Increasing Returns and Market Efficiency in Agricultural Trade*

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Abstract

Using detailed trader surveys in Benin, Madagascar, and Malawi, this paper investigates the presence of increasing returns in agricultural trade. After analyzing margins, costs, and value added, we find little evidence of returns to scale. Motorized transport is found more cost effective for large loads on longer distances. But transporters appear to pool quantities from multiple traders. Margin rates show little relationship with transaction size. Personal travel costs are a source of increasing returns, but the effect is small. Consequently, total marketing costs are nearly proportional to transaction size. Working and network capital are key determinants of value added. Constant returns to scale in all accumulable factors – working capital, labor, and network capital – cannot be rejected. This implies that policies to restrict entry into agricultural trade are neither necessary nor useful. Governments should focus instead on technological and institutional innovations to upgrade agricultural markets.

Keywords: agricultural markets; transactions costs; Africa; transport; marketing margins; traders

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1. Introduction

Over the last two decades, the world has witnessed a landslide movement towards market liberalization. Although the pace and depth of liberalization have varied from place to place, the movement has affected both international and domestic markets and no continent has been spared. The kind of markets that have emerged from this movement differs markedly across sectors and countries, however. Trade in agricultural commodities is a striking illustration (e.g. Swinnen 1997, Kherallah, Delgado, Gabre-Madhin, Minot & Johnson 2000). In developed economies, liberalization has resulted in concentration and vertical integration, with a small number of large corporations purchasing directly from farmers and selling to distributors. In many instances, producers have become sub-contractors with agro-business corporations that provide them with credit and inputs and purchase their output. A corporation such as Cargill, for instance, commands a major share of all grain produced in the U.S. Mid-West. Agro-businesses also take care of quality control, transport, storage, and processing (Jaffee & Morton 1995).

In contrast, market liberalization in poor countries has resulted in deconcentration and specialization. As state-controlled agricultural marketing boards were abolished or scaled down, domestic trade in agricultural products was taken over by a myriad of small operator operating in a rudimentary fashion. This is particularly true in Africa (e.g. Staatz, Dione & Dembele 1989, Berg 1989, Barrett 1997*a*, Fafchamps & Minten 1999, Fafchamps & Minten 2002, Jayne & Jones 1997, Coulter & Poulton 1999). The presence of a large number of traders suggests that competition is fierce. One therefore expects individual traders to be fairly efficient given the constraints they face. At the same time, concentration (measured by the Gini coefficient) is extremely high, suggesting that at least some trading enterprises benefit from increasing returns.

What remains unclear is how firms of extremely different sizes manage to coexist in the same market and what effect this has on system-wide efficiency. The productivity of an industry as a whole depends on the individual productivities of the firms that make up the sector (e.g. Sutton 1998, Tybout 2000). The presence of infra-marginal firms reduces average efficiency. It also suggests that more efficient firms collect rents and fail to take advantage of their higher productivity to eliminate inefficient ones. Tentative evidence to this effect can be found in the large gap often observed in Africa between producer and consumer food prices (e.g. Ahmed & Rustagi 1984, Staatz, Dione & Dembele 1989, Minten & Kyle 1999, Barrett 1997*b*, Barrett & Dorosh 1996). Studies of African traders, however, have often emphasized their rationality and (constrained) efficiency. They are described as doing the best they can given the difficult circumstances in which they operate (e.g. Bauer 1954, Jones 1959, Eddy 1979, Staatz, Dione & Dembele 1989, Meillassoux 1971, Cohen 1969).

The purpose of this paper is to investigate whether market liberalization and widespread competition have resulted in an efficient marketing system for agricultural products in sub-Saharan Africa. To address this question, we need to find out whether the agricultural marketing system as a whole is efficient, that is, whether traders are capable of capturing gains from coordination and of achieving system-wide returns to scale. To address this question, we depart from the current literature which has focused primarily on price movements (e.g. Timmer 1986, Ravallion 1986, Baulch 1997, Dercon 1995, Badiane & Shively 1998) and focus instead on trader costs and margins. Detailed surveys of traders in three recently liberalized countries, Benin, Madagascar, and Malawi, are used to this effect. We seek to uncover evidence that increasing returns to scale and returns to vertical integration remain unexploited. Our working hypothesis is that, if unexploited returns to scale or coordination are present, agricultural trade would become more efficient by concentrating and integrating vertically. The end result would be a marketing system that resembles more closely that observed in developed economies.

In contrast to (e.g. Morrison & Siegel 1997, Morrison & Siegel 1999, Millan 1999) who find evidence of increasing returns in US and Spanish manufacturing, our results fail to uncover evidence of increasing returns in trade. Personal travel costs are the only possible exception. Results show that African traders frequently travel to distant markets to identify, inspect, and purchase supplies. Personal travel costs represent on average 17% of marketing costs in Benin, 21% in Madagascar, and 32% in Malawi. Since personal travel costs per unit decrease with the amount purchased, one would expect large traders to outcompete small ones and eventually to eliminate them. Although large relative to other marketing costs, personal travel costs nevertheless remain too small to generate noticeable increasing returns in trade. Transport costs, which are the main component of marketing costs, show little reduction with load size, probably because of load pooling by transporters.

Traders with insufficient working capital to purchase large loads compensate for higher unit costs in various ways. Some concentrate on micro-retail, that is, they buy from large traders and resell locally in smaller quantities. So doing, they avoid having to travel outside of their market or market town. Others vertically integrate in the sense that they purchase small quantities from peri-urban villages to resell directly to urban consumers. Contrary to what is observed in developed economies, large agricultural traders specialize primarily in wholesale; they are less vertically integrated, i.e., they are less likely to purchase directly from producers and to sell directly to consumers. They also concentrate in trading per se, less so in transport, storage, and processing. Finally, large traders tend to source their supplies from more distant markets, relying for that purpose on their extensive network of business contacts.

Taken together, these results depict a sector where concentration is primarily the result of the patient accumulation of working capital and business contacts. Returns to scale may be present but, given the high volatility of agricultural markets, they are not large enough to eliminate small businesses who manage to survive in specific market niches. System-wide efficiency could be improved by de-emphasizing personal travel and relying more widely on telephones to place orders. This would require more trust among traders and a more widespread use of checks and invoicing.

The paper is organized as follows. The conceptual framework is presented in Section 2. The economic and political context of the studied countries is briefly discussed in Section 3. The data are presented in Section 4. In Section 5 we discuss the main characteristics of surveyed traders. An analysis of transport costs is presented in Section 6. Margins and marketing costs are examined in Section 7. Returns to scale at the level of the firm are investigated in Section 8. Conclusions appear at the end.

2. A conceptual framework

The aggregate efficiency of agricultural marketing – in a potentially Pareto efficient sense – can be expressed as the consumer surplus plus the agricultural producer surplus minus marketing costs. This implies that total surplus is largest when the consumer price is equal to the producer price plus marketing costs – there is no rent in trade – and when unit marketing costs are minimized for the marketing chain as a whole (e.g. Gardner 1975, Dornbusch, Fisher & Samuelson 1977, Takayama & Judge 1971, Benischka

& Binkley 1995).

Marketing rents are likely to arise when traders collude or occupy a monopoly or monopsony position. Given that in Africa markets for domestically consumed agricultural products are characterized by widespread competition and free entry, collusion in the sense of price fixing is probably not a serious concern. In their study of agricultural traders in Madagascar, for instance, Fafchamps & Minten (2002) find no evidence of price fixing. They do, however, find evidence of returns to business networks, a form of collusion that works through information sharing and better contract enforcement. Here we focus our attention on the minimization of unit marketing costs.

Let p_p and p_c denote producer and consumer price, respectively. The unit marketing costs of trader i are denoted c_i. We assume perfect competition in trade. Arbitrage therefore requires that:

$$p_c = p_p + \sum_{i=1}^{M} c_i$$

where M is the number of traders who handled the goods between producer and consumer.

Marketing costs per unit are in general function of the quantities q_i handled by each individual trader, the distance d_i traveled between trader i and his or her supplier, and the number M of intermediaries between producer and consumer. The marketing tasks undertaken by trader i is represented by a vector $f_i = \{f_i^1, ...f_i^F\}$ with each individual task $f_i^j = \{0, 1\}$. Typical tasks are assembly, quality verification and grading, transport, storage, processing, retail, and micro-retail. Individual traders may undertake one or several tasks, e.g., purchase from producers (assembly) and sell to consumers (retail). The model can be expanded to include storage but we ignore it for now. Marketing efficiency is maximized when:

$$\min_{M, q_i, d_{ij}} \sum_{i=1}^{M} c_i(q_i, d_i, f_i) \text{ subject to } \sum_{i=1}^{M} d_i = \bar{d}$$

where the total distance $\bar{d}$ between producer and consumer is taken as given. If $c_i(q_i, d_i, f_i)$ is uniformly decreasing in q_i, marketing efficiency is achieved by concentrating all trade into the hands of a single trading firm. If, however, $c_i(q_i, d_i, f_i)$ is decreasing in q_i only up to a minimum efficient scale $\bar{q}$ beyond which unit cost is constant, firms of different sizes may coexist. But no firms of size smaller than $\bar{q}$ should be observed. Above $\bar{q}$, size is irrelevant for efficiency (Bain 1956).

Turning to transport, if $c_i(q_i, d_i, f_i)$ is decreasing in distance, transport should be combined into a single long haul $\bar{d}$ instead of multiple short hauls. Efficient modes of transportation may also vary by distance, e.g., large trucks cheaper on long hauls, wheelbarrows and bicycles on short hauls. If, in contrast, $c_i(q_i, d_i, f_i)$ is constant with d_i, bunching transport is unnecessary.

Regarding the number of intermediaries M, efficiency depends on the presence of economies of scope across marketing tasks. For instance, if unit costs are lower when assembly is combined with quality verification and grading, it is more efficient for these two tasks to be undertaken by a single trader. Formally, two tasks f^j and f^k should be combined if:

$$\begin{aligned} c_i(q_i, d_i, \{...f_i^j &= 1, ..., f_i^k = 1, ...\}) < \\ c_i(q_i, d_i, \{...f_i^j &= 1, ..., f_i^k = 0, ...\}) + c_i(q_i, d_i, \{...f_i^j = 0, ..., f_i^k = 1, ...\}) \end{aligned} \tag{2.1}$$

Vertical integration, i.e., $M = 1$, is optimal whenever economies of scope are strongest, that is, when $c(q, d, \{1, 1, 1, ..., 1\})$ provides the lowest unit cost.

Market efficiency can thus be studied by analyzing the shape of the unit cost function and testing whether there are (1) increasing returns to size, i.e., $\frac{\partial c}{\partial q} < 0$; (2) increasing returns to scale in transport, i.e., $\frac{\partial c}{\partial d} < 0$; and (3) economies of scope, i.e., equation (2.1). The structure of costs can then be used to ascertain whether the size and activity distribution of trading firms is consistent with market-wide efficiency.

It is important to recognize that inference regarding costs and returns to scale depends on agents' behavior. In a perfect competitive world in which all traders face the same factor costs and make zero profits, traders would all be at the same point along their cost curve. In particular this would imply that all traders performing the same market function would have the same size and costs. With decreasing returns, all traders would be arbitrarily small; with increasing returns, a single trader would capture all the market. Only in the presence of constant returns to scale would we observe traders of various sizes. In this case, the size distribution of firms would by itself provide information about returns to scale.

As we shall see, there is enormous dispersion in the size distribution of trading firms in all three surveyed countries. This by itself constitutes evidence in favor of constant returns to scale. However, since most factors of production are self-provided in an environment characterized by an extreme paucity of wage employment and very thin financial markets, it is very unlikely that traders all face the same factor costs. Moreover, the very high levels of firm turnover observed in the sector (e.g. Daniels 1994, Barrett 1997*a*) indicates that many traders are forced to exit, especially small ones. If increasing returns to scale were present, this could indicate that they are not operating at an efficient scale. With traders facing different factor costs and possibly operating at an inefficient scale, it should be possible to identify the presence of increasing returns to scale.

