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On trade efficiency in the Ethiopian agricultural markets

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Abstract

The availability of enabling institutions, information systems and infrastructure is a precondition to enhance agricultural markets' efficiency, and make market actors less vulnerable to price instability. This paper investigates whether the focus on institutional and technological upgrading is enough to make Ethiopian agricultural markets more efficient. In particular, given that a requirement for exchange efficiency is the lack of unexploited mutually beneficial spatial arbitrage opportunities, we look for evidence of increasing returns to transaction size and returns to scale in transport using detailed trader surveys collected in 2001 and 2007. Whilst transport costs could be reduced by assembling loads and avoiding trans-shipments for the transporters, we find no evidence that transport and handling costs are a source of increasing returns to transaction size. Hence, the presence of many small market intermediaries is not a source of inefficiency in Ethiopia, and concentration in market intermediation is not necessary for social efficiency.

Keywords: Ethiopia, market efficiency

JEL classification: O13; Q13

1. Introduction

Ethiopia, a landlocked country, is particularly exposed to food price instability (Byerlee, Jayne, & Myers, 2006). The collapse in the farm gate price of maize by 80 percent in early 2002, following two years of bumper harvest, harshly hit smallholders inducing them to reduce fertilizer application by 22 percent (Rashid & Dorosh, 2008; Rashid & Negassa, 2011). This in turn worsened the impact of the mid-2002 drought that posed 15 million people at risk of starvation, a risk then averted by the prompt intervention of donors (Rashid & Negassa, 2011). The situation reversed in late 2005 and early 2006, when consecutive years of good harvests were accompanied by the steep surge in staple prices, a puzzle later explained by the expansionary monetary policy pursued by the Central Bank (Rashid & Lemma, 2011). In early 2008, balance of payment shortage, encountered by the government and caused by the sharp increase in fuels' bills, was withstood through foreign exchange rationing; as a consequence, domestic prices increased above the import parity (ibid.).

Inaccurate forecasts and macroeconomic instability added to foreign exchange constraints, growth of population, urbanization and per capita income (Rashid & Dorosh, 2008), and high food production variability (depending on the vagaries of nature and the predominance of rain-fed agriculture) make Ethiopia vulnerable to both price collapse and hikes. Whereas sound macroeconomic policies would allow to prevent shocks and climate smart agriculture would make yields less erratic, "if agricultural markets are characterized by inadequate infrastructure, information asymmetry and incomplete markets […] prices are bound to be volatile" (Rashid, 2011: 15). Infrastructure, information, institutions and policies facilitating market exchange are market fundamentals: They are key determinants of transaction costs and, consequently, of market efficiency. High transaction costs limit the country's capacity to operate on world markets (Byerlee et al., 2006), and traders' ability to move food from moisture-reliable to drought-prone areas.

Aware of the urgent need to move beyond 'getting prices right' and towards 'getting markets right' (Gabre-Madhin & Mezgebou, 2006; The World Bank, 2004), "so as to address market failures arising from imperfect information, contract enforcement and property rights" (Barrett & Mutambatsere, 2005: 8), the Ethiopian Government recently started investing in infrastructure and institutions for market development. Therefore, from 2002 to 2008, the percentage of rural population accessing all-season roads increased from 26 to 33 percent, the number of mobile phone subscribers rose from around 50,000 to almost 2 ML (The World Bank, 2009), and jumped up to 4ML in 2009 (The World Bank, 2010). In April 2008, the Ethiopian Commodity Exchange was launched. This formal market institution is attempting to introduce more transparency and accountability in the marketing system.

Addressing the sources of market failure is a fundamental long-run solution to agricultural markets' inefficiency and price risk (COMESA & ACTESA, 2010; Rashid & Jayne, 2010), which implies that undertaken attempts shall continue and be strengthened. We nonetheless wonder whether this is the only solution. Given that a requirement for exchange efficiency is the lack of unexploited mutually beneficial spatial arbitrage opportunities (Rashid & Minot, 2010), we question the existence of unexploited increasing returns to transaction size and returns to scale in transport in the Ethiopian agricultural trade. If increasing returns were found, smaller trading activities would be more inefficient than bigger ones, and "one would expect certain traders to grow over time and to eventually eliminate inefficient small operators". Considering that this "natural 'maturation' process of liberalized agricultural markets" might take time, "policy intervention might […] be required to speed" it up (Fafchamps, Gabre-Madhin, & Minten, 2005: 437).

