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Behaviour and performance of traders in the gum arabic supply chain in Senegal:

Investigating oligopsonistic myths.

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Abstract

Farmers face monopsonist/oligopsonist structures in agricultural or forest products markets because of the limited choice of traders/buyers. As a consequence, these farmers and traders alike, in successive transactions along the supply chain, may get lower prices in selling their products. This leads to a problem of double (or even multiple) marginalisation. We investigate oligopsonist tendencies in the trade of gum arabic, a non-timber forest product which is widely used as an additive in food and non-food industries. We compute traders' shares and a corresponding Herfindahl index in primary, transport and wholesale markets of gum arabic in Senegal to analyse the market concentration; through a gllamm procedure we analyse determinants of these market shares and finally by a weighted least square regression, we analyse determinants of marketing margins of individual traders. The computed Herfindahl index was found too low to have any influence on margins and hence oligopsonist powers could not be confirmed. Instead traders' margins depend on costs, risk and uncertainty that they face. Consequently, traders were not found exploitative; their power is derived from access to capital and market characteristics.

Key words: oligopsony, double marginalisation, Herfindahl index, market accession, market exit, risk, marketing margins.

1. Introduction

Markets of agricultural or forest products are often imperfect, especially in developing countries. Towards the consumer end of the supply chain, monopolies or oligopolies are found with many consumers buying from a limited number of retailers. On the other side of the chain, farmers often face monopsonies or oligopsonies because they have a limited choice of traders to whom they can sell. Furthermore, within the supply chain, the number of buyers

at different intermediary levels, from producers to the processing and/or export level, is successively often smaller than the number of sellers. This might imply imperfect competitive market structures with successive oligopsonist tendencies. Due to these successive oligopsonies, buyers may offer lower prices compared to what they would pay if they were in a competitive market, because they also face lower prices in the markets where they sell. As a consequence, the traded volumes are smaller than if the market was perfectly competitive. Furthermore, the market power with successive oligopsonies applied at each level of the supply chain results in a fall in the prices consecutively paid and quantities consecutively traded along the chain. This problem was first described by Spengler (1950) and has become known as ‘double marginalisation’ in reference to a simultaneous exercise of market power by trading agents against each other. Arguably, double marginalisation does not only determine the price levels in the chain and the volume marketed, but it also affects marketing margins (Spengler, 1950; Lantz, 2009).

The specific role of traders and intermediaries in agricultural markets in developing countries has been subject of many studies in context of their different roles and functions: as intermediaries in searching for a trading partner (e.g., Gabre-Madhin, 2001); as brokers in improving market efficiency (e.g., Gabre-Madhin, 2001); or as risk bearers in exploring or creating market exchange opportunities (e.g., Rubinstein and Wolinsky, 1987; Gadde and Snehota, 2001). However, claims were often made that these traders exploit farmers by capturing excessive ‘monopsonist rents’ (McMillan et al., 2002; Fafchamps and Gabre-Madhin, 2006; Fafchamps and Hill, 2008) or by colluding (Batt, 2004). Yet, empirical studies such as Batt et al. (2009) or Mose (2007) fail to substantiate such exploitation. In the presence of competition among traders in the maize market in Kenya studied by Mose (2007), no evidence of such exploitation was found.

Fafchamps and Hill (2008) explained that the perception of farmers' exploitation by traders is associated with traders taking advantage of the farmers' low bargaining power and their ignorance on price movements but also with high transport and transaction costs in marketing that these traders face. Lele (1981) explained that these marketing costs result from the long chain of intermediaries from producer to consumer. Some large traders can handle a large share of marketed quantities and surpluses, yet rural traders are often found to work on low margins and earn a meagre income; in fact they are 'just rational and acting under constrained efficiency' (Fafchamps et al., 2003). These small rural traders transact small quantities because of limited access to working capital, limited storage facilities, and high marketing and transaction costs due to extensive travelling on poor roads and inadequate transport infrastructure and services in rural areas (World Bank, 2007)

Poor infrastructure not only increases costs of transportation; it also causes delays in transport and consequently decreases profitability (Schroeter and Azzam, 1991; Fafchamps and Gabre-Madhin, 2001; Shackleton and Shackleton, 2004; Eskola, 2006). Price uncertainty, inconsistent government policies and continued suspicion of trader activity are also found to seriously constrain trade (Schroeter and Azzam, 1991). These constraints not only increase marketing costs, but also determine the environment in which traders operate. This environment in turn influences traders' behaviour including the distribution of market power and profits or margins earned in the market (Raper et al., 2000; Myers et al., 2010).

Despite the importance given to marketing costs and the distribution of market power, both issues have seldom been investigated in the context of oligopsonies and double marginalisation problem. In this chapter we address this gap by studying the case of the performance of traders in the supply chain of gum arabic in Senegal. We investigate the gum market structure and assess its impacts on market outcomes (marketing margins).

Different categories of intermediaries in the Senegalese supply chain of gum arabic and *in extenso* of many raw agricultural and forestry products can be distinguished, namely: (a) a primary category of village traders and mobile traders; (b) an intermediate category of transporters; and (c) a high category of wholesalers, exporters and processors (Figure F1 in appendix). A successive oligopsonistic market structure in the gum arabic chain is observed as local traders purchase gum from many producers but they sell this gum to fewer transporters, whose main function is to move the gum. They in turn sell to fewer wholesalers; and in this high category, the number of local processors and exporters is very limited. We focus our analysis on those primary traders who move between producing villages or weekly markets to buy gum from the collectors, on transporters who move to rural markets in production regions to buy gum from primary traders, and on wholesalers who are established in cities neighbouring the production zones. We describe their role and analyse how the market structures in which they operate influence their performance in the gum business. We specifically investigate whether the variations in the marketing margins are indeed a result of market power as predicted by the double marginalisation. We base this analysis on data collected from the Sylvopastoral and Eastern regions of Senegal from 124 traders who are village, mobile, transporters and wholesale traders.

In the next section we develop a theoretical framework to analyse oligopsonies and to explain the theoretical consequences of the double marginalisation problem. Next the structure of the supply chain of gum arabic in Senegal is explored. This is followed by a methodology and a results section. Finally we discuss these results, and give conclusions.

2. Oligopsony markets

As mentioned in the introduction, the agricultural marketing system in most developing countries is characterised by oligopolistic and oligopsonistic structures. On the side of outputs markets, oligopolistic systems are observed where there are relatively few distributors and

numerous consumers (Mendoza and Rosegrant, 1995). Markets of raw agricultural and forest products mainly exhibit oligopsonistic features as there are numerous farmers or collectors, and relatively few traders. Along supply chains of raw products, successive intermediaries function in similar oligopsonies that are associated with the presence of non-competitive buyers at the different levels of the market namely primary and intermediate traders, wholesalers, or processors (Lele, 1981).

Generally in oligopsonistic markets, numerous sellers compete to sell their product to a small number of (often larger and more powerful) buyers (Jehle and Reny, 2000). The most important characteristics of oligopsonies are that: (1) these markets are dominated by a small number of buyers; (2) sellers face few alternatives to sell their goods and if other alternative buyers exist, these tend to be less desirable for instance because markets are inaccessible; and (3) the market shows significant barriers to entry that enable buyers to attain and retain market control (Rogers and Sexton, 1994; Bergman and Brännlund, 1995). Barriers to market entry can be natural, formal or informal. Menzie and Prentice (1987) explain that natural barriers include 'natural' or geographic barriers such as being remote or landlocked. Formal trade barriers are defined as any direct action that restricts trade such as a government policy or regulation (Ackah and Morrissey, 2005), and may include patents, taxes, quantitative restrictions, and quality requirements (Menzie and Prentice, 1987). Informal trade barriers impact on trade indirectly. These include individual constraints such as difficult access to credit, lack of capital to expand the business or to engage in storing the products, lack of or limited business skills/knowledge, and problems due to the institutional framework such as long supply chains or lack of established rules of transaction. Other informal barriers include social, linguistic or cultural differences which have an effect on negotiation (Kherallah et al., 2000; Eskola, 2006).

Oligopsonistic market structures have received relatively little attention in agricultural economics literature. Early in the 20th century, economists started to recognize the imbalance of power between farmers and the system of sale for their produce. Cooperation for joint performance (cooperatives, associations) was considered as a way to correct these imbalances (Nourse, 1922). The Structure-Conduct-Performance approach was occasionally used to analyse oligopoly power and its impacts on consumers in the context of industrial organisation studies; yet, it is only the ‘New Empirical Industrial Organization’ (NEIO) theory that investigated the relevance of traders’ oligopsony power over farmers in inputs markets (Myers et al., 2010). A few studies that focused on oligopsonies laid emphasis on testing, measuring or determining this oligopsony power in different industries and markets (e.g., Ukrainian milk processing industry (Perekhozhuk et al., 2009), U.S. Paper Industry (Mei and Sun, 2008), and UK Salmon markets (Fofana and Shabbar, 2008)). Other studies focused on finding measures or strategies for mitigating this oligopsony power, e.g., theoretically through vertical integration (Loertscher and Reisinger, 2009) or empirically through Fair Trade in the coffee market (Piyapromdee et al, 2008). Some authors analysed the price determination in oligopsonic markets while others focussed on issues of double marginalisation as a consequence of repeated oligopsonies in the chain. We take a closer look at the literature on both issues in the next sections.

Studies by Just and Chern (1980), Sexton (1990), Chen and Lent (1992), Rogers and Sexton (1994), and Myers et al. (2010) provide guidelines on modelling oligopsony relationships between firms and industries. Firms operating within oligopsonies exhibit strategic behaviour as each firm has to be aware of the actions of the other market participants. When firms decide to cooperate, collusion takes place within the industry (e.g., explicitly through cartels) or price leadership occurs when one firm is followed by other firms in the industry.

Profits for an oligopsonist depend not only on demand and supply but also on the behaviour of competing traders. The more the competitors buy, the lower the market price will be. This is due to a 'payoff interdependency' as explained by Church and Ware (1999). Since traders operate in a strategic context, to determine the profit-maximizing quantity, each trader has to figure out how much his competitor is going to buy and sell while recognizing that the competitor is also going through the same thinking process. Each buyer knows that if he can unilaterally increase his market share by acquiring more products, his profits will increase. However, if all firms exercise their power and compete aggressively for more market share, even if they are fewer on the market, they will all be worse off: the resulting low prices will lower both aggregate and individual profits.

Successive oligopsonies in supply chain: the double marginalisation problem

The general double marginalisation problem in supply chains occurs when two (or more) independent firms have large market power and exercise this power to set up prices at mark ups different than MC: monopolies' prices are above MC and monopsonies' prices are below MC; these deviations yield deadweight losses. With successive market imperfections, actors reduce their combined profit by simultaneously exercising their market power and as such no stable equilibrium is reached in the market (Lantz, 2009). In the next paragraphs the problem of double marginalisation is illustrated by taking the case of successive monopsonies instead of oligopsonies to facilitate graphical clarity.

