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## **MTID\* DISCUSSION PAPER NO. 60**

### **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 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.

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# **INCREASING RETURNS AND MARKET EFFICIENCY IN AGRICULTURAL TRADE**

Marcel Fafchamps<sup>1</sup>, Eleni Gabre-Madhin<sup>2</sup> and Bart Minten<sup>3</sup>

## **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 remains untouched. However, the kind of markets that have emerged from this movement differs markedly across sectors and countries. Trade in agricultural commodities offers a striking illustration (Swinnen 1997, Kherallah et al., 2002). 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 on contract with agri-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. Agri-businesses also take care of quality control, transport, storage, and processing (Jaffee and Morton, 1995).

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In contrast, market liberalization in poorer countries has resulted in de-concentration 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 operators operating in a rudimentary fashion. This is particularly true in Africa (Staatz, Dione, and Dembele, 1989; Berg 1989; Barrett, 1997; Fafchamps and Minten, 1999; Fafchamps and Minten, 2002; Jayne and Jones, 1997; Coulter and 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, indicating the co-existence of a few very large enterprises with a large number of very small trading enterprises, which suggests 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 (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 (Ahmed and Rustagi, 1987; Staatz et al., 1989; Minten and Kyle, 1999; Barrett, 1997; Barrett, 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 (Bauer, 1954; Jones, 1959; Eddy, 1979; Staatz et al., 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 (Timmer 1986; Ravallion, 1986; Baulch, 1997; Dercon, 1995; Badiane, 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 to 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 evidence of increasing returns in US and Spanish manufacturing (Morrison and Siegel, 1997; Morrison and Siegel, 1999; Millan, 1999), 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 out compete small ones and eventually to eliminate them. Although large relative to other marketing costs, personal travel costs nevertheless remain too small to generate increasing returns in trade. Transport costs, which are the main component of marketing costs, show little reduction with transaction size because of load pooling.

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 data and main characteristics of surveyed traders are discussed in Section 3. An analysis of transport costs is presented in Section 4. Margins and marketing costs are examined in Section 5. Conclusions and policy implications are discussed 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 (Gardner, 1975; Dornbusch, Fisher, and Samuelson, 1977; Takayama and Judge, 1971; Benischka and Binkley, 1995). Marketing rents are likely to arise when traders collude or occupy a monopoly or monopsony position. Given that agricultural markets in Africa are characterized by widespread competition and free entry, collusion is not a serious concern. Fafchamps and Minten (2002), for instance, reject collusion among agricultural traders in Madagascar. Consequently, 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  $f_i = \{f_i^1 \dots f_i^F\}$  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:

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

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 point  $\bar{q}$  beyond which unit cost is a constant, firm 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:

$$c_i(q_i, d_i, \{ \dots f_i^j = 1, \dots, f_i^k = 1, \dots \}) < c_i(q_i, d_i, \{ \dots f_i^j = 1, \dots, f_i^k = 0, \dots \}) + c_i(q_i, d_i, \{ \dots f_i^j = 0, \dots, f_i^k = 1, \dots \})$$

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

In practice, unit cost has several components: (1) what we call *marketing costs*, that is, measurable cash outlays that vary with traded quantities  $c_i^u$ , 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  $p_i^s - p_i^a - c_i^u - c_i^f / q_i$  where  $p_i^s$  is the sales price of trader  $i$ ,  $p_i^a$  is the purchase price, and  $c_i^u$  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*  $\mu_i^n \equiv (p_i^s - c_i^u) / p_i^a - 1$ .

Investigating these three categories of costs is the object of the rest of the paper. After having presented the countries and data, we begin by taking a close look at marketing costs. We first examine transport costs in detail. 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 both underwent a liberalization of domestic food marketing. But they differ dramatically in the role played by the private 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 and 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) were 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 (Seppälä, 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, 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 delivery to 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 mid 1983 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 was reduced in 1995 to 10%. 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 (Kherallah et al., 2002; Staatz, Dione & Dembele 1989). Trade in agricultural products in Madagascar has been analyzed by other authors, most notably (e.g. Barrett 1997a, Barrett 1997b) 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).

All three surveys focus on agricultural traders at both the wholesaler and retailer level.<sup>4</sup> 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 both 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 663 agricultural traders.

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

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<sup>4</sup> Efforts to include agricultural inputs and cash crops into the survey were largely unsuccessful. 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 Société 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 handful of independent tobacco traders are recorded in the Malawi survey.

were entered into a spreadsheet and the sample was drawn randomly from the census data using a computer algorithm. A total sample of 738 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 (fraisana). Rural fraisanas were selected through stratified sampling based on agro-ecological characteristics so as to be representative of the various kinds 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. Only 30% of the surveyed 1997 traders were still operating in 2001. The 2001 sample is constructed so as to be representative of the trader population in 2001.

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

## 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, Fafchamps, Kachule, Soule & Khan (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 Benin traders, with Malawian traders in between.

### FIRM ASSETS

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 has 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.