Despite the wide available literature on market integration in Ethiopia, no prior econometric estimation has been conducted on market efficiency by making use of survey data on marketing costs, prices and margins. Preliminary descriptive analysis can be found in Rashid and Negassa (2011), where emphasis is given to the absolute change in nominal and real costs and margins between 2007 and 1996 and 2007 and 2002 respectively. These variations, while informative to draw conclusions on 'what-if' hypothetical situations, do not shed light on who benefits from any gap between buying and selling prices, i.e. whether it is traders themselves or, potentially, farmers and/or consumers. Our econometric investigation resembles the one carried out by Fafchamps, Gabre-Madhin and Minten (2005) for Benin, Madagascar and Malawi. In this paper, though, we not only rely on modified estimation techniques and results' interpretation, but also make use of two different datasets for the same country. The 2002 Survey of Grain and Coffee Traders (Gabre-Madhin, IFPRI, & ILRI, 2002) includes 561 traders in 45 markets around the country and refers to the period from December 2000 to December 2001, when real prices were decreasing in Ethiopia. The Ethiopia Commodity Exchange (ECX)

Trader Survey 2007 (Gabre-Madhin, IFPRI, & EDRI, 2007) collects information on 457 traders in 21 markets and covers the months from November/December 2006 to May/June 2007, when prices of both food and cash crops were rapidly surging. The unique datasets make it possible to investigate whether market efficiency in agricultural trade changed in the two years, given that producer prices were moving in opposite directions. Both surveys stretch over the main harvest seasons in Ethiopia (known as the 'Meher' and the 'Belg' seasons), when crop commercialization activities by farmers are usually thriving and trading opportunities for traders are excellent.

The main body of the paper includes a literature review session, specification of applied methodologies and discussion of research findings for marketing costs, margins and prices. Conclusion and policy recommendations follow.

2. SHORTCOMINGS OF EXISTING STUDIES ON MARKET INTEGRATION

Spatial market integration can be conceptualised with either the notion of 'tradability' or 'efficiency'. Tradability implies that the Walrasian excess demand for a commodity is transferred between spatially distinct markets. The transfer could correspond to the physical flow of the good and/or the transmission of price shocks. Pareto-inefficient distributions are consistent with the notion of tradability (Barrett, 2001; Barrett & Li, 2002; Barrett & Mutambatsere, 2005).

Market efficiency implies that, when trade occurs, all rents to spatial arbitrage are exhausted and Pareto efficiency is attained. Excluding both the possibility of segmented equilibrium when no trade exists and of binding trading quotas, the strict equality of the Enke-Samuelson-Takayama-Judge (ESTJ) multiple competitive equilibria corresponds to,

$$p_s^1 = p_p^0 + c^{01} \quad (1)$$

where p_p^0 is the price in the purchase market 0, p_s^1 is the price in sales market 1 and c^{01} is the total amount of costs to transfer the good from 0 to 1. In other words, "when trade occurs, price differentials should move one-for-one with the costs of spatial arbitrage, a slightly more general variant of the law of one price" (Barrett & Li, 2002: 293).

At the individual level of analysis, traders are making zero marginal profits (i.e. their total profit is maximized); at the aggregate level, there are no incentives for potential new entrants to engage in market intermediation and long-run competitive market equilibrium is achieved.

Hence, spatial market integration analysis (under the assumption of no trading quotas) relies on the availability of data for three variables: trade volumes, prices and transaction costs. Nonetheless, as reminded by Barrett (2001: 22), contemporaneous price, trade volumes and transaction costs series are still noisy and short duration, particularly in developing countries.

Cereal market integration studies in Ethiopia, conducted after the new government launched major market reforms in 1992 (see Rashid & Negassa, 2011), focused on bivariate correlation coefficients between distinct markets (Dadi, Negassa, & Franzel, 1992), error-correction representations of cointegrated systems assuming a stable relationship between nonstationary price series (Dercon, 1995), autoregressive distributed lag modelling approach to cointegration analysis (Getnet, Verbeke, & Viaene, 2005) and common trend and multivatiate cointegration analyses (Rashid, 2011).

Correlation coefficients discern market integration based on the comovement of prices, and independently from transfer costs, even though non-random variation in transfer costs may lead to reject market integration while spatial arbitrage conditions hold (Baulch, 1997). Apart from ignoring transfer costs, cointegration tests assume a linear relationship between market prices that is not met when transaction costs get large and trade becomes discontinuous so that "equilibrium condition binds with equality in some periods and is slack in others" (Barrett & Li, 2002: 294; Baulch, 1997). Linear representations assuming stationary time series data also fail when nonstationarity is observed in transfer cost series due to technological change, demand shocks and/or government interventions (Barrett & Li, 2002). Thus, cointegration methods are neither necessary nor sufficient for markets to be in ESTJ spatial equilibrium (1) (Barrett, 1996; Baulch, 1997; Fackler, Goodwin, Bruce, & Gordon, 2001; McNew & Fackler, 1997).

Moreover, the aforementioned studies on Ethiopia cannot accommodate interseasonal flow reversals related to "insufficient storage or processing capacity, local liquidity constraints, or higher risk of theft or political instability in rural areas" (Moser, Barrett, & Minten, 2009: 283). When trade flows are bidirectional, transfer costs are positive in some period and negative in others.