Consider the case of a monopsony and three successive stages of marketing: (1) the acquisition of the product by a trader from farmers in a particular village; (2) a trader supplies the product from the village to a wholesaler; and (3) a wholesaler supplies to an exporter or a processor who aims at maximizing his profits in the transformation of the raw product and there is no vertical integration. Figure 1 illustrates the analysis of double marginalisation with

successive monopsonies¹; this model is not tested in the paper, but it is important to show the effects of the characteristics of market power. Let P_v , P_w , and P_e , represent the prices offered by a village trader to farmers, a wholesaler to a trader and an exporter to wholesaler respectively in a supply chain. S_f and S_v are the farm and trader supply curves, respectively. MC_v and MC_w are the trader and wholesaler's marginal cost curves, respectively, derived from total cost functions. MR_v and MR_w are the trader and wholesaler's marginal revenue curves. Because a monopsonist is a price maker with extensive market control, he buys the quantity that equates marginal cost and marginal revenue and he pays a lower price for each unit of the product.

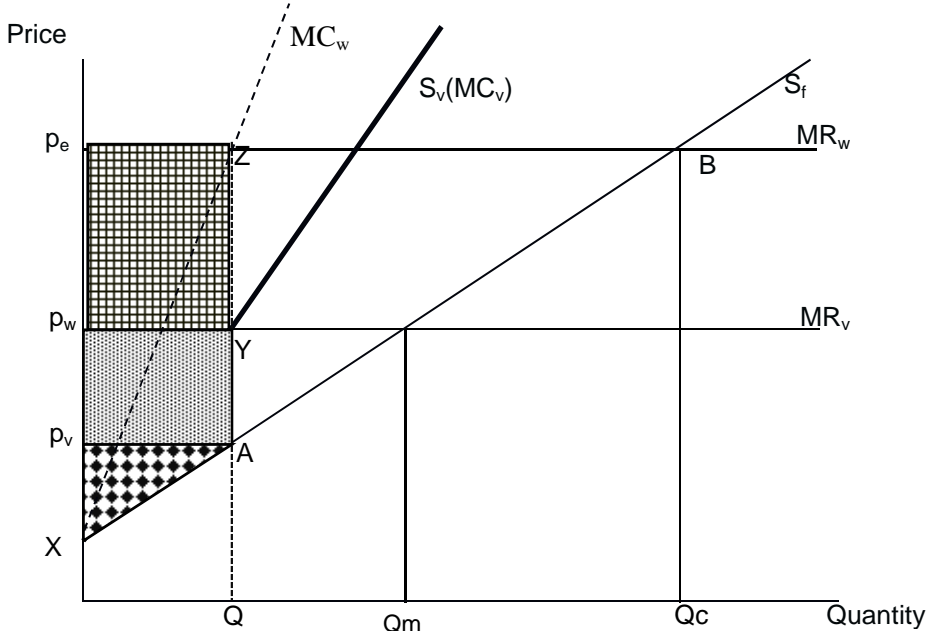


Figure 1. The problem of double marginalisation for successive monopsonies

Q is the quantity bought by a monopsonistic trader from farmers (in the village) at price p_v . The village trader supplies to the wholesaler. This wholesaler is also a monopsonist; hence he pays a price P_w that is lower than the competitive price. The exporter pays P_e and the quantity supplied by a wholesaler is Q .

¹ Figure 1 of successive monopsonies relaxes the assumptions of oligopsony for the purpose of clarity. These assumptions relate to the MR curves, and the fact that here the price determination depends only on MR/MC of the single monopsonist buyer and not on based on the actions of the other buyers.

The farmer's surplus is p_vAX , the village trader's surplus is p_vAYP_w . and the wholesaler's surplus is P_wYZP_e . Hence with successive monopsonies, the aggregate surplus earned along the chain is $XAZP_e$ which is obtained from trading Q quantity of the product.

If the respective traders along the chain were operating in perfectly competitive conditions, the quantity purchased and price to the producer would be greater than in the presence of monopsonies. For instance at the export price P_e , a farmer in a competitive setting could supply Q_c and the surplus throughout the chain would be XP_e . This competitive surplus is greater than the aggregate monopsonists' surplus.

As the number of imperfect marketing stages increases, the effect of such imperfections on the farmer(price) becomes even more pronounced because each trader in each stage aims at earning a monopsonistic profit (McMillan et al., 2002).

In successive oligopsonies, the impact of double marginalisation in depressing prices, quantity traded and overall surplus in the chain will depend on market concentration and the type of interaction allowed between traders.

The generally proposed solution to the double marginalisation problem is vertical integration which should lead to higher chain profits (Spengler, 1950, Gaudet and Van Long, 1995). Vertical integration eliminates some of the monopoly (monopsony) mark-ups, leading to a lower sale (higher buying) price and an increase in welfare (West, 2000). From a New Institutional Economics perspective, vertical integration may also act positively on profits through minimization of transaction costs.

While surpluses for traders have been explained above by market power in relation to the prices and quantities in transaction, it is important to consider that these surpluses may also depend on the determinants of the marginal costs which are associated with functions performed by these traders. These are outlined in the next section.

Functions and costs of trading

The role of a trader is to transport, grade, bring to market and sell products to consumers (Eaton et al. 2007). Kotler (1997) listed nine market functions: (1) information collection and dissemination; (2) development and dissemination of persuasive communications about offers; (3) negotiation attempts to reach final agreement on price and other items of the offers; (4) ordering backward communication of intentions to buy; (5) financing acquisition and allocation of funds required to finance the carrying of inventory; (6) risk taking in connection with carrying out channel work; (7) successive storage, processing and movement of physical products; (8) payment of bills; and (9) actual transfers of title of goods. All these marketing functions are associated with marketing costs and transaction costs including the cost of searching for an exchange partner (Gabre-Madhin, 1999); the cost of acquiring information specially in the context of information asymmetries (Ellis, 1988; Hobbs, 1996; Upton, 1996); and negotiation costs and costs for concluding and enforcing a contract (Hobbs, 1996).

As mentioned in the introduction, marketing costs are especially high in developing countries due poor infrastructure and inefficient transport system, inadequate storage capacity, lack of reliable market information or modern communication facilities, and significant variations in product form, variety and quality (Rogers and Sexton, 1994; Harris-White, 1997; Batt, 2004). These factors also make trade in developing countries very risky. In the markets of non-timber forest products such as gum arabic, costs are even higher because producers are often dispersed over large areas and markets are located in marginalized areas characterized by poorly developed transport and communication infrastructure.

Social capital and the use of intermediaries may reduce transaction costs and risk. According to Fafchamps and Minten (2001), social capital through kinship or networks may help economize on transactions costs by speeding up the search for trading partners,

providing insurance in order to enforce contracts and facilitating the circulation of information (Fafchamps and Minten, 2001; Le Goulven, 2001).

Finally, it should be noted that in addition to marketing functions and costs, other factors influence marketing margins. Wohlgenant (2001) summarized several studies and identified these factors as technical and structural changes, cooperative behaviour, government programs, product quality and seasonality.

Structure of gum arabic supply chain in Senegal

Similar to agricultural markets in Africa studied by Fafchamps (e.g., Fafchamps and Minten, 1998, 2000; Fafchamps et al., 2003; Fafchamps and Gabre-Madhin, 2006), markets for raw gum arabic are characterized by a large number of gum collectors and relatively few traders and companies.

Table 1. summarizes the features of gum trade for different categories of traders in relation to the supply of gum arabic (i.e., factors that influence the supply of gum on the market), demand for gum arabic(i.e., factors that influence the supply of gum on the market), transaction costs (i.e., factors that determine the extent of transaction costs in markets of gum arabic), risks and uncertainty(i.e., factors that influence the magnitude of risk or uncertainty in marketing gum arabic), and quality requirements (i.e., requirements for quality improvement and maintenance).

Table 1. Features and determinants of gum arabic trade

Determinants of trade	Primary traders	Transporters	Wholesalers	Processors and exporters
Supply of gum	-Production potential -Labour time and opportunity costs -Price offered to gum collectors -Other incentives to collectors to supply gum -Interlocked contracts	-Number of markets and seller -Price offered to primary traders	-Quantities gathered by transporters -Price offered to gum transporters	-Quantities gathered in the production zone -Price offered to wholesalers
Demand of gum	-Price offered by transporters -Buyers' access to working capital, credit, marketing costs	-Price offered by wholesalers -Buyers' access to working capital, credit, marketing costs	-Price offered by exporters and processors -Buyers' access to working capital, credit, marketing costs	-International prices -Own capital, possibility to access credit, marketing and shipping costs -Contracts
Transaction costs	-Production widely dispersed -Opportunistic behaviour	-Road connection and means of transport -Dispersed markets -Opportunistic behaviour	-Loading and unloading sacks, quality monitoring, and payment of road fees -Opportunistic behaviour	Loading and unloading sacks, quality monitoring, and payment of road fees
Risk and uncertainty	-Contract and market -Production failure -Competition over supply -Price uncertainty	-Loading, discharge capacity and delays -Contract and market -Competition over supply -Price uncertainty	-Loading, discharge capacity and delays -Contract enforcement	-Loading, discharge capacity and delays -Contract enforcement
Quality requirements			Sorting and grading has to be done	Investment in machinery for grading

3. Methodology

As explained above, the behaviour and performance of a trader in a supply chain structured as successive oligopsony are influenced by his action and his strategy towards his competitors. The current section details the theoretical framework which identifies the role of market power to the analysis of oligopsonistic behaviour. Empirical specifications are also presented.

Theoretical framework

Gum collectors are assumed to be homogeneous and distributed uniformly. Traders are homogeneous and price takers in their selling markets. The final customer in the market chain is considered to be the exporter of raw gum or a processor who uses raw gum to manufacture various products; however the processing or exporting levels are outside the scope of the current study.

Let us assume that the market for gum arabic is composed of n traders (i.e., the buyers) facing numerous sellers (i.e., collectors or traders at successive levels in the chain). The trader maximizes profits at:

$$\pi_i = (p_i - b_i)q_i - c(q_i) \quad (1)$$

where π_i is profit of trader i , p_i and b_i are his selling and buying prices, q_i is the quantity traded and $c(q_i)$ the cost function of trading this quantity, with $c'(q_i) > 0$. Typically, q_i is an endogenous variable for a trader in an oligopsonistic position. The value of q_i depends on his activities, but also on the quantities bought by other traders so that $p_i = p(Q)$ and $Q = \sum q_i$.

Maximization gives as first-order condition:

$$p_i - b_i - c'(q_i) = 0 \quad (2)$$

If the trader wants to buy a larger quantity, he offers a higher price, hence the last term is positive, making marginal cost somewhat lower than the gross margin. Lower $c'(q_i)$ implies lower values of q_i , hence the trader buys smaller quantities than he would have done if $c'(q_i)$ was not responsive to his actions.

As it is, the effect of q_i on q can be written as $\frac{\partial q}{\partial q_i} = \frac{1}{\epsilon_i} \frac{q}{q_i} \frac{1}{1 + \alpha}$. The first two factors are the inverse of the supply elasticity ϵ_i . The last factor shows how total quantity responds to a unit change in i 's purchases, which is:

$$\frac{\partial q}{\partial q_i} = 1 + \sum_{j \neq i} \frac{q_j}{q} \frac{\partial q}{\partial q_j} \equiv 1 + \alpha \quad (3)$$

For simplicity we assume that α , a measure for the degree of collusion, is constant over all i .