In practice, unit cost has several components: (1) what we call *marketing costs*, that is, measurable cash outlays that vary with traded quantities c_i^v, such as transport costs; (2) what we call *operating costs*, that is, measurable cash outlays that do not vary directly with quantity traded c_i^f, such as rental of facilities and market fees; and (3) what we call *profits*, that is, residual returns to non-traded inputs such as working capital, family labor, and managerial talent $p_i^s - p_i^a - c_i^v - c_i^f/q_i$ where p_i^s is the sales price of trader i, p_i^a is the purchase price, and c_i^v and c_i^f are as defined earlier. Other measures of interest are what, for the purpose of this paper, we call the *gross margin rate* $\mu_i^g \equiv p_i^s/p_i^a - 1$ and the *net margin rate* $\mu_i^n \equiv (p_i^s - c_i^v)/p_i^a - 1$.

In his theoretical analysis of the food marketing chain, Gardner (1975) points out that different marketing costs enter the marketing cost function in different ways. In particular, transportation and loading costs are likely to vary with the quantity of the transported goods. In contrast, storage and grading losses should be roughly proportional to the value of the traded commodity. Hence a mixture of absolute and relative margins should be expected. In our case, grading losses are non-existent since there is no grading, and storage losses are low given the very short duration of storage by traders. Hence it is reasonable to assume that most marketing costs vary with quantity but not with value.

Given the nature of the data, increasing returns could manifest themselves in a variety of ways. For instance, it is possible that big traders use their lower costs to squeeze out small traders by keeping gross margins low. To the extent that marketing costs fall with transaction size, increasing returns would manifest themselves in the form of smaller net margins for small transactions. Alternatively, it is possible that all traders face the same out-of-pocket marketing costs – in which case their gross and net margins would be the same on average – but big traders have higher returns to fixed factors such as labor and working capital, either because their operating costs are lower per value traded, or because they are able to process larger quantities. In these cases, increasing returns would manifest themselves as higher profits. To test for the presence of increasing returns, it is therefore necessary to conduct a detailed analysis of traders' cost and profit structure. The object of the rest of the paper is thus to investigate the above three categories of costs as well as profits for evidence of increasing returns. After having presented the countries and data, we begin by taking a close look at transport costs. We then turn to marketing costs and margins. We conclude with an examination of operating costs and profits.

3. Market liberalization

The three study countries, Benin, Madagascar, and Malawi, were chosen because they all underwent a liberalization of domestic food marketing. But they differ dramatically in the role that was played by the private sector prior to liberalization. In Benin, the Office National des Céréales (ONC) created in 1983 attempted unsuccessfully to control 25% of the cereals market. It reached only 5% in 1990 due to a lack of human and financial resources (Badiane, Goletti, Kherallah, Berry, Govindan, Gruhn & Mendoza 1997). With the exception of the 1976-77 period, market prices of cereals were never controlled and private traders largely dominated food markets even prior to liberalization. The market reforms launched in 1990 effectively dismantled the ONC, transforming it into an agency responsible for supporting food security and for providing market information and extension to farmers. Currently, the government's role in domestic food markets is extremely small, controlling only 0.15% of the annual volume of maize traded.

The situation in Malawi is different in that the government effectively controlled domestic food markets. The Agricultural Development and Marketing Corporation (ADMARC) was established as a monopsonistic buying agent for smallholders' maize, at guaranteed fixed prices. ADMARC provided pan-territorial and pan-seasonal prices for farmers, requiring it to subsidize maize prices with export earnings from tobacco. As the world prices for tobacco deteriorated, its ability to continue maize subsidies was eroded in the early 1980s. In 1981, Malawi embarked on a series of structural adjustment programs, which entailed adopting a flexible exchange rate regime and moving slowly toward liberalizing its price and marketing policies (Seppala 1997). In 1987, a new series of structural adjustment loans were launched, with the conditionality of complete privatization of maize marketing. However, although private trading was allowed in this period, producer prices remained fixed by the government until as late as 1995, when a price band was established (Badiane et al. 1997). ADMARC administers the price band and acts as buyer of last resort. Despite privatization and the closing of a number of ADMARC buying centers, ADMARC remains dominant in the maize market, with private traders engaged in bulking for ADMARC (Beynon, Jones & Yao 1992).

In Madagascar too, the government was, for a time, capable of controlling domestic food markets. After independence, governments gradually increased their intervention in agricultural markets so that, by the end of the 1970's, most trade in agricultural products was in the hands of the state (e.g. Dorosh & Bernier 1994, Shuttleworth 1989, Berg 1989). A reversal of policy took place in the 1980's with a gradual transition from a state food marketing system to a liberalized market. From before liberalization on, the government supplied all the big cities with subsidized rice (Roubaud 1997). The subsidy program continued until October 1988 but its importance declined gradually. In November 1986, the government introduced a buffer stock scheme in response to high seasonal prices during that year and to defend the ceiling price. However, the buffer stock scheme was poorly administered and was ultimately terminated in 1990. In 1991, the government introduced an import tax of 30% on rice to protect local production. This tax has been changed many times since. The current situation can be described as one in which private traders have been given free reign to set buying and selling prices and to move agricultural products around the country. The state continues to intervene in agricultural markets through buying and selling operations conducted for example by SOMACODIS but these operations only represent a very small percentage of the total volume of food products transacted domestically. In this respect Madagascar resembles many other African countries that have gone through a similar cycle of government interventionism and retreat (e.g. Staatz, Dione & Dembele 1989, Gabre-Madhin 1997). Trade in agricultural products in Madagascar has been analyzed by other authors, most notably Barrett (1997*a*), Barrett

(1997*b*), and Berg (1989).

4. The data

Surveys of traders of domestic agricultural products were conducted in 1999/2000 in Benin (August-September 1999) and Malawi (August 1999-February 2000). A market-level survey was also conducted in order to obtain information on the marketing environment. The work was coordinated by the International Food Policy Research Institute (IFPRI), Oxford University, and the World Bank. Data collection in the field was directed by the Laboratoire d'Analyse et de Recherche Economique et Sociale (LARES) in Benin, and by the Agricultural Policy Research Unit (APRU) in Malawi. A similar survey was conducted in Madagascar in the Fall of 2001. Survey work was undertaken in collaboration between Cornell University, Oxford University, and the local Ministry of Scientific Research (FOFIFA). Funding for survey work was provided by USAID and the Pew project.

All three surveys focus on agricultural traders at both the wholesaler and retailer level.[1] Survey sites are market towns active in agricultural products. 24 markets were selected in Benin, 30 in Madagascar, and 40 markets in Malawi based on their trade importance and the availability of secondary price data. Due to the absence of reliable census information on the population of traders in all three countries, a census of traders was conducted in each selected market.

In Benin, the survey team counted all traders present on the market in a given day. This count was supplemented by lists of traders obtained from the ONASA (Office National d'Appui à la Sécurité Alimentaire) and the regional bureaus of the Ministry of Commerce. These lists include larger traders who need not have a stall on the market itself. The two lists and the count were combined to construct a frame from which a sample was randomly drawn, resulting in a total sample of 641 agricultural traders.

[1] Efforts to include agricultural inputs and cash crops into the survey were largely unsucessful. In Benin, it became clear early on that fertilizer and seed trade are closely linked to the production of cotton. Cotton marketing is under the monopoly of a parastatal enterprise, the Societé Nationale de Promotion Agricole (SONAPRA). Input trading is done primarily through village cooperatives called Groupements Villageois (GV), rather than by individual traders. The GVs purchase inputs from 9 government-licensed fertilizer importers and distribute these inputs among their members. The marketing of cotton, the dominant export crop, goes entirely through SONAPRA.

In the case of Malawi, the distribution of fertilizer and other agricultural inputs is dominated by few very large firms, such as OPTICHEM and Norsk/Hydro. Inputs are distributed throughout the country by traders operating as selling agents for large corporations. A specific survey was organized for these selling agents, who do not conduct purchases, but who do sell independently. Results are not discussed here. A handfull of independent tobacco traders are recorded in the Malawi survey.

In Malawi, a reconnaissance survey of traders was conducted in July-August 1999 to count and identify traders according to their status (independent, buying agent, or selling agent), their level (retail or wholesale), and the types of products they trade. The information on the name, type, and location of traders from the reconnaissance survey were entered into a spreadsheet and the sample was drawn randomly from the census data using a computer algorithm. A total sample of 732 traders was interviewed in Malawi.

In Madagascar, three main agricultural regions were selected (Fianarantsoa, Majunga, and Antananarivo) and the sampling frame within these regions was set up as follows. Traders were surveyed in three different types of location: big and small urban markets in the main town of every province (faritany) and district (fivondronana); urban areas outside urban markets; and rural markets at the level of the rural county (firaisana). Rural firaisanas were selected through stratified sampling based on agro-ecological characteristics so as to be representative of the various kind of marketed products and marketing seasons. Traders operating in urban markets are mostly wholesalers, semi-wholesalers, and retailers. Urban traders located outside regular markets are bigger traders, processors (e.g., rice millers) and wholesalers. Traders operating on rural markets are mostly big and small assemblers and itinerant traders. A first trader survey was undertaken in 1997 in the same location. The 2001 sample is constructed so as to be representative of the trader population in 2001[2] and the part of the questionnaire used in this analysis is identical to that used in Benin and Malawi. Only 30% of the surveyed 1997 traders were still operating in 2001, a reflection of the very high level of firm entry and exit that is typical of agricultural trade in sub-Saharan Africa (e.g. Barrett 1997*a*, Daniels 1994). In total, some 894 traders were interviewed in Madagascar – a sample size slightly larger than that used for Benin and Malawi to account for the larger population and size of the country.

The questionnaire covers the following main areas: (a) characteristics of the trader and trading enterprise; (b) factors of productions and operating costs; (c) trading activities and marketing costs; (d) relationships and coordination costs. Data are also collected on search behavior and costs, quality inspection, contract enforcement and dispute settlement, information, and property rights enforcement

[2]Exiting firms were replaced with entering firms so as to maintain the representativeness of the sample.

(Gabre-Madhin, Fafchamps, Kachule, Soule & Khan 2001).

5. Main characteristics of surveyed traders

The main characteristics of surveyed traders are summarized in Table 1. A more detailed description of traders in Benin and Malawi can be found in Gabre-Madhin et al. (2001) and Fafchamps & Gabre-Madhin (2001). The overwhelming majority of independent trading enterprises are held in sole ownership by a local resident who is also a national of the country studied. Most of the surveyed traders are women. Madagascar traders are on average much better educated than Beninese traders, with Malawian traders in between.

Average working capital – the money traders use to purchase agricultural products and pay marketing costs – is fairly large by the standards of the countries concerned. The median is much smaller, however. Most working capital comes from internal sources. The only source of external finance that is used by a sizeable proportion of respondents is loans from friends and relatives. Surveyed traders appear surprisingly unequipped. The overwhelming majority of them do not own (serious) weighting equipment, transportation, or storage facilities. Only 3% of the total sample have a telephone. In terms of value, vehicles are the most important equipment item. But ownership of vehicles is heavily concentrated, with a large proportion of surveyed traders without vehicles. Apart from the trader himself or herself, surveyed enterprises do not employ an abundant manpower. Non-family employees only account for a small fraction of manpower. Wages paid are very low. A large proportion of family workers receive no wage. In contrast, non-family workers nearly always receive a wage.

Information was collected on the last transaction undertaken by respondents. A 'transaction' is essentially a load that is assembled by the trader in the supply market, transported to the sales market, and sold over a period of time. On average, the quantity purchased is remarkably similar across the countries: around 2.5 metric tons of agricultural produce in Benin and Malawi, 1.6 metric tons in Madagascar. The value is also surprisingly similar. The average distance between the purchase and sale market is between 40 and 70km. Median distances are shorter, however: most agricultural traders travel very short distances to their supply market. The median number of days elapsed since the last purchase is equally short: it varies between one week in Benin and Madagascar to three days in Malawi. The majority of traders keep the products they sell for a short period only, typically the time it takes to sell the batch of purchased goods. Very few traders store agricultural products for more than a month.