**Table 1—Main characteristics of surveyed business**

	Unit	Benin		Madagascar		Malawi	
		Mean	Median	Mean	Median	Mean	Median
<b>Characteristics of trader</b>							
Percent of women	percent	81%		61%		36%	
Years of schooling	# of years	2	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
<b>Last transaction</b>							
Quantity purchased	kg	2489	1000	1584	240	2485	420
Value of the last purchase	US dollars	435	159	329	62	417	102
Distance of 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 :							
transport costs	US dollars/ton	18	15	11	2	31	21
personal travel costs	US dollars/ton	11	10	5	0	15	12
bagging costs	US dollars/ton	3	1	4	0	10	1
taxes and fees	US dollars/ton	2	1	0	0	2	1
Marketing costs/purchase price	percent	13%	10%	5%	1%	17%	9%
Net Margin rate (2)	percent	11%	8	27%	11%	37%	27%
<b>Annual sales</b>							
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%
<b>Operating costs</b>							
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
<b>Return to unpaid factors</b>							
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 observation (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

## MARGINS

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, 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 trader's reports 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  $f_i$ .

## MARKET STRUCTURE

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-retailers. 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.

**Table 2—Categories of Traders**

	<b>Benin</b>		<b>Madagascar</b>		<b>Malawi</b>
Collector-retailers	65	11%	202	23%	367
Collectors	263	45%	133	15%	194
Retailers	78	13%	332	37%	77
Wholesalers	175	30%	220	25%	22
Number of valid observation	581		894		660

Using the proportion of traders falling in different categories, we construct an (somewhat heroic) estimate of the average number of transactions between farmer and consumer.<sup>5</sup> 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 gross margin rates are 23% in Benin, 32% in Madagascar, and 53% in Malawi. If all traders charge the average margin, the consumer price in Benin would be 102% above the farmer price ( $1.23^{3.4}=2.02$ ). Similar calculations for Malawi and Madagascar yield

<sup>5</sup> 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.

consumer prices 134% ( $1.53^2=2.34$ ) and 97% ( $1.32^{2.4}=1.97$ ) above farmer prices, respectively.<sup>6</sup> These calculations, however heroic they may be, suggest that differences in gross margin rates across countries largely reflect different levels of vertical integration.

## COSTS

Detailed information was collected on the various out-of-pocket costs 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 represents by far the largest component of marketing costs, accounting for 50-60% of the total. 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 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,

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<sup>6</sup> Using medians instead yields a price gap of 76% in Benin and 96% in 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.<sup>7</sup> 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.

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<sup>7</sup> Traders who derive less than 10% of their annual revenue from agricultural trader are omitted.

## 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 marketing costs. The importance of rural roads is a feature common to other parts of the developing world (Jacoby 2000; Binswanger, Khander and Rosenweig 1993) but particularly crucial in Africa (Ahmed and Rustagi 1987). 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, transport costs per Kg 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.<sup>8</sup>

If traders transport small loads on small, half-empty trucks, transport costs are higher than optimal. They could be reduced and trade efficiency could be improved by organizing larger loads. In contrast, if transporters efficiently pool loads from multiple traders, 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.

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<sup>8</sup> 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.

Transport costs also depend on distance traveled. If loading (and off-loading) costs are negligible, transport costs are roughly proportional to 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 would be cheaper.

To test for transport efficiency, we proceed as follows. Let  $c'_i(q_i, d)$  denote transport costs per Kg. We assume:

$$c'_i(q_i, d_i) = \theta q_i^\alpha d_i^\delta e^{u_i} \quad (6.1)$$

Where  $\theta, \alpha$  and  $\delta$  are parameters to be estimated,  $q_i$  is load size,  $d_i$  is distance, and  $u_i$  is an error term. If transport is inefficient, large loads cost less per Kg than small loads and the coefficient on load size is significantly negative. Transport efficiency thus requires that  $\alpha = 0$ . The absence of fixed transport costs with respect to distance implies  $\delta = 1$ . 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  $\delta$  to be further below 1 in low trade density areas.

For each respondent, information was collected on transport costs 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. The

others transport products across markets, nearly always with a external transporter. 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 handcarts and ox-carts. Train transport is not used by respondents in either of the countries studied. 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 than motorized transport. 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 traveled has a strongly significant effect on transport cost but  $\delta$  is significantly smaller than one in all three countries, suggesting the presence of large loading and offloading 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 Benin 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.

**Table 3—Determinants of transport costs**

(dependent variable is the log of transport costs; estimator is OLS with robust standard errors)

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

To investigate these issues further, we examine whether transport costs vary by mode of transport. We re-estimate equation 6.1 separately for motorized and non-motorized transport. We expect to find a large  $\delta$  and correspondingly large  $\theta$  for non-motorized transport. For this estimation to yield meaningful results, we need to correct for selection bias: presumably traders choose the cheapest mode of transport available. To control for this possibility, we estimate a two-step self-selection model (see Maddala (1983), page 257-258). Let  $c_n$  and  $c_m$  denote the cost of non-motorized and motorized transport, respectively.