The formula for $c'(q)$ then becomes:

$$c'(q) = \frac{1}{1 + \alpha} \left(\frac{1}{\epsilon_i} \frac{q}{q_i} + \alpha \right) \quad (4)$$

Following Chen and Lent (1992) we can multiply both sides by q and sum over all i .

Assuming that the marginal costs are insensitive to market shares, the result for an average trader is:

$$c'(q) = \frac{1}{1 + \alpha} \left(\frac{1}{\epsilon} + \alpha \right) \quad (5)$$

or

$$c'(q) = \frac{1}{1 + \alpha} \left(\frac{1}{\epsilon} + \alpha \right) H \quad (6)$$

where H is the Herfindahl index of market power. It is a measure of the relative average size of traders in relation to the market and an indicator of the amount of competition among them (Chen and Lent, 1992). If $H = 1/n$, there is perfect competition or all traders are of equal size and if $H = 1$, the market behaves as a pure monopsony. Increases in the Herfindahl index indicate a decrease in competition while reductions in the Herfindahl index indicate an increase in competition. Values of H between $1/n$ and 1 correspond to different degrees of oligopsony. Equation (6) shows that the higher is H (i.e., the larger and more unequal the market shares), and the higher the level of collusion (α), the lower will be $c'(q)$ and therefore q itself. By implication, p will be lower too, and less will be bought, thus depressing the buying prices, while enlarging the gross margins at the trader's level.

Empirical specifications

The empirical application of the profit maximisation model in oligopsony markets of gum arabic is made in reference to equations (1) and (6); where we explore the magnitude of market power and the margins and explain determinants of market power (in terms of the share of traders in market) and marketing margins. First, we compute market shares of traders based on the transaction quantity of each trader in proportion to the total size of transactions in that market; and on the basis of these market shares, a Herfindahl index of power in each market is derived. We then analyse on the individual level the factors that influence the traders' market share and derive an interpretation for market accession. Secondly, we compute gross margins per unit of transaction based on the buying and selling prices and then net margins subtracting the fixed and variable costs involved in buying and selling. Finally, at the market level, we analyse the factors that influence the marketing margins and derive an interpretation for market exit.

(1) Computing market share and deriving the Herfindahl index

The Herfindahl index (H) is a measure of market power, and it involves the calculation of the market share of each trader as a ratio of the total quantity of his transactions on the total quantity of transactions conducted in each market.

Since data on the total quantities corresponding to transactions in primary, transporting and wholesale markets were not directly available², the total size of each market was estimated using one of the different approaches described below: (a) in case all traders operating in a market were interviewed and each trader indicated the total quantity of his transactions in the market, the sum of quantities of all traders was obtained (e.g., primary markets of Barkédji, Labgar, Séno Youpé); (b) in case all traders in a primary market could not be interviewed, total quantities supplied by producers were calculated based on the

² Secondary data is scarce and that it was not possible to interview all traders in all markets due to their absence or reluctance to accept interviews.

average number of producers who sell in a particular market and the average quantity supplied by producers in that market; (c) the average annual transactions in some markets were available from secondary sources (CSE (2006) and EXPERNA (2008) in the period 2011-2004 and 2005-2006 in the SPZ and ES respectively. Such averages served as an estimate of the current market size assuming that transactions followed similar trends over time (e.g., Linguère, Kamb); (d) in transporting markets, the aggregation of quantities from primary markets is computed; and (e) in wholesale markets, the weighted average production of the last five years (COMTRADE, 2011) served as an estimate of the current exports. Weights in the wholesale markets of the SPZ and ES were derived as 55 and 5 per cent of the exports from SPZ and ES respectively (the remaining 40 per cent exports are from the Northern region (DEFCCS, 2005; Diop 2005)).

A trader's share is computed as the proportion of his total transaction quantities over the total market size:

$$\text{Share}_i = \frac{Q_i}{Q} \text{ such that } \sum_i \text{Share}_i = 1 \quad (7)$$

In the second step, the Herfindahl index is calculated by taking into account the number of traders and variance between their shares:

$$H = \frac{1}{N} + NV \quad (8)$$

where N is the number of traders in the market and V is the statistical variance of traders' shares defined as:

$$V = \frac{\sum_i (\text{Share}_i - \frac{1}{N})^2}{N-1} \quad (9)$$

If all traders have equal shares, then V is zero and H equals 1/N. If the number of firms in the market is held constant, a higher share dispersion will result in a higher index value. As such computed, the value of the Herfindahl ranges from 1/N to 1 where a very low index implies competition while an index close to 1 implies high concentration (refer to equation (6)).

A normalised Herfindahl index is computed so that it ranges between 0 and 1:

$$L^* = \frac{1/n}{1/n} \quad (10)$$

When $n = 1$, $L^* = 1$, which is the case of pure monopsony. If traders have equal shares, $n = 1/n$ and $L^* = 0$ (there is no dispersion meaning that $n = 0$), which is the case of perfect competition.

There are other measures of market power at the market level including the four-firm concentration ratio³. Unlike this concentration ratio, the Herfindahl index reflects both the distribution of the market shares of the top four firms and the composition of the market outside the top four firms. It also gives proportionately greater weight to the market shares of the larger firms, in accordance with their relative importance in competitive interactions (Kelly, 1981).

(2) Computing margins

Two types of unit margins are computed as follows:

$$\text{Gross margin} = P - C \quad (11)$$

$$\text{Net margin} = \text{Gross margin} - M \quad (12)$$

With:

- Selling price (P): the price at which the trader (a primary trader, transporter or wholesaler) sells the gum to a 'superior' trader (a transporter, wholesaler or exporter respectively). In the sale market, the trader is considered to be a price-taker, thereby having no influence on the determination of this price;
- Buying price (C): the price at which the buyer (primary trader, transporter or wholesaler) obtains gum either from gum collectors in the case of primary traders and subsequently in the chain from an 'inferior' trader (primary trader or transporter).

Marketing costs (M) include:

³ The Lerner index is another measure of power at the firm level. It measures the extent to which a given firm's buying prices exceed marginal costs (Rogers and Sexton, 1994).

- Transport cost: is a combination of distance and transport mode. Primary traders often use horse or donkey carts in travelling to villages or hire public transport in travelling to town market. Transporters or wholesalers who travel to rural markets use trucks. The transport function reflects a fixed cost that varies only with distance and a proportional cost that varies with the quantity to transport (refer to chapter 4);
- Storage cost: while building up the volumes, hoarding stocks in order to get a good price or waiting for a buyer, traders will incur a storage cost. This is the actual or imputed cost for hiring a room in which to store gum for the duration of gum harvesting season;
- Cleaning and sorting cost: in order to improve its value, traders may clean gum by removing impurities and mixtures, and grade gum based on visible qualities of gum including the size of nodules and their colour;
- Hired labour cost: depends on the average daily wages, the number of days that a trader hires labourers and the number of labourers hired in the season;
- Other costs: mainly communication and road fees as given by traders.

Data

A survey of traders involved in gum arabic marketing was conducted in Senegal in the two major gum producing areas namely the Sylvopastoral Zone and Eastern regions between February and May 2009. The sample of traders was designed to be representative of all the traders involved in the gum arabic supply chain in these two regions of study where gum arabic is actually produced and marketed. Traders interviewed in each region comprised of primary traders (village and mobile traders), transporters and wholesalers. These traders were interviewed using a questionnaire which pertained to individual characteristics of the traders, market characteristics, and marketing elements. Additional informal interviews were held with exporters and processors.

In total, a random sample of 124 traders were formally interviewed; 90 in SPZ and 34 in ES. The distribution of traders reflects the interest in gum production and trade in SPZ. In the past, traders limited their procurement activities to SPZ with the aim of minimising transport costs thereby maximizing their profits; production and trade in the more remote ES was low (AGC, 2007).

Secondary data sources were also used. These include the Atlas published by the Ministry of Environment (CSE, 2006) on the markets statistics in SPZ and the EXPERNA report on production statistics in ES (EXPERNA, 2008).

(1) Explaining individual shares of traders in a market

The determinants of the market share of a trader are analysed. We distinguish trader and market characteristics. Human capital, social capital, and wealth are variables that have been recurrent in the study of various aspects of trading (e.g., Fafchamps and Minten, 1998, 2001); however, market factors were not previously given attention.

(a) Variables associated with trader characteristics are:

- Education: this is a dummy that takes a value of 1 if the trader has received some form of education whether in the Coranic or formal schools or 0 otherwise. The educated traders might have knowledge in running their business and thereby earn high margins;
- Trader's experience: this is the number of years that the trader has spent in the gum business. The more experienced traders can take advantage of their knowledge and business skills to have high shares in the market;
- Wealth: this wealth substitutes the accessibility to capital because formal institutions that would supply credit are quasi-inexistent in the rural areas. Two variables proxy the trader's wealth: (1) the value of livestock owned by the trader and (2) the number of houses that the trader possesses. These proxies are exogenous to market share because they are based on

historical decisions and not causally related to the trade of gum. The higher the wealth, the higher the possibility to have funds and therefore the higher would be the market share;

- Number of family relatives involved in gum business: this number indicates the range of trader's network. Such network facilitates the access to information regarding the supply and demand markets;

- Number of language spoken: this indicates the ease of communication which facilitates transactions especially in a multilingual society like in Senegal. The more languages spoken by a particular trader, the higher would be his market share;

- Possession of a telephone: this is a dummy variable that takes the value of 1 if a trader possesses a (mobile) telephone or 0 otherwise. The possession of a telephone facilitates communication in terms of accessing information on markets, prices and transactions. Hence if a trader has a telephone, he might have a higher share of the market than a trader who does not have the telephone; and,

- Area of operation: rural markets in Senegal held on different days in the week, hence the area of operation is represented by the number of markets (and villages) in which traders could have their supplies. The area of operation is exogenous to market share; a large market share does not mean that a trader operates in several market. Instead, the larger is the area, the larger may be the quantity of trader's transactions.

(b) Variables associated with market characteristics are:

- Market size: this is the total of the quantities transacted in that market. This size is expected to have a positive effect on the market share;

- Number of buyers: this is the number of all traders who operate in a particular market. This number is expected to have a decreasing effect on the market share as it implies competition over the transactions;

- Distance of the market or village from the nearest town: this is the distance in kilometres from the town to the market or village. The longer the distance, the lower would be the buying price;
- Distance from Dakar: this is the distance in kilometres from Dakar to the buying place. The longer the distance, the lower would be the buying price because of the higher costs for a buyer to transport to Dakar;
- The existence of storage in the market: this is a dummy variable that takes a value of 1 if storage is available in the market or 0 otherwise. This variable indicates that in the market where storage is provided, traders might take advantage of storage in terms of building-up volumes or waiting for buyers thereby increasing their market share.

Due to the presence of explanatory variables at two levels namely the low level of traders and the high level of market, the generalized linear latent and mixed models (gllamm) procedure is used instead of a standard regression. This gllamm procedure takes into account the hierarchical structure of the data by explicitly allowing a random effect of the higher level at the market and thereby correcting for the independence of observation. This is because traders of a certain category who are drawn from a market would be more homogeneous than if traders were randomly sampled from a larger population (see Rabe-Hesketh et al. (2004) for details on gllamm).