In the table, we report the *gross margin rate* $\mu_i^g = p_i^s/p_i^a - 1$. Ultimately, this ratio determines the gap between producer and consumer price and hence the efficiency of market intermediation. As is common in African agricultural markets, we see that the gross margin rate among surveyed traders is quite high – on average, the sales price is 23% higher than the purchase price in Benin, 32% higher in Madagascar, and 53% higher in Malawi. Gross margins on the last purchase also vary widely. Close to 3% of surveyed traders report selling at or below the purchase price. At the other end of the spectrum, some traders report selling at close to 10 times the purchase price.

Gross margin rates differ widely across the three countries. What does this imply for the spread between producer and consumer prices? The answer to this question depends on the number of times an agricultural commodity changes hands before reaching the consumer. Although we cannot estimate this number directly, we can venture a guess on the basis of the composition of the sample with respect to marketing task f_i.

There are basically four categories of traders in our surveys: those who buy from and sell to traders ('wholesalers'); those who buy from farmers but sell to traders ('collectors'); those who buy from traders but sell to consumers ('retailers'); and those who buy from farmers and sell to consumers ('collector-retailers' – the omitted category.). The three countries differ markedly regarding the respective proportions of sampled traders falling in these four categories (Table 2). In Benin, close to half the sample is made of collectors who sell to other traders. Wholesalers represent one third of the sample. The smallest category is collector-retailer. By contrast, more than half the sample in Malawi is made of collector-retailers; the next most important category is collectors. This means that, in Benin, close to half sampled traders source their products from other traders. Only 15% do so in Malawi, implying that vertical integration across the marketing chain is more developed in Malawi. Madagascar occupies an intermediate situation.

Using the proportion of traders falling in different categories, we construct a (somewhat heroic) estimate of the average number of transactions between farmer and consumer.[3] We obtain an average of 3.4 transactions in Benin, 2.4 transactions in Madagascar, and 2 transactions in Malawi. Differences are primarily due to the proportion of traders who buy from farmers and sell directly to consumers. These estimates can then be used to guess the average spread between producer and consumer price. The lower number of transactions in Malawi implies that this spread need not be larger than in Benin even though the average margin is higher. We have seen in Table 1 that the median gross margin rates are 18% in Benin, 14% in Madagascar, and 40% in Malawi. If all traders charge the median margin, the consumer price in Benin would be 76% above the farmer price ($1.18^{3.4}$=1.76). Similar calculations for Malawi and Madagascar yield consumer prices 96% (1.4^2 =1.96) and 37% ($1.14^{2.4}$ =1.37) above farmer prices, respectively.[4] These calculations, however heroic they may be, suggest that differences in gross margin rates across countries largely reflect different levels of vertical integration.[5]

Detailed information was collected on the various out-of-pocket expenditures incurred in the process of assembling, transporting, and selling the last quantities purchased. For the purpose of this paper, we refer to these cash outlays as marketing costs. Transport costs, which include on- and off-loading, represent by far the largest component of marketing costs, accounting for 50-60% of the total.[6] The importance of transport costs in sub-Saharan Africa has long been noted (e.g. Gersovitz 1989, Gersovitz 1992, Omamo 1998). The second most important component is the trader's travel. This cost alone represents on average 15% of marketing costs in Benin, 34% in Madagascar, and 37% in Malawi. Other costs such as bagging costs and taxes and fees represent only a small portion of marketing costs.

Marketing costs are small – of the order of \$11 to \$31 per ton. Corresponding medians are even lower. Marketing costs are lowest in Madagascar because the sample is dominated by retailers who

[3] To obtain this estimate, we reconstruct the hypothetical path of 100 purchases from farmers. Proportions of purchases ending in the hands of various types of traders are constructed by weighting proportions reported in Table 5 by volume of trade. In Benin, after reweighing, 20 purchases from farmers are sold by traders immediately to consumers; the others go to a second trader. In the second round of sales, 26 sales again go to consumers; the rest go to a third trader, etc. These calculations are conducted until all 100 purchases have been sold to consumers. The average number of transactions is the average number of sales before reaching a consumer. Sensitivity analysis is conducted by experimenting with various task decompositions, alternative assumptions regarding sampling proportions, etc. Alternative averages differ slightly. Our 'best' estimate is reported here.

[4] Using average margins instead yields a price gap of 102% in Benin, 97% in Madagascar, and 134% in Malawi. Given the wide variation in unit margin due to measurement error, using averages probably yields an overestimate.

[5] The approach used here differs from that adopted in market studies that collect price information for an homogeneous good in a few well defined markets. In our case this approach proved impractical and unreliable because of the very large number of origination and delivery points. There are also different products, qualities, times, and forms of delivery. As a result, price levels are not directly comparable, hence our approach based on margin rates.

[6] Reported on- and off-loading charges accounts for 25-30% of total transport costs.

purchase from nearby markets – and thus incur little or no cash outlays for transport and the like. At the median, marketing costs represent 9-10% of the purchase price in Benin and Malawi, and only 2% in Madagascar. If we deduct marketing costs from the sales price, the resulting *net margin rate* $\mu_i^n = (p_i^s - c_i^v)/p_i^a - 1$ remains high: 11% on average in Benin but as high as 27% and 37% in Madagascar and Malawi, respectively. Medians are quite a bit lower, however, except in Malawi. These differences further suggest that agricultural trade may be less efficient in Malawi.

Information was also collected on annual sales and operating costs. Survey results indicate that average sales per trader are higher in Malawi and Madagascar than in Benin. The difference between the value of sales and purchases is higher in Malawi: the selling price is on average 22% above the buying price in Benin and 27% in Madagascar against 49% in Malawi. Margins vary dramatically across traders, however. Some respondents appear to be incurring massive losses while others make windfall profits. Part of this variation undoubtedly comes from measurement error – because respondents do not hold accounts, annual sales and purchases are extrapolated on the basis of a few key indicators. But the variation also suggests that unit margins in agricultural trade are extremely volatile.

One may surmise that higher margins in Malawi are needed to cover higher operating costs. This is not the case. On average, operating costs are relatively small – less than $1000. There is also a lot of variation in their composition across countries. Operating costs are dominated by vehicle maintenance and insurance in Benin, storage and pest control in Malawi, and rental fees in Madagascar. Each of these costs is incurred only by a very small fraction of the trader population, as can be seen from the abundance of zero median values. The data also show the burden of taxation to be small: less than $100 a year compared to an average annual turnover measured in tens of thousands of dollars. While very few traders pay income tax, market fees are paid by most of them. For small traders, market fees are the only form of operating cost they incur. Since market fees do not increase proportionally with trade volume, they affect primarily small to medium-size traders; they are a regressive tax. Given that transport represents such a large component of traders' costs, we speculate that traders probably pay more taxes through gasoline taxes than through all other forms of taxation combined.

By constructing an estimate of annual marketing costs, the data can be used to construct a rough estimate of the return to self-provided factors of production. This measure, which for simplicity we call 'profit', is computed as sales minus purchases, marketing costs, and operating costs.[7] It represents payments to self-provided factors such as working capital, owned storage facilities, equipment, vehicles, and unpaid labor by the entrepreneur and family helpers. Computed profits suffer from severe measurement error because they are obtained by subtracting poorly measured costs from poorly measured revenues. Measurement errors therefore compound themselves and individual measures of profit should be regarded with caution. Average profits are shown to be non-negligible but these figures are driven by a small number of outliers. Median profits provide a more accurate picture. They are much lower: $116 in Benin, $536 in Madagascar, and $1147 in Malawi. They correspond to a median profit rate on purchases of 7% in Benin, 11% in Madagascar, and 25% in Malawi.

6. Testing the Efficiency of Transport

We now seek to understand the determinants of marketing costs c_i^v. In the three studied countries, transport is the largest component of out-of-pocket marketing costs. The importance of rural roads is a feature common to other parts of the developing world (e.g. Jacoby 2000, Binswanger, Khander & Rosenzweig 1993) but particularly crucial in Africa (Ahmed & Rustagi 1984). Consequently, we begin by taking a close look at transport costs. We seek to uncover whether transport benefits from returns to scale.

We have two reasons to suspect that large loads are cheaper to transport (per Kg) than small loads. First, conditional on the choice of vehicle, costs per Kg to the transporter are a decreasing function of load size, up to the point where the vehicle is full: a half-empty truck costs more per Kg than a full one. Second, we suspect that small trucks are less cost efficient than large ones.[8] If traders transport small loads on small, half-empty trucks, transport costs are higher than optimal. Total intermediation costs could then be reduced – and trade efficiency improved – by organizing larger loads and ensuring no truck travels half empty. Casual empiricism suggests that, if anything, trucks in Africa tend to be overloaded.

[7] Traders who derive less than 10% of their annual revenue from agricultural trade are omitted.

[8] For one, over a reasonable range, the price of a truck increases less rapidly than the weight it can carry. Secondly, driver costs are essentially the same for a large or small truck.

However, there could be other reasons why small loads lead to higher unit transport cost, such as longer waiting time for transporters and the need to make many stops to load and off-load passengers and cargo. If transporters efficiently and timelessly pool loads from multiple traders, in a competitive equilibrium the size of an individual trader's load should have no effect on transport cost per Kg. Transport efficiency can thus be tested by checking whether traders who transport larger loads pay less per Kg.

Transport costs also depend on distance travelled.[9] During transport itself, costs such as fuel, driver's time, and vehicle amortization are basically proportional to distance. If loading (and off-loading) costs to the transporter are negligible,[10] unit transport costs should therefore increase proportionally with distance. Over very short distances, however, loading costs could be large relative to total transport costs. Moreover, they are likely to be larger for large motorized vehicles than for carts and donkeys, especially if we include the time waiting for a full load to be assembled. As a result of loading and waiting costs, it would probably not be justified to use large trucks over short distances as we would expect small trucks or even non-motorized transport to be cheaper.

To test for transport efficiency, we proceed as follows. As discussed earlier, we assume that transport costs are a function of the quantity transported, not of load value. Let $c_i^t(q_i, d)$ denote transport costs per Kg. We posit a logarithmic relationship between costs, quantity transported, and distance travelled:

$$c_i^t(q_i, d_i) = \theta q_i^{\alpha} d_i^{\delta} e^{u_i} \tag{6.1}$$

where θ, α and δ are parameters to be estimated, q_i is load size, d_i is distance, and u_i is an error term.[11] If

[9] In the survey we attempted to collect information on road quality and vehicle operating costs from respondents but this proved unrealistic. Since most respondents are not transporters, they are not a reliable source of information on vehicle operating costs and are poor judge of the vehicle wear and tear caused by different road conditions.

[10] Some on- and off-loading costs are borne directly by traders and are discussed in Section 7 together with other marketing costs. Here we think of loading costs to the transporter, such as the time wasted waiting for the truck to be full and the many stops required to load and off-load passengers and cargo.

[11] In principle, we could have used a linear formulation for equation (6.1). In such formulation, the intercept could be interpreted as loading costs and the slope with respect to distance as the variable transport cost.

There are two reasons why we opt for a logarithmic form. The first is theoretical. When agents choose among several transport technologies, the relationship between transport cost and distance is no longer linear. As agents switch from, say, a wheelbarrow to a pick-up truck as distance and quantity increase, they incur higher loading costs but lower travel costs. Since agents endogenously select the cheapest mode of transport, the relationship between distance and transport costs has a lower initial intercept but a slope that falls as agents switch to cheap long haul transport modes. This non-linearity with respect to distance is easily accommodated by a logarithmic form.

The second reason is that the sample distribution of unit transport costs c_i^t is far from normal – it has a fat upper tail corresponding to a small number of cases of long haul transport. Estimating the model linearly gives enormous weight to these observations and it makes coefficient estimates sensitive to outliers and hence makes the results non robust. It also makes inference problematic since errors are not distributed normally. Taking logs of the dependent variable yields a transport costs are proportional to quantity transported ($\alpha = 0$), this means that transporters efficiently combine loads of various sizes so that small loads are not penalized. If, in contrast, the coefficient on load size is significantly negative and large loads cost less per Kg than small loads, then it should be possible to reduce the aggregate transport cost of agricultural products by combining quantities transported into larger loads. Finding that $\alpha = 0$ therefore implies that it would be be possible to reduce transport costs by having traders operating on a larger scale and hence transporting larger loads.