We have:

$$\begin{aligned}\log c_n^t &= X' \beta_n + u_n \\ \log c_m^t &= X' \beta_m + u_m\end{aligned}$$

Define  $z = \frac{X' \beta_n - X' \beta_m}{\sigma}$  and  $u = \frac{u_m - u_n}{\sigma}$  with  $\sigma^2 = \text{var}(u_n - u_m)$ . A trader selects non-motorized transport if  $c_n < c_m$  that is, if  $u > z$ . Vice versa for motorized transport.

We thus have:

$$\begin{aligned}E[c_n^t \mid u > z] &= X' \beta_n + \sigma_{nu} \frac{\phi(z)}{\Phi(z)} \\ E[c_m^t \mid u < z] &= X' \beta_m - \sigma_{mu} \frac{\phi(z)}{1 - \Phi(z)}\end{aligned}$$

With  $\sigma_{nu} = \frac{\sigma_{nm} - \sigma_n^2}{\sigma}$  and  $\sigma_{mu} = \frac{\sigma_m^2 - \sigma_{nm}}{\sigma}$  (Maddala 1983). The above equation suggests a method for obtaining a consistent estimator of  $\beta_n$  and  $\beta_m$ : regress the choice of mode

of transport on a vector of instruments, e.g., trader characteristics; compute the Mills ratios; and regress  $c_n$  and  $c_m$  on  $X$  and the Mills ratios.

Results from this procedure are shown on Table 4. Instruments include trader characteristics that may affect the choice of transport mode. In all three countries, distance traveled raises the probability of using motorized transport. Self-selection has a strong effect on the choice of non-motorized transport in Benin: without self-selection, the average cost of non-motorized transport would be higher. Self-selection is also significant in the motorized transport regression for Madagascar. In other regressions, the self-selection correction is not significant. Previous results regarding load size are confirmed: non significant in Benin; significant and negative in Malawi and Madagascar. 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.<sup>9</sup>

We conduct a similar analysis for the choice between small and large trucks, conditional on using motorized transport. Results (not shown here to save space) show that, in both countries, large trucks are more likely to be used on long distances. In Benin, they are also more used for large transactions. The self-selection correction is large and significant for small trucks in Malawi: if traders did not self-select away from small trucks, transport in small trucks would be more expensive. The same is true for large trucks in Madagascar.

Taken together, our results suggest that transport follows some economic rationale. Motorized transport is used on longer distances when it is cheaper. But

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<sup>9</sup> 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.

increasing returns to load size are present in two of the three countries 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, traders bringing large loads pay less for transport. In these two countries, transport cost per kg could be potentially reduced by organizing larger loads.

**Table 4—Selection Correction Motorized/Non-Motorized**

		Benin			Madagascar			Malawi		
		Non-motorized	Motorized	Non-motorized	Motorized	Non-motorized	Motorized	Non-motorized	Motorized	Motorized
<b>A. Transportation cost</b> (dependent variation is transport cost in log)										
Distance travelled	log	0.315	<b>2.43</b>	0.369	<b>16.78</b>	0.355	<b>6.72</b>	0.535	<b>8.85</b>	0.385
Load size	log	-0.028	-0.49	0.008	0.52	-0.101	<b>-3.25</b>	-0.051	<b>-1.71</b>	-0.216
Beans and peanuts	yes=1	0.485	<b>2.20</b>	0.113	1.11	0.328	<b>3.45</b>	0.148	1.27	0.355
Roots and tubers	yes=1	0.817	<b>3.08</b>	-0.104	-0.79	0.717	<b>5.18</b>	-0.080	-0.59	0.54
Fruits and vegetables	yes=1	0.432	1.52	0.460	<b>2.59</b>	0.232	0.72	-0.311	-0.71	0.298
Mills ratio (from selection equation)	see text	-0.304	<b>-2.80</b>	0.036	1.24	0.110	1.10	-0.201	<b>-2.88</b>	-0.43
Intercept		0.863	<b>1.81</b>	0.555	<b>3.90</b>	3.107	<b>11.67</b>	3.147	<b>15.67</b>	2.11
Number of observations		74		502		359		267		85
R-squared		0.738		0.534		0.340		0.389		0.369
<b>B. Selection equation</b> (dependent variable is 1 if used motorized transport)										
Distance travelled	log	2.129	<b>4.61</b>	z-stat.		Coef.	<b>7.19</b>	z-stat.		Coef.
Distance squared	log <sup>2</sup>	-0.217	<b>-2.76</b>	z-stat.		Coef.	0.096	z-stat.		Coef.
Load size	log	0.017	0.11	z-stat.		Coef.	0.024	z-stat.		Coef.
Beans and peanuts	yes=1	-1.123	-0.63	z-stat.		Coef.	0.066	z-stat.		Coef.
Roots and tubers	yes=1	-0.369	-0.17	z-stat.		Coef.	0.019	z-stat.		Coef.
Fruits and vegetables	yes=1	-0.984	-0.39	z-stat.		Coef.	0.605	z-stat.		Coef.
Gender	female=1	-0.647	-1.09	z-stat.		Coef.	0.552	z-stat.		Coef.
Age	level	-0.010	-0.58	z-stat.		Coef.	0.034	z-stat.		Coef.
Working capital	log	0.118	0.54	z-stat.		Coef.	0.010	z-stat.		Coef.
Manpower	log	0.523	<b>1.68</b>	z-stat.		Coef.	0.046	z-stat.		Coef.
Business contacts	log	0.232	1.52	z-stat.		Coef.	-0.162	z-stat.		Coef.
Value of vehicles	log(x+1)	-0.135	-1.47	z-stat.		Coef.	-0.005	z-stat.		Coef.
Value of non-motorized transport equipt.	log(x+1)	-0.052	-0.40	z-stat.		Coef.	0.098	z-stat.		Coef.
Number of suppliers		-0.056	<b>-2.04</b>	z-stat.		Coef.	-0.014	z-stat.		Coef.
Intercept		-1.982	-0.68	z-stat.		Coef.	-2.942	z-stat.		Coef.
Number of observations		581		672		Coef.	0.75	z-stat.		Coef.
PseudoR-squared		0.834		0.408		Coef.	0.408	z-stat.		Coef.