Attempts to take into account nontrivial transaction costs led to threshold autoregression (TAR) and threshold cointegration methods and to the Parity Bound Model (PBM). Nevertheless, the first two methodologies still assume constant transaction costs, continuous trade flows or both (Barrett, 2001). The PBM establishes probabilistic limits within which it is likely for spatial arbitrage conditions (i.e. segmented equilibrium, competitive equilibrium and existence of binding trading quotas) to be met. PBM's original version (Sexton, Kling, & Carman, 1991) was extended by Baulch (1997), who integrated prices and transaction cost series, Barrett and Li (2002) who incorporated trade flow data, Negassa and Myers (2007) that allowed for dynamic shifts in regime probabilities in response to changes in marketing policy, and Moses and al. (2009) that relaxed the assumption of constant unobservable transfer costs across space and time. In particular, Negassa and Myers (2007)'s extended PBM was applied to Ethiopian maize and wheat markets with reference to the period 1996-2002, given that in 1999 the Ethiopian Grain Trade Enterprise (EGTE) was re-established as a public marketing enterprise, relieved of the responsibility of grain price stabilization and required to focus on exports.

The original and extended Parity Bound Models rely on arbitrary half-normality and normality distribution assumptions, not justified by economic theory (Barrett & Li, 2002; Fackler et al., 2001). Moreover, they disregard the time series properties of the data and offer only static comparisons; consequently, they do not allow the "analysis of dynamics of inter-temporal adjustment to short-run deviations from long-run equilibrium and potentially important distinctions between short-run and long-run integration" (Barrett & Mutambatsere, 2005: 5; Ravallion, 1986).

Most importantly, even those studies that take transaction costs into consideration ignore whether these costs are minimised. Transaction costs' minimization is required to maximize welfare and reach social efficiency. The analysis of market efficiency in Ethiopia disregarded this requirement so far. Hence, this paper attempts to address the existing shortcoming. In particular, we ask the questions: Is market intermediation efficient in the Ethiopian agricultural markets? Are there increasing returns to transaction size and to scale in transport in agricultural trade? We address these questions by focusing on transaction costs and margins, as referred to the last completed transaction (for which all activities between purchase and sale were finalised).

This level of analysis is appropriate mainly 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, 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" (Fafchamps et al., 2005: 425).

The consideration of two different years (2001 and 2007) allows drawing conclusions on any variation in social efficiency during years of decreasing and increasing prices respectively.

3. RETURNS TO SCALE IN TRANSPORT AND INCREASING RETURNS TO TRANSACTION SIZE

Ethiopian agricultural markets were formally liberalised after the overthrow of the Derg regime in May 1991, even though quota delivery by traders to the Agricultural Marketing Corporation (AMC, later renamed EGTE), had been abolished since March 1990 together with the removal of restriction on grain movement (Rashid & Negassa, 2011). Both in 2001 and in 2007, price instability and lack of regulation of unlicensed businesses were mentioned by surveyed traders as the most severe problems affecting grain and coffee markets in the country (2001 and 2007 survey results). Existence of collusion (i.e. price fixing by certain market actors) was stated by a meagre 3.33 percent of all traders interviewed in 2007. Therefore, the assumption of perfect competition in agricultural trade does not seem unrealistic for Ethiopia.

Together with perfect competition in trade, marketing costs' minimization is needed to achieve social efficiency of product allocation across markets (Barrett, 2001). In other words, Pareto efficiency is maximized when marketing costs are minimized, under the assumption of no rent in trade (Fafchamps et al., 2005). c^{01} in (1) is restated as

$$c^{01} = c^{01}(q_i, d_i) \quad (2)$$

where q_i and d_i are the quantities handled and the distance travelled by each trader i. Whilst transaction costs minimization should hold for the marketing chain as a whole, the distinction between collectors, retailers and wholesalers is blurred[1] in the Ethiopia agricultural markets. This is indicated by the great variability of the quantity purchased in the last recorded transaction for both 2001 (mean 62 ql., median 20 ql.) and 2007 (mean 220 ql., median 50 ql.). We thus avoid introducing a marketing-task categorical variable in the analysis in order to find evidence for economies of scope, and look instead for increasing return to size and to scale in transport.

Increasing returns to transaction size $\{[\partial c^{01}(q_i, d_i)/\partial q_i] < 0\}$ and increasing returns to scale in transport $\{[\partial c^{01}(q_i, d_i)/\partial d_i] < 0\}$ for traders using transporters imply that trading is more efficient if in the hands of big trading businesses and if transport is combined into a single long haul (Fafchamps et al., 2005). The following sections further investigate.