A similar reasoning can be held with respect to distance. The absence of fixed transport costs with respect to distance implies $\delta = 1$, in which case unit transport costs increase proportionally with distance. In the presence of loading costs, total transport costs per Km should be higher on short than long distances, implying that costs increase less than proportionally with distance. In this case, it may be possible to reduce aggregate transport costs by avoiding trans-shipment and transporting directly from producers to consumers or consumer markets. By the same reasoning, factors that increase loading costs to the transporter should reduce δ. For instance, in areas with a low density of trade, more time is required to fill a large truck since the frequency of transactions is low. Consequently, we expect δ to be further below 1 in low trade density areas since waiting costs are a higher proportion of total transport cost.

For each respondent, information was collected on transport charges for various routes and means of transportation. One fifth of surveyed traders claim not to undertake any transport, by which they mean that they buy and sell from the same market. For these traders, no transport cost data were collected. Other traders transport products across markets, nearly always with a external transporter.[12] Many of them report transport cost information for different routes, which is why we have more observations than traders who actually transport goods.[13]

The data show that most transport takes place in trucks, half of which are small pick-ups. Some transport takes place with non-motorized means of transport such as hand-carts and ox-carts. Train

symmetrical, bell-shaped distribution of the dependent variable, and hence more accurate inference.

[12] For the econometric analysis, we only use those observations in which an external transporter was used.

[13] The presence in the sample of traders who do not undertake any transport does not affect regression results in Tables 3 and 4 because these regressions are estimated using data reported only by those traders who transport agricultural products. The reader should also keep in mind that the transport figures reported in Table 1 refer to the last transaction. Many traders who reported 0 transport costs on their last transaction nevertheless incurred transport costs on earlier transactions, and hence were able to answer questions on transport costs.

transport is not used by respondents in any of the studied countries. Measured in dollars per ton per Km, transport costs average $0.43 in Benin, $0.70 in Malawi, and $4.60 in Madagascar, respectively. Transport charges vary dramatically by mode of transport, however. Non-motorized transport costs on average $1.78 in Benin, $1.20 in Malawi, and $7.96 in Madagascar. The very high figure for Madagascar is due to the high proportion of very short trips (i.e., a few hundred meters) in and around markets. In contrast, motorized transport is much cheaper. It costs on average $0.28 per ton per Km in Benin, $0.63 in Malawi, and $0.67 in Madagascar, respectively. There is therefore evidence that non-motorized transport costs much more per Kg to traders than motorized transport.[14] Non-motorized transport, however, is used primarily on short distances – less than 1km in Madagascar, 4km on average in Benin, 12km in Malawi. Large trucks are used primarily on long distances – 120km in Malawi, 160km in Benin, 210km in Madagascar. Pick-up trucks are used primarily on medium distances, e.g., 25 to 70km.

To test for returns to load size, we estimate equation (6.1) in log form. Results are shown on Table 3. As expected, distance travelled has a strongly significant effect on transport cost but δ is significantly smaller than one in all three countries, suggesting the presence of large loading and off-loading costs. These costs are larger in Malawi and Madagascar than in Benin, possibly because of the lower density of population and thus of agricultural trade, and thus a higher waiting time for transporters.

We find no evidence of returns to load size in Benin, but the load size coefficient is significant in Malawi and Madagascar: individual traders transporting larger loads face lower transport costs in these countries. Again, this might be due to the fact that population density is higher in Benin: as a result of increased frequency of transport, truckers more easily fill their vehicle with loads from multiple traders. With enough competition, this should ensure that Beninese traders with small loads are not penalized. Whatever the reason, our results suggest that transport cost per Kg could be reduced in Malawi and Madagascar by organizing larger loads.

To investigate these issues further, we examine whether transport costs vary by mode of transport. We reestimate equation (6.1) separately for motorized and non-motorized transport, correcting for self-selection.[15] We expect to find a large δ and correspondingly large θ for non-motorized transport. Results,

[14] Unfortunately, we do not have information on relative vehicle operating costs.

[15] We correct for selection bias by estimating the two-step switching regression model suggested by Maddala (1983), page

not presented here to save space, show that, in all three countries, distance travelled raises the probability of using motorized transport. Previous results regarding load size are confirmed. Load size has no significant effect on the choice of transport mode, but it has a strong negative effect on transport cost in Madagascar and Malawi.[16] We conduct a similar analysis for the choice between small and large trucks, conditional on using motorized transport. Results show that, in all three countries, large trucks are more likely to be used on long distances.

Taken together, our results suggest that transport follows some economic rationale. Motorized transport is used on longer distances when it is cheaper. But increasing returns to load size are present in two of the three countries – Madagascar and Malawi – where traders transporting larger loads pay less for transport. This may be due to lower population density leading to a lower frequency of transactions, longer waiting time, and a higher likelihood that trucks do not travel full. In such an environment, one would expect traders bringing large loads to pay less for transport because they shorten the transporter's waiting time. In these two countries, transport cost per Kg could be potentially reduced by organizing larger loads.

7. Margins and Marketing Costs

We have investigated whether returns to load size are present in transport. We now turn to total marketing costs c_i^v and marketing margin rates μ_i^g and μ_i^n. We have seen that agricultural traders vary dramatically in size and profitability. We also noted very large differences in margins and costs across the three countries. The question we now ask is whether returns to scale or economies of scope are present and whether their presence can account for differences across traders and countries.

We focus on the costs and margins relative to the last recorded transaction. This is an appropriate level of analysis for two reasons. First, it is the level at which we can contrast selling and buying price. The difference between these two prices is the ultimate yardstick of trading efficiency: the smaller the difference is, the more welfare for producers and consumers. Second, it is the level at which we can best

257-258. Instruments include trader characteristics that may affect the choice of transport mode but not the price charged by the transporter. Self-selection has a strong effect on the choice of non-motorized transport in Benin and is significant in the motorized transport regression for Madagascar. In other regressions, the self-selection correction is not significant.

[16] Keep in mind that load size here refers to the load carried by the trader, not the total load on the truck, which often is larger because truckers combine loads from multiple traders.

examine marketing costs and their effect on margin rates.

We wish to ascertain whether there are increasing returns to transaction size. One possible source of increasing returns is if traders who operate on a larger scale are able to offer a lower consumer price or a higher producer price. If this is true, the gross margin rate μ_i^g would be an decreasing function of transaction size q_i. Another possibility would be that marketing costs would be lower for large transactions. In this case, total marketing costs c_i^v would decrease with transaction size q_i. If large transactions have both a lower μ_i^g and and lower c_i^v, it would be interesting to know whether they have the same μ_i^n, in which case we could say that cost savings resulting from larger transactions are passed onto consumers and producers.

7.1. Marketing costs

To investigate these ideas, we first estimate kernel regressions of marketing costs c_i^v expressed in US$ per Kg. Results are summarized in Figure 1. We find that personal travel costs per kilogram fall dramatically with transaction size. This is anticipated since travel costs do not depend on the quantities purchased. In contrast, handling costs (mostly bagging) increase with transaction size in Benin and Malawi, presumably because in small transactions handling is done directly by the trader and is not included. Transportation costs display a mostly positive relationship with transaction size. This is because many small transactions do not incur transport expenses: retailers purchase small quantities from a wholesaler for sale in the same town or market. As a result of personal travel costs, a negative relationship between transaction size and marketing costs is obtained in Malawi. In Madagascar, marketing costs show little relationship with transaction size while in Benin they tend to increase.

The above univariate analysis is subject to omitted variable bias as it ignores the effect of other factors that affect costs. We therefore turn to multivariate analysis and add regressors to control for the distance between point of purchase and point of sale d_i, the duration of storage s_i, and the marketing task f_i. Crop and region dummies are included as well. We expect marketing costs to be higher for long distance purchases – because of transport and personal travel costs – and when storage duration is longer – to cover storage costs. With respect to marketing task f_i, we follow Table 2 and distinguish between wholesalers, collectors, retailers, and collector-retailers – the omitted category. We expect traders who straddle more than one function to incur higher marketing costs.

Results are presented in Tables 4 (Benin), 5 (Madagascar), and 6 (Malawi). To control for self-selection, we rely on a Heckman procedure. The log of marketing costs is the dependent variable, conditional on a cost being incurred. Trader characteristics such as gender, number of vehicles, working capital, storage capacity, and number of business contacts serve as instruments in the selection equation.[17]

As before, our main objective is to test whether marketing costs increase proportionally with transaction size measured in Kg.[18] If marketing costs per Kg are higher for small quantities, aggregate intermediation costs could be reduced by increasing average transaction size. We find that, conditional on being incurred, all marketing costs except personal travel are roughly proportional to transaction size. However, in all cases except one, we can reject the hypothesis that marketing costs are exactly proportional to transaction size: the coefficient of transaction size is significantly smaller than 1 in all three countries. The results therefore suggest the presence of increasing returns to transaction size, possibly because of the presence of fixed transaction costs.

Among the other results of interest is the strong and robust effect of distance: both the probability of incurring marketing costs and the amounts incurred increase with distance. The effect is strong and significant in all cases. The length of time elapsed between purchase and sale has no systematic effect on marketing costs. Turning to marketing tasks, results are contrasted between the three countries. In Benin, collector-retailers have a lower likelihood of incurring marketing costs, particularly for transport and handling. This suggests that they might operate in a different manner. Closer examination of the data, however, reveals that Beninese collector-retailers (of which there are 65 in the sample) do not significantly differ from other traders regarding transaction size, distance, length of storage, or number of vehicles owned. Conditional on incurring marketing costs, collector-retailers incur costs similar to other categories. Other results of interest are that retailers are less likely to incur personal travel costs and handling charges, probably because they travel much shorter distances to their source of supply.

[17]The choice of instruments is motivated as follows. Owning a vehicle reduces the probability of relying on hired transporters. But when external transport is used and out-of-pocket transport charges are incurred, it should not affect transport cost. Being a woman might reduce the probability of personal travel due to parenting responsibilities and the like. But conditional on travelling, it should not affect travel costs.

[18]Marketing costs recorded in our surveys depend on quantity not on value.

7.2. Margin rates

We have found evidence of increasing returns to transaction size in marketing costs. We now investigate whether these results carry over to gross and net margins. We again begin by estimating kernel regressions of margin rates on transaction size. Results are summarized in Figure 2. Six curves are shown, two for Benin, two for Madagascar, and two for Malawi, together with their 95% confidence interval. In all cases, the upper curve is the gross margin rate μ_i^g and the lower curve is the net margin rate μ_i^n. For Benin and Madagascar, we find no evidence that margins decrease with transaction size; if anything, we see a slight increase. In Malawi, results suggest that, beyond a certain threshold, margins drop with transaction size. This is particularly true for the net margin rate.[19] At prima facie, therefore, we find little evidence of increasing returns to transaction size.

Univariate analysis is subject to omitted variable bias since it fails to take into account other factors that affect margins and costs. To control for these effects, we add regressors for the distance between point of purchase and point of sale d_i, the duration of storage s_i, and the marketing task f_i. We expect the gross margin rate to be higher for long distance purchases because of transport and personal travel costs. On average, the gross margin rate should be higher when storage duration is longer, if only to cover storage costs. Controls are also added to account for differences across crops and regions.

Margin rates – our dependent variables – are seriously affected by measurement error. Indeed, because respondents do not hold accounts, recall errors and reporting errors are large. As is well known, subtracting (the log of) two variables measured with error tends to magnify measurement error. In our case, this results in very large outliers and fat tails in the distribution of the dependent variables. OLS is known to be vulnerable to this problem, a point that is confirmed in our data. OLS results are not robust: they are very sensitive to small changes in sample size, for instance resulting from the inclusion or omission of regressors. To minimize the effect of outliers, we first redefine the dependent variable as $\log(\mu_i^g + 1)$ and $\log(\mu_i^n + 1)$ so as to obtain a 'leaner' upper tail. We also resort to median regression because they are known to be less sensitive to outliers – an observation again confirmed here.