**Table 5—Determinants of marketing costs in Benin**

(dependent variable is log of marketing costs; Heckman maximum likelihood estimator)

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

## 7. INCREASING RETURNS TO TRANSACTION SIZE

We have investigated whether returns to load size are present in transport. 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 were true, the gross margin rate  $\mu_i^g$  would be a 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  $c_i^p$  would decrease with transaction size  $q_i$ . If large transactions have both a lower  $\mu_i^g$  and lower  $c_i^p$ , it would be interesting to know whether they have the same  $u_i^n$ , in which case we could say that cost savings resulting from larger transactions are passed onto consumers and producers.

We now turn to total marketing costs  $c_i^p$  and marketing margin rates  $\mu_i^g$  and  $\mu_i^n$ . 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 examine marketing costs and their effect on margin rates.

## 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 costed. 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 obtains 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 5 (Benin), 6 (Madagascar), and 7 (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.<sup>10</sup>

As before, our main objective is to test whether marketing costs increase proportionally with 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.

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-

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<sup>10</sup> 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 traveling, it should not affect travel costs.

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 Benin 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.

**Table 6—Determinants of marketing costs in Madagascar**

(dependent variable is log of marketing cost, Heckman maximum likelihood estimator)

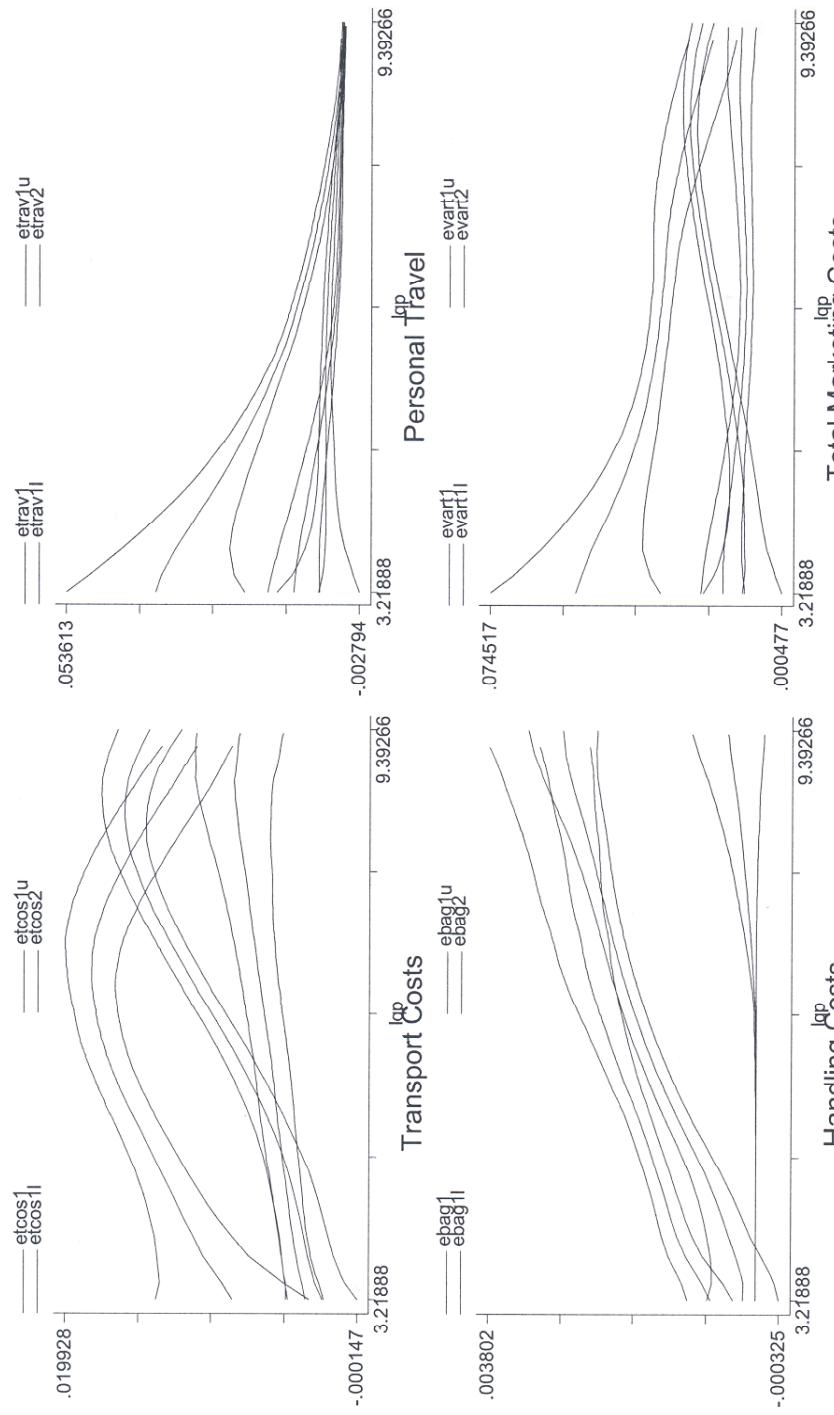
	Unit	Transport		Travel		Marketing costs		Total
		Coef.	z stat.	Coef.	z stat.	Coef.	z stat.	
<b>A. Conditional equation</b>								
<b>Transaction characteristics</b>								
Transaction size	log	0.719	<b>13.16</b>	0.105	1.39	0.656	<b>12.59</b>	
Distance between purchase and sale (km)	log(x+1)	0.494	<b>12.07</b>	0.576	<b>9.07</b>	0.572	<b>14.08</b>	
