Gum Arabic Producers' Contracting Preferences in Sudan: Agency and Transaction Costs Perspectives

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Abstract

The gum export from Sudan showed fluctuating & declining trend in the last decades. This situation and the specific characteristics of gum industry entail an investigation in alternative coordination mechanism, such as contracting. Ordered logit model used to study the effects of gum, farm, and producer and gum market characteristics on gm producers' participation in long-term contracts. Transaction costs and agency theories were used as conceptual framework to identify the determinants factors for gum producers contracting behaviours. From the model results, we concluded that the information accessing and interpreting capabilities, uncertainty, loans, other support services, fewness of traders increase the likelihood of contracting. Asset specificity, large gum farm and number of trees decrease the probability of contracting. In order to increase the producers' participation and encourage them to joint contract farming schemes, the government and companies should adopt the polices and strategies that provide producers with support services such as drinking water, seasonal loans, communication & transportation infrastructures and disseminate market information. The government should also implement policies that encourage researches and technologies that increase gum trees productivity, decrease yield variability and reduce the dependence on man labour. Further studies on the possible roles for contracting in the gum industry of Sudan are also recommended.

1. INTRODUCTION

Gum Arabic tree (*Acaica Senegal*) is a perennial crop which widely distributed across the low rainfall woody Savannah Zone in Sudan, between latitudes 10 and 14 north. Sudan economy is primarily agricultural with about 80 % of work forces engaging in agricultural sector, which constitutes about 39 % of the GDP and accounted for about 25 % of total exports in 2001 (WB, 2003). More than 80 % of rural population depends on forest products and gum arabic accounts for about15.3% of producers' income and 10% of other farmers' income in the gum belt (Taha, 2000). Gum arabic has many uses, as an emulsifier, thickener and stabilizer in food, pharmaceutical, painting and printing industries. It also used as a source of fuel, forage, timber, medicine, handicraft, domestic utensils, soil fertility, shade and shelter, amenity and agro-forestry (Vogt, 1995).

Sudan is the major producer and exporter of gum and was contributed with about 60% of world export in 1990's and Gum Arabic Company (GAC) had the concession of export since 1969 till mid 1990's. Major importing countries includes; United States, European Union and Japan (GAC, 2000). Declining and fluctuating exports characterized gum industry of Sudan during the last decades. Five years annual export averages declined from 46,550 tonnes in 1960's to only18,358 tonnes in 1990's (WB, 2003). As the result, many customers turned to low quality gum and synthetic substitutes while some importers began an effort to expand the available sources of gum to build a reliable and affordable supply (Seif el Din, 1995 & Rahim, 2006). Average price received by the producer as a percentage of world prices dropped from about 50% in 1980's to less than 25% in 1990's (WB, 2003).

Many studies conducted to study the factors behind this declining and fluctuating exports (e.g. Awouda, 1999; Mahmud, 2004; and Rahim, 2006). They mainly focused on institutional environments, such as pricing policies, and ecological factors and little has been done to study the institutional arrangements, such as producers-buyers relationships, contracting, market structure and transaction costs related to them as possible factors for declining and fluctuating gum arabic supply.

In 1990's the government of Sudan introduced new policy measures to increasing and stabilizing gum export; such as export liberalizing and increasing producers' price as incentive to increase producers' participation in the gum industry. The policies had limited success which can attributed to the following factors: specific gum characteristics, very thin market, long supply chain and high level of risks and uncertainty in the gum industry of Sudan. All these factors increase transaction costs in the gum supply chain, which increase consumers' prices and reduce producers' returns. As the result, many customers start to use low quality gum and synthetic substitutes while many producers discouraged from participation where more than 40% of them didn't participate during 1993-1998 (Awouda, 1999).

The specific gum characteristics include: firstly; it is a tree crop, which increases its level of asset specificity, which subject producers to opportunistic behaviours from buyers. Secondly; relatively small gum farms (17.1 ha) and low productivity of gum trees (42.2 Kg/ha) (El Khalifa et al, 1989). Thirdly; it has long harvesting period (3-4 months), large number of harvests per season (6 to 8), and high dehydration rate. These characteristics put the gum producers among two difficult choices; either to sell gum commodity immediately after harvesting to avoid dehydration losses

and in small quantities with high transaction costs, or store it until collection of large quantities which subject them to risks of weight loss and prices uncertainty.

The specific characteristics of gum industry necessitate an investigation in alternative market coordination mechanism, long term contracts, to solve the current gum arabic supply problem. Contracting has many benefits that can improve the level of gum arabic producers' participation. Contract provides information about inputs and outputs markets, shifts production and prices risks, stabilizes farmers' incomes and improves incentives (see Knoeber & Thurman, 1995; Key & Runsten, 1999; and Hudson & Lusk, 2004). Income uncertainty entails a cost to farmers that would reduce the crop supply, if farmers are risk averse. Contract farming improve efficiency of production and increase participation by reducing the level of risk facing the farmers, mainly on non-traditional crops such as gum arabic. As argued by Eswaran and Kotwal (1985) contracts serve as substitutes for the absence or imperfections of markets for some factor inputs and outputs. At farmers' level where large-scale vertical integration of productive resources is relatively impractical contracting can plays a critical role in coordinating the activities. Warning *et al* (2000) argued that the development of intermediary institutions make small farmers more desirable partners for agri-business firms through mitigating the effect of transaction costs barriers.