[19] Some of the details of Figure 1 are not robust to alternative definitions of margins. For instance, if we use unit margins in US$ per Kg instead of margin rates, we observe a rapid drop in Malawi. In contrast, if we use the log of margin rates, non-linear patterns become more accentuated in both countries. What is robust across methods is that margins fall in Malawi beyond a given threshold while they rise slightly in Benin.

Results, summarized in Table 7 for gross margin rates, confirm univariate results regarding the effect of transaction size: gross margin rates are constant in Benin and Madagascar but fall with transaction size in Malawi. Put differently, traders operating on a larger scale in Malawi offer better prices to producers and consumers. The magnitude of the effect is small, however: a tenfold increase in transaction size from the median $102 would reduce the gross margin by 0.2 percentage points. Albeit the spread between producer and consumer price could be reduced if traders in Malawi operated at a larger scale, this effect would be small.

Results for net margin rates are presented in Table 8. We see that, after deduction of marketing costs, transaction size has no significant effect on margin rates in either of the three countries. Although we found marketing costs to decrease with transaction size, the effect is not strong enough to generate a negative relationship between net margin rates and transaction size: traders who buy in larger quantities do not, on average, have significantly higher net margin rates.

Other results of interest from the two Tables are that, in agreement with expectations, μ_i^g increase with distance travelled and storage duration. The effect is strong and significant in all three countries. Once marketing costs are deducted, however, margins in Benin and Malawi fall with distance while storage duration is no longer significant. This suggests that, in these two countries, transport costs increase faster with distance than purchase prices fall. In Madagascar, distance and storage duration remain positive and significant.

The regressions of Tables 7 and 8 also throw some light on differentiation by task. We expect collector-retailers to have higher margins than other traders because they bypass the middlemen; consequently, they should combine the collector's, wholesaler's and retailer's margins. By the same reasoning, wholesalers are expected to have the smallest margin rate since they perform fewer marketing functions. Once we deduct marketing costs, we expect these differences to decrease since involvement in multiple tasks also raises costs. As expected, collector-retailers have significantly higher margin rates than other traders. At the other hand of the spectrum, wholesalers have the smallest margin rates in all three countries. Once marketing costs are deducted, however, differences are no longer significant, except for collectors in Malawi, who continue to have lower margins than other traders, and for wholesalers and retailers in

Madagascar. The exception for collectors in Malawi is probably due to the way collectors operate: in contrast to Benin where collectors go back and forth between supply and purchase markets, incurring some transport costs in the process, Malawian collectors 'sit' in their supply village and incur few transport costs.

7.3. Price levels

To further investigate the relationship between margins, transaction size, and marketing tasks, we estimate similar regressions for purchase and sales price p_i^s and p_i^a (in logs). We expect traders who purchase directly from farmers to pay less. By the same token, we expect traders who sell to consumers to charge more. The presence of quantity discounts (lower purchase prices and higher sales prices) might again suggest the existence of returns to transaction size.

Results shown on Table 9 indicate the presence of large quantity discounts in Malawi and Madagascar. Such discounts are not present in Benin. But the discounts go in the same direction for purchase and sales price: traders who purchase larger quantities pay less per Kg but sell for less as well.

As expected, retailers and wholesalers pay more for the products they purchase. The effect is strong and significant in all three countries countries. Contrary to expectations, however, we do not find that retailers and collector-retailers sell at a higher price. In Benin and Madagascar, retailers and wholesalers sell at a higher price than collectors and collector-retailers. In Malawi, collectors receive a lower price than other traders, but wholesalers charge a price that is not significantly different from that of retailers and collector-retailers. These results are not due to transaction size, distance, or storage effects: omitting these variables from the regression leads to similar qualitative results. One possible explanation for these puzzling results is that the boundary between wholesale and retail is blurred, as the overwhelming majority of respondents who describe themselves as wholesalers also operate as retailers.

8. Returns to scale and factors of production

The analysis conducted until now focused on what matters for farmers and consumers, namely the gap between buying and selling prices. We also examined marginal costs for evidence of increasing returns.

In practice, however, returns to scale may arise not because of marketing margins but because of fixed factors and operating costs. Large traders may indeed sell at prices comparable to small traders but make more profit. In this situation, large traders would have similar gross and net margin rates but higher profits.

To investigate this possibility, we turn to another section of the questionnaire that collected information about total annual purchases $p_i^a Q_i$ and sales $p_i^s Q_i$ where Q_i denotes quantity sold over the entire year. The difference between the two – corrected for changes in stocks – is our measure of annual value added:[20]

$$V_i^g = Q_i(p_i^s - p_i^a) + \Delta stock$$

We also consider value added minus operating costs (excluding wages) $V_i^o \equiv V_i^g - c_i^f$; and profits $V_i^p \equiv V_i^g - c_i^v Q_i - c_i^f$. In principle, V_i^p is a better measure of returns to fixed factors, but it is subject to more measurement error. After taking logs, we also lose those observations for which, after subtracting $c_i^v Q_i$ and c_i^f, V_i^p becomes negative.

We estimate an equation of the form:

$$V_i^g = aK_i^\alpha L_i^\beta N_i^\gamma H_i^\theta e^{u_i}$$

where K_i stands for working capital, L_i is labor, N_i is social network capital, and H_i is human capital. We estimate the above regression in logs with our three measures of V_i^g, V_i^o, and V_i^p. We test for the presence of constant returns in accumulable factors, i.e., working capital, social network capital, and labor. A similar approach was used by (Fafchamps & Minten 2002) and (Fafchamps & Minten 2001).

Working capital is the rotating fund of the trader. Labor is measured in total months worked. Social network capital is the number of traders known in supply and purchase markets. Human capital is captured by gender, trade experience, years of schooling, and number of languages spoken. To control for simultaneity bias, working capital, labor, and network capital are instrumented using start-up working and network capital, age of trader and age squared, parental experience in trade, and number of siblings

[20] Because traders hold very few stocks, results are insensitive to the correction for changes in stock.

and children aged 15 and above. Region dummies are included to control for location-specific effects.

Results are presented in Table 10. Estimated coefficients are quite stable across regressions in spite of the loss of observations due to negative value added and missing information. Value added depends primarily on working and network capital, except in Madagascar where network capital is not significant.[21] In Benin and Malawi, the coefficient of labor is negative in all regressions except one, and it is never significant. In Madagascar, labor is positive and significant in one of the three regressions. Years of schooling have a negative effect on performance in all three countries; the coefficient is significant in four out of six regressions. In Malawi, female traders are less productive than their male counterparts; in the other two countries, there is no significant difference.

The presence of constant returns in working capital and labor alone is mildly rejected in only two of the three regressions in Benin. But it can no longer be rejected once marketing costs are deducted from value added. Constant returns to scale in working capital, labor, and network capital cannot be rejected in all countries and all regressions. From this we conclude that the data show no strong evidence of increasing returns to scale: large traders do not obtain a systematically higher return to accumulable factors of production. This conclusion is particularly strong if we include network capital in the list of accumulable factors of production.

9. Conclusions

In this paper, we have examined how margins and marketing costs vary across agricultural traders in sub-Saharan Africa. We expected to find evidence of returns to scale, especially regarding transport and travel costs. If increasing returns exist, the presence of myriads of small traders would be inefficient. With increasing returns, one would expect certain traders to grow over time and to eventually eliminate inefficient small operators. But obstacles to firm growth such as poor access to capital and coordination failure in transport might delay the process. Policy intervention might then be required to speed up the natural 'maturation' process of liberalized agricultural markets.

[21] This is a surprising result given that work on an earlier 1997 survey showed a strong returns to network capital (e.g. Fafchamps & Minten 2002, Fafchamps & Minten 2001). This issue deserves more investigation but since it is not the focus of this paper, we leave it for now.

Contrary to expectations, we find very little evidence that returns to scale exist in agricultural trade. This conclusion is reached after a detailed analysis of transport costs, unit margins, marketing costs, and annual value added using survey data from three African countries, Benin, Madagascar, and Malawi. Regarding transport costs, we find that motorized transport is more cost effective for large loads on longer distances. But transporters are often able to pool small quantities from multiple traders. This is especially true in Benin where population density – and thus the frequency of market interaction – is higher. As a result, traders are able to rely on motorized transport except for very short distances, e.g., within a market or a town. We also find no evidence that larger trucks are systematically more cost effective than small pickup trucks, although the data indicates that traders switch to large trucks for large transactions and long distances.

Margin rages show little relationship with transaction size. We find that all marketing costs except personal travel increase more or less proportionally with transaction size. As anticipated, personal travel costs are a source of increasing returns, but the effect is not very large. Consequently, total marketing costs are nearly proportional to transaction size. Turning to annual value added, we find that working capital and social network capital are key determinants of traders' performance. Labor is non-significant in all regressions except one. We cannot reject the presence of constant returns to scale in all accumulable factors – working capital, labor, and social network capital.

It is often believed that the presence of many small traders in agricultural markets is a source of inefficiency. In response to this perception, many governments have intervened to restrict entry into agricultural trade, either by licensing traders or rationing the allocation of market stalls. The evidence presented here suggest that these policies are neither necessary nor useful.

This does not mean that agricultural markets in Africa could not be improved. It is striking to note, for instance, that so little use is made of telephones, invoicing, payment by check, grading, quality certification, and brand names. This makes agricultural trade unwieldy. Although brokers and other intermediaries are found in Benin, their role remains peripheral. Moreover, in the absence of organized commodity exchanges, the use of brokers does not guarantee a fair, transparent price (Gabre-Madhin 2002). Contracts for future delivery are virtually unknown and traders cannot seek cover against adverse price risk by buying futures.

Upgrading agricultural markets along these lines would undoubtedly require better institutions for the enforcement of contracts, whether formal or informal. Once market institutions are modernized, it is not unlikely that returns to concentration and vertical integration will arise, triggering a reorganization of the sector away from small traders. If anything, the very high returns to network capital that are apparent in the data are suggestive of the benefits that could be obtained by reducing commitment failure and by sharing information (Fafchamps & Minten 2002). With their current level of technology and institutional sophistication, however, large traders have no strong advantage over small ones. There is no efficiency reason why the presence of small agricultural traders should be discouraged. Policies to upgrade agricultural markets should focus instead on technological and institutional innovations.