3.1. Testing for transport efficiency

Similarly to Benin, Madagascar and Malawi (Fafchamps et al., 2005), transport from purchase to final sales markets (including loading and off-loading borne directly by the trader) represented the greatest component of marketing costs both in 2001 and 2007. The road network in the country substantially expanded since 1991: from 1992 to 2008, the length of rural roads increased five times, that of asphalt roads by 71 percent and of gravel roads by 60 percent (Rashid & Negassa, 2011). Such development contributed to the reduction of the share of transport costs from 70 percent of total marketing costs in 2001 to 65 percent in 2007.

We define transport costs as in Fafchamps et al. (2005);[2] namely,

$$c_i^t(q_i, d_i) = \Theta q_i^{\alpha} d_i^{\delta} e^{u_i} \quad (3)$$

where c_i^t is the transport cost per quintal, q_i is the load size (i.e. quantity purchased and transported in quintals), d_i is the distance travelled (i.e. kilometres from purchase to sale market) and u_i is the error term. For estimation purposes, we consider the subsample of traders that used a transporter in the last completed transaction, who did not buy and sell in the same market and that do not operate as brokers, buying and/or selling agents, and are not exporters.

Holding d_i fixed, if $\alpha < 0$, c_i^t could be reduced by facilitating the operation of big trading businesses that need to transport large loads and/or by organising larger loads from multiple traders. Holding q_i fixed and in the presence of non trivial loading and off-loading costs to the transporter (which are also fixed with respect to distance, and cause transport costs per km to be lower on long distances), finding $\delta < 1$ would suggest to avoid trans-shipments. Thus, transport

[1] For example, although the 2007 survey was addressed to wholesalers only, 37 percent of traders declared to purchase some percentage of their most traded product/s either from small-scale farmers or from commercial farmers, and 62 of them declared to sell some of it/them to final consumers.

[2] The main reason for the adoption of a logarithmic formulation of equation (3) is the skewness of the sample distribution of unit transport costs which makes coefficient estimates sensitive to unusual and influential data. Limited information is provided from both 2002 and 2007 surveys on mode of transport from purchase to final sale markets, which could further justify the use of a logarithmic function (see Fafchamps et al., 2005). In 2002, for example, 137 (out of 561) interviewed traders stated that their main mode of transport was Isuzu 70-100 ql. (36 percent of them), Isuzu 30-50 ql. (31 percent) and trailer (23 percent). In 2007, 132 (out of 457) interviewed traders stated to mainly use trailer (48 percent of them) or Isuzu 30-50 ql. (40 percent). Very few traders used non-motorized modes of transport (i.e. on foot, by bicycle, hand cart, horse or donkey cart) in both 2002 (3 percent of all respondents) and 2007 (2 percent).

costs could be reduced by assembling loads, so as to reduce the time the transporter has to wait for the truck to be full, and by transporting directly from purchase to final sale markets.

Equation (3) is estimated by OLS with robust standard errors for both 2001 and 2007. Estimation results are reported in Table 1.

Table 1: Determinants of transport costs (dependent variable is the log of transport costs)

OLS estimation with robust standard errors		2001		2007	
	Unit	Coef.	Std. err.	Coef.	Std. err.
Distance travelled	log	0.477***	0.05	0.473***	0.04
Load size	log	0.038	0.09	-0.049*	0.03
Cash crops (food crops=omitted category)	yes=1	0.787***	0.28	1.624***	0.39
Distance x Cash crops	log x dummy	-0.355***	0.13	-0.565***	0.15
Intercept		0.011	0.13	0.224**	0.10
Number of observations		153		85	
R-squared		0.592		0.439	
Test that distance travelled coefficient=1		*F*-test	*p*-value	*F*-test	*p*-value
Cash crops (i.e. coffee and oilseeds)		60.09	0.0000	55.65	0.0000
Food crops (i.e. cereals and pulses)		97.19	0.0000	203.60	0.0000

* p < 0.10, ** p < 0.05, *** p < 0.01

The coefficient for travelled distance is significantly smaller than one both in 2001 and 2007, and with very similar magnitude. Moreover, loading and off-loading costs are larger for cash crops' traders. This could be explained by the fact that commercialization of oilseeds is "generally greater in less densely populated domains" (Chamberlin, Pender, & Yu, 2006: 46), where transporters have to wait longer to fill their vehicles. On the contrary, cereals and pulses are usually commercialized in areas of medium to high population density (ibid.: 45,46).

Returns to load size are found only in 2007: The negative coefficient of quantity transacted (significant at the 10 percent level) indicates that transport costs could potentially be reduced by assembling loads from multiple traders and/or promoting the activity of large traders.