The objective of this paper is to determine the factors that affect gum producers' participation in long term contract. New institutional economic, namely transaction costs and agency theories, will be used as a framework to study the impacts of gum, farm, producer and market characteristics on producer's contractual behaviours. We hypothesised that high level of risks and uncertainty in gum industry increase the transaction costs of spot market coordination, which raises the likelihood of producers' participation contract farming.

Transaction costs had been used by many studies to analyze contract farming decisions in agricultural sector. For example Katchova & Miranda (2004), Vergera *et al* (2004) and Chen *et al*, (2006) examined the effects of transaction costs on producers decisions for participation in marketing contracts. Some studies overviewed the implications of contract farming in developing countries (Kristen & Sartorius, 2002). Agency theory used to study the problem of risks, imperfect information and incentives alignments in agricultural sector (Knoeber & Thurman, 1995 and Allen & Lueck, 1999). The impact of institutional, structural and technical variables on contract structure & duration in agricultural sector were studied by using principal-agent framework (Lajili *et al,* 1997 and Green & Coq, 2006).

This study aims to define policy interventions and institutional arrangements that could mitigate the effects of transaction costs barriers, reduce risk and uncertainty and improve producers' participation to stabilize and increase the share of Sudan in the world market. Section two of this paper present theories and methods used in this study, and overviews the agency and transaction costs theories as conceptual framework. It also includes sampling procedures and data collection. The last part of section two present the theoretical model and description of variables. The results and discussion of the model are included in section three. The paper ended by the summary and policy implications in section four.

2.   THEORIES AND METHODS

There are many institutional contexts through which vertical coordination can be accomplished in different industries. The institutional economic literature identified three broad types of coordination mechanisms: Neo-classical spot market, vertical integration and bilateral contracts. Institutional environment affects agents' choices between firms, contracts and market for exchange coordination. Contract is a necessary mechanism to induce producers to produce goods that have few marketing outlets (thin markets). Market contracts have advantage over integration when the scales of production are different between the stages in the good supply chains as in the gum industry of Sudan (Minot 1986 and Williamson, 1991). Studies of institutions for market exchange are focusing on two dimensions both of them linked to contracts. First dimension concerns with exchange coordination, which is a function of contracts; and coordination problem is essentially information problem. Second dimension concerns with contracts enforcement; more broadly both dimensions are transaction costs problem (Gabre-Madhin, 2003).

2.1 Agency Theory, Transaction Cost Economics and Contract Farming:

Two new institutional economic theories have been utilized to study contracts: agency theory and transaction costs economics and become the most dominant approaches in this field. Both theories have different views towards the role of contract. Agency theory views contracts as a tool for risks transfer and incentives alignment (Hart & Holmstrom, 1987). Transaction cost economists tend to view contracts as devices to organize ex ante & ex post activities of trading especially, ex post bargaining and hold-up problems in transaction specific-investment relationships (Williamson 1975; and Klein, Crawford, & Alchian 1978).

Agency theory use the term contract to encompass any transaction and thus agency's literature contains little explicit discussion about either the decision or duration of contract and its primary

concern is the form of contracts (Lyons, 1996). Unlike agency theorists, the decision to contract and determinants of contract duration have been central concerns of transaction costs economists. They tend to draw a clear distinction between contractual and non-contractual exchange. Therefore, agency and transaction costs theories give a sound theoretical framework for addressing contracting decisions. These two theories suggest that an asset specificity and uncertainty may strongly influence vertical coordination decisions (Frank and Henderson, 1992).

Agency theory addresses information asymmetry, risks transfer and incentive incompatibility between trading parties and concerns with designing an optimum contracts forms. The typical agency model begins with assumption that the producer (agent) is risk averse and the buyer (principal) is risk neutral. Contractual forms between principal and agent affected by asset specificity, risk exposure, frequency of transaction, nature of exchanged goods & services, institutional environment, and human propensity for opportunism (Jaffee & Morton 1995).

Transaction costs economics underlie on two behavioural assumptions; bounded rationality and opportunism. In spite of their best efforts to deal with the complexity and unpredictability of the world around them, individuals are limited in their ability to plan and accurately predict for future. Opportunism assumption suggests that some economic actors are "self-interest seeking with guile" (Williamson, 1975). Williamson (1991) summarizes earlier works and identifies uncertainty, asset specificity, and frequency of transaction as the three critical dimensions that affect the level of transaction costs and contractual arrangement choices. He also argues that transaction costs facing different individuals differ according to their location, knowledge, social status and wealth endowment. Gum producers have high variability in these transactional costs factors, which need to be considered as determinant factors for producers' participation in long term contracts.

Much of the analysis in transaction costs economics (TCE) literature are based on argument that economics institutions develop to minimize the costs of transacting, either within firms or through contractual arrangements that lie outside the firms' organizational structures (Coase, 1937 and Williamson, 1979). When assets are sufficiently specialized and activities to be performed occur at frequent intervals, reliance on contracts may give way to unified governance. Gum arabic is tree crop and mainly produced for thin market, which increase its level of asset specificity and increase the probability of using contracts as coordination mechanism.