Days between purchase and sale	log(x+1)	-0.077	-1.00	0.140	1.37	-0.039	-0.49	
<b>Marketing task (collector-retailer=omitted category)</b>								
Collector	yes=1	0.290	1.15	-0.004	-0.02	0.417	<b>1.75</b>	
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	
<b>Crop type(cereals=omitted category)</b>								
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	<b>1.75</b>	
Fruits and vegetables	yes=1	-0.032	-0.05	1.319	1.42	1.192	<b>5.39</b>	
<b>Region dummies(north=omitted category)</b>								
Central	yes=1	0.471	<b>3.09</b>	0.558	<b>2.10</b>	0.537	<b>3.16</b>	
South	yes=1	0.358	<b>2.29</b>	0.213	1.02	0.575	<b>3.63</b>	
Intercept		3.344	<b>9.75</b>	6.151	<b>12.67</b>	3.644	<b>9.55</b>	
<b>B. Selection equation</b>	Unit							
<b>Transaction characteristics</b>								
Transaction size	log	0.119	1.51	-0.038	-0.59	0.327	<b>4.50</b>	
Distance between purchase and sale(km)	log(x+1)	0.337	<b>6.09</b>	0.338	<b>8.38</b>	0.230	<b>4.32</b>	
Days between purchase sale	log(x+1)	-0.027	-0.30	0.019	0.25	-0.214	<b>-2.17</b>	
<b>Marketing task(collector-retailer=omitted category)</b>								
Collector	yes=1	0.342	1.39	-0.018	-0.07	-0.337	-1.15	
Retailer	yes=1	0.765	<b>4.46</b>	0.197	1.06	0.238	0.99	
Wholesaler	yes=1	0.567	<b>2.41</b>	-0.182	-0.77	-0.074	-0.27	
<b>Crop type(cereals=omitted category)</b>								
Beans and pulses	yes=1	-0.404	<b>-2.46</b>	-0.306	<b>-1.72</b>	-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	<b>2.15</b>	
<b>Regions dummies (north=omitted category)</b>								
Central	yes=1	0.375	<b>2.05</b>	0.239	1.30	0.485	<b>2.27</b>	
South	yes=1	-0.102	-0.65	0.570	<b>3.41</b>	0.291	<b>1.70</b>	
<b>Trader characteristics(selection instruments)</b>								
Working capital	log	-0.043	-0.76	0.012	0.19	-0.186	<b>-3.30</b>	
value of transport vehicles	log(x+1)	-0.024	<b>-2.43</b>	-0.034	<b>-2.86</b>	-0.019	<b>-1.80</b>	
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	<b>1.75</b>	-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	<b>2.26</b>	
/athrho		0.954	<b>3.32</b>	0.141	0.82	<b>1.048</b>	<b>2.17</b>	
/lnsigma		0.128	<b>1.80</b>	-0.041	-0.54	<b>0.200</b>	<b>2.56</b>	
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	
Test if coef. of transaction size = 1			F-stat	p-value	F-stat	p-value	F-stat	p-value
			26.48	0.0000	141.8	0.0000	43.42	0.0000

Note: Handling costs omitted from this table because too few uncensored observation (19).