3.2. Marketing costs

We now investigate the existence of returns to transaction size by focusing on variable marketing costs from purchase to sale for the last completed transaction. If the derivative of total marketing costs c^{01} with respect to quantity transacted q_i is negative (i.e. marginal costs are decreasing as quantity transacted increases), larger trading businesses would be more cost-efficient than smaller ones. For analytical purposes, the main components of marketing costs are separately considered; namely, transport costs (inclusive of loading and off-loading costs to the trader), handling costs (i.e. costs of empty sacks and of bagging and sewing; representing 20 percent of total marketing costs both in 2001 and 2007), and the residual voice 'others'.

Furthermore, we focus on the subsample of traders (either using a transporter or not) who do not operate as brokers, buying and/or selling agents, and that are not exporters. Each trader i decides whether to realise a certain activity ($T_i = 1$, ex. loading, off-loading and transporting, bagging and sewing etc.) if the marginal benefit in doing so exceeds the marginal cost $\{Z_i^{'}\alpha + u_i > 0$. Then,

$$T_i = 1 \ \{Z_i^{'}\alpha + u_i > 0\}$$
$$T_i = 0 \ \{Z_i^{'}\alpha + u_i \leq 0\} \quad (4)$$

where $Z_i^{'}$ is a latent continuous variable. If $\{T_i = 1\}$, the trader incurs in cost c_i,

$$c_i = c_i^{*}, \qquad if \ T_i = 1$$
$$c_i \text{ not observed}, \ \ if \ T_i = 0 \quad (5)$$

where c_i^{*}, the potential cost borne by each trader, corresponds to

$$c_i^{*} = X_i^{'}\beta + \varepsilon_i \quad (6)$$

The vector X includes distance between purchase and sale market (in km), load size (in ql.), storage duration (i.e. number of days between purchase and sale), location of the trading business (i.e. 'North' if the business is located in North of Ethiopia,[3] 'South' if it is in the South of the country or 'Addis Ababa', if placed in the central market) and traded crop (i.e. 'cash crops' including coffee and oilseeds or 'food crops' like cereals and pulses). Selection instruments (which enter the vector Z, but not X) are working capital (i.e. current amount of funds used for trading purposes), storage capacity (i.e. maximum quantity in ql. that the trader can store in one or more storage facilities under his/her exclusive control), and number of regular partners (i.e. social capital).[4]

If we reject the null hypothesis of no selection bias,

$$H_0: \rho_{\varepsilon u} = 0 \quad (7)$$

where $\rho_{\varepsilon u}$ is the correlation coefficient between the selection equation (4) and the outcome equation (6), we control for sample selection by relying on the Heckman Maximum Likelihood Estimation (MLE) procedure. Moreover, as the coefficient estimates represent changes in the desired or potential quantities transacted, we derive the variation in the actual quantities through the Dow & Norton (2003: 8) decomposition,

$$\frac{\partial E[c_i|X_i,Z_i]}{\partial x_{ki}} = \frac{\partial \Pr[c_i>0|X_i,Z_i]\times E[c_i|B_i>0,X_i,Z_i]}{\partial x_{ki}} \quad (8)$$

Table 2 thus reports conditional marginal effects, evaluated at sample means of continuous variables and for the discrete change from zero to one for dummy variables.

The effect of travelled distance is always positive and highly significant, for all voices of marketing costs and for both 2001 and 2007. The longer the distance between purchase and

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[3] 'North' includes Tigray, Afar, Amhara and Benishangul Gumuz; 'South' includes Oromiya, Dire Dawa, Harari and the Southern Nations, Nationalities, and People's Region; Somali and Gambela regions were not surveyed.

[4] The choice of exclusion restrictions is based on the reasoning that, for example, having a certain amount of funds available for trading purposes (i.e. working capital) may increase the probability of bearing transport, loading and handling costs. Yet, once these costs are incurred in to, their total amount does not depend on how much working capital the trader has at his/her disposal.

sales markets, the higher the marketing costs, in particular transport costs and the residual voice 'other costs' (including personal travel costs and phone and radio messaging costs). The impact of storage duration on marketing costs is generally smaller and less statistically significant than that of distance. The more time elapses from purchase to sale, the higher the storage costs (entering the residual cost category 'others'). In 2001, storage length significantly affected handling costs at the 1 percent level, although a 1 percent increase in the number of storage days would increase the handling costs by 0.051 percent only.

We find no evidence that the main components of marketing costs (i.e. transport and handling) are a source of increasing returns to transaction size. In other words, transaction size has no systematic effect on the main marketing costs, and bigger trading businesses do not seem more efficient in minimising these costs than smaller ones. Whilst increasing returns to transaction size are found for the category 'other costs' in both 2001 and 2007, the effect is more pronounced in 2001 and tends to become smaller and less statistically significant in 2007. The limited number of uncensored observations for the main components of 'other costs' does not allow further investigation of which costs are decreasing as quantity transacted increases.