2.2   **Theoretical Model:**

In transaction costs framework, contracting for additional period is a function of other party's performance and reduction in the costs of bargaining and contracting, i.e. the forgone benefits of not contracting (Roberts and Key, 2005). In agency theory the benefits are derived from sharing risks and incentives alignment, therefore agency theory would predict contracting and contract duration to be positively related to the level of risks (and uncertainty) and importance of incentives alignment. Thus, the factors that increase the benefits from contracting will increase the probability of long-term contract. As argued by (Hart and Holmström, 1987) to generate testable implications for contract duration from agency theory, it is thus necessary to introduce transaction costs, and this study intended to do that. Although there are many contract categories, many researches treat contracting decision as a question of contract duration (Joskow, 1987; Saussier, 1998; and Masten & Saussier, 2002). In this study we will treat the contracting decision as a question of contract duration. Absence of contract, or spot market trade, would then correspond to the limiting case of contract duration equal to zero.

Producer's decision to accept long-term contract or to use spot market is a function of return under contract, c; return under spot market, s; transaction costs associated with contract, t_c, transaction costs associated with spot market, t_s, incentives associated with contract, i_c, and incentives associated with spot market, i_s; which is assumed to be continuous and differentiable. Gum producers select to contract for additional period if the expected net returns from doing so are greater than organizing the exchange in spot markets. The following formula represents the optimal choice of market coordination mechanism by the gum producers to maximize the value of return from gum trade:

$$G^* \quad = G_c, \quad \text{if } V_c > V_S \tag{1}$$
$$= G_S, \quad \text{if } V_c \leq V_S$$

where G_c represents contracting, G_s represent spot market, V_c and V_s the corresponding values of transaction under contract and spot market respectively and G^* represents actually chosen coordination mechanism. The expected returns for gum producers from organizing the trade under different mechanisms are difficult or impossible to detect. Theory of contract relates the benefits of alternative coordination mechanisms to observable transaction attributes. The following functional forms represent the benefits of contracting and spot market transactions:

$$V_c \quad = V_c (X, e_c) = \beta X + e_c \qquad\qquad (2)$$

$$\text{and,} \qquad V_s \quad = V_s(X, e_s) = \alpha X + e_s \qquad\qquad (3)$$

Where **X** represents a vector of observable attributes affecting the gains from trading under the relevant coordination mechanism, these attributes include: asset specificity, risk & uncertainty, frequency of transaction, incentives alignment etc, which originate from product, farm, producer and market characteristics. e_c and e_s are error terms that may reflect either variables omitted or errors or misperceptions on the part of producer about the true values of V_c and V_s.

We can represent the probability that contracting will be chosen over the spot market as $Pr(G^* = G_c) = Pr(V_c > V_s) = Pr(e_s - e_c < (\beta - \alpha)X)$. In words, an element of **X** whose effect on the expected gains from trade under contracting, **β**, is greater than its effect under spot market, **α**, will increase the likelihood of producers' participation in contract. Gum producer is expected to maximize his return form whole possible contracting period (gum trees lifetime); accordingly we could represent the continuous analogy to the discrete choice decision represented by equation (1) as:

$$\max_\tau V_c (\tau) + V_s (T - \tau), \qquad\qquad (4)$$

where τ represents contract duration chosen by the gum producer, T the potential duration of relationships between the gum producers and trading parties, $V_c(\tau)$ the cumulative value of contractual exchange over the τ periods covered by the contract, and $V_s(T - \tau)$ the value of trade in the periods following expiration of the contract (spot market transactions period). Optimal contract duration, τ^*, is the value of τ that satisfies the first order condition (FOC) of equation (4) with respect to τ, which result in following expression:

$$\text{FOC} \quad [V_c (\tau) + V_s (T - \tau)] \quad \text{with respect to } \tau \text{ is}$$

$$(V^\tau_c (\tau) - V^\tau_s (\tau) = 0$$

$$V^\tau_c (\tau *) = V^\tau_s (\tau *) \qquad\qquad (5)$$

In words, the gum producer would continue to increase contract duration until the value of transacting under a contract for an additional period was just equal to the (foregone) value of transacting without a contract in that period. Our inability to observe the contracting parties' subjective expectations of V_c and V_S necessitates the development of hypotheses that relate these values to observable attributes of transactions, which affect the level of transaction costs and

incentives under contracting and its alternative. Letting **X** and **e** again represent observable and unobservable attributes, we rewrite (5) as:

$$V_c^{\tau} (\tau, X, e_c) = V_s^{\tau} (\tau, X, e_s) \qquad (5)'$$

Linearizing these functions as:

$$V_c^{\tau} (\tau, X, e_c) = \beta_0 + \beta_1 \tau + \beta_2 X + e_c \qquad (6)$$

$$V_s^{\tau} (\tau, X, e_s) = \alpha_0 + \alpha_1 \tau + \alpha_2 X + e_s \qquad (7)$$

By substituting (6) & (7) in (5)' we find:

$$\beta_0 + \beta_1 \tau + \beta_2 X + e_c = \alpha_0 + \alpha_1 \tau + \alpha_2 X + e_s \qquad (8)$$

By rearranging (8) we find the expression for optimal contract duration τ^*, of the following form:

$$\tau^* = \varphi_0 + \varphi_1 X + e \qquad (9)$$

where $\quad \varphi_0 = \dfrac{(\beta_0 - \alpha_0)}{(\alpha_1 - \beta_1)}$; $\qquad \varphi_1 = \dfrac{(\beta_2 - \alpha_2)}{(\alpha_1 - \beta_1)}$; $\qquad$ and $\quad e = \dfrac{(e_c - e_s)}{(\alpha_1 - \beta_1)}$

For values of τ strictly between 0 and T, elements of X that increase the value of contracting for another period greater than the foregone benefits of transacting without a contract in that period ($\beta_2 - \alpha_2 > 0$) will result in contracts of longer predicted duration. Econometrically, equation (9) would seem to fit neatly the standard regression model. If the unobserved determinants of contract duration, which contained in (e_c), are correlated with the observed variables, ordinary least squares (OLS) estimates of the coefficients in equation (9) will be biased (Maddala, 1983). Empirical research on contract duration has generally recognized this problem and has sought to account for the potential bias using maximum likelihood estimation techniques (Joskow, 1987; and Crocker & Masten, 1988).