**Table 7—Determinants of marketing costs in Malawi**

(dependent variable is log of marketing costs; Heckman maximum likelihood estimator)

A. Conditional equation	Transaction characteristics	Unit	Transport		Travel		Handling		Marketing costs		Total
			Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	Coef.	t stat.	
	Transaction size	log	0.914	<b>25.240</b>	0.084	<b>2.030</b>	1.222	<b>24.330</b>	0.918	<b>20.070</b>	
	Distance between purchase and sale (km)	log(x+1)	0.285	<b>7.280</b>	0.547	<b>8.750</b>	0.077	<b>2.460</b>	0.619	<b>18.630</b>	
	Days between purchase and sale	log(x+1)	0.066	1.500	0.062	1.170	-0.149	<b>-2.050</b>	0.045	0.730	
<b>Marketing task (collector-retailer=omitted category)</b>											
	Collector	yes=1	-0.284	<b>-2.430</b>	0.253	<b>1.820</b>	0.075	0.500	-0.255	<b>-1.970</b>	
	Retailer	yes=1	-0.161	-1.440	0.082	0.850	0.431	<b>2.290</b>	-0.050	-0.310	
	Wholesaler	yes=1	0.021	0.130	0.348	1.510	0.367	<b>1.720</b>	-0.036	-0.190	
<b>Crop type(cereals=omitted category)</b>											
	Beans and pulses	yes=1	0.154	1.450	0.239	<b>1.960</b>	0.239	1.640	0.154	1.030	
	Roots and tubers	yes=1	0.225	<b>1.970</b>	0.081	0.550	0.267	<b>1.740</b>	-0.036	-0.210	
	Fruits and vegetables	yes=1	0.719	<b>3.060</b>	0.295	1.140	1.837	<b>7.630</b>	1.124	<b>4.810</b>	
<b>Region dummies(north=omitted category)</b>											
	Central	yes=1	-0.005	-0.050	-0.194	<b>-1.650</b>	0.212	1.410	-0.133	-1.060	
	South	yes=1	0.113	1.090	0.234	<b>1.980</b>	0.423	<b>3.250</b>	0.047	0.330	
	Intercept		-4.847	<b>-17.810</b>	-1.793	<b>-6.510</b>	-8.185	<b>-29.880</b>	-5.572	<b>-17.570</b>	
<b>B. Selection equation</b>											
<b>Transaction characteristics</b>											
	Transaction size	log	0.166	<b>1.790</b>	0.008	0.070	-0.248	<b>-3.260</b>	-0.123	-1.370	
	Distance between purchase and sale(km)	log(x+1)	0.638	<b>10.460</b>	1.445	<b>8.690</b>	0.062	1.000	0.221	<b>3.660</b>	
	Days between purchase sale	log(x+1)	0.122	1.250	-0.008	-0.060	0.515	<b>4.840</b>	0.285	2.360	
<b>Marketing task(collector-retailer=omitted category)</b>											
	Collector	yes=1	-0.547	<b>-2.170</b>	-0.475	-1.300	0.346	<b>1.670</b>	-0.258	-1.180	
	Retailer	yes=1	-0.074	-0.280	0.241	0.990	-0.599	<b>-2.360</b>	-0.517	<b>-2.000</b>	
	Wholesaler	yes=1	-0.605	-1.340	-0.791	-1.190	0.166	0.390	5.310	<b>21.870</b>	
<b>Crop type(cereals=omitted category)</b>											
	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	<b>-2.220</b>	0.255	1.080	0.231	0.780	
	Fruits and vegetables	yes=1	1.067	<b>1.920</b>	-1.451	<b>-2.490</b>	-0.986	<b>-3.460</b>	0.166	0.400	
<b>Regions dummies (north=omitted category)</b>											
	Central	yes=1	-0.195	-1.080	-0.915	<b>-2.770</b>	-0.781	<b>-4.240</b>	-0.483	<b>-2.440</b>	
	South	yes=1	0.135	0.430	-0.184	-0.760	-0.514	<b>-2.180</b>	-0.039	-0.130	
<b>Trader characteristics(selection instruments)</b>											
	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	<b>-1.990</b>	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	<b>2.540</b>	-0.018	-0.120	-0.245	<b>-2.500</b>	0.003	0.030	
	Gender	female=1	0.081	0.410	-1.078	<b>-3.250</b>	-0.074	-0.420	-0.273	-1.060	
	Intercept		-2.427	<b>-4.140</b>	-0.827	-1.090	2.461	<b>4.800</b>	1.528	<b>2.530</b>	
	/athrho		0.013	0.090	0.265	1.670	-1.287	<b>-2.360</b>	-0.001	-0.010	
	/Insigma		-0.353	<b>-7.070</b>	-0.253	<b>-3.300</b>	0.081	1.180	0.070	<b>1.830</b>	
	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	



**Figure 1. Costs and Transaction Size**

## 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  $\mu_i^g$  and the lower curve is the net margin rate  $\mu_i^n$ . 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.<sup>11</sup> 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. Because margin rates are sensitive to measurement error, we minimize the effect of

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<sup>11</sup> 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.

outliers by using median regression and by redefining the dependent variable as

$\log(\mu_i^n + 1)$  and  $\log(\mu_i^n + 1)$ .