Increasing returns to transaction size could be found not only because bigger trading businesses are more cost-efficient than smaller ones, but also because they manage to buy at a higher price and/or sell at a lower price than smaller intermediaries. The next section shed some light on this possibility.

4. MARGIN RATES AND PRICE LEVELS

We now proceed with the analysis of market intermediation efficiency by focusing on margin rates and price levels.

4.1. Gross margin rate and price levels

The gross margin rate (μ_i^g) is defined as the difference between sales (p_i^s) and purchase price (p_i^p) relative to the purchase price for the last completed transaction (Fafchamps et al., 2005);

$$\mu_i^g \equiv \left[\left(p_i^s/p_i^p\right) - 1\right] \tag{9}$$

The average gross margin rate recorded in 2007 (4.6 percent) is smaller than the average for 2001 (9.7 percent), but more volatile (standard deviation of 17.2 in 2001, and of 16.9 in 2007). Though, in 2007 there were less extreme values. In fact, 5.2 percent of surveyed traders reported selling at a price lower than the purchase price in 2001, and 3.8 percent of all traders did so in 2007. Meantime, 2.6 percent of all traders in 2001 and 1.1 percent in 2007 sold at a price more than 50 percent higher than the purchase price.

Were bigger trading businesses able to sell the commodity traded in the last transaction at a lower price p_i^s and buy it for a higher price p_i^p than smaller traders? In other words, is the derivative of gross margin μ_i^g with respect to load size q_i negative $\left(\partial\mu_i^g/\partial q_i < 0\right)$? This would constitute further evidence of increasing returns to transaction size.

Table 2: Marginal effects for the Heckman maximum likelihood estimations of marketing costs (dependent variable is the log of marketing costs)

		Transport				Handling				Other costs			
		2001		2007		2001		2007		2001		2007	
	Unit[a]	Mgl. Effect	Std. err.	Mgl. effect	Std. err.	Mgl. effect	Std. err.	Mgl. effect	Std. err.	Mgl. effect	Std. err.	Mgl. effect	Std. err.
Transaction characteristics													
Distance travelled (km)	log(x+1)	0.506***	0.02	0.342***	0.02	0.030***	0.01	0.034**	0.01	0.217***	0.02	0.108***	0.02
Load size (ql.)	log	0.024	0.03	-0.005	0.04	-0.005	0.02	0.020	0.03	-0.105**	0.05	-0.070*	0.40
Storage duration (No. days)	log(x+1)	0.053*	0.03	0.102**	0.05	0.051***	0.02	-0.048	0.04	0.077*	0.04	0.105*	0.06
Crop type (food crops=omitted category)													
Cash crops	yes=1	-0.019	0.06	0.002	0.06	0.016	0.04	0.219***	0.05	-0.172**	0.09	0.007	0.07
Region dummies (North=omitted category)													
For 2001: South and Addis Ababa	yes=1	-0.022	0.03			0.132***	0.02			0.299***	0.05		
For 2007: South	yes=1			0.069	0.05			-0.102***	0.04			0.117**	0.06
For 2007: Addis Ababa	yes=1			0.300***	0.08			0.048	0.05			-0.013	0.09
Number of observations (of which uncensored)		451(324)		360(253)		451(350)		360(300)		451(240)		360(323)	
Log pseudolikelihood		-271.911		-222.183		-98.549		-149.861		-351.084		-278.686	
LR test of indep. eqns. (rho = 0)/χ^2 (1)		3.09		23.57		12.13		6.94		29.99		8.72	
p-value for the LR test		0.079		0.000		0.000		0.008		0.000		0.003	
/athrho (Std. error in parenthesis)		0.766(0.26)		1.850(0.32)		-1.355(0.17)		-1.321(0.24)		-1.532(0.17)		-1.425(0.40)	
/lnsigma (Std. error in parenthesis)		-1.171(0.06)		-0.882(0.05)		-1.544(0.05)		-1.215(0.05)		-0.703(0.06)		-0.745(0.05)	
rho		0.645		0.952		-0.875		-0.867		-0.911		-0.891	
sigma		0.310		0.414		0.213		0.297		0.495		0.475	
lambda		0.200		0.394		-0.187		-0.257		-0.451		-0.423	

* p < 0.10, ** p < 0.05, *** p <0.01.
LR is the Likelihood Ratio test for independent between selection and outcome equations, distributed as a chi-square with 1 degree of freedom.
(a) Unit: log(x+1) means the regressor is computed as the logarithm of (x+1) to avoid losing observations which original value is zero.