2.3 Study Area, Data and Variables Description:

2.3.1 Data and Study Area:

Gum arabic belt covers very large area of central Sudan (10 -14 North) and complete coverage for whole area is so difficult. Accordingly, this study carried out on a sampling basis, which may not efficiently represent the whole producers. The sample was selected from Northern and Western Kordofan states, to represent a wide area of gum belt and to accurately reflect production and marketing conditions. The data were collected between March and August 2005 and covered two

seasons 2003/2004 and 2004/2005. Therefore, generalisation of study results for whole areas and producers may not be possible without taking these limitations into consideration. Detailed questionnaire constructed to collect a comprehensive data on gum farming system, institutional arrangements, market characteristics and producers' socioeconomics environment.

2.3.2 Variables Description:

The variables needed for analysis were generated through surveying the gum producers. We asked them about their preferences towards participation in contracts and preferable duration. Proxy indicators developed from gum, farm, producer and market characteristics to operationalize the concepts derived from transaction costs and agency theories; such as asset specificity, uncertainty, frequency of exchange, risks transfer and incentives alignment; and their impacts on contract duration. The dependent variable will be contract duration (CONTDUR). In this study, instead of choosing between contract and spot market, producers could be viewed as they choosing how many periods their contract should cover and duration equalize to zero in case of spot market exchange. About 73% of producers prefer contracting; and the average preferred duration is 5 years. Appendix (A) compares the means of explanatory variables that might explain the variations in producers' contracting preferences.

This study considers different factors that may affect gum producers' participation in contracts, which mainly originate from gum, farm, gum producer and market characteristics. The data about the above mentioned characteristics variables were collected and appendix (B) presents codes, description, means, standard deviations and their hypothesized relationships to contract duration. First category was introduced to capture the effects of gum and farm characteristics (risks, uncertainty, asset specificity and scale of production). Second category used as proxy to the impact of producer's characteristics (information accessing & interpreting capabilities and negotiations skills). Third category used to capture the effect of market characteristics (traders' concentration and market accessibility).

2.3.2.1 Gum and Farm Characteristics Variables:

In this section gum and farm characteristics that affect the level of asset specificity, uncertainty and frequency of transactions were introduced. Gum arabic crop has high level of asset specificity that arises from two factors: it is a tree crop and requires long investment period in a non redeployable asset and mainly produced for very thin market. Therefore, gum producers are expected to participate in contracts to avoid companies' potential expropriation for quasi-rents

derived from producer investments in a highly specific crop and to avoid potential hold-up problems. Consistent with theories, gum producers, with high level of gum asset specificity, were anticipated to associate with contracts having longer duration, greater and flexible sharing rates. Two variables used as proxy to asset specificity; the size of gum farm (GFRMSIZE) and ratio of gum farm to the areas other field crops (GUMCROPR). The number of trees owned by the producer (NOTREES) used to reflect asset specificity and scale of production.

According to agency theories, the large farm size and number of trees increases the level of asset specificity and risk facing gum producers and raise likelihood of their participation in contracts. At the same time, provided that gum trees have very low productivity, the large gum farm and number of trees increase the quantity produced, reduce the transaction costs of spot market transactions and decrease the likelihood of participation in contract farming schemes. Therefore, the expected relations of the gum farm size and number of trees to contract duration are uncertain. The high ratio of gum farm to other crops increase the level of risk and positive relations is expected between contract duration and ratio of gum farm to other crops areas. The average gum farm is 33 hectare, average ratio of gum farm to other crops area is 1.5 and average number of trees per producer is 4083.

The sources of risk and uncertainty in agricultural sector are mainly related to specific crop characteristics, such as degree of perishability, degree of specificity in quality requirements and timing of harvests and deliveries. The gum arabic crop is imperishable and quality requirements can easily be fulfilled. Timing of trees scratching, harvesting and delivering product to market are the main sources of risks and uncertainties. Delaying market delivery can lead to huge losses due to high dehydration rate and weight loss; in addition to high variability in gum prices during and between the seasons. Therefore, contracting can serve as a tool to partially shift price and production risks from poor producers to wealthy buyers (companies), which attract more producers to participate in contracting schemes.

Markets imperfection and ecological factors are representing other sources of risks and uncertainty in the gum supply chain. Market imperfection caused by poor flow of information about demand, supply and prices; which induce producers to depend more on non-market coordinating methods, including contract farming (Frank & Henderson, 1992). Pests and drought are among the main causes of ecological uncertainty, and increase the variability of gum yields. Reduction of risks and uncertainty by partially shifting it via contracting increases the probability of contracting, especially risks for averse producers (Knoeber & Thurman, 1995).