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Table 1. Main characteristics of surveyed businesses

	Unit	Benin		Madagascar		Malawi	
Characteristics of trader		**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Percent of women	percent	81%		61%		36%	
Years of schooling	# of years	2.0	0	8.4	9	5.6	6
Working capital	US dollars	1470	333	4182	154	560	136
Loans from friends and relatives	percent receiving	9%		9%		21%	
Percent with telephone	percent	4%		4%		2%	
Percent with motorized vehicle	percent	15%		8%		6%	
Manpower	number of people	2.1	1	1.9	1.00	1.6	1
Last transaction							
Quantity purchased	kg	2489	1000	1584	240	2485	420
Value of the last purchase	US dollars	435	159	329	62	417	102
Distance from purchase to sales market	km	69	23	39	1	53	15
Days since last purchase	days	22	8	11	7	8	3
Gross margin rate (1)	percent	23%	18%	32%	14%	53%	40%
Marketing costs, of which:	US dollars/ton	18	15	11	2	31	21
transport costs	US dollars/ton	11	10	5	0	15	12
personal travel costs	US dollars/ton	3	1	4	0	10	1
bagging costs	US dollars/ton	2	1	0	0	2	1
taxes and fees	US dollars/ton	0.4	0	1	0	0.9	0
Marketing costs/purchase price	percent	13%	10%	5%	1%	17%	9%
Net margin rate (2)	percent	11%	8%	27%	11%	37%	27%
Annual sales							
Value of annual purchases	US dollars/year	14493	4242	30903	7514	32807	4378
Value of annual sales	US dollars/year	18321	5316	41648	8617	43705	6759
Annual sales - annual purchases	US dollars/year	3828	825	11419	792	10898	1741
Value sales/value purchases -1	percent	22%	20%	27%	17%	49%	39%
Operating costs							
Rental of shop or storage facility	US dollars/year	70	0	170	0	19	0
Pest control	US dollars/year	107	0	47	0	21	0
Electricity	US dollars/year	1	0	77	0	10	0
Telephone	US dollars/year	20	0	44	0	5	0
Maintenance of vehicles	US dollars/year	300	0	58	0	46	0
Vehicle insurance	US dollars/year	25	0	36	0	5	0
Fees and market taxes	US dollars/year	30	0	92	10	69	50
Income tax on trading activity	US dollars/year	1	0	13	0	15	0
Wages	US dollars/year	53	0	122	0	111	0
Theft	US dollars/year	22	0	10	0	22	0
Returns to unpaid factors							
Total marketing costs (estimated)	US dollars/year	2088	389	1768	66	9257	397
Total operating costs	US dollars/year	615	26	946	97	324	83
Return to unpaid factors	US dollars/year	1762	116	9345	472	3108	1147
Return/Value of annual purchases	percent	4%	7%	10%	9%	34%	25%
Number of observations (varies somewhat across variables)		641		894		732	

(1) Gross margin rate = sale price/purchase price -1

(2) Gross margin rate = (sale price-marketing costs)/purchase price -1

Table 2. Categories of Traders

	Benin		Madagascar		Malawi	
Collector-retailers	65	11%	202	23%	367	56%
Collectors	263	45%	133	15%	194	29%
Retailers	78	13%	332	37%	77	12%
Wholesalers	175	30%	220	25%	22	3%
Number of valid observations	581		894		660	

Table 3. Determinants of transport costs
(dependent variable is the log of transport cost; estimator is OLS with robust standard errors)

		Benin		Madagascar		Malawi	
	Unit						
Distance travelled	log	0.523	**14.83**	0.356	**23.64**	0.384	**13.69**
Load size	log	0.006	0.45	-0.099	**-5.18**	-0.077	**-3.85**
Type of product (cereals = omitted category)							
Beans and peanuts	yes=1	0.415	**3.06**	-0.019	-0.74	0.615	**2.38**
Roots and tubers	yes=1	0.658	**3.68**	-0.026	-0.78	0.563	**2.04**
Fruits and vegetables	yes=1	0.506	**2.62**	0.002	0.02	-0.324	-0.91
Distance x beans and peanuts	logxdum	-0.072	**-1.97**	0.304	**3.68**	-0.106	**-1.85**
Distance x roots and tubers	logxdum	-0.179	**-3.87**	0.399	**3.08**	-0.073	-1.02
Distance x fruits and vegetables	logxdum	0.034	0.68	0.071	0.27	0.260	**2.59**
Intercept		0.081	0.56	3.412	**29.63**	1.401	**8.02**
Number of observations		807		770		774	
R-squared		0.751		0.602		0.347	
Test that distance travelled coefficient =1		F-test	p-value	F-test	p-value	F-test	p-value
Cereals		182.51	0.0000	24.07	0.0000	482.65	0.0000
Beans and peanuts		2155.97	0.0000	15.94	0.0001	207.12	0.0000
Roots and tubers		463.32	0.0000	3.44	0.0639	108.83	0.0000
Fruits and vegetables		147.36	0.0000	4.90	0.0271	13.60	0.0002

Table 4. Determinants of marketing costs in Benin
(dependent variable is log of marketing costs; Heckman maximum likelihood estimator)

A. Conditional equation		**Transport**		**Travel**		**Handling**		**Total marketing costs**	
Transaction characteristics	**Unit**	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.
Transaction size	log	1.034	**29.600**	0.031	0.860	1.078	**33.190**	0.928	**35.380**
Distance between purchase and sale (km)	log(x+1)	0.452	**18.790**	0.768	**21.880**	0.108	**4.900**	0.405	**24.420**
Days between purchase and sale	log(x+1)	-0.039	-1.160	0.007	0.140	0.076	**2.370**	0.046	**1.830**
Marketing task (collector-retailer=omitted category)									
Collector	yes=1	-0.009	-0.110	0.216	**1.950**	0.013	0.090	0.040	0.550
Retailer	yes=1	0.058	0.390	-0.088	-0.330	-0.141	-0.460	-0.566	**-3.490**
Wholesaler	yes=1	-0.308	**-2.840**	-0.058	-0.440	0.325	**2.190**	-0.120	-1.370
Crop type (cereals=omitted category_									
Beans and pulses	yes=1	-0.066	-0.590	0.083	0.690	0.097	0.880	0.050	0.590
Roots and tubers	yes=1	-0.089	-0.760	-0.157	-1.120	0.380	**2.270**	-0.007	-0.060
Fruits and vegetables	yes=1	0.228	1.640	0.070	0.460	0.111	0.280	0.094	0.640
Region dummies (north=omitted category)									
Central	yes=1	-0.296	**-3.040**	0.265	**2.390**	-0.331	**-4.030**	-0.087	-1.270
South	yes=1	-0.161	**-2.280**	0.218	**2.440**	-0.627	**-7.490**	-0.066	-1.060
Intercept		-6.185	**-31.450**	-2.744	**-17.920**	-7.247	**-32.000**	-5.039	**-35.830**
B. Selection equation									
Transaction characteristics	**Unit**								
Transaction size	log	-0.001	-0.010	-0.123	**-2.150**	0.219	**2.260**	-0.118	-0.470
Distance between purchase and sale (km)	log(x+1)	0.889	**3.570**	0.749	**9.340**	0.424	**6.520**	5.408	**7.600**
Days between purchase and sale	log(x+1)	-0.152	-1.190	0.022	0.300	0.138	**1.680**	-0.542	**-2.360**
Marketing task (collector-retailer=omitted category)									
Collector	yes=1	1.112	**2.640**	0.105	0.320	1.511	**5.370**	1.860	**3.190**
Retailer	yes=1	1.029	**2.250**	-1.202	**-2.700**	0.369	1.160	1.095	**1.840**
Wholesaler	yes=1	1.372	**2.850**	-0.046	-0.150	1.159	**4.150**	9.229	**7.440**
Crop type (cereals=omitted category_									
Beans and pulses	yes=1	0.414	1.410	-0.807	**-2.940**	0.097	0.350	8.082	**10.650**
Roots and tubers	yes=1	0.486	1.220	-0.829	**-3.640**	-0.989	**-2.930**	0.067	0.120
Fruits and vegetables	yes=1	-0.170	-0.420	-0.568	**-2.130**	-1.061	**-2.490**	0.371	0.620
Region dummies (north=omitted category)									
Central	yes=1	-0.102	-0.330	0.709	**2.950**	-0.690	**-2.900**	-0.184	-0.330
South	yes=1	-0.379	-1.050	1.683	**5.260**	-0.587	**-2.170**	0.222	0.420
Trader characteristics (selection instruments)									
Working capital	log	0.369	**2.810**	-0.280	**-3.110**	-0.075	-0.830	0.713	**2.730**
Value of transport vehicles	log(x+1)	-0.142	**-2.200**	-0.017	**-3.010**	-0.005	-0.110	-0.091	-0.830
Capacity of storage facilities	log(x+1)	0.067	**2.050**	0.087	**12.500**	-0.068	**-2.260**	-0.024	-0.380
Number of business contacts	log	-0.032	-0.350	0.139	**2.390**	-0.293	**-3.890**	-0.528	**-2.360**
Gender	female=1	0.383	0.830	0.716	**12.790**	0.269	0.870	0.271	0.460
Intercept		-2.482	**-2.490**	-1.403	.	-0.753	-1.140	-0.509	-0.390
/athrho		-0.501	**-2.530**	16.311	488.050	0.312	**2.200**	-0.047	-0.300
/lnsigma		-0.382	**-6.940**	-0.473	-6.250	-0.444	**-9.670**	-0.607	**-11.860**
rho		-0.463	-0.711	1.000	1.000	0.303	0.034	-0.047	-0.342
sigma		0.683	0.613	0.623	0.537	0.641	0.586	0.545	0.493
lambda		-0.316	-0.535	0.623	0.531	0.194	0.032	-0.026	-0.194
Number of observations		477		477		477		477	
of which uncensored		433		268		380		459	
		F-stat.	p-value	F-stat.	p-value	F-stat.	p-value	F-stat.	p-value
Test if coef. of transaction size = 1		0.94	0.3332	729.16	0.0000	5.75	0.0164	7.56	0.0060

Table 5. Determinants of marketing costs in Madagascar
(dependent variable is log of marketing costs; Heckman maximum likelihood estimator)

A. Conditional equation		**Transport**		**Travel**		**Total marketing costs**	
Transaction characteristics	**Unit**	Coef.	z stat.	Coef.	z stat.	Coef.	z stat.
Transaction size	log	0.719	**13.16**	0.105	1.39	0.656	**12.59**
Distance between purchase and sale (km)	log(x+1)	0.494	**12.07**	0.576	**9.07**	0.572	**14.08**
Days between purchase and sale	log(x+1)	-0.077	-1.00	0.140	1.37	-0.039	-0.49
Marketing task (collector-retailer=omitted category)							
Collector	yes=1	0.290	1.15	-0.004	-0.02	0.417	**1.75**
Retailer	yes=1	0.078	0.40	-0.167	-0.70	0.190	0.95
Wholesaler	yes=1	-0.165	-0.74	-0.368	-1.23	-0.198	-0.89
Crop type (cereals=omitted category_							
Beans and pulses	yes=1	-0.052	-0.32	0.264	1.15	0.227	1.47
Roots and tubers	yes=1	0.252	1.43	0.120	0.61	0.313	**1.75**
Fruits and vegetables	yes=1	-0.032	-0.05	1.319	1.42	1.192	**5.39**
Region dummies (north=omitted category)							
Central	yes=1	0.471	**3.09**	0.558	**2.10**	0.537	**3.16**
South	yes=1	0.358	**2.29**	0.213	1.02	0.575	**3.63**
Intercept		3.344	**9.75**	6.151	**12.67**	3.644	**9.55**
B. Selection equation	**Unit**						
Transaction characteristics							
Transaction size	log	0.119	1.51	-0.038	-0.59	0.327	**4.50**
Distance between purchase and sale (km)	log(x+1)	0.337	**6.09**	0.338	**8.38**	0.230	**4.32**
Days between purchase and sale	log(x+1)	-0.027	-0.30	0.019	0.25	-0.214	**-2.17**
Marketing task (collector-retailer=omitted category)							
Collector	yes=1	0.342	1.39	-0.018	-0.07	-0.337	-1.15
Retailer	yes=1	0.765	**4.46**	0.197	1.06	0.238	0.99
Wholesaler	yes=1	0.567	**2.41**	-0.182	-0.77	-0.074	-0.27
Crop type (cereals=omitted category_							
Beans and pulses	yes=1	-0.404	**-2.46**	-0.306	**-1.72**	-0.194	-1.11
Roots and tubers	yes=1	-0.134	-0.66	0.133	0.67	0.055	0.23
Fruits and vegetables	yes=1	13.957	.	0.896	1.34	4.269	**2.15**
Region dummies (north=omitted category)							
Central	yes=1	0.375	**2.05**	0.239	1.30	0.485	**2.27**
South	yes=1	-0.102	-0.65	0.570	**3.41**	0.291	**1.70**
Trader characteristics (selection instruments)							
Working capital	log	-0.043	-0.76	0.012	0.19	-0.186	**-3.30**
Value of transport vehicles	log(x+1)	-0.024	**-2.43**	-0.034	**-2.86**	-0.019	**-1.80**
Capacity of storage facilities	log(x+1)	-0.032	-1.12	-0.019	-0.66	-0.031	-0.99
Number of business contacts	log	0.138	**1.75**	-0.154	-1.66	0.161	1.66
Gender	female=1	0.058	0.53	-0.015	-0.12	0.089	0.70
Intercept		-0.320	-0.49	-0.935	-1.22	1.500	**2.26**
/athrho		0.954	**3.32**	0.141	0.82	**1.048**	**2.17**
/lnsigma		0.128	**1.80**	-0.041	-0.54	**0.200**	**2.56**
rho		0.742		0.140		0.781	
sigma		1.137		0.960		1.222	
lambda		0.843		0.135		0.954	
Number of observations		665		665		665	
of which uncensored		501		175		551	
		F-stat	p-value	F-stat	p-value	F-stat	p-value
Test if coef. of transaction size = 1		26.48	0.0000	141.80	0.0000	43.42	0.0000

Note: handling costs omitted from this table because too few uncensored observations (19).