Results, summarized in Table 8 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 of \$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.

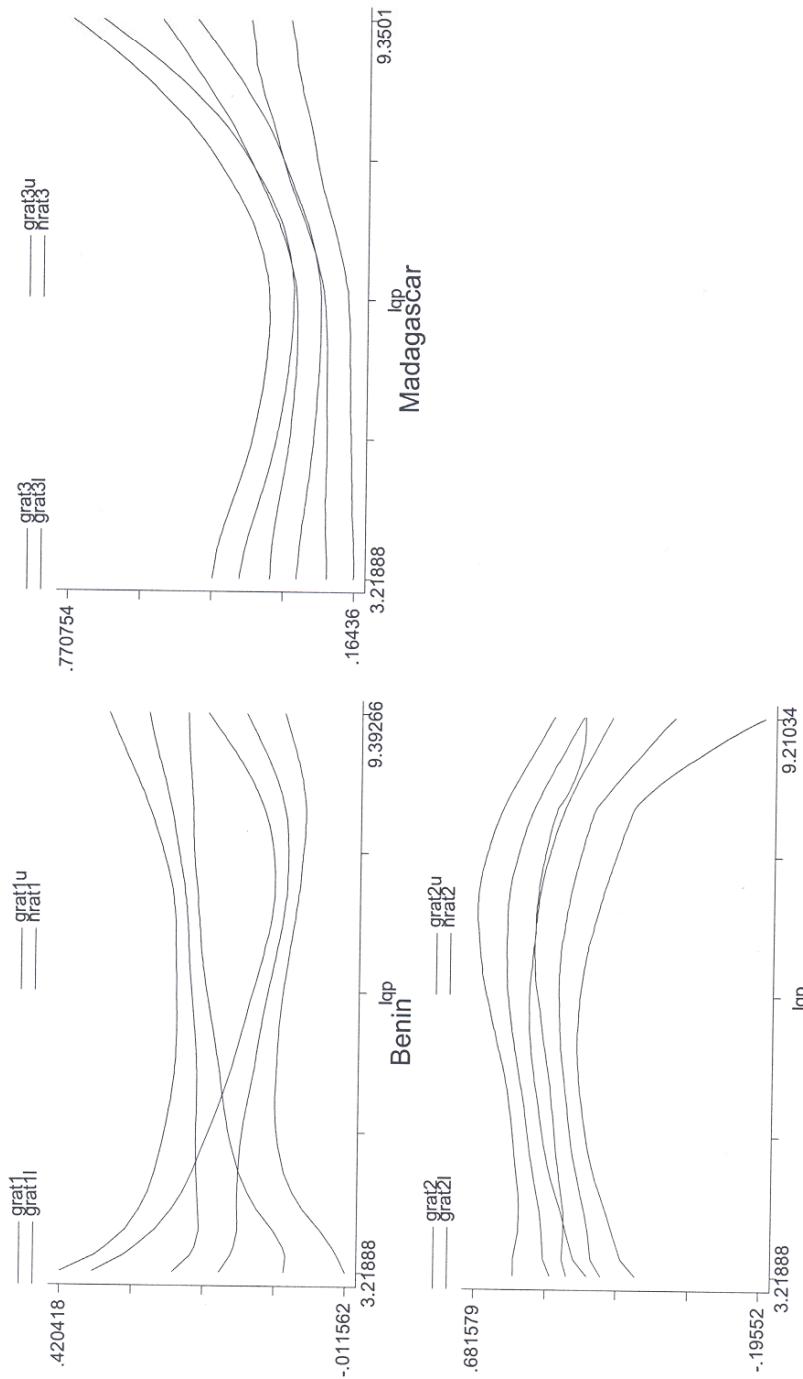
Results for net margin rates are presented in Table 9. We see that, after deduction of marketing costs, transaction size has no significant effect on margin rates in either of the three countries. Although we found marketing costs to decrease with transaction size, the effect is not strong enough to 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,  $\mu_i^g$  increase with distance traveled and storage duration. The effect is strong and significant in both 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.

## **8. INCREASING RETURNS TO SCOPE OF ACTIVITIES**

We now address whether increasing returns to scope of activities, that is, by the extent of marketing tasks undertaken, are present. The regressions of Tables 8 and 9 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 Malawi. 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 fewer transport costs.



**Figure 2. Margins and Transaction Size**

**Table 8—Determinants of Gross Margin Rates**

(dependent variable is log of sales price/purchase price ration; median regression)

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

**Table 9—Determinants of Net Margin Rates**

(dependent variable is log of (sales price-marketing costs)/purchase price ratio; median regression)

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

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 10 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. 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.