To examine the effects of risks and uncertainty that originate from market imperfection and ecological factors we introduced the following variables. Receiving less than expected prices (LESSPRCE), yields and prices variations between 2004 and 2005 (PRICVART & YIELDVAR). Assuming that gum producers are risk averse and based on agency theory, the expected relationships between these three variables and contract duration are positive. About 81% of producers who received less than expected prices at the beginning of the season prefer contracting compare to 53% of who received expected prices. About 82% of producers who had high variations in producers' prices (>40%) prefer contracting compare to 61% of who had low variations (≤40%). About 81% of producers who had high yields variation (>30%) prefer contracting compare to 65% of who had low variation (≤ 30%). Finally, the diversification of income sources can serve as security measure against risks and uncertainty. Availability of non-agricultural income sources (NAGRSINC) used to measure the effects of income diversification on producer's contracting preferences and negative relationships expected.

2.3.2.2 Producer Characteristics Variables:

The following producer's characteristics were included: household size (FAMSIZE), experience (EXPERNCE), education (EDUCTION), number of producers' visits to city markets (NOVSTMKT) and producer's knowledge about ongoing export liberalization debates (LIBDEBAT). The last four variables were used to capture the effects information accessing and interpreting capabilities and negotiation skills on producer contracting preferences and positive relationship expected between them and contract duration. Better information reduces the transaction that arises from information asymmetry between the producer (agent) and buyer (principal). Large household (FAMSIZE) provides cheap labour, reduces risk of dependence on hired labour and enables gum producers to fulfil contract terms and increase the probability of contracting.

About 78% of highly experienced producers (>15 years) prefer contracting versus 61% of less experienced ones (≤15 years). Almost 83% of large household producers prefer contracting versus 73% small household producers. Around 38% of producers are illiterate, 25% pre-schooled & 37% attended primary and secondary schools. 68% of illiterate producers prefer contracting versus 76% of who had primary/secondary school. Half of the respondent producers reported that they know gum export liberalization debate and 77% of them prefer contracting versus 69% of who know nothing. 67% of less frequent city visitors (<20/season) prefer contracting versus 80% of frequent visitors (≥20 /season).

2.3.2.3   Market Characteristics Variables:

According to Key and Runsten (1999) first constraint in principal-agent states that producer will accept contract if contracting offers him greater satisfaction than any alternative marketing coordination options. In industries where few companies are monopolizing the export market, the producers are unwilling to participate in contracts because companies can keep producers' profits just above the point at which producers would switch to alternative crops. Hence, the ability of companies to set profitable terms depends on the markets structure. Competition improves the gum producers' bargaining power and companies compete to give best contracts that may include provision of inputs, credit, extension and services which make contracting more attractive and profitable. Therefore, successful contracting may achieved through creating more competitive markets.

According to transaction costs theory, the problems of small-numbers bargaining induce hybrid and vertical forms of coordination rather than spot markets. Therefore, fewness of buyers should positively predict contracting as producers may utilize contracting to reduce potential opportunistic behaviours when few buyers bargain. Contract farming is also more likely when upstream or downstream industry commit to large sunk investments in assets and as the transaction costs of using market place increases (Klein, Crawford, & Alchian, 1978; Williamson, 1975, 1986; and Frank & Henderson, 1992). Gum industry in Sudan characterized by large number of producers and few buyers. This situation increases transaction costs of marketing that may arise from direct costs of buyers searching, indirect costs of producers' weak bargaining power and buyers' opportunistic behaviours.

The effects of market characteristics on the gum producers' contracting preferences were captured by the following variables (Appendix A). Presence of gum companies at producers' area (GUMCOMP), number of traders in producers' villages (NOOTRDRS) and number of traders' visits to producers' villages (NOVSTDRS) improve producers' access to spot markets, reduce transaction costs and decrease the likelihood of gum producers' participation in contracts. Producers' institutions (GUMINST) according to transaction costs theories improve producer's access to markets, reduce spot transaction costs and decrease the likelihood of participation in contracts. According to agency theory, producers' institutions enable risk averse producers to joint contracts by improving their bargaining power and reducing the costs of contracting. Therefore, the expected relation between producers' institution variable and contract duration is uncertain.

The distance to city markets (DSTMKT), companies support (SUPCOMP) and accessibility to loans (ACCLOANS) is expected to have positive impact on contract duration. Gum industry characterized by high frequency of transactions and gum producers who located far away from markets are more likely to participate in contracts. The provision of loans and support services by gum companies attract more producers to joint contract farming schemes.

The primary analysis for market characteristics variables showed the following results: about 78% of gum producers who have no gum companies in their regions prefer contracting compare to 68% of who have gum companies. The average number of traders' visits to producer's village who prefer contracting is 15 compare to10 among who not prefer contracting. The average number of gum traders in the producers' villages who prefer contracting is 5.1 compare to 5.5 among producers who not prefer contracting. About 78% of producers have no producers institutions prefer contracting compare to 59% of who have institutions. About 80% of gum producers who received support from companies prefer contracting compare to 72% of who did not receive any support. The average distance to city market for producers who prefer contracting is 10.2 km compare to 8.4 km for producers who not prefer it. Most of producers (78%) have no access to loans and 82% of them prefer contracting compare to 71% of who had access to loans.