Table 6. Determinants of marketing costs in Malawi
(dependent variable is log of marketing costs; Heckman maximum likelihood estimator)

A. Conditional equation		**Transport**		**Travel**		**Handling**		**Total marketing costs**	
Transaction characteristics	**Unit**	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.
Transaction size	log	0.914	**25.240**	0.084	**2.030**	1.222	**24.330**	0.918	**20.070**
Distance between purchase and sale (km)	log(x+1)	0.285	**7.280**	0.547	**8.750**	0.077	**2.460**	0.619	**18.630**
Days between purchase and sale	log(x+1)	0.066	1.500	0.062	1.170	-0.149	**-2.050**	0.045	0.730
Marketing task (collector-retailer=omitted category)									
Collector	yes=1	-0.284	**-2.430**	0.253	**1.820**	0.075	0.500	-0.255	**-1.970**
Retailer	yes=1	-0.161	-1.440	0.082	0.850	0.431	**2.290**	-0.050	-0.310
Wholesaler	yes=1	0.021	0.130	0.348	1.510	0.367	**1.720**	-0.036	-0.190
Crop type (cereals=omitted category_									
Beans and pulses	yes=1	0.154	1.450	0.239	**1.960**	0.239	1.640	0.154	1.030
Roots and tubers	yes=1	0.225	**1.970**	0.081	0.550	0.267	**1.740**	-0.036	-0.210
Fruits and vegetables	yes=1	0.719	**3.060**	0.295	1.140	1.837	**7.630**	1.124	**4.810**
Region dummies (north=omitted category)									
Central	yes=1	-0.005	-0.050	-0.194	**-1.650**	0.212	1.410	-0.133	-1.060
South	yes=1	0.113	1.090	0.234	**1.980**	0.423	**3.250**	0.047	0.330
Intercept		-4.847	**-17.810**	-1.793	**-6.510**	-8.185	**-29.880**	-5.572	**-17.570**
B. Selection equation	**Unit**								
Transaction characteristics									
Transaction size	log	0.166	**1.790**	0.008	0.070	-0.248	**-3.260**	-0.123	-1.370
Distance between purchase and sale (km)	log(x+1)	0.638	**10.460**	1.445	**8.690**	0.062	1.000	0.221	**3.660**
Days between purchase and sale	log(x+1)	0.122	1.250	-0.008	-0.060	0.515	**4.840**	0.285	2.360
Marketing task (collector-retailer=omitted category)									
Collector	yes=1	-0.547	**-2.170**	-0.475	-1.300	0.346	**1.670**	-0.258	-1.180
Retailer	yes=1	-0.074	-0.280	0.241	0.990	-0.599	**-2.360**	-0.517	**-2.000**
Wholesaler	yes=1	-0.605	-1.340	-0.791	-1.190	0.166	0.390	5.310	**21.870**
Crop type (cereals=omitted category_									
Beans and pulses	yes=1	0.041	0.170	-0.095	-0.320	-0.192	-0.940	0.027	0.100
Roots and tubers	yes=1	-0.041	-0.160	-0.804	**-2.220**	0.255	1.080	0.231	0.780
Fruits and vegetables	yes=1	1.067	**1.920**	-1.451	**-2.490**	-0.986	**-3.460**	0.166	0.400
Region dummies (north=omitted category)									
Central	yes=1	-0.195	-1.080	-0.915	**-2.770**	-0.781	**-4.240**	-0.483	**-2.440**
South	yes=1	0.135	0.430	-0.184	-0.760	-0.514	**-2.180**	-0.039	-0.130
Trader characteristics (selection instruments)									
Working capital	log	-0.042	-0.420	-0.200	-1.320	0.065	0.810	-0.001	-0.010
Value of transport vehicles	log(x+1)	-0.007	-0.150	-0.122	**-1.990**	0.027	0.800	0.009	0.180
Capacity of storage facilities	log(x+1)	0.034	1.110	0.073	1.590	0.020	1.020	0.042	1.490
Number of business contacts	log	0.244	**2.540**	-0.018	-0.120	-0.245	**-2.500**	0.003	0.030
Gender	female=1	0.081	0.410	-1.078	**-3.250**	-0.074	-0.420	-0.273	-1.060
Intercept		-2.427	**-4.140**	-0.827	-1.090	2.461	**4.800**	1.528	**2.530**
/athrho		0.013	0.090	0.265	1.670	-1.287	**-2.360**	-0.001	-0.010
/lnsigma		-0.353	**-7.070**	-0.253	**-3.300**	0.081	1.180	0.070	**1.830**
rho		0.013	-0.254	0.259	-0.046	-0.858	-0.982	-0.001	-0.179
sigma		0.702	0.637	0.776	0.668	1.085	0.947	1.073	0.995
lambda		0.009	-0.182	0.201	-0.020	-0.931	-1.348	-0.001	-0.194
Number of observations		532		532		532		532	
of which uncensored		374		319		449		491	
Test if coef. of transaction size = 1		5.66	0.0173	494.10	0.0000	19.55	0.0000	3.22	0.0727

Table 7. Determinants of Gross Margin Rates
(dependent variable is log of sales price/purchase price ratio; median regression)

		Benin		Madagascar		Malawi	
Transaction characteristics	**Unit**	**Coef.**	**t stat.**	**Coef.**	**t stat.**	**Coef.**	**t stat.**
Transaction size	log	0.001	0.440	-0.002	-1.610	-0.007	**-2.950**
Distance between purchase and sale (km	log(x+1)	0.004	**4.240**	0.011	**10.650**	0.006	**4.300**
Days between purchase and sale	log(x+1)	0.005	**2.870**	0.013	**5.930**	0.011	**3.440**
Marketing task (collector-retailer=omitted category)							
Collector	yes=1	-0.001	-0.210	0.009	1.470	-0.033	**-4.310**
Retailer	yes=1	-0.019	**-2.810**	-0.019	**-4.720**	-0.019	**-2.130**
Wholesaler	yes=1	-0.025	**-4.250**	-0.025	**-4.470**	-0.036	**-2.500**
Crop type (cereals=omitted category_							
Beans and pulses	yes=1	-0.015	**-3.050**	-0.001	-0.170	0.018	**2.340**
Roots and tubers	yes=1	0.006	1.070	0.058	**11.760**	0.111	**13.270**
Fruits and vegetables	yes=1	0.014	**2.010**	0.012	0.570	0.039	**2.770**
Region dummies (north=omitted category)							
Central	yes=1	0.018	**4.360**	-0.037	**-8.630**	0.003	0.470
South	yes=1	0.021	**5.500**	-0.038	**-10.040**	0.008	0.970
Intercept		0.054	**5.990**	0.079	**10.750**	0.139	**9.400**
Number of observations		517		865		518	
Pseudo R-squared		0.114		0.182		0.155	

Table 8. Determinants of Net Margin Rates
(dependent variable is log of (sales price-marketing costs)/purchase price ratio; median regression)

		Benin		Madagascar		Malawi	
Transaction characteristics	**Unit**	**Coef.**	**t stat.**	**Coef.**	**t stat.**	**Coef.**	**t stat.**
Transaction size	log	0.001	0.350	0.002	1.170	0.005	1.360
Distance between purchase and sale (km	log(x+1)	-0.025	**-12.670**	0.007	**6.020**	-0.017	**-7.400**
Days between purchase and sale	log(x+1)	0.002	0.530	0.018	**7.510**	-0.000	-0.010
Marketing task (collector-retailer=omitted category)							
Collector	yes=1	-0.010	-0.850	-0.011	-1.520	-0.032	**-2.640**
Retailer	yes=1	0.000	0.020	-0.024	**-5.390**	-0.001	-0.090
Wholesaler	yes=1	-0.019	-1.460	-0.030	**-4.920**	0.007	0.320
Crop type (cereals=omitted category_							
Beans and pulses	yes=1	0.021	**1.910**	0.001	0.200	0.074	**6.010**
Roots and tubers	yes=1	0.000	0.030	0.056	**10.640**	0.072	**5.600**
Fruits and vegetables	yes=1	0.007	0.470	-0.074	**-3.300**	0.072	**3.330**
Region dummies (north=omitted category)							
Central	yes=1	-0.008	-0.870	-0.034	**-7.330**	0.029	**2.860**
South	yes=1	0.010	1.270	-0.036	**-8.870**	0.029	**2.330**
Intercept		0.039	**1.970**	0.044	**5.500**	0.035	1.490
Number of observations		516		848		502	
Pseudo R-squared		0.231		0.125		0.097	

Table 9. Determinants of Price Levels
(dependent variable is log of price per Kg; median regression)

		Benin				**Madagascar**				**Malawi**			
		Purchase price		**Sale price**		**Purchase price**		**Sale price**		**Purchase price**		**Sale price**	
Transaction characteristics	**Unit**	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.
Transaction size	log	0.001	0.090	0.000	0.010	-0.027	**-3.880**	-0.022	**-2.750**	-0.070	**-4.270**	-0.071	**-5.300**
Distance between purchase and sale (km)	log(x+1)	-0.024	**-3.900**	-0.016	**-2.310**	0.004	0.950	0.026	**4.730**	0.039	**3.550**	0.049	**5.550**
Days between purchase and sale	log(x+1)	0.002	0.160	0.005	0.410	0.002	0.210	0.025	**2.110**	-0.028	-1.200	0.024	1.320
Marketing task (collector-retailer=omitted category)													
Collector	yes=1	0.010	0.270	0.060	1.500	-0.050	**-1.650**	-0.002	-0.050	0.016	0.290	-0.134	**-2.920**
Retailer	yes=1	0.284	**6.340**	0.263	**5.130**	0.186	**9.550**	0.073	**3.240**	0.117	**1.810**	0.039	0.740
Wholesaler	yes=1	0.276	**7.040**	0.256	**5.660**	0.240	**8.920**	0.109	**3.450**	0.183	**1.710**	0.104	1.220
Crop type (cereals=omitted category)													
Beans and pulses	yes=1	1.090	**32.510**	1.029	**26.620**	0.591	**29.100**	0.584	**24.800**	1.101	**18.930**	1.146	**24.540**
Roots and tubers	yes=1	0.388	**9.810**	0.365	**8.020**	-0.462	**-19.720**	-0.341	**-12.610**	-0.396	**-6.520**	-0.107	**-2.180**
Fruits and vegetables	yes=1	0.818	**17.620**	0.873	**16.230**	0.194	**1.940**	0.352	**2.990**	1.222	**12.270**	1.709	**21.080**
Region dummies (north=omitted category)													
Central	yes=1	-0.257	**-9.250**	-0.240	**-7.520**	-0.114	**-5.690**	-0.206	**-8.790**	0.123	**2.550**	0.099	**2.510**
South	yes=1	-0.182	**-7.220**	-0.179	**-6.120**	-0.121	**-6.800**	-0.238	**-11.500**	0.294	**4.820**	0.349	**7.220**
Intercept		-1.943	**-32.170**	-1.803	**-26.020**	7.504	**215.130**	7.714	**191.250**	-1.621	**-14.990**	-1.403	**-15.980**
Number of observations		520		517		865		881		527		520	
Pseudo R-squared		0.427		0.429		0.367		0.389		0.476		0.502	

Table 10. Returns to Fixed Factors
(dependent variable is log of value added; instrumental variable regression)