(2) Explaining marketing margins

We test the correlation between marketing margins and market power and investigate determinants of these margins. Following our theoretical model and studies by Wohlgenant (2001) and Fafchamps, et al. (2003), the following determinants of marketing margins are included:

- Marketing costs () include all the costs spent by trader in selling gum. As mentioned above, these include the transport, storage, cleaning and sorting, labour, and other costs.

These costs were computed per kg of gum arabic sold. The costs have a decreasing marginal effect on the margins and hence are expressed as a quadratic form.

- Distance to sell: this is the physical distance in kilometres from the trader’s business (base) to the selling market. Margins are expected to increase with distance.
- Price uncertainty: this was calculated as the deviation of the price received by the trader from the mean sale price in each market in the previous season. The higher this deviation and hence the uncertainty, the higher would be the margin retained by the trader.
- Risk: traders in gum arabic face a number of risks that can be idiosyncratic risk or systemic market risk. Idiosyncratic risk affects an individual trader and includes for instance the failure to obtain gum as contractual payment, finding a buyer, or delays; systemic market risk affects almost all traders in the market in a similar way and includes for instance production failure, competition over supplies, or unpredictable price variations. The individual and market risk are each indicated by a dummy that takes a value of 1 if a trader has indicated in the interviews concern for any component of this risk or 0 otherwise⁴.

The variance is assumed to be dependent on the size of costs; hence as the with the costs increase, the variance also increases. Due to this heteroskedasticity, the analysis of total costs variable on marketing margins would lead to inefficient estimates with a standard regression. Instead, the weighted least square estimation is used. Greene (2008) defines the weighted least square estimator as:

$$= \frac{\sum}{\sum} \quad (13)$$

Where the weight $= \frac{1}{\text{variance}}$. Here, observations with smaller variances receive a larger weight in the computations of the sums and therefore have greater influence in the estimates

⁴ Due to the difficulty of quantifying risk, we relied on an indication of perception of risk related to the gum trading.

obtained. Analytical weights were used by estimating a regression based on ¹ because the variance is not constant.

Having explained the variables included in the study, we now present the results of our empirical analysis.

4. Results

There are differences in characteristics of market transactions, market power and the exercise of this power towards achieving performance between primary traders, transporters and wholesalers. In this section we first present an overview of characteristics of gum arabic market in terms of traders' transactions and test the concentration of market power. This leads us to analysing determinants of such market power and discussing their potential effect.

Characteristics of the groups of traders

In terms of transactions, an overview of quantities, prices, costs and margins associated with buying and selling gum shows differences between zones and categories of traders (Table 2). Because the gum production in the two zones (SPZ and ES) is different, they are reported separately.

Table 2. Descriptive statistics of gum trade components

	All traders			Primary traders			Transporters			Wholesalers			Equality test		
	Senegal (124)	SPZ (90)	ES (34)	Senegal (88)	SPZ (69)	ES (19)	Senegal (29)	SPZ (16)	ES (13)	Senegal (7)	SPZ (5)	ES (2)	Category	Region	Region X category
<i>Quantities (tons)</i>															
Total quantity	5.27 (18.2)	6.52 (21.2)	1.97 (2.7)	1.49 (1.9)	1.71 (2.0)	0.68 (0.9)	5.00 (7.5)	6.73 (9.8)	2.89 (1.8)	53.93 (59.5)	72.20 (61.9)	8.25 (8.1)	27.3***	35.9**	17.9***
Quantity per transaction	1.15 (5.9)	1.42 (6.9)	0.43 (0.5)	0.14 (0.2)	0.13 (0.2)	0.17 (0.3)	0.83 (1.3)	0.98 (1.7)	0.63 (0.5)	15.14 (21.6)	20.57 (23.9)	1.58 (1.1)	15.8***	20.8***	12.2***
<i>Prices (CFA/kg)</i>															
Buying price	568.95 (206.5)	453.89 (67.4)	873.53 (122.6)	511.70 (175.2)	427.2 5	818.42 (109.6)	705.8 6	535.6 3	915.38 (71.8)	721.43 (281.1)	560.00 (41.8)	1125.0 (106.1)	47.8***	482.2***	5.3***
Selling price	670.29 (222.4)	549.07 (71.5)	991.18 (156.4)	611.45 (176.9)	526.9 3	918.42 (107.0)	794.8 3	596.8 8	1038.4 (110.2)	894.04 (344.4)	701.66 (90.2)	1375.0 (176.8)	55.2***	453.1***	9.7***
<i>Marketing costs (CFA/kg)</i>															
Transport cost to buy	10.61 (28.5)	13.56 (32.7)	2.79 (6.5)	6.72 (16.0)	7.38 (17.5)	4.31 (8.3)	24.47 (50.0)	43.54 (61.6)	1.00 (2.4)	2.11 (2.8)	2.95 (2.9)	0.00 (0.0)	4.3**	3.9**	5.8***
Transport cost to sell	14.91 (20.4)	16.13 (21.2)	11.67 (18.3)	16.29 (23.3)	17.03 (23.6)	13.62 (22.5)	10.04 (8.5)	13.59 (10.2)	5.66 (0.4)	17.63 (14.4)	11.83 (5.2)	32.15 (23.3)	1.22	0.21	1.14
Storage cost	2.32 (5.7)	2.29 (2.4)	2.39 (2.1)	2.05 (6.3)	2.08 (7.1)	1.91 (2.1)	1.88 (2.4)	1.07 (2.4)	2.88 (2.2)	7.5 (5.8)	9.00 (6.3)	3.75 (1.8)	1.6+	0.4	1.0
Sort cost	1.69 (2.7)	1.13 (2.4)	3.18 (3.0)	1.57 (2.6)	1.04 (2.3)	3.47 (3.0)	2.07 (2.9)	1.13 (2.4)	3.23 (3.1)	1.71 (2.9)	2.40 (3.3)	0.00 (0.0)	0.4	0.8	2.3*
Hired labour cost	18.94 (30.6)	16.87 (26.1)	24.43 (40.3)	17.77 (28.5)	19.27 (28.7)	12.33 (27.8)	21.05 (36.6)	9.04 (12.3)	35.84 (50.1)	24.88 (33.2)	8.77 (6.9)	65.14 (43.6)	1.6	7.2***	5.2***
Other expenses	8.07 (10.6)	8.12 (9.3)	7.93 (13.5)	8.23 (11.2)	8.25 (9.7)	8.17 (15.8)	6.41 (8.6)	5.69 (6.8)	7.30 (10.6)	12.83 (9.6)	14.07 (9.6)	9.74 (12.2)	0.7	0.1	0.2
<i>Margins (CFA/kg)</i>															
Gross margin	101.34 (60.8)	95.18 (58.4)	117.65 (65.0)	99.75 (53.1)	99.68 (56.2)	100.00 (40.8)	88.97 (60.5)	61.25 (28.5)	123.08 (72.5)	172.61 (105.9)	141.66 (106.7)	250.00 (70.7)	8.5***	10.2***	4.6**
Net margin	55.42 (55.5)	50.64 (53.1)	68.06 (60.5)	53.84 (50.7)	52.00 (52.8)	60.50 (43.0)	47.51 (53.2)	30.73 (32.9)	68.16 (66.5)	108.06 (95.6)	95.60 (85.3)	139.24 (151.6)	3.8**	3.0*	0.8

Note: Mean values are given and their corresponding standard deviations are indicated in parentheses Equality test is the ANOVA.

Significance: *** for 1%; ** for 5%, * for 10%, + for 15%

The different categories of traders are significantly different in characteristics of their transactions including quantities, prices and costs. Traders of gum arabic in the Sylvopastoral zone (SPZ) are significantly different from traders in Eastern Senegal (ES) in quantities (the total quantity and the average quantity per each transaction are higher in SPZ than in ES); buying and selling prices (gum traders in SPZ buy and in turn sell gum at lower prices than traders in ES; and price variations in ES are larger compared to SPZ which could also be due to the fewer number of traders interviewed in ES); unit transport cost to buying within regions (traders in SPZ have a higher cost of transportation per unit to the buying villages and markets than traders in ES); labour cost per unit (traders in SPZ have a lower labour cost per unit than traders in ES); and margins (traders in SPZ have lower gross and net margins than traders in ES).

The above differences across the zones can be explained by the differences in the magnitude of gum collection activities and the nature of gum businesses. Collection of gum has been done in the Sylvopastoral zone for several centuries (Webb, 1985). This zone is easily accessible from Dakar, its main town Linguère is about 260 kilometres from Dakar with a well-built off-season road infrastructure. The cities situated along the road from Linguère to Dakar are also important transaction points for gum trade such as Dahra and Touba where most wholesalers and some exporters are found.

Collection of gum is a recent activity in Eastern Senegal, undertaken following the raised awareness that the region has enormous potential in terms of the presence and productivity of *Acacia senegal* trees (DEFCCS, 2005). However, collection is still done at a very small scale and small quantities are obtained by harvesters. Furthermore, the region is landlocked, situated at about 600 kilometres from Dakar and without proper road infrastructure⁵. Apart from EXPERNA (an association of gum collectors), the other large

⁵ The road stretching from the city of Kaolack to Tambacounda (280 kilometres) was only constructed in 2008-2009.

traders operating in ES are found in markets in Bakel and Goudiry. These traders transact with large wholesalers found in the region or in Kaolack.

The presence of EXPERNA seems to lead to higher prices in the region compared to the Sylvopastoral zone because the association bargains better conditions directly with exporters or foreign companies. Traders are forced to match the EXPERNA prices whereas the lack of organisation in SPZ leaves collectors dependent on traders in terms of prices.

Significant differences are also observed within categories of traders across regions with respect to the quantities traded, prices, costs and margins. Figure 2 compares prices, costs and margins for the different categories of traders in the gum production zones.