3.   MODEL IMPLEMENTATION AND RESULTS DISCUSSION

Regression analysis is used to determine the relationships between the gum producers' contracting preferences and gum, farm producer and market characteristics. Econometrically, equation (9) below seem to fit neatly the standard regression model (OLS).

$$\tau^* = \varphi_0 + \varphi_1 X + e \qquad\qquad (9)$$

Two aspects of contract duration, however, necessitate departures from the standard model (OLS). First is the duration's natural lower bound of zero, which affects how distribution of the error term is parameterized. Second is that OLS assumes that the dependent variable "contract duration" (CONTDUR) is continuous and does not take into consideration the ordered nature of our dependent variable (see Maddala, 1983 and Saussier, 2000). Therefore, ordered logit would be the adequate technique to address contract duration problem in this study and the model is specified as:

CONTDUR   = f (GMFMSIZE, GUMCROPR, NNOTREES, LESSPRCE, PRICVART,
YIELDVAR, NAGRSINC, NEXPRENC, FAMSIZE, EDUCTION, LIBDEBAT,
NOVSTMKT, GUMCOMP, SUPCOMP, GUMINST, NOOTRDRS, NOVSTDRS,
DSTMKT, ACCLOANS).

3.1   Model Estimation and Discussion:

Table (1) present the results of the model and shows the estimated coefficients, Z statistics, significance level and odd ratios (odds ratio is equal to the probability of event occurrence divided by the probability of not occurrence (Pi/ "1- Pi"). The odds ratios for each factor tell you, for example, how much more likely the educated producer is to participate in contracting than illiterate producer (see Greene, 2003). Stata software was used and the model is fitted to our data with significance chi-squared of 64.14 (at 0.000) and pseudo-R2 equal to 0.2030. Ten of nineteen variables had coefficients that significantly different from zero, and showed expected signs except the yields variation variable.

3.1.1   Gum and Farm Characteristics (asset specificity & Uncertainty):

The three variables used to capture the effects of asset specificity have negative effects on contract duration and failed to support agency theories proposition that risk averse producers with high specific assets are more probable to joint contracts The number of gum trees is the only variable that has a significant estimator. Allen and Lueck (1999) also concluded that their evidence fails to

support standard principal-agent model with risk aversion as an explanation of contract choice in North American agriculture.

The large number of trees, gum farm & high ratio of gum farm to other crops are also a measure for degree of specialization and production scale. Gum trees have low productivity where large production scale and high specialization increase the tradable gum size, which reduce the spot markets transaction costs and discourage contracting. This may explain the negative relations between the gum farm size, ratio of gum farm to other crops area and number of gum trees. Katchova & Miranda (2004) also found that specialized farmers are more likely to contract more frequently, i.e. prefer shorter contract or spot markets.

From the results we conclude that the reduction in the spot market transaction costs offset the impact of asset specificity and risks that may arise from thin markets in the trade-off between spot market and contract coordination. The same conclusion was reached by Hudson and Lusk (2004) that "the marginal utility of transaction cost attributes outweighs the marginal utility of risk avoidance attributes". The other explanation for negative effects of asset specificity variables may be that, the transaction costs of maladaptation and renegotiation of contracts have a higher impact than the asset specificity costs on adoption of contract by gum producers.

Two of the four variables used to capture the effects of uncertainty on producers' contracting preferences were resulted in significant estimators. Receiving less than expected prices have positive effects on contract duration and showed expected sign and increases the probability of producers' participation in contracts. The result supported the transaction costs propositions that high uncertainty increases the likelihood of contracting. The odd ratio for selling with less than expected price is the highest among all significant estimators (6.074). The odd in favour of participating in long term contracts among who receive lower prices is higher by 607% than who received the expected gum prices. Many studies were confirmed the relationships between uncertainty and degree of vertical coordination (Lajili et al, 1997; Hobbs & Linda, 2000; and Boerner & Macher, 2003).

The variation in gum arabic yield is second uncertainty variable and it failed to support agency & transaction costs theories, and showed significant negative impact on contract duration. The ecological factors are the main sources of uncertainty in the gum industry which include drought, pests and diseases. Gum producers who had high yield variation did not prefer contract farming, i.e. they may avoid the transaction costs that arise from renegotiation and maladaptation. About

55% of producers mentioned the high variations in yield as a main reason for not preferring contracts, which support model results. The results suggest that price uncertainty increases the likelihood of participation in long-term contracts while production uncertainty reduces it.

3.1.2   Producer Characteristics (Information accessing & interpreting capabilities):

Four of the producers' characteristics variables have significant positive impact on contract and had expected signs. Gum producer experience is only insignificant variable in this category. Gum arabic producers, who know gum export liberalization debate, highly educated and visit city markets frequently, are more likely to participate in contract farming. These results confirmed the presence of positive relations between contract duration and producers' information accessing and interpreting capabilities. Goodwin & Kastens (1996) found that educational program has significance impact on adoption of marketing contracts.

Information accessing and interpreting capability prevent gum producers from falling into lock-up problems and opportunistic behaviours from contractors (buyers) that arise from information asymmetry. It reduces the transaction costs of contracting and increase the probability of gum producers' participation in contract farming. In addition to that, highly educated producers and who have access to market information have better bargaining capabilities and negotiation skills that increase their returns from contracting and increase the probability of participation in contracts. Vergera, *et al* (2004) also found significant relations between the information costs and selection of market coordination mechanisms.

