VERTICAL COORDINATION IN THE LOCAL FOOD CHAINS: EVIDENCE FROM FARMERS' IN ETHIOPIA

Abebe Ejigu Alemu
PhD Candidate, Katholieke Universiteit Leuven
abebe.ejigualemu@student.kuleuven.be

Erik Mathijs
Professor, Katholieke Universiteit Leuven
erik.mathijs@ees.kuleuven.be

Miet Maertens
Professor, Katholieke Universiteit Leuven
miet.maertens@ees.kuleuven.be

Jozef Deckers
Professor, Katholieke Universiteit Leuven
seppe.deckers@ees.kuleuven.be

Kidanemariam G.egziabher,
PhD candidate, Katholieke Universiteit Leuven
kidanemariamgegziabher.gebrehiwot@student.kuleuven.be

Hans Bauer
Research Coordinator, MU-IUC
Hans.Bauer@vliruos.be

Kindeya G.hiwot
Associate Professor, Mekelle University
kindeyagl@yahoo.com

-Abstract-

Closer coordination has improved smallholder access to resources, technology and markets. The absence of contracts has led the coordination of the local food chains in rural Ethiopia to remain poorly functioning. Despite the huge agrifood potential in Ethiopia, the loose coordination among the actors resulted in failure of the supply chain to offer economic incentives to producers and to deliver

quality products to processors/traders. This study aims at examining key determinants for farmers' participation in contracts or cooperatives. A structured survey was administered to 827 farmers in Tigray, Ethiopia. Household's land size, livestock, product characteristics, need of credit for inputs and technology and transaction costs were found to influence participation. Based on our findings we suggest policy makers to recognize the role contracts play in the supply of credits, inputs and improving market conditions in rural Ethiopia.

Key words: Vertical coordination, agrifood, supply chain, farmers.

JEL: Q13,D22,R20

1. INTRODUCTION

Vertical Coordination (VC) for agrifood products has long been in place in the developed world and increasingly expanding in the developing and transition economics due to the liberalization and globalization of trade (Swinnen and Maertens, 2007). The expansion of processors in developing countries enhances the practice of VC particularly in the dairy, poultry, fresh fruit and vegetable sectors (Dries et al., 2009). VC refers to the synchronization of successive stages of production and marketing with respect to quality, quantity and timing of product flows and can be thought of as an institutional arrangement between spot market and vertical integration (Swinnen and Maertens, 2007).

The causes to move toward VC consists of changes in consumers' demand for food quality and safety, and the capital and technology constraints farmers are facing to meet quality requirements (Swinnen and Maertens, 2007). To this end, Bienabe and Sautier (2005) classified the constraints affecting the agricultural marketing systems in developing countries as production related and trade related. Production related challenges include lack of finance to make farm investments (poor wealth status) leading to the application of traditional production systems, and poor storage and high post harvest losses. Trade related constraints are high transaction costs, market risks, information asymmetry, weak bargaining power, and the lack of human and social capital. The nature of agricultural products forces farmers to present their produce to the market at the time of harvest, which results in excess supply, undermining both the prices and the revenue they expect from the produce. Investing in storage and farm technology is also difficult at individual farmer level leading them to contract or join cooperatives (Bienabe and Sautier 2005).

Transaction costs comprise of search, negotiation and monitoring costs that emanate from transaction characteristics such as uncertainty, frequency and asset specificity (Abduli and Birachi, 2008; Williamson, 1979). The degree of quality uncertainty forces firms to have commitments as these guarantee quality differentiation. Products like milk are characterized by apparent quality variability attributed to missing quality checking mechanisms leading firms to prefer VC.

The size of the farm and the autonomy farmers aspire in making production decisions have also been recognized as key drivers of VC (Davis and Gillespie, 2007; and Simmons et. al. 2005). The size of the farm increases the market risk pushing farmers to look for a secured market for their produce and push firms to VC. Producers are also motivated to invest in specific assets if they make specific agreements with integrators to have a secured market. The specific farm investment growers made motivates them to favor VC. Nevertheless, a large number of smallholders in poor economic conditions dominate the farming system in developing counties where VC could play a considerable role in creating access to capital and technology thereby transforming the agricultural system.