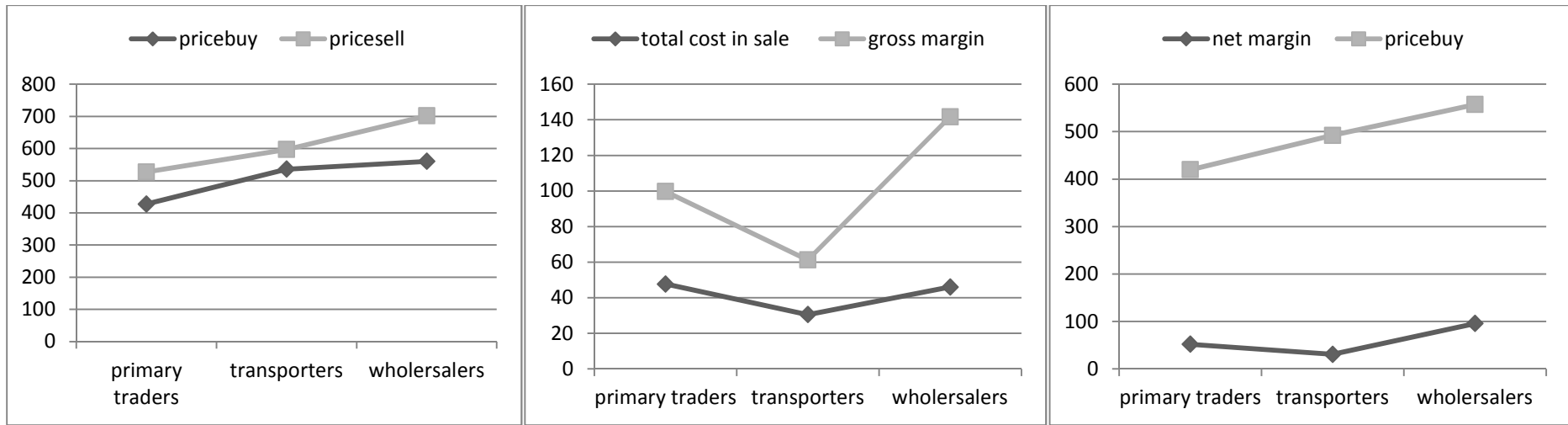


Figure 2a. Prices, costs and margins per categories of traders in the Sylvopastoral Zone

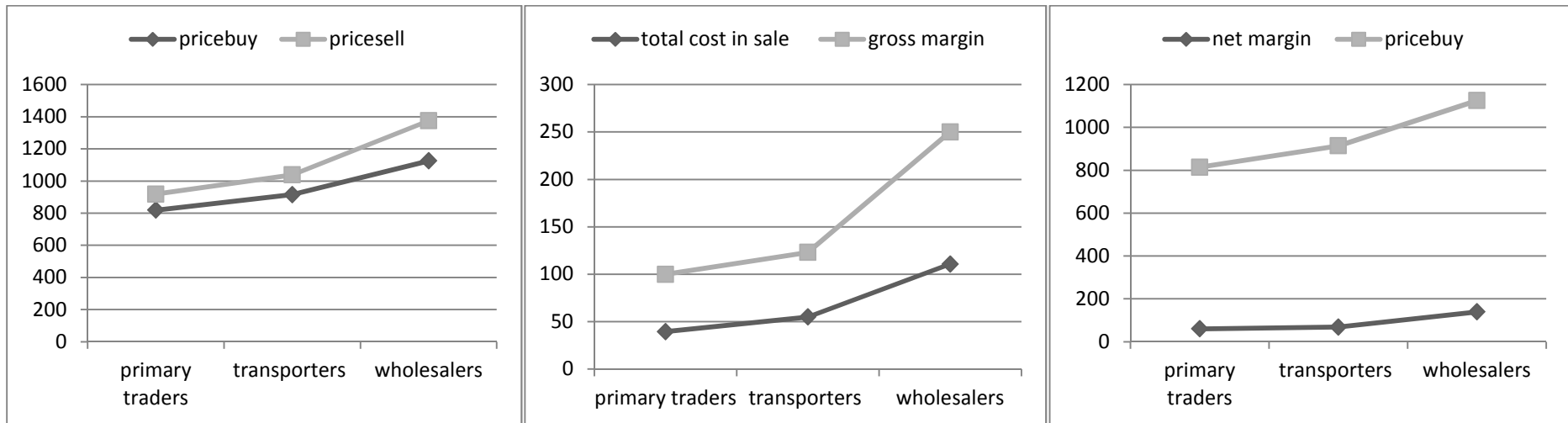


Figure 2b. Prices, costs and margins per categories of traders in Eastern Senegal

In SPZ, the buy and sell prices (and) increase from one category of trader to another. Moreover, transporters buy at the selling price of primary traders; but on average, wholesalers can buy at a price slightly lower than the selling price of transporters. As the quantity increases, the gross margin (-) would normally increase and the costs reduce because of economies of scale. The gross margins are lowest for transporters, but so are also their total costs. This enables them to earn a sufficient a margin that is proportionate to the value added. Wholesalers, who have total costs that are almost the same as those of primary traders, have the largest margins.

A comparison of the net margins and the buying price (p_b) shows that on average p_b shifts upward along the different categories of traders and the net margins also increase except for transporters whose net margin is lower.

In Eastern Senegal, the buying and selling prices vary in the same direction from one category of trader to another, and wholesalers can buy at a price slightly higher than the average selling price of transporters. We observe that the total costs and gross margins also increase consecutively for the different categories of traders. However the gross margins are largest for wholesalers. A comparison between the buying price and net margins shows that on average, the real buying price and net margins increase throughout for different categories of traders.

On the market share and Herfindahl index

According to theory, it is expected that traders who operate in oligopsonistic markets acquire gum arabic at a price below the competitive market price. To investigate the presence of oligopsonistic tendencies, market shares for individual traders and the Herfindahl index (H) were calculated following equations (7) to (10) (Table 3 and disaggregated results for markets in Table T1 in appendix).

Table 3. Average individual shares and normalised Herfindahl indices in gum markets^a

	Number of markets	Number of traders	Mean individual share (percentage)	Normalised Herfindahl index
<i>All traders</i>				
All markets	30	124	14.3(12.05)	0.130 (0.12)
Primary traders	21	88	13.2 (11.31)	0.127 (0.14)
Transporters	7	29	16.4 (12.18)	0.135 (0.09)
Wholesalers	2	7	25.0 (19.37)	0.148 (0.00)
<i>Sylvopastoral Zone</i>				
All markets	21	90	13.3 (11.02)	0.132 (0.14)
Primary traders	15	69	12.0 (9.88)	0.129 (0.15)
Transporters	5	16	18.1 (13.35)	0.139 (0.11)
Wholesalers	1	5	20.1 (17.20)	0.148
<i>Eastern Senegal</i>				
All markets	9	34	17.3 (14.42)	0.125 (0.08)
Primary traders	6	19	17.6 (14.83)	0.121 (0.10)
Transporters	2	13	13.3 (9.39)	0.125 (0.03)
Wholesalers	1	2	33.3 (23.57)	0.148

^a Mean values are given and their corresponding standard deviations are indicated in parentheses.

The shares of individual traders and Herfindahl index of market power vary between markets; while some markets display competitive tendencies, other markets display (strong) oligopsonistic features.

A comparison between the Sylvopastoral zone and Eastern Senegal shows that the average market share of traders in the SPZ is lower than that of traders in ES. Furthermore, the average individual shares of traders are lower in SPZ than in ES except for transporters. The average Herfindahl index of markets in the SPZ is higher than that of markets in ES because this normalised index adjusts for the number of traders which is smaller in ES than in SPZ. Furthermore, the average Herfindahl indices in primary traders' and transporters' markets are higher in SPZ than in ES, while the average Herfindahl index of wholesalers is the same in both regions. As on average the indices are low, we observe the presence of competition or at the most, moderate concentration. In both regions, the Herfindahl index increases as trading of gum moves along the supply chain: it is lowest in primary markets and

highest in wholesale market. This situation is realistic because the move along the chain is associated with fewer and fewer buyers, with relatively ‘stronger’ (oligopsony) power.

In sum, the computations of market power revealed that on average there are no or at the most low oligopsonist tendencies. Yet, it remains important to investigate factors that might influence this market power through the distribution of individual shares of traders.

Individual shares of trader in a market

Market shares express the relative size of the trader’s transactions; these shares vary in accordance to several factors including the market size and the number of buyers. However, the question arises as to why there are wide differences in the computed shares, implying that besides the market size and the number of buyers there are other factors at play. These factors are grouped into trader characteristics and market characteristics (Tables 4 and 5).

Table 4. Descriptive statistics of trader characteristics influencing market share^a

	All traders			Primary traders			Transporters			Wholesalers			Equality test ^b		
	Senegal (124)	SPZ (90)	ES (34)	Senegal (88)	SPZ (69)	ES (19)	Senegal (29)	SPZ (16)	ES (13)	Senegal (7)	SPZ (5)	ES (2)	Trader	Region	Region X category
Education (1: formal education)	0.68 (0.04)	0.61 (0.05)	0.85 (0.06)	0.69 (0.05)	0.61 (0.06)	1 (0.00)	0.62 (0.09)	0.63 (0.12)	0.62 (0.14)	0.71 (0.18)	0.60 (0.24)	1 (0.00)	0.6	6.6***	12.1**
Experience in gum business years)	13.0 (9.15)	16.0 (8.63)	4.9 (4.45)	13.2 (9.37)	15.8 (8.88)	3.7 (2.56)	15.0 (1.29)	16.7 (7.44)	6.7 (6.26)	13.4 (10.06)	16.6 (10.38)	5.5 (0.71)	0.6	19.9***	0.2
Wealth ('000000 CFA livestock value)	5.1 (4.70)	5.4 (4.42)	4.3 (5.37)	4.5 (4.11)	4.6 (3.84)	2.2 (5.06)	5.9 (5.52)	6.8 (4.89)	4.7 (6.24)	9.0 (6.33)	12.0 (4.44)	1.5 (2.18)	1.3+	8.9***	3.5**
Number of houses	1 (0.59)	1 (0.63)	1 (0.50)	1 (0.47)	1 (0.47)	1 (0.45)	2 (0.74)	2 (0.75)	1 (0.60)	2 (0.90)	2 (0.84)	1 (0.00)	3.5**	11.2	6.0***
Family relatives in gum business (persons)	1 (1.06)	1 (1.08)	0 (0.29)	1 (1.13)	1 (1.12)	0 (0.23)	1 (0.86)	1 (0.97)	0 (0.38)	1 (0.53)	1 (0.45)	0 (0.00)	0.4	10.9***	0.7
Languages spoken (language)	2 (0.75)	1 (1.08)	2 (0.63)	2 (0.72)	2 (0.73)	2 (0.71)	2 (0.67)	2 (0.77)	2 (0.48)	3 (0.90)	3 (1.09)	3 (0.00)	4.5**	0.1	0.6
Possession of telephone (1: owns a phone)	0.65 (0.04)	0.66 (0.05)	0.62 (0.08)	0.64 (0.05)	0.61 (0.06)	0.74 (0.10)	0.59 (0.09)	0.75 (0.11)	0.38 (0.14)	1 (0.00)	1 (0.00)	1 (0.00)	4.3*	0.2	9.6*
Operation area (markets)	3 (1.93)	3 (1.97)	2 (1.77)	2 (1.61)	3 (1.64)	2 (1.49)	3 (2.18)	3 (2.30)	2 (2.11)	1 (1.29)	1 (1.74)	1 (0.00)	4.3**	0.6+	0.4

^a Mean values are given and their corresponding standard deviations or standard errors are indicated in parentheses respectively for continuous variables or categorical variables.

^b Equality test refers to two-way ANOVA test for continuous variables or Chi-square test for categorical variables.

Significance: *** for 1%; ** for 5%, * for 10%, + for 15%.