Table 3: Determinants of gross[a] and net[b] margin rates (dependent variable in log)

Median regression with bootstrapped standard errors (1,000 replications)		Gross margin rate				Net margin rate			
		2001		2007		2001		2007	
	Unit[a]	Coef.	*t* stat.	Coef.	*t* stat.	Coef.	*t* stat.	Coef.	*t* stat.
Transaction characteristics									
Distance travelled (km)	log(x+1)	0.024***	7.39	0.007***	3.93	-0.008***	-3.10	-0.003***	-2.66
Load size (ql.)	log	0.001	0.63	0.003**	2.47	-0.003	-1.56	0.000	0.17
Storage duration (No. days)	log(x+1)	0.001	0.25	0.004**	2.20	0.000	-0.02	0.004**	2.45
Crop type (food crops=omitted)									
Cash crops	yes=1	-0.002	-0.34	-0.002	-0.39	-0.004	-0.60	0.011**	2.26
Location dummies (North=omitted)									
For 2001: South and Addis Ababa	yes=1	0.000	-0.02			-0.002	-0.79		
For 2007:									
South	yes=1			0.003	1.49			0.003**	2.01
Addis Ababa	yes=1			-0.002	-1.54			-0.003**	-2.08
Intercept		0.017***	5.14	0.002	0.81	0.014***	4.99	0.000	-0.14
Number of observations		450		358		450		359	
Pseudo *R*-squared		0.162		0.093		0.033		0.036	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. (a) Unit: log(x+1) means that the regressor is computed as the logarithm of (x+1) to avoid losing observations which original value is zero. (a) For gross margin rate, the dependent variable is $\log(\mu_i^g + 1)$. (b) For net margin rate, the dependent variable is $\log(\mu_i^n + 1)$.

Estimation results are reported in Table 3 (first four columns for 2001 and 2007). To account for outliers and reporting errors (which are inevitable because Ethiopian traders do not hold books of account), we rely on the median estimator for μ_i^g (with bootstrapped standard errors, 1,000 replications). Hence, estimates approximate the conditional median of the response variable given certain values of the predictor variables. The regressors are those that entered the sample selection estimations for marketing costs (previous section 3.2 and excluding selection instruments).

As expected, the coefficients for travelled distance (for both 2001 and 2007) and storage duration (for 2007) are positive and significant: The longer the distance between purchase and sales markets and the length of storage the higher the marketing costs, the greater the gap between sales and purchase price.

Gross margin rates are constant with transaction size in 2001, and slightly increase with load size in 2007, when a tenfold increase in the purchased quantity from the median of 50 quintals would raise the gross margin by 0.30 percentage points. We analyse this result further by estimating median regressions for the sale price p_i^s and purchase price p_i^p. Estimates in Table 4 show that traders operating on a larger scale in 2007 were both paying a smaller purchase price and offering a smaller sale price, but the reduction in p_i^p was greater than that in p_i^s, which explains why the first derivative of μ_i^g with respect to q_i is positive. Hence, concentrating trading activities in the hands of big traders would not necessarily increase market efficiency.[5]

Table 4: Determinants of price levels (dependent variable is log of price per ql.)

Median regression with bootstrapped standard errors (1,000 replications)		Purchase price				Sale price			
		2001		2007		2001		2007	
	Unit[a]	Coef.	*t* stat.	Coef.	*t* stat.	Coef.	*t* stat.	Coef.	*t* stat.
Transaction characteristics									
Distance travelled (km)	log(x+1)	-0.048***	-3.52	0.022	1.19	-0.029*	-1.79	0.022	1.19
Load size (ql.)	log	-0.061	-2.76	-0.165***	-6.29	-0.063***	-2.78	-0.154***	-5.45
Storage duration (No. days)	log(x+1)	0.040	1.55	0.054	1.35	0.038	1.45	0.040	1.02
Crop type (food crops=omitted)									
Cash crops	yes=1	-0.153	-3.17	0.394***	6.40	-0.149***	-3.30	0.477***	7.08
Location dummies (North=omitted)									
For 2001: South and Addis Ababa	yes=1	0.007	0.23			-0.011	-0.30		
For 2007:									
South	yes=1			-0.010	-0.25			-0.032	-0.74
Addis Ababa	yes=1			-0.044	-0.77			-0.028	-0.48
Intercept		2.110	55.53	2.677***	46.71	2.152***	52.46	2.697***	43.74
Number of observations		453		358		450		362	
Pseudo *R*-squared		0.083		0.221		0.065		0.234	

* p < 0.10, ** p < 0.05, *** p <0.01. (a) Unit: log(x+1) means that the regressor is computed as the logarithm of (x+1) to avoid losing observations which original value is zero.