Assuming that gum producers visits city markets to sell gum crop, the high transaction costs of spot markets encourage gum producers to participate in contracts. The producers' household size is the last variable that showed significant positive effects on contract duration. The large household supply cheap labour for gum production and marketing activities which enables the producers to fulfil contract conditions, in term of quantity, quality & delivery time.

3.1.3   Market Characteristic (markets accessibility and traders' concentration):

Three variables were showed significant impacts on contract duration and have expected signs.

Table 5.3   Significance of Gum, Producer's and Market's Characteristics Variables on the Selection of Contract Duration

Variable	CODE	Estimated Coefficient	Z-Statistic	Signifi-cance	Odd Ratio
A. Gum and Farm Characteristics Variables					
(Asset Specificity, risk and uncertainty)					
Gum farm size	GMFMSIZE	-0.0054	-0.98	0.325	0.995
Ratio of gum farm to other crops area	GUMCROPR	-0.1210	-0.80	0.423	0.886
Number of trees owned by producer.	NOTREES	-0.2515	-1.84	0.066*	0.777
Selling with less than expected prices	LESSPRCE	1.8040	3.35	0.001***	6.074
Variation in prices received (2004-05)	PRICVART	0.0041	0.90	0.367	1.004
Variation in Yields (2004-05)	YIELDVAR	-0.0159	-1.79	0.074*	0.984
Non-agricultural income sources	NAGRSINC	-0.5261	-1.03	0.301	0.591
B. Producer's Characteristics					
(Information accessing & interpreting capabilities)					
Experience of gum producer	EXPRENCE	0.0824	0.50	0.614	1.086
Producer's Family size	FAMSIZE	0.1429	1.73	0.084*	1.17
Education level	EDUCTION	0.4024	1.72	0.085*	1.495
Knowing export liberalization debate	LIBDEBAT	1.3476	2.59	0.010***	3.848
Number of visits to city markets	NOVSTMKT	0.5271	3.70	0.000***	1.694
C. Market Characteristics					
(markets accessibility and traders' concentration)					
Accessibility to gum companies	GUMCOMP	0.0158	0.03	0.977	1.016
Getting support from gum companies	SUPCOMP	0.5271	3.70	0.023**	0.215
producer's institutions	GUMINST	-0.7563	-1.14	0.254	0.469
number of traders in producer's village	NOOTRDR	-0.2443	-1.70	0.089*	0.783
Traders' visits to producer's village	NOVSTDR	0.1070	0.78	0.435	1.113
Distance to city market	DSTMKT	-0.1578	-1.24	0.213	0.854
Accessibility of loans to producers	ACCLOANS	1.3136	2.25	0.025 **	3.720

LR Chi2(19)	=	65.16	Log Likelihood =	- 125.4177	
Prob > Chi2	=	0.0000	Pseudo R2 =	0.2062	

Gum companies' supports and loans accessibility have positive relations while number of gum traders in producers' village showed a negative sign. Therefore, provision of support services, mainly drinking water, transportation and seasonal loans increase the likelihood of gum producers' participation in contracts. The Gum Arabic crop is labour intensive and produced in the dry season of Semi-arid Savannah, which increases the importance of loans and drinking water supply. Some producers mentioned that the person who provide drinking water have to share one third of gum produce. Gum producers who have access to loans are more capable to hire labour and fulfil contract terms and conditions.

The number of traders in producers' village has significant negative relation to contract duration, which reduces the likelihood of participation in contracts. This result can be explained by the following reasons: firstly; the high level of competition between traders increases producer's spot market prices. Secondly, the large number of traders improves producers' access to spot markets. Thirdly, the large number of traders improves producers' access to loans and discourages them from jointing contracts. Bhuyan (2005) found significant positive relation between the degree of vertical integration and fewness of buyers & sellers.

4.   CONCLUSIONS AND IMPLICATIONS OF THE STUDY

4.1   Conclusion:

The ordered logit model results proved the presence of deterministic role for gum, farm, producer and market characteristics on gum producers' participation contract farming schemes. The following specific conclusions were derived from results of the model; high level of producers' information accessing and interpreting capabilities, high level of uncertainty, availability of loans and companies' support increases, fewness of traders the likelihood of contracting among gum producers. Asset specificity has negative impacts on the likelihood of participation in contracts; this unexpected result may be due to specific gum characteristics, namely low productivity and high dehydration rate. Large gum farm and number of trees increase tradable gum quantities, which reduce transaction costs of spot markets coordination and decrease the probability of contracting. Therefore, although the high level of asset specificity increases the incidence of opportunism and hold-up problems, the risks that originate from them are overweight by the reduced transaction costs that arise from large scale of production and high asset specificity. The results showed the importance of transaction costs & agency problems in determining the gum producers' contract farming decisions.

The high level of risks and uncertainty were proved to have significant impact on producers' participation in contract farming, the high variation in producers prices within the season increases the probability of participation while the high variation in yield reduce it. The third variable, producers' price variation between the seasons, showed insignificant positive impact on contract duration. Education, knowing liberalization debates and number of visits to city markets used as a proxy for gum producers' market information accessing and interpreting capabilities, which increase the probability of participation in contract farming schemes. Availability of market information decreases the probability of opportunism, hold-up problems and reduces the costs of maladaptation in contracts. The household size increase the likelihood of participation in contracts, large family avail cheap labour & enable producers to fulfil contracts conditions in terms of quantity, quality and delivery time.