## 9. RETURNS TO SIZE OF BUSINESS ASSETS

The analysis conducted until now focused on the gap between buying and selling prices for the last transaction. We also examined marginal costs for evidence of increasing returns. In practice, however, returns to scale may arise not because of marketing margins on a specific transaction, 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 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:<sup>12</sup>

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

We also consider two additional measures: value added minus operating costs (excluding wages)  $V_i^o \equiv V_i^g - c_i^f$ ; and value-added minus both operating costs and variable marketing costs. This latter measure can be defined as profits

$$V_i^p \equiv V_i^g - c_i^v Q_i - c_i^f .$$

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<sup>12</sup> Because stocks are minimal, results are insensitive to the correction for changes in stock.

In principle,  $V_i^p$  is a better measure of returns to fixed factors, but it is subject to more measurement error. We also lose a lot of observations for which, after subtracting  $c_i^v Q_i$  and  $c_i^f$ , and  $c_i^f, V_i^p$  becomes negative.

We estimate an equation of the form:

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

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

Results are presented in Table 11. 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.<sup>13</sup>

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 both 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.

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<sup>13</sup> 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.

**Table 10—Determinants of Price Levels**

(dependent variable is log of price per Kg; median regression)

Transaction characteristics		Benin				Madagascar				Malawi			
		Unit	Purchase price Coef.	T stat	Sale price Coef.	T stat	Purchase price Coef.	T stat	Sale price Coef.	T stat	Purchase price Coef.	T stat	Sale price Coef.
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
<b>Marketing task (collector-retailer=omitted category)</b>													
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
<b>Crop type (cereals=omitted category)</b>													
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
<b>Region dummies (north=omitted category)</b>													
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 11—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	<b>5.470</b>	0.893	<b>4.420</b>	0.711	<b>3.360</b>
Manpower in months worked (*)	log	-0.606	-1.260	-0.875	-1.590	0.007	0.010
Network capital (*)	log	0.541	<b>5.880</b>	0.613	<b>5.990</b>	0.387	<b>2.630</b>
Years of schooling of trader	level	-0.060	<b>-2.090</b>	-0.057	<b>-1.720</b>	-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 traders	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	<b>1.740</b>	0.232	1.030	0.281	0.980
Southern region	yes=1	0.346	<b>1.940</b>	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		0.20	0.6526	0.81	0.3675	0.04	0.8477
<b>B. Madagascar</b>		<b>Coef.</b>	<b>t-stat.</b>	<b>Coef.</b>	<b>t-stat.</b>	<b>Coef.</b>	<b>t-stat.</b>
Working capital(*)	log	0.425	<b>3.500</b>	0.418	<b>3.140</b>	0.448	<b>3.440</b>
Manpower in months worked (*)	log	0.905	1.580	1.206	<b>2.030</b>	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 traders	level	0.407	<b>3.110</b>	0.351	<b>2.310</b>	0.388	<b>2.500</b>
Gender of trader	female=1	0.125	0.840	0.118	0.690	0.070	0.420
Central region	yes=1	-0.816	<b>-3.210</b>	-0.893	<b>-2.950</b>	-0.751	<b>-2.390</b>
Southern region	yes=1	-0.522	<b>-2.610</b>	-0.576	<b>-2.540</b>	-0.537	<b>-2.300</b>
Intercept		9.348	<b>5.930</b>	9.482	<b>5.620</b>	8.778	<b>5.280</b>
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		0.4	0.5288	1.41	0.2361	0.39	0.5346
<b>C. Malawi</b>		<b>Coef.</b>	<b>t-stat.</b>	<b>Coef.</b>	<b>t-stat.</b>	<b>Coef.</b>	<b>t-stat.</b>
Working capital(*)	log	0.582	<b>3.140</b>	0.677	<b>3.320</b>	0.571	<b>2.500</b>
Manpower in months worked (*)	log	-0.167	-0.270	-0.354	-0.540	-0.218	-0.290
Network capital (*)	log	0.562	<b>3.850</b>	0.655	<b>4.020</b>	0.669	<b>3.600</b>
Years of schooling of trader	level	-0.016	-0.790	-0.038	<b>-1.710</b>	-0.061	<b>-2.260</b>
Years of experience of trader	log	0.096	1.130	0.068	0.720	0.086	0.800
Nber of languages spoken by traders	level	-0.039	-0.580	0.030	0.400	0.016	0.190
Gender of trader	female=1	-0.407	<b>-2.730</b>	-0.453	<b>-2.780</b>	-0.504	<b>-2.740</b>
Central region	yes=1	0.085	0.630	0.138	0.930	0.323	<b>1.910</b>
Southern region	yes=1	-0.111	-0.450	-0.153	-0.570	0.081	0.280
Intercept		3.059	<b>3.330</b>	2.309	<b>2.210</b>	2.494	<b>2.250</b>
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.

## 10. 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.

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 rates show little relationship with transaction size. Albeit univariate analysis indicates that margins rates decrease with transaction size in Malawi, the effect is no longer significant once we deduct marketing costs, which tend to be proportionally larger for small transactions. We also find some evidence that vertically integrated traders have higher unit margins, but the evidence is not fully consistent.

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. 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 suggests 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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