traded on the market. Additionally, it provides greater insight for the marketing choices made by farmers in selling natural rubber. The result is in line with Sigei et al. (2015), who found that in Kenya, ownership of transport means increased small-scale farmers' market participation.

Conclusion and policy recommendations

This study used household survey data collected from smallholder natural rubber farmers in Gibi and Kakata districts in Liberia to analyse the effect of transaction costs on smallholders' choice of selling outlets. The effect was estimated using a binary logistic regression model to discern the significant factors influencing smallholder natural rubber farmers' decision to sell at the farm gate or alternative markets. The results support the hypothesis and the findings of previous empirical studies that transaction costs are the main determinants of smallholder rubber farmers' choice of selling outlets.

The results show that variable transaction costs related to market access, such as distance to the nearest market, had a negative and significant influence on the farmer's decision to sell produce at the farm gate. This result contradicts previous empirical studies that found the distance to have a positive influence on farm gate. Similarly, fixed transaction costs such as time taken to find potential buyers had a positive and significant influence on farm-gate sales, while ownership of transport means and access to market information reduced the likelihood of making farm-gate sales. These results support previous studies on transaction costs that show the negative influence of transport means and access to information on farm-gate sales. Variables such as access to extension services had a positive and significant influence on farm-gate sales, and household size had a negative and significant influence on farm-gate sales. In the literature, access to extension increased farmers' understanding of different marketing outlets and information about prices that enhance market participation.

The study recommends the establishment of market support services by the government of Liberia and NGOs in the form of a market information system, accessible markets, and transportation means. This will provide up-to-date and reliable information on potential trading partners and prices, which will reduce the transaction costs of accessing information. This will also improve farmers' bargaining power and prevent them from being exploited by middlemen. The positive influence of access to extension services on the decision to sell at the farm gate calls for extension officers to be more versatile in the services provided. Government and non-governmental extension agents could provide training in marketing and help farmers choose marketing outlets that offer higher prices. This can be done through a village-based field trip, social learning, organising a weekly radio talk show about the marketing of natural rubber that farmers can listen to, or using information communication technology to disseminate marketing information. The government of Liberia could also improve the logistics services provided to extension officers to help overcome the logistics constraints they face and enable them to reach dispersed communities.

Due to limited funding, the study was only conducted in Margibi County, Gibi and Kakata districts. Transaction costs vary from one region to another depending on the communication, market, and road infrastructure in the area. Therefore, the marketing of natural rubber in Margibi County may differ from other counties in Liberia. It is suggested that a similar study be undertaken in other counties.

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