Contracts are being implemented in many parts of the world and mixed results are reported in developing countries. Contracts facilitate smallholders' access to the global chains and offer economic benefits. Processor/supermarket chains supply inputs and technology to acquire standard products that can fit to consumers' requirements. Economic agents in the chain relieve producers' problems of information, finance, and market, thereby improving earnings (Bolwig et al., 2009; Dries, et al., 2009; Miyata et al., 2009; Rao and Qaim, 2011). Nevertheless, it is argued that smallholders have been excluded from contracts due to their inability to comply with standards and quality requirements (Weatherspoon and Reardon, 2003). Empirical studies by Miyata et al., (2009) and Rao and Qaim (2011) however indicated that smallholders can benefit from contracts.

Cooperatives are also dominant in agriculture, and help reduce transaction costs and improve the bargaining power of the smallholders and help minimize the market risk producers face (Ortmann and King, 2007). Cooperatives are also facilitating technology transfer and farmers trust if information is transmitted via cooperatives (Nwankwo et al., 2009). Smallholder farmers also own farm resources communally and share resources common to all. The producers' desire to get storage and processing equipment and technology also drives them to cooperate. However, cooperatives often fail in developing countries due to free riding and control problems (Ortmann and King, 2007).

Ethiopia's agrifood potential in terms of livestock, bee colonies, fruit and crop production is reported to be high but only a small amount is marketed and rarely meets minimum quality standards. The rudimentary farm technology, the meager farm investment, the missing investment in quality, the imperfect credit and input markets and high transaction costs characterize the agrifood circumstances. Government is found to be the hub in the distribution of credit for inputs; and the rural development offices (RDOs) are given the role to channel all the credit and input support provided to the farmers. Closer coordination perhaps could transform the production and the market situations in the local food chain as it is evidenced in Madagascar, Kenya, Senegal, China and India (Maertens and Swinnen, 2009; Miyata et al., 2009; Rao and Qaim, 2011).

However, existing literature is developed in the context of global chains that devotes little attention on how VC systems perform with respect to local chains. Existing studies also focus on the motives toward VC considering a particular product. Cognizant to these research gaps, we initiated this study to determine the key motives that drive farmers to move toward VC in the context of local chains. We also consider cooperatives as a vertical integration schemes because cooperatives are owned by farmers and they contain two or more successive stages (production, processing or marketing) in the food supply chain (Hendrikse and Bijman, 2002).

We hypothesized that resource-rich farmers are driven to contracts due to input and product market imperfection that cannot be overcome by their wealth. On the other hand, resource-poor farmers can obtain a higher agrifood income by cooperative membership as mediated by better market conditions and higher investment supply from the government and NGOs. Cooperatives also pool resources that enable members to have common investment ownership.

The remaining part of the paper is organized as follows: the next section briefly reviews the data collection; section two presents the summary statistics, results and discussion; and the last section sums up the paper with conclusions.

2. DATA COLLECTION

Tigray Region is one of the states in Ethiopia with an estimated total population of about 4.3 million, among which 19.5% are urban inhabitants. The region is primarily agricultural as more than 80% of the population is employed in the sector. Livestock plays a significant role in the rural economy of Tigray. A survey was designed in the Geba catchment area (5200 km^2). The catchment represents the main agro-ecological zones of the Northern Ethiopian highlands. Six districts

namely Atsbi, Degua Temben, Enderta, Hintalo Wajirat, Kilite Aulalo and Ofla, were selected based on the agrifood potential they possess and the presence of contracts and cooperatives. A structured questionnaire was administered to 827 farmers and data collection was administrated through trained enumerators from June-July 2010. Lists of the farmers' names were obtained from 'tabia[1]' rural development offices and random sampling was employed to select respondents.

2. RESULTS

2.1 Summary Statistics

More than half of the farmers (52.36%) engaged in spot markets. Nearly 19% sold on contract and the rest 29.36% was member in a cooperative. More male headed households were found in both contracts and cooperatives. Those with smaller family size were found operating more in open markets. The size of the average landholding is relatively lower for those who operate in cooperatives (0.77 hectare). Distance to district markets is longer for farmers operating in open markets and contracts but shorter for cooperative participants (Table 1).