4.2. Net margin rate

The net margin rate is derived by deducing marketing costs (i.e. variable costs, c_i^v) from the difference between p_i^s and p_i^p at the numerator of the gross margin;

$$\mu_i^n \equiv \{[(p_i^s - c_i^v)/p_i^p] - 1\} \tag{10}$$

The average net margin rate was negative in 2001 (-2.4 percent) and close to zero in 2007 (0.04 percent). In section 3.2, we saw that larger transactions are not associated with lower costs of transport, loading, off-loading and handling. In section 4.1, we saw that the gross margin rate

[5] The ECX Trader Survey 2007 provides information on the percentages of purchases bought by each trader *i* from small-scale and commercial farmers and the percentages of sales sold to final consumers, for all products traded by *i* since the start of the production year. Assuming these percentages did not change for the last completed transaction, we re-estimate the purchase price p_i^p including among the covariates the variables 'from farmers' (i.e. share of the load size bought from farmers) and re-estimate the sales price p_i^s including among the regressors the variable 'to consumers' (i.e. share of the load size sold to final consumers). We find a coefficient of -0.202 for the variable 'from farmers', and of 0.227 for the variable 'to consumers' (estimation results significant at the 1 percent level, not reported to save space). Therefore, the more traders buy from farmers the less they pay, the more they sell to consumers the more they gain. Among the traders who bought exclusively from farmers, 45 percent traded 50 ql. or less in the last transaction; among those that sold entirely to consumers, only 16 percent traded more than 50 ql. We thus argue that large quantity discounts are not necessarily related to the size of the trading business.

is not smaller the bigger the trading business, but it either remains constant or increases to some extent. It is then not surprising to find that net margin does not vary with load size (see Table 3, last four columns for 2001 and 2007).

The coefficient for storage duration remains positive and significant in 2007; moreover, the length of storage impacts with the same magnitude (0.004) and significance level (5 percent) on both the gross and net margins. This is in line with the conclusions drawn in section 3.2, according to which days of storage have a minor effect on marketing costs.

The longer the distance between purchase and sales markets, the smaller the net margin. Focusing on 2001 (for which significant results associated with distance are available for prices and margins), as the distance travelled increases purchase price decreases (-0.048) more than sales price (–0.029); hence, the gross margin rises (+0.024). At the same time, and as it was reported for Benin and Malawi by Fafchamps et al. (2005), transport costs and other marketing costs increase most probably faster than the fall of p_i^p, so that net margins drop (-0.008).

5. CONCLUDING REMARKS

The 2007-09 food price crisis hit Ethiopia harshly: Even when world food prices began falling back towards former levels, domestic prices in Ethiopia carried on surging. A long-lasting reason of price instability was associated to market failure: The inability of agricultural markets to efficiently move food crops from surplus to deficit regions. The consequent recognition that policies aimed at 'getting prices right' in Ethiopia and other less developed countries were failing due to incomplete markets has spurred a new wave of reforms, directed instead at 'getting markets and institutions right'. In particular, the Ethiopia Government began implementing post-structural reforms in the late Nineties in order to enhance the '3 I's of market development': Incentives, Infrastructure and Institutions.

In this paper we investigate whether the focus on the 3 I's is a necessary, non-sufficient, condition to achieve rural market efficiency in Ethiopia: Is the presence of many small traders in the Ethiopian agricultural markets a source of inefficiency? Should the Ethiopian Government restrict entry in agricultural trade, formalize trading activities and facilitate the operation of big trading businesses?

In particular, given that a requirement for exchange efficiency is the lack of unexploited mutually beneficial spatial arbitrage opportunities (Rashid & Minot, 2010), we look for evidence of unexploited increasing returns to transaction size and returns to scale in transport in the Ethiopian agricultural trade. We rely on the 2002 Survey of Grain and Coffee Traders (Gabre-Madhin et al., 2002) and the ECX Trader Survey 2007 (Gabre-Madhin et al., 2007) to analyse market efficiency in agricultural trade in two very different years, when prices were respectively decreasing (in 2001) and rapidly increasing (in 2007). Conclusions are based on a throughout investigation of marketing costs, margin rates and prices.

We find that transport costs could be reduced by assembling loads and avoiding trans-shipments, in order to allow transporters to transport directly from purchase to final sales markets. We find no evidence that the main components of marketing costs (i.e. transport and handling) are a source of increasing returns to transaction size; hence, larger transactions are not associated with lower costs of transport, loading, off-loading, bagging and sewing. Similarly, margin rates show little relationship with load size. These results hold for both 2001 and 2007.

Transaction costs' minimization is required to maximize welfare and reach social efficiency, but bigger trading businesses do not seem more efficient in minimising variable marketing costs than smaller ones. Hence, concentration in market intermediation is not necessary for social efficiency. Enhancement of the existing institutional framework, information systems and infrastructure would help instead reduce transaction costs, facilitate the movement of commodities throughout the country and make Ethiopia less vulnerable to internally-caused and externally-related price shocks. Further analysis is needed to highlight which one/s among the 3 I's may make Ethiopian traders more able to mitigate ex ante and cope ex post with the risk of price instability, which they unanimously perceived as the major risk affecting their agricultural markets both in 2001 and in 2007.

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