Table 5. Descriptive statistics of market characteristics influencing market share^a

	All markets			Primary			Transporting			Wholesale			Equality test ^b		
	Senegal (30)	SPZ (21)	ES (9)	Senegal (21)	SPZ (15)	ES (6)	Senegal (7)	SPZ (5)	ES (2)	Senegal (2)	SPZ (1)	ES (1)	Trader Category	Region	Region X category
Market size (ton)	34.0 (68.54)	42.5 (78.70)	11.5 (9.53)	16.8 (11.29)	20.4 (10.02)	3.6 (1.13)	30.2 (17.90)	38.5 (40.88)	20 (0.00)	266.3 (160.05)	360.0	32.0	778.2***	1283.8***	570.7***
Buyers (persons)	7 (2.15)	7 (2.09)	7 (2.34)	8 (2.13)	8 (1.90)	7 (2.85)	6 (1.86)	6 (2.50)	7 (0.00)	4 (0.98)	5	3	8.3***	0.6	1.2
Distance to nearest town (km)	54.1 (50.93)	63.3 (51.25)	29.8 (41.80)	64.7 (54.74)	73.6 (52.89)	32.4 (50.14)	33.0 (25.24)	38.4 (20.47)	26.3 (29.58)	8.1 (21.54)	0	285	3.2**	0.3+	2.1+
Distance to Dakar (km)	420.9 (130.45)	351.3 (62.09)	605.5 (68.60)	413.5 (119.57)	360.9 (64.87)	604.8 (62.77)	461.7 (149.57)	338.4 (20.47)	613.5 (80.43)	345.7 (147.41)	260	560.0	3.7**	197.2***	1.0
Storage (1: available)	0.38 (0.04)	0.40 (0.05)	0.32 (0.08)	0.41 (0.05)	0.38 (0.06)	0.53 (0.12)	0.17 (0.07)	0.31 (0.12)	0.00 (0.00)	0.86 (0.14)	1	0.50	12.4***	0.6	18.3***

^a Mean values are given and their corresponding standard deviations or standard errors are indicated in parentheses respectively for continuous variables or categorical variables.

^b Equality test refers to two-way ANOVA test for continuous variables or Chi-square test for categorical variables.

Significance: *** for 1%; ** for 5%, * for 10%, + for 15%.

On average the proportion of traders who are educated is smaller in SPZ than in ES; not surprisingly traders in SPZ have longer experience in gum business than traders in ES; in terms of livestock values, traders in SPZ are wealthier than traders in ES; traders in SPZ have more relatives involved in gum business than traders in ES; and the area of operation of traders in the SPZ is larger than in ES.

There are also significant differences in characteristics of traders across different market type. For instance, in terms of livestock ownership value, primary traders are less wealthy especially compared to wholesalers. Primary traders have less relatives involved in the business; wholesalers speak on average 2 languages; the proportion of traders who own a telephone is smallest for transporters; and primary traders operate in most markets. Nevertheless, there are significant differences within categories of traders across regions with respect to education, wealth, house ownership and possession of telephone.

Furthermore, there are significant differences in market characteristics across the zones. Markets in the SPZ are larger as the average quantity transacted is higher than in ES; markets in the SPZ are nearer to Dakar than in ES; and markets in the ZSP are further from towns than in ES. There are also significant differences across market categories. For instance, primary markets are smallest and wholesale markets are largest in size; buyers are most numerous in primary markets and least numerous in wholesale markets; primary markets are located furthest from the town and wholesale markets are located nearest to town; and transporters buy in markets that are located furthest from Dakar. Furthermore, the lowest proportion of transporting markets have adequate storage. Market categories across regions differ with respect to market size, distance to nearest town and availability of adequate storage.

The influence of trader and market characteristics on the trader's individual share in the market are shown in table 6.

Table 6. Gllamm results for traders' market shares (percentage)^a

	All traders			Primary traders			Transporters		
	Senegal	SPZ	ES	Senegal	SPZ	ES	Senegal	SPZ	ES
Education (1: formal education)	3.033+ (2.301)	2.6481+ (2.398)	0.340 (6.273)	3.605+ (2.455)	3.844* (2.015)	0.038 (0.505)	-2.005 (3.922)	16.391** (8.235)	8.485*** (1.846)
Experience in gum business (years)	0.195** (0.107)	0.154* (0.116)	0.319 (0.261)	0.290*** (0.107)	0.263** (0.100)	1.420*** (0.411)	0.341+ (0.228)	0.995** (0.444)	0.333*** (0.121)
Wealth (log livestock value)	1.117+ (0.954)	0.198 (1.032)	3.387* (1.931)	2.310** (0.973)	1.611* (0.865)	7.358** (3.151)	-0.643 (1.860)	0.350 (3.083)	1.882** (0.975)
Number of houses (houses)	1.259 (1.954)	3.415* (2.167)	-1.710 (4.598)	3.762+ (2.484)	3.626+ (2.322)	3.283 (6.356)	4.434+ (3.006)	8.762* (4.485)	3.646** (1.964)
Family relatives in gum business (persons)	0.198 (1.222)	0.325 (1.080)	0.728 (6.931)	1.315* (1.063)	1.270+ (0.881)	2.304* (12.978)	-2.900 (2.771)	6.112+ (3.912)	2.825 (2.433)
Languages spoken (language)	5.475*** (1.500)	5.478*** (1.520)	6.445+ (4.634)	7.154*** (1.516)	7.075*** (1.322)	-4.635 (6.868)	0.237 (2.979)	2.450 (3.939)	13.277*** (3.216)
Possession of a telephone (1: owns a phone)	6.321*** (2.014)	4.714** (2.117)	10.465* (5.732)	4.444** (2.050)	4.621** (1.783)	8.987*** (9.526)	10.397*** (3.228)	6.891* (4.277)	3.034+ (2.760)
Area of operation (markets)	0.070 (0.502)	0.104+ (0.514)	1.709+ (1.663)	1.112** (0.503)	1.405*** (0.335)	0.316 (2.103)	0.222 (0.754)	-0.871 (2.001)	0.235 (0.913)
Market size (ton)	-0.023 (0.017)	-0.021 (0.017)	0.158 (0.284)	0.313** (0.133)	0.278+ (0.117)	5.685* (3.274)	0.143+ (0.121)	0.138+ (0.138)	-0.025 (0.402)
Buyers (persons)	-0.980** (0.479)	-0.762+ (0.535)	-0.101 (1.488)	-1.261** (0.504)	-1.298** (0.539)	-0.936 (1.701)	-1.117* (1.158)	-0.340 (1.484)	-0.004 (0.867)
Distance to nearest town (km)	0.049* (0.029)	0.033 (0.081)	0.171* (0.081)	0.093*** (0.034)	0.059 (0.069)	0.429* (0.980)	0.232** (0.103)	0.382 (1.327)	0.002 (0.343)
Distance to Dakar (km)	-0.048** (0.022)	-0.045 (0.067)	-0.011 (0.049)	-0.071*** (0.026)	-0.047 (0.055)	0.158* (0.092)	0.155*** (0.055)	0.002 (0.613)	0.030 (2.621)

Storage (1:available storage)	5.529*	2.266*	8.877*	1.876	3.327+	14.959**	0.205	6.056	5.924***
	(2.355)	(2.725)	(4.302)	(2.631)	(2.590)	(6.151)	(3.798)	(6.498)	(2.070)
Zone (1:ES)	18.390***			28.266***			-34.015**		
	(6.914)			(9.172)			(14.834)		
Constant	-4.206	12.824	-56.530	-8.296	-3.065	-235.580	-56.018*	-44.812	65.900
	(16.618)	(24.333)	(56.203)	(17.141)	(20.116)	(50.545)	(33.858)	(18.398)	(16.726)
F	3.39***	2.53***	1.80+	4.68***	3.84***	1.54+	1.47*	0.83+	2.18+
Adjusted R-squared	0.202	0.171	0.225	0.355	0.334	0.248	0.179	0.138	0.470
Number of traders	124	90	34	88	69	19	29	16	13
Number of markets	30	21	9	21	15	6	7	5	2
Variance at traders' level	108.708	90.573	103.349	78.789	50.862	82.586	55.660	56.803	5.309
	(13.809)	(13.502)	(25.071)	(11.879)	(8.659)	(26.795)	(14.619)	(20.058)	(2.082)
Variance at market level	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.0001)	(0.000)	(0.0001)	(0.0001)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)

^a Standard errors are in parentheses.

Significance: *** for 1%; ** for 5%, * for 10%, + for 15%

The results show a large variance at the traders' level but a close to zero variance at the market level. Pooled over all types of traders, the market share of an individual trader is positively influenced in a significant way by education, experience in gum business, wealth in livestock value, knowledge of languages and possession of a telephone that is used to gather market information; these possibly refer to communication and negotiation skills. A large number of buyers operating in a market has a negative effect on the individual market share. Traders' individual market shares evolve with increased physical distance of the market from the town, and better availability of storage facilities. But the longer the physical distance of the market from Dakar, the smaller is the trader's individual market share; this would be the effect of primary markets in SPZ. Furthermore, the regional dummy indicates that individual market shares in Eastern Senegal are larger than shares in the SPZ.

Specifically for traders in SPZ, the individual market share is positively influenced by education, experience in gum business, his wealth in number of houses possessed, knowledge of languages, possession of a telephone that is used to gather the market information, and area of operation. The lower the number of buyers who operate in a market and the better the availability of storage facilities in a market, the larger would be the trader's individual market share. Specifically for traders in ES, the individual market share is positively influenced by wealth in value of livestock owned, knowledge of languages and possession of a telephone that is used to gather the market information, and the area of operation. The longer the distance to the nearest town, the larger would be the trader's individual market share.

Variables that have a positive influence on the market share of an individual traders in primary markets are education, experience in gum business, and access to funds as represented by the wealth in livestock value owned and house possessed, family network in business, knowledge of languages, possession of a telephone, area of operation, size of the market and distance to nearest town. The variables that have a negative influence are the

number of buyers who operate in a market and distance of the market from Dakar. Furthermore, the regional dummy indicates that individual market shares in ES are larger than shares in the SPZ in primary markets. Within these primary markets, the influential determinants may differ in the SPZ than ES.

Variables that have a positive influence on the market share of an individual traders in transport markets are experience in gum business, access to funds as represented by the houses possessed, knowledge of languages, possession of a telephone that is used to gather the market information, the size of the market, distance to nearest town, distance to Dakar and availability of storage. The number of buyers who operate in a market has a negative influence on the market share. Furthermore, the regional dummy indicates that individual market shares in ES are smaller than shares in the SPZ in transport markets. Also within these transport markets, the influential determinants differ between the SPZ and ES.

The significant influence of variables vary within markets or zones, and even if data set was not large enough to elicit the determinants of wholesalers' market shares, the results above enable us to substantiate that all in all there is positive influence of education and business experience of the trader (these factors can be designated as human capital); access to funds represented by ownership of livestock or houses (financial capital); the network of relatives who are also involved in gum business (social capital); information accessibility represented by the number of languages spoken and telephone ownership (communication capital); and area of operation (physical capital). Market characteristics such as market size and availability of storage have a positive impact on the individual market shares whereas competition over transactions indicated by the number of buyers reduces the market share. If the market is physically located far away from town, it might attract only a few buyers and hence lead to large individual shares in the market. Primary traders who are located nearer to Dakar have larger individual market shares. Transporters who are located further away from

Dakar have larger individual market shares. The latter can be explained by the function of transporters.

Interpretation on the accession to gum arabic markets

The relatively low levels of concentration of market power observed in gum arabic markets might be an indication of free entry in these markets. However, in some markets high entry requirements are set implying that there may be barriers restricting market accession and expansion within the market or expansion of the area of operation. Such barriers determine not only the structure of the market but also the performance of the market actors. Here, we re-interpret determinants of the market share distribution in terms of factors influencing market accession bearing in mind that the importance of such factors varies along stages of the gum supply chain.