A. Benin	**Unit**	**Gross value added**		**Minus operating costs**		**Minus marketing costs**	
		Coef.	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Working capital (*)	log	0.902	**5.470**	0.893	**4.420**	0.711	**3.360**
Manpower in months worked (*)	log	-0.606	-1.260	-0.875	-1.590	0.007	0.010
Network capital (*)	log	0.541	**5.880**	0.613	**5.990**	0.387	**2.630**
Years of schooling of trader	level	-0.060	**-2.090**	-0.057	**-1.720**	-0.063	-1.540
Years of experience of trader	log	-0.021	-0.150	-0.066	-0.400	-0.196	-1.000
Nber of languages spoken by trader	level	0.101	1.390	0.084	1.040	0.100	1.110
Gender of trader	female=1	-0.113	-0.490	-0.217	-0.830	-0.149	-0.440
Central region	yes=1	0.348	**1.740**	0.232	1.030	0.281	0.980
Southern region	yes=1	0.346	**1.940**	0.187	0.950	-0.196	-0.850
Intercept		-0.192	-0.200	0.032	0.030	1.268	1.040
Number of observations		472		442		332	
R-squared		0.358		0.275		0.242	
		F-stat.	p-value	F-stat.	p-value	F-stat.	p-value
Test working capital and labor jointly		18.64	0.0000	10.99	0.0000	7.16	0.0009
Test CRS in working capital and labor		3.09	0.0795	4.71	0.0305	0.20	0.6564
Test CRS in working capital, labor, and contacts		0.2	0.6526	0.81	0.3675	0.04	0.8477

B. Madagascar							
		Coef.	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Working capital (*)	log	0.425	**3.500**	0.418	**3.140**	0.448	**3.440**
Manpower in months worked (*)	log	0.905	1.580	1.206	**2.030**	0.798	1.340
Network capital (*)	log	0.008	0.060	0.044	0.290	0.095	0.640
Years of schooling of trader	level	-0.017	-0.930	-0.014	-0.690	-0.011	-0.540
Years of experience of trader	log	0.118	0.650	0.012	0.060	0.084	0.450
Nber of languages spoken by trader	level	0.407	**3.110**	0.351	**2.310**	0.388	**2.500**
Gender of trader	female=1	0.125	0.840	0.118	0.690	0.070	0.420
Central region	yes=1	-0.816	**-3.210**	-0.893	**-2.950**	-0.751	**-2.390**
Southern region	yes=1	-0.522	**-2.610**	-0.576	**-2.540**	-0.537	**-2.300**
Intercept		9.348	**5.930**	9.482	**5.620**	8.778	**5.280**
Number of observations		704		620		582	
R-squared		0.410		0.379		0.426	
		F-stat.	p-value	F-stat.	p-value	F-stat.	p-value
Test working capital and labor jointly		16.48	0.0000	15.05	0.0000	13.62	0.0000
Test CRS in working capital and labor		0.42	0.5153	1.38	0.2409	0.21	0.6454
Test CRS in working capital, labor, and contacts		0.40	0.5288	1.41	0.2361	0.39	0.5346

C. Malawi							
		Coef.	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
Working capital (*)	log	0.582	**3.140**	0.677	**3.320**	0.571	**2.500**
Manpower in months worked (*)	log	-0.167	-0.270	-0.354	-0.540	-0.218	-0.290
Network capital (*)	log	0.562	**3.850**	0.655	**4.020**	0.669	**3.600**
Years of schooling of trader	level	-0.016	-0.790	-0.038	**-1.710**	-0.061	**-2.260**
Years of experience of trader	log	0.096	1.130	0.068	0.720	0.086	0.800
Nber of languages spoken by trader	level	-0.039	-0.580	0.030	0.400	0.016	0.190
Gender of trader	female=1	-0.407	**-2.730**	-0.453	**-2.780**	-0.504	**-2.740**
Central region	yes=1	0.085	0.630	0.138	0.930	0.323	**1.910**
Southern region	yes=1	-0.111	-0.450	-0.153	-0.570	0.081	0.280
Intercept		3.059	**3.330**	2.309	**2.210**	2.494	**2.250**
Number of observations		583		565		494	
R-squared		0.379		0.352		0.304	
		F-stat.	p-value	F-stat.	p-value	F-stat.	p-value
Test working capital and labor jointly		23.55	0.0000	22.65	0.0000	13.46	0.0000
Test CRS in working capital and labor		1.71	0.1913	1.97	0.1608	1.41	0.2349
Test CRS in working capital, labor, and contacts		0.00	0.9591	0.00	0.9642	0.00	0.9686

(*) Instrumented using start-up working and network capital, age of trader and age squared, parental experience in trade, and number of siblings and children aged 15 and above.

All costs in US$ per Kg

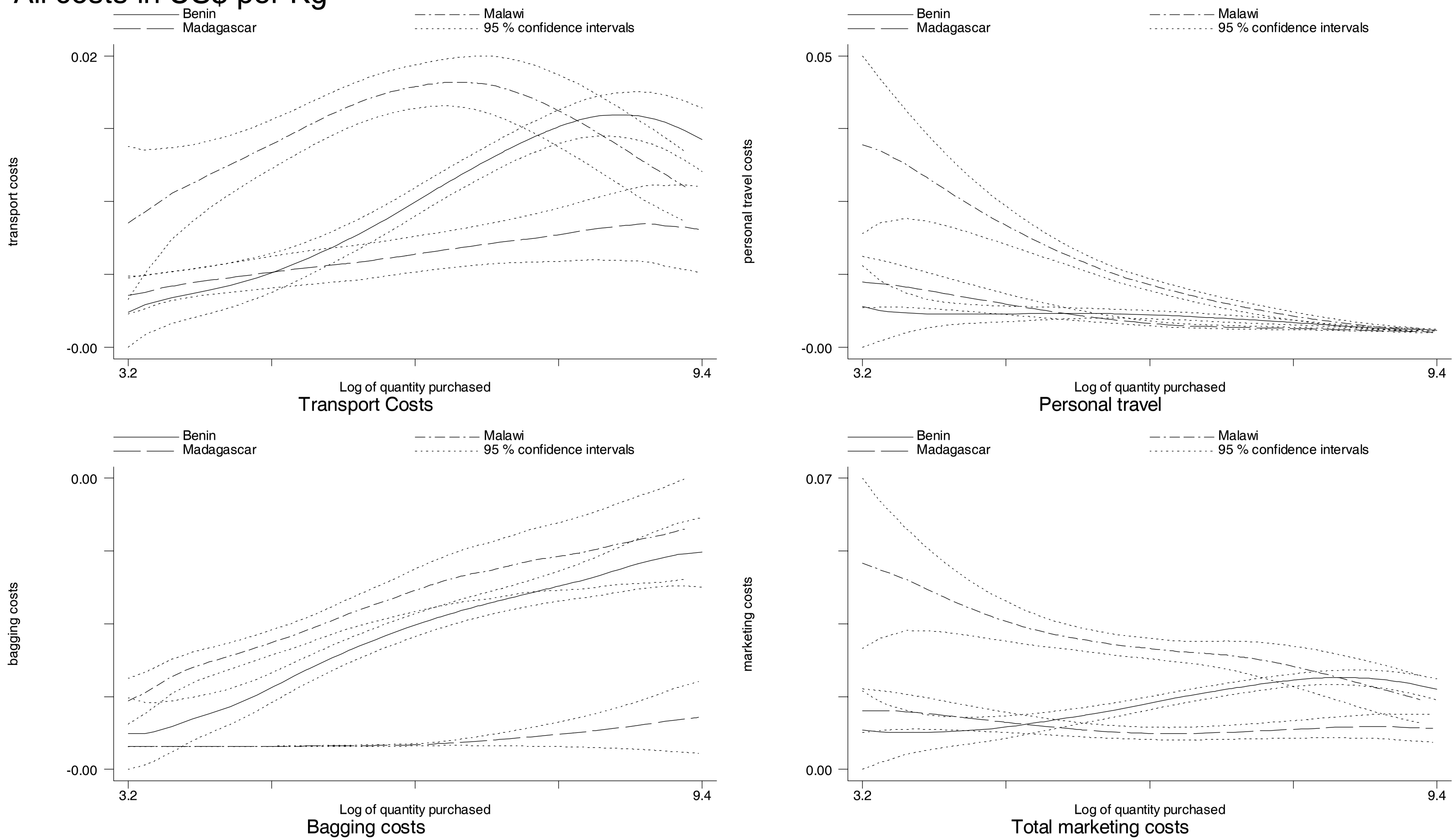

Figure 1. Costs and Transaction Size

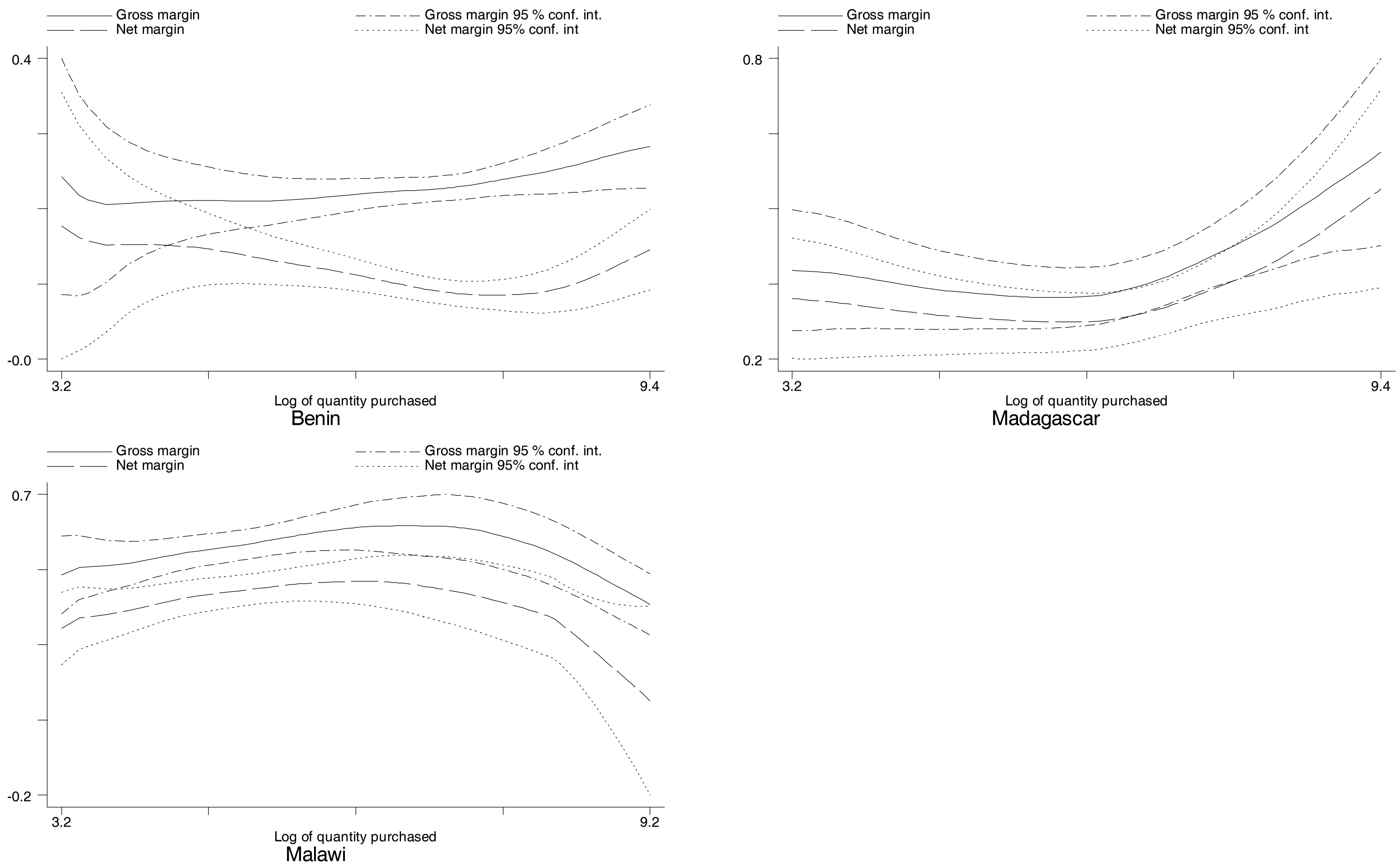

Figure 2. Margins and Transaction Size