Table 1: Descriptive statistics summary

Variable	Open market		Contract		Cooperative	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Sex	0.871	0.336	0.783***	0.413	0.803**	0.399
Age	44.067	12.452	42.987	11.208	43.748	12.006
Active family	2.644	1.170	2.968***	1.313	2.986***	1.376
Education	2.628	2.993	2.701	2.960	3.046	3.314
Dairy	0.218	0.020	0.744***	0.035	0.885***	0.022
Honey	0.782	0.020	0.256***	0.035	0.115***	0.022
Land size	0.893	0.586	0.917	0.631	0.768***	0.695
Distance to market	11.879	7.583	11.077**	9.876	6.358***	6.433
Tropical Livestock Unit	4.427	4.094	4.000	2.510	3.587	2.915
Tropical livestock unit 5 years ago	4.139	6.224	3.316**	3.139	2.635***	3.042
Distance to RDO	3.521	3.136	4.737***	6.148	2.474***	3.026
Participation in administration	0.672	0.470	0.713	0.454	0.659	0.475
Number of observation	426		144		212	

*,**,***, significant at the 10, 5, and 1 per cent significance levels

[1] Tabia is the smallest administrative unit

2.2   Drivers of Vertical Coordination
2.2.1   Econometric Analysis

In this study, three coordination options are recognized and the probability to choose one of the coordination systems (contract, cooperative or spot market) is estimated using a multinomial logit model. The probability of a farmer to choose for contract or cooperatives is predicted using the following multinomial logistic regression (Davis and Gillespie, 2007):

$$\Pr(C_i^* = m \,/\, X) = \frac{\exp(\beta X)}{\sum_{j=1}^{3} \exp(\beta X)}, m = 1,2,3$$

Table 2: variables and expected signs

Variable type	character	Units of measure	Expected signs to		
			spot	contract	cooperative
Sex	Binary	1 if Male, 0 for female	-	+	+
Age	Continuous	Number of years	-	+	+
Education	Continuous	Years	+	-	+
Active family members	Continuous	Head count	+	-	+
Product Dummy	Binary	1 if Diary 0 otherwise	-	+	+
Distance to market	continuous	Kilometers	-	+	+
Tropical Livestock Unit	continuous	Number	+	+	-
Land size	Continuous	Hectare	+	+	-
Admin. participation	Binary	1 if yes, 0 otherwise	-	+	+
Distance to RDO	Continuous	kilometers	-	+	-

To predict the probability of choosing contract or cooperatives, product characteristics, distance to market, land size, membership in farmers association, administrative participation, Tropical livestock unit (TLU[2]) and distance to RDO as a proxy for credit and input constraints were used as explanatory variables.

2.2.2   Results and Discussion

We run the pooled data to capture product characteristics. Moreover, a larger sample size provides a more efficient estimation of unknown parameters. Furthermore, the Chow test was conducted to reconfirm treatment of the pooled data for the two products. We also conducted the Hausman IIA test and found no evidence to reject the null (χ^2=3.06). The Mlogit model result is presented on table 4. The result indicates that the wealth of the household has positive

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[2] The conversion factor for Tropical Livestock Unit (TLU) is as follows: camel=1; cattle=0.7, sheep=0.1, goat=0.1, horse=0.8, donkey=0.5, mule=0.7, chickens =0.01.

contribution to contracts. An increase in a hectare of land results in 12.5% (p≤ 0.05) increase in the probability of contract. As the size of the land increases, they start to retreat from contracting once they built their capacity to cope with all the barriers they face due to their wealth. The result indicated that when the land size is beyond 1.61 hectare, the propensity to contract starts to decline.

Table 4: Marginal Effect: Mlogit Model

variable	Contract		Cooperative	
	parameter	Std. Err.	parameter	Std. Err
sex	-0.006	0.038	0.030	0.042
age	-0.002*	0.001	0.000	0.002
Active family	0.017	0.013	0.013	0.014
education	-0.002	0.005	0.004	0.006
dairy	0.181***	0.031	0.364***	0.038
Land size	0.123**	0.062	-0.231***	0.062
Land size^2	-0.064**	0.026	0.072***	0.024
TLU5	0.021**	0.009	-0.010	0.007
TLU5^2	-0.002**	0.001	0.000*	0.000
Distance to Market	0.005***	0.002	-0.007**	0.003
Member of Association	-0.126***	0.036	0.045	0.073
Administration Participation	0.074***	0.028	0.016	0.037
Distance to RDO/Tabia	0.009***	0.003	-0.010	0.006
No. of observation	766			
Wald chi2(26)	259.83***			
Pseudo R2	0.2275			