Market accession may be influenced by access to capital: (1) human capital: while education might be or not always be important in starting a gum business, at least some experience in general business is a prerequisite as an indication of the skills to transact in gum markets; (2) financial capital: with difficulties to access credit especially in rural areas, the backup of own (old) capital is needed to start or expand the business; (3) social capital: most gum business are families directly or indirectly supported by a system of networks of family relatives. These networks serve not only the purpose of information provider but can also act as transaction partners; (4) communication capital: information systems play an important role in determinant market shares. Such information systems pertain to the markets, prices and gum-transaction related conditions. and (5) physical capital. Other influences of market accession may include geographical barriers reflected by distances to towns or Dakar. These barriers imply that there are high transport costs which are intensified by missing roads or the generally bad conditions of rural roads. As the gum producers are dispersed, extending the area of operation may be very difficult for a trader. Furthermore, legal requirements must be

fulfilled in order to start and register the business in terms of start-up capital and further fiscal duties (AEPC, 2007). These requirements may be difficult to achieve for individuals and even companies.

Marketing margins

Computations of the market power revealed no or at the most low oligopsonist tendencies. This would imply that little evidence is found for oligopsonistic margins while determining their buying prices. We explored, at the market level, whether the margins observed are associated with market power and found no correlation between the margins and market power.

The net margins as proportions of selling price are 17.3, 9.6 and 18.5 per cent in primary, transporting and wholesale markets respectively. The above margins were compared to margins earned in other markets for agricultural inputs or products, or for non-timber forest products. For instance, in the yellow maize market of Mozambique, Zucula and Massinga (1993) found that net margins ranged from 8.3 to 19 per cent of the total price for the retailers; in the fertilizer market in Uganda, Omamo (2003) found that retail margins ranged from 5 (in Bukedea) to 28 per cent (in Kabale); in the market of non-timber forests in Cameroon, Ndoye et al. (1998) found that the marketing margins obtained by traders varied between 16 per cent for African pear (*Dacryodes edulis*) and 30 per cent for wild mangoes (*Irvingia spp.*) of the value of sales; in the market of frankincense in Tigray, Kassa et al. (2011) found that the wholesalers earned marketing margins of 41.1 per cent and 31.4 per cent in 2007 and 2010 respectively. This comparison implies that the margins earned by traders in the gum arabic sector are not as excessive as in the comparison cases, and these traders might hence not just be labelled as exploitative.

Even if the exercise of market power by buyers could not be confirmed, the question remains as to why these margins are large, at least in some markets, even larger in comparison

to the costs involved in trade. The reason might be that these margins depend on the supply conditions prevailing in the market but also on the need to cover for the uncertainty associated with volatility in the gum price or quality variations and the risk involved in trade either at the individual or market level. We investigate the influence of such sale costs, price uncertainty and risk on the gross margins. Table 7 presents these factors' descriptive statistics. A Breusch-Pagan test for heteroskedasticity rejected the null hypothesis of constant variance ($\chi^2(1) = 15.13^{***}$); the weighted least square regression is used to correct for this heteroskedasticity, analytical weights are used with the total cost as the weight variable (the weight is equal to inverse of squared total costs). Table 8 presents the regression results for determining the gross margins.

Table 7. Descriptive statistics of trade characteristics influencing gross margins^a

	All traders			Primary traders			Transporters			Wholesalers			Equality test ^c		
	Senegal (124)	SPZ (90)	ES (34)	Senegal (88)	SPZ (69)	ES (19)	Senegal (29)	SPZ (16)	ES (13)	Senegal (7)	SPZ (5)	ES (2)	Categor y	Region	Region X
Gross margin (CFA/kg)	101.34 (60.85)	95.18 (58.40)	117.65 (65.00)	99.75 (53.09)	99.68 (56.25)	100.00 (40.82)	88.97 (60.55)	61.25 (28.49)	123.08 (72.50)	172.61 (105.93)	141.66 (106.72)	250.00 (70.71)	8.5***	10.2***	4.6**
Total marketing costs (CFA/kg)	45.62 (39.73)	44.54 (35.86)	49.59 (48.95)	45.91 (37.66)	47.68 (39.17)	39.50 (31.68)	41.46 (43.27)	30.52 (15.30)	54.92 (61.00)	64.55 (50.54)	46.06 (26.44)	110.76 (80.92)	2.2+	4.7**	3.4**
Distance to sell (km)	47.7 (83.36)	43.0 (64.08)	60.0 (120.9)	46.6 (89.54)	33.7 (58.30)	93.3 (151.6)	32.3 (42.29)	52.9 (43.92)	4.5 (15.76)	124.7 (98.85)	132.6 (119.47)	105.0 (21.21)	3.7**	0.1	5.0***
Price uncertainty (CFA/kg) ^b	-13.77 131.45)	-13.77 136.30)	32.69 (119.6)	-13.77 (109.8)	-13.77 (102.4)	50.00 (136.4)	-34.61 (191.7)	-21.87 (243.9)	-34.61 (106.8)	0.00 (89.44)	70.00 (109.54)	0.00 (0.00)	1.2	0.3	3.1
Idiosyncratic risk (1:recognised)	0.56 (0.50)	0.69 (0.46)	0.21 (0.41)	0.59 (0.49)	0.70 (0.46)	0.21 (0.42)	0.41 (0.50)	0.62 (0.50)	0.15 (0.37)	0.71 (0.49)	0.80 (0.45)	0.50 (0.71)	3.5+	23.3***	24.7***
Systemic market risk (1:recognised)	0.52 (0.50)	0.51 (0.50)	0.56 (0.50)	0.46 (0.50)	0.46 (0.50)	0.47 (0.51)	0.76 (0.43)	0.81 (0.40)	0.69 (0.48)	0.29 (0.49)	0.20 (0.45)	0.50 (0.71)	9.2***	0.2	10.1*

^a Mean values are given and their corresponding standard deviations or standard errors are indicated in parentheses respectively for continuous variables or categorical variables.

^b Median value is given for the price uncertainty variable because the mean value is 0.

^c Equality test refers to two-way ANOVA test for continuous variables or Chi-square test for categorical variables.

Significance: *** for 1%; ** for 5%, * for 10%, + for 15%.

Table 8. Weighted least square regression results for traders' gross margins (CFA/kg)^a

	All traders		Primary traders		Transporters	
	Senegal (124)	SPZ (90)	ES (34)	Senegal (88)	SPZ (69)	Senegal (29)
Total costs	1.060*** (0.314)	1.202*** (0.389)	0.774+ (0.632)	1.112*** (0.415)	1.120*** (0.536)	-0.187 (2.104)
Total costs squared/200	-0.412* (0.327)	-0.670* (0.451)	-0.082 (0.558)	-0.652*** (0.595)	-0.721** (0.815)	0.559 (5.495)
Distance to sell (km)	0.109+ (0.077)	0.143** (0.094)	0.033+ (0.057)	0.037+ (0.041)	0.072+ (0.108)	0.631*** (0.182)
Price uncertainty (CFA/kg)	0.015 (0.036)	0.036+ (0.041)	-0.024 (0.132)	-0.016 (0.056)	-0.000 (0.071)	0.033+ (0.039)
Idiosyncratic market risk (1:recognised)	25.733** (12.950)	18.305+ (14.240)	31.842 (45.628)	33.141** (16.378)	32.394* (19.356)	5.395 (20.025)
Systemic market risk (1:recognised)	27.111** (11.031)	14.298+ (13.879)	41.841* (22.771)	30.211** (13.918)	30.832* (17.872)	21.760+ (23.559)
Zone (1:ES)	29.567** (13.717)			18.845+ (13.640)		88.514*** (25.189)
Constant	18.363* (17.592)	25.734 (21.323)	49.290* (29.459)	20.708 (21.950)	16.992 (27.566)	8.058 (50.681)
F	5.47***	3.00***	3.16***	4.05***	3.54***	3.95***
R-squared	0.315	0.286	0.397	0.307	0.309	0.583

^aAnalytical weights are used. The weight variable is the total costs.

Robust standard errors with corrected heteroskedasticity are in parentheses.

Significance: *** for 1%; ** for 5%, * for 10%, + for 15%

As mentioned above, traders in ES earn a higher gross margin than traders in SPZ; the gross margin is highest for wholesalers. The cost of selling gum is lower in SPZ than in ES, while the concern for individual risk is indicated by a higher proportion of traders in SPZ than in ES, and the concern for market risks is more pronounced among traders in ES.

There are also significant differences in characteristics of trade across different market types. For instance, transporters have the lowest cost of selling gum especially compared to wholesalers; the distance to sell is lowest among transporters and highest among wholesalers; the proportion of traders who indicated concern for individual risk is lowest with transporters and highest with wholesalers; and the proportion of traders who indicated concern for market risk is highest with transporters and lowest with wholesalers. Furthermore, there are significant differences within categories of traders across regions with respect to cost of selling gum, distance to sell, and concerns for individual and market risk.

In general and specifically in SPZ, the gross margin will increase with price uncertainty, distance to sale place and concerns for individual and market risk. The gross margin also increases with the costs however at decreasing rate. In ES, larger margins are typically retained than in SPZ. Specifically in ES, longer distance to sale and higher concerns for individual and market risk significantly increase the need for retaining larger margins.

Gross margins for traders in primary markets and specifically in SPZ are positively influenced by distance to sale, concerns for individual and market risk, and costs. Primary traders in ES retain larger margins; the most influential factor for these traders is market risk.

Gross margins for transporters are positively influenced by the distance to sale, price uncertainty, and concerns for individual risk. These margins are a decreasing function of cost involved in selling. In the SPZ, the significant variables influencing gross margins are price uncertainty, distance to sale, and concerns for individual and market risk. Transporters in ES

retain larger margins; the most influential factors for these traders are the distance to sale, and concerns for market risk.

Influential factors could not be determined for wholesalers. However, the analysis suggests that gum traders retain margins due to high marketing costs, long distances to sale, high price uncertainty, and higher perception of idiosyncratic and systemic market risk. According to the traders during the interviews, marketing costs in the gum arabic are high due poor infrastructure and inefficient transport system, and lack of market information. Trade in markets involves a lot of price uncertainty and high risks especially in terms of regularity of supply that can be associated with production failure, finding a market, and inability or high costs of enforcing contract. These factors make trade in gum arabic not only costly but also very risky and due to risk averseness, traders retain higher margins.

Interpretation on the exit from gum arabic markets

We did not interview traders who withdrew from gum trade. However, the analysis of factors influencing the traders' margins enables us to reflect on potential causes of exit of traders from gum arabic markets. Therefore, we re-interpret the determinants of the gross margins in terms of factors influencing market exit bearing in mind that the importance of such factors varies along stages of the gum supply chain.

Market exit results from the unprofitability of business: for the pooled data, the fixed cost was estimated at 45 CFA per kilogram of gum arabic bought (less than 10 per cent of the buying price); hence it is not excessively high to drive a trader out of business. The infrastructural problem as reflected by the distance and the uncertainty could lay some strain on the trader's profitability; and the importance of risk is certainly noticeable. In the systemic context, supply shortages may be the main causes of exit: if there are recurrent production failures, traders may move out of the gum arabic sector and invest their time and money elsewhere; the low production levels implying large variable costs may cause losses to traders

especially if they cannot negotiate higher selling prices. On an individual level, the risk of contract defaulting is important especially at the primary trading level: a trader who has offered commodities or funds to be reimbursed by the supply of gum in an interlocked system is often deceived by the collector who side-sells his product to another buyer (DEFCCS, 2005). Such repetitive defaults may seriously jeopardize the trader's profitability as he may even need to incur some cost to enforce the contract if at all he wants to stay in business.