Besides improving market information accessing, frequent visits to city markets increase the likelihood of contract farming in other ways. Firstly, they may participate in contract farming to minimise the transaction costs of frequent spot markets exchange. Secondly, the producers who perform other jobs at city market have less time to sell through spot markets, which also increase the probability of participation in contracts. On the other hand, the size of the gum farm, gum other field crop ratio, producers' prices variation between seasons, non agricultural income, experience, presence of producers' institutions, accessibility of companies, number of traders' visits to villages and the distance to city markets were proved to have no significant impacts on producers' participation in contract farming.

4.2   Policy Implications:

The policy recommendations for proposed alternative long-term contract farming coordination mechanism were derived from findings of chapter V. In recent years many gum producers cooperatives were formulated by the assistance from local governments and Forestry Administration. The establishment of producers' cooperatives aimed to increase the earnings through improving the bargaining power and negotiation skills. This new trend may not lead intended objectives, because gum exporting companies can also adopt strategies that strengthen their positions and continue to reap the big share from gum trade. The solution for this situation could be by adoption of contract farming schemes, which reduce the impact of risk and uncertainties, on producers and gum companies. Contract farming can assist in incentives alignment and risks transfer that may encourage more producers to participate in the gum industry of Sudan.

Assuming that the Government, Forestry Administration, gum companies & producers institutions will adopt this new market coordination mechanism, the following policy recommendations were proposed, which targeted the factors that have deterministic impacts on producers' participation in contract farming schemes:

- to adopt policies that encourage researches and technologies that increase the productivity of gum trees & reduce yield variability. The results showed that gum producers did not prefer contracting due to high yields variability.
- provision of support services, such as drinking water, transportation & communication infrastructures, loans, market information and enhancing producers' information accessing & interpreting capabilities through extension, training and education programs.
- Adoption of contracting schemes and pricing systems that take into consideration the specific characteristics of gum industry such as high dehydration rate of gum crop, long harvesting period and low productivity.

Finally this study recommend further studies on the possible role of contracting in the gum industry, namely interlinked & services provision contracts, pricing system and quality & quantity control measures. Further studies are recommended to examine the transactional costs & agency problems in the gum supply chain that may prevent producers & buyers from being participant in contract farming and gum industry of Sudan.

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Appendix (A): Compares means of explanatory variables that might explain the variations in gum producers' contracting preferences

Variable Description	Not Prefer Contract Farming (N=27)	Prefer Contract Farming N=74
The size of gum farm owned by producer	45.6296	43.0811
Ratio of producer gum farm to area of other crops	1.4630	1.4749
The number of gum trees owned by producer	4229.0122	4030.6307
Receiving less than expected prices	0.5185	0.7973
Variation in producers' prices between 2004 &2005	39.2222	55.4189
Variation in Yield by producer between 2004 and 2005	40.2222	32.6081
Availability of Non agricultural sources of income	0.5185	0.5541
Presence of gum companies in producer region	0.5926	0.4595
Presence of producer owned gum institutions	0.3333	0.1757
The size of gum arabic producer's family	7.037	7.527
Experience of gum producer	24.3846	27.0405
Education level of gum producer	1.037	1.1757
Knowing the current liberalization debates	0.4444	0.5405
No. of producer's visit to city market during the season	19.8704	25.2432
Distance to city markets	8.4074	10.1757
Producer who get support from gum companies before	0.1111	0.1622
Number of traders residing in your village	5.4815	5.1351
Average number of traders visits to village/season	9.8519	14.5676
Producers who had access to loans before	0.1481	0.2432

Appendix (B): Descriptions, codes, expected signs, means and standard deviations of variables used in contract duration model

Variables	Codes	Expected Signs	Means	Standard Deviation
DEPENDENT VARIABLE:				
Contract Duration	CONTDUR		1.86	1.46
EXPLANATORY VARIABLES:				
A. Gum and Farm Characteristics Variables				
(Asset specificity, risk and uncertainty)				
The size of the gum farm	GMFMSIZE	+/-	43.76	51.78
Ratio of gum farm to other crops areas	GUMCROPR	+	2.18	3.34
Number of gum trees owned by producer	NOTREES	+/-	4084	3938
Receiving less than expected prices	LESSPRCE	+	0.72	0.45
% variation in producer prices bet. 2004&2005	PRICVART	+	51.09	47.35
% variation in producer yields bet. 2004&2005	YIELDVAR	+	34.64	26.93
Availability of non-agricultural income sources	NAGRSINC	-	0.55	0.50
B. Producer's Characteristics Variables				
(Information accessing and interpreting capabilities)				
Producer household size	FAMSIZE	+	7.40	2.52
Experience	EXPRENCE	+	26.35	12.89
The level of education	EDUCTION	+	1.14	1.08
Knowing gum export liberalization debate	LIBDEBAT	+	0.51	0.50
Number of visits to city markets	NOVSTMKT	+	23.81	18.00
C. Market Characteristics Variables				
(markets accessibility and traders' concentration)				
Companies presence in producers' area	GUMCOMP	-	0.50	0.50
Companies support to producers in the past	SUPCOMP	+	0.15	0.36
Marketing institution in producer's villages	GUMINST	+/-	0.22	0.41
Number of traders residing inside the village	NOOTRDRS	-	5.23	2.69
Number of traders' visits to producers' village	NOVSTDRS	-	13.31	10.00
Distance to city market	DSTMKT	+	9.70	9.25
Accessibility of loans	ACCLOANS	+	0.22	0.41