*, **, ***, significant at the 10, 5, and 1 per cent significance levels

Similar results are also found with regard to livestock implying that an increase in one unit of TLU raises the probability to contract by 2.1% (p≤0.05). However, if the TLU is greater than 11 (10.64), the propensity to contract declines. On the contrary, land size is found to have a negative impact on the propensity to join cooperatives implying that small land holders are motivated to join cooperatives as they need organized support from government and NGOs. Based on the model result, one hectare increase in the size of the land reduces the probability to join cooperatives by 23.1% (p≤ 0.01).

Product characteristics significantly affect the choice of VC mechanisms and fresh milk producers were found favoring contracts or cooperatives as milk is highly perishable demanding processing equipment or a secured market compared to honey. The lion's share of farmers did not have the processing/storage technology at individual level and they are driven to contracts or cooperatives. A dairy farmer is 18.1% (p≤ 0.01) and 36.4% (p≤ 0.05) more likely to engage in a contract or to join a cooperative respectively.

Farmers located farther from the market are expected to face high searching costs and market risk that increases the propensity to contract. The result reveals that one kilometer increase in distance to market raises the probability to contract and reduces the probability to cooperate by 0.5% ($p \le 0.01$) and 0.7% ($p \le 0.05$) respectively. This implies that farmers who are located far from markets face higher transaction costs and they opt for contracting. However, those who are close to the market, as they are smallholders, they perhaps prefer cooperatives to have market power as they present small amounts to the market through cooperatives.

Moreover, lack of institutions and their consequent impact on monitoring costs are controlled in terms of the active administrative participation of the farmer in the form of local security, local judges and other activities. Farmers actively involved in local administration were more likely to contract as it perhaps protects them from defaulting contractors. Contracts may serve as a self enforcing mechanism. The model indicated a 7.4% ($p \le 0.01$) increase in the possibility of contracting.

Credit and input constraints are considered as important determinants for the shift to VC. The credit, input, and extension service provision from the RDO is estimated in terms of proximity to the office. Those who are located far from the office may prefer contracts due to getting less attention and support from the RDO office. This is due to the expected infrequent follow up and visits by the RDO officers. The farther the distance, the higher is the likelihood to contract and the result revealed a 0.9% ($p \le 0.01$) increase in the probability to contract.

We further find that membership in a water use association is negatively related to contracting: the likelihood of contracting is reduced by 12.6% ($p \le 0.01$). Farmers with less connection and networking perhaps prefer contracts.

The age of the household head was found determinant in choosing coordination mechanisms and younger household favor contracts supporting the studies by Simmons et al. (2005) and Davis and Gillespie (2007). This may be because younger household heads are more flexible in accepting contracting as new institutional arrangements. Younger household heads may also need more credit, as they are at the start of their venture.

3. CONCLUSIONS AND IMPLICATIONS

The agrifood supply chain in the rural markets of Ethiopia is composed of a large number of smallholder producers, retailers, cooperatives, wholesalers, a few processors and consumers. Loose coordination prevailed among successive stages

in the chain. Open market mechanisms are still dominant although contracts are emerging and contracts are largely used in the dairy supply chain as milk is highly perishable and vulnerable for adulteration. Producers' desire for a secured market for their produce induces contracting. The practice of cooperatives for honey and fresh milk marketing is also common among the rural households.

Household wealth, perishability of products, imperfect capital and input markets, and distance to markets were found to influence the choice of marketing channel. Lack of contract enforcement institutions also contributes to the practice of contracting. Poor households are driven to cooperatives as cooperatives are promoted by the government and non-government organizations to get organized support in terms of credit and inputs.

Strengthening contracts would help improve access to capital and technology that has long been supplied by the government. The government support has limitations as it rations resources. Agrifood processing firms will facilitate credit and technology supply that help improve production, productivity, and income. Encouraging private sector participation in the agro-processing areas and linkages with producers is an important intervention to be considered by policy makers. Furthermore, strengthening marketing cooperatives should aim at upgrading the supply chain because they perform collection and processing so as to improve the shelf life of agrifood products.

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