5. Discussion and conclusions

This study investigates the behaviour and performance of gum traders in the oligopsonistic market for gum arabic in Senegal. Oligopsonic markets are characterised by a small number of buyers who face a relatively larger number of sellers; this is a situation that is often observed in the marketing of raw agricultural or forest products in developing regions and specially in the rural areas where accessibility to the production zones, high transaction costs and various other barriers significantly restrict entry and expansion of traders. Institutions such as associations/cooperatives or contracts which could change the structure of markets in such a way that buyers and sellers get equivalent market power, are often missing in these areas. Oligopoly markets for the supply of consumable products have received attention; however, despite that the oligopsonist situation is commonly observed on the production side, it seemed not to have caught the interest of researchers who at times merely confirmed the common belief that traders are exploitative. Such idea of exploitation is usually associated with the fact that even in markets where traders could act competitively, they would choose to collude or excessively exert their market power in order to bring down the price.

As oligopsonies are observed at the consecutive levels of the supply chain, the tendencies to drive-down the buying price result in lowering the transaction volumes and total margins of the chain. These tendencies hence cause a double/multiple marginalisation problem. Furthermore, a formal profit maximisation model shows that a firm involved in

oligopsony markets is directly linked to the actions of the competitors and suppliers. These principles form the theoretical basis for the current study.

After classifying traders in the gum business into primary traders, transporters and wholesalers, we found that these categories of traders are significantly different in the characteristics of their transactions. A comparison of buying and selling prices, various marketing costs and derived margins show that the wholesalers earn the highest margins along the gum supply chain while the transporters earn the lowest margins. Wholesalers benefit from the wide deviations between the buying and selling price, and hence earn high gross margins. Furthermore, as the wholesalers transact with large quantities, their unit costs remain relative low which lead them to even higher net margins. This cost situation remains a problem to the business of primary traders because even if they can earn large margins, transacting small quantities entails high unit costs which lead them to low net margins and little payment to gum collectors. More specifically, this may explain the slow market development in Eastern Senegal: because of low production capacity in region, the unit cost remains high for all categories of traders specially in terms of labour and transport as the region is also constrained by problems of accessibility and remoteness. Fafchamps and Gabre-Madhin (2006) and Kwoka (1977) also found that the larger traders or firms can earn higher margins. The same conclusion also applies by considering the buying circumstances: primary traders need to get their supplies in visiting dispersed villages with scattered collectors that each sell small quantities, transporters need to visit several markets in the production zones to obtain gum from the primary traders, and wholesalers just generally remain established in their own shops and are supplied by transporters, hence with lower marketing costs and risks.

Investigations of whether the performance of the traders was driven by their relative power in the market started with the calculation of the market shares of traders and the Herfindahl index. Within the markets, there are variations in the shares of individual traders

and between markets there are variations in the values of the Herfindahl index. These values generally increase from primary traders to transporters and wholesalers implying that the upward move along the chain leads to higher market power and stronger oligopsonistic tendencies. We found that the share of a trader in a market is influenced by several factors that can be grouped into the elements of capital: human capital (experience in business and the possibility to communicate); financial capital (possibility to make available funds to be used in trade); physical capital (area of operation); and social capital (a network of relatives involved in business who can act as source of information and knowledge, and possibly as transaction partners). Fafchamps (1996, 1999, 2002, 2006), Fafchamps and Minten (2000) and Fafchamps and Gabre-Madhin (2006) had also found that traders rely extensively on such networks as relationships increase trust by granting and receiving credit, exchanging price information, and economizing on quality inspection thereby reducing transactions costs and increasing trading margins. At market level, its size and the availability of storage increase the trader's individual market share whereas competition over transactions indicated by the number of buyers reduces the market share. While this share can be increased by expansion of trading area, barriers due to capital constraints and the legal framework may be significant. Capital and market factors could also be the main cause of market accession.

Computations of market power showed that there were no or very small oligopsonistic tendencies in the gum arabic market. Market power was not found to influence the margins earned by traders. Rather these margins seem to depend on the supply conditions, marketing costs, perception of price uncertainty and risk. According to Harris-White (1997) or Batt (2004), shortcomings associated with poor infrastructure and inefficient transport system, and lack of market information increase marketing costs. Brorsen et al. (1985), Schroeter and Azzam (1991) and Holt (1993) found that price uncertainty and risk indeed influence the marketing margins. The magnitude of risk could also be the main cause of market exit.

These findings imply that traders in the gum market, while working towards enlarging their supplies do not follow the oligopsonistic tendencies or exercise their power in an exploitative manner. Such exploitation on the seller would constrain supply and profits for the whole chain because the buying price is kept artificially low. Instead, the margins that traders keep are a reflection of the costs, uncertainty and risk that they face while conducting their trade. The study has therefore shown that traders are not necessarily exploitative in terms of using their market power towards producers in the primary markets or other traders in the intermediate or wholesale markets; they may pay a low price because they face risk and uncertainty, and high costs, especially if they are not able to exploit scale economies. In other words, the benefits that they could obtain from gum trading may be limited by poor market access conditions such as poor transportation conditions, lack of infrastructure and market information in addition to individual and market related risks. Our results show interesting similarities on the performance of rural money lenders who act as a source of informal rural credit. While they are often accused of being usurious by charging high interests, their returns can be justified by their methods of screening borrowers and enforcing repayment in the presence of imperfect information (Aleem, 1990; Hoff and Stiglitz, 1995). The study has also served to remind about the important functions of rural traders in general and of the gum traders in particular in regard to the gum sector despite the difficult marketing conditions.

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Appendix A.

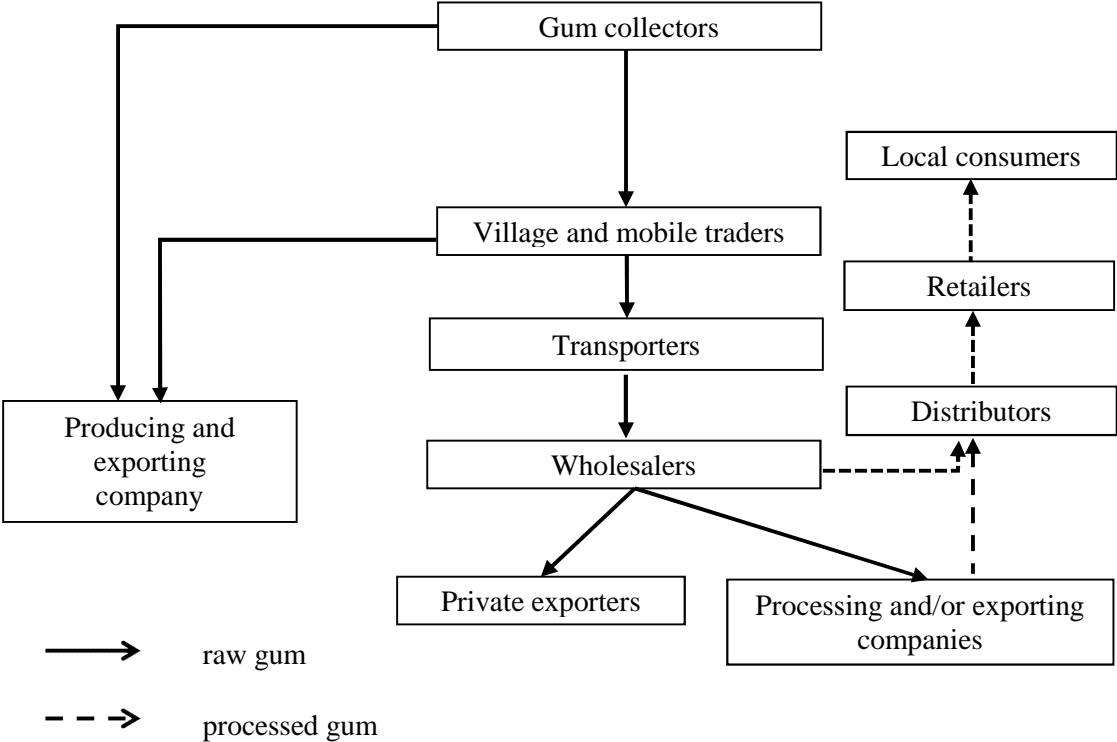


Figure F1. Supply chain of raw and processed gum arabic

Source: Sène and Ndione (2007), Ndione et al. (2001). (Edited)

Table T1. Average market share and Herfindahl index per market and category of trader^a

Market	Primary traders		Transporters		Wholesalers	
	Individual share (percentage)	Herfindahl index	Individual share (percentage)	Herfindahl index	Individual share (percentage)	Herfindahl Index
<i>Sylvo pastoral zone</i>						
Barkédji	10.0 (19.612)	0.590	10.9 (10.461)	0.142		
Dodji	12.5 (6.442)	0.080	25.0 (5.555)	0.018		
GuèyeKadar	16.7 (11.758)	0.166				
Kamb	20.0 (11.566)	0.094				
Linguère	14.3(5.735)	0.039	20.0 (14.789)	0.197		
Labgar	10.0 (10.886)	0.119	20.0 (9.577)	0.058		
Linde	12.5 (8.102)	0.053				
Louguéré Thioly	14.3 (6.552)	0.065				
Nakara	12.5 (6.665)	0.053				
Ndiayène Fouta	11.1 (4.689)	0.021				
Ranéro	11.1 (6.978)	0.062				
Thiel	10.0 (6.632)	0.044				
Vélingara	6.7 (2.801)	0.014	20.0(21.683)	0.281		
Widou	14.3 (10.132)	0.164				
Yaré Lao	16.7 (19.367)	0.372				
Dahra					20.1 (17.200)	0.148
<i>Average SPZ</i>	<i>12.0 (9.875)</i>	<i>0.129(0.155)</i>	<i>18.1 (13.355)</i>	<i>0.139 (0.107)</i>	<i>20.1 (17.200)</i>	<i>0.148 ()</i>
<i>Eastern Senegal</i>						
Bala	16.7 (20.711)	0.258	14.3 (10.814)	0.100		
Brifal	20.0 (1.863)	0.002				
Gabou	14.3 (9.196)	0.092	12.5 (8.622)	0.149		
Goudiry	10.0 (6,9526)	0.048				
Kadiel	33.3 (17.271)	0.119				
Séno Youpé	33.3 (26.305)	0.208				
Tambacounda					33.3 (23.575)	0.148
<i>Average ES</i>	<i>17.6 (14.827)</i>	<i>0.121 (0.096)</i>	<i>13.3 (9.389)</i>	<i>0.125 (0.035)</i>	<i>33.3(23.575)</i>	<i>0.148 ()</i>
<i>Senegal</i>						
<i>Average</i>	<i>13.2(11.307)</i>	<i>0.127 (0.139)</i>	<i>16.4 (12.184)</i>	<i>0.135 (0.088)</i>	<i>25.0 (19.367)</i>	<i>0.148 (0.000)</i>

^aStandard deviations are in parentheses