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# The Brokerage Institution and the Development of Agricultural Markets: New Evidence from Ethiopia

Maria Quattri, Adam Ozanne, and Seneshaw Tamru

Development Strategy and Governance Division, International Food Policy Research Institute – Ethiopia Strategy Support Program II, Ethiopia

Ethiopia Strategy Support Program II (ESSP II)

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## Table of Contents

## List of Tables



## List of Figures



## Appendix

## Abstract

Recognition that policies aimed at 'getting prices right' in less-developed countries have not been successful due to incomplete markets has spurred a new wave of reforms aimed instead at 'getting markets and institutions right'. Previous studies of this policy shift have documented the potentially crucial role played by the brokerage institution in crop commercialization. However, few have investigated the factors that influence wholesalers' decisions regarding their use of brokers. Results from a primary survey with traders show that brokerage services are particularly valuable for wholesalers who lack social capital and storage capacity, who are based in areas with low population density, and who trade at a distance, especially when roads are not asphalt. Buyers in drought-prone domains rely on brokers more for their long-distance purchases, while sellers in moisture-reliable domains employ brokers more for their long-distance sales. These results provide useful indications regarding where and how the recent formalization of brokerage functions through the Ethiopian Commodity Exchange (ECX) could be most beneficial for the functioning of Ethiopian agricultural markets.

**Keywords:** Ethiopian Agricultural Markets, Brokers, ECX

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# 1. Introduction

Major policy reforms were undertaken in Ethiopia in the early 1990s in order to substitute a free-market system for the centrally planned and controlled socialist economy that had been in place since 1974. These reforms were based on the idea that eliminating distortionary economic interventions by the state was a precondition for 'getting prices right', which was itself necessary for spurring private investment and economic growth (Timmer 1986).

Studies conducted in the post-reform era have found that liberalization succeeded in enhancing price transmission between the main regional markets in Ethiopia (Jayne, Negassa, and Myers 1998; Negassa and Jayne 1997). Nevertheless, it has also been widely recognized that, "The withdrawal of parastatals from core input marketing activities created a void that the private sector often failed to fill due to underdeveloped physical communications, power and transport infrastructure, credit constraints, and continued bureaucratic impediments that increased transaction costs for input suppliers" (Barrett and Mutambatsere 2008, 7). To address the challenges posed by failing and incomplete markets, the Ethiopian government implemented a number of post-structural market reforms focused instead on 'getting institutions right' (Barrett and Mutambatsere 2008) and 'getting markets right' (World Bank 2004).

Brokerage is one of the institutions that might contribute to such reforms and enhance the operation of markets. Several studies have documented the crucial role played by brokers and outlined the benefits farmers and wholesalers alike derive from engaging the services of brokers (see Dessalegn, Jayne, and Shaffer 1998; Fafchamps and Gabre-Madhin 2001; Gabre-Madhin 2001a; Jabbar et al. 2008). However, very few studies have investigated the variables influencing economic agents' decisions to use brokers and, to our knowledge, only Gabre-Madhin (2001a) has attempted to explain, through econometric modeling, the actual decision processes followed by traders in choosing whether or not to use brokers.

The aim of this paper is to shine light on wholesalers' use of brokers in Ethiopian grain markets, and to contribute to the literature on the roles played by social capital, trading practices, institutions, and infrastructure in the development of agricultural markets. In particular, we ask two questions. First, which variables significantly affect wholesalers' decisions regarding whether or not to use brokers and how much to use them? Second, which traders would benefit most from the formalization of brokerage activities?

These research questions are especially relevant to the current debate regarding the role and importance of the Ethiopian Commodity Exchange (ECX). Launched in April 2008, as a national and multi-commodity exchange resulting from a public-private partnership, the ECX formalized and strengthened the functions typically conducted by brokers. Essentially we estimate traders' use of brokers in their main markets for buyers and sellers separately,[1] using data collected through the ECX Trader Survey 2007 (Gabre-Madhin, IFPRI, and EDRI 2007) conducted by Gabre-Madhin, the International Food Policy Research Institute (IFPRI) and the Ethiopian Development Research Institute (EDRI).

[1] Some traders are both buyers and sellers; others are only buyers or sellers. Nonetheless, even when traders act as both buyers and sellers, the impact of transaction costs on their trading decisions (especially whether and how much to use brokers) varies according to what they are doing; namely, buying or selling. Buyers, for example, seem to be more concerned about ensuring that the quality of transacted crops conforms to their expectations (Gabre-Madhin 2001b); therefore, transaction costs for quality evaluation may have a greater impact on their trading decisions. The treatment of buyers and sellers as two separate categories attempts to address this apparent dichotomy in their perception of transaction costs, though the results of the econometric analysis tend to be more robust for buyers than for sellers.

The rest of this paper is organized as follows: Section 2 reviews the literature on the relevance of the brokerage institution for agricultural markets and traders' attempts to minimize high transaction costs through the use of brokers. Section 3 introduces the details of the estimation procedure, data, and summary statistics. Section 4 presents and discusses the main research findings. Section 5 concludes.

## 2. Literature review

### 2.1. The relevance of the brokerage institution for agricultural markets

Researchers have documented the essential role of intermediaries in agricultural markets for a number of Sub-Saharan Africa countries. For example, in Benin and Malawi brokers compensate for the lack of networks of business partners available to traders (Fafchamps and Gabre-Madhin 2001). In Tanzania, brokers encourage impersonal exchange by acting as guarantors for the parties involved in trade (Eskola 2005). In Uganda, they provide information, funding, and technical assistance to wholesalers of fresh fruits and vegetables (Bear and Goldman 2005); and in Kenya they represent the first alternative for farmers to other forms of collective action such as producer marketing groups (Shiferaw et al. 2009). In northern Nigeria, brokers facilitate pig marketing (Ajala and Adesehinwa 2007) and in Nairobi—a leading terminal market for livestock from throughout the greater Horn of Africa—they facilitate livestock trade. Given the cross-border nature of these trading networks, trust between brokers and traders is essential (Bailey et al. 1999).

The important role played by brokers has also been reported outside Africa. In Brazil, for example, they support farmers by helping to minimize price risk in future and derivative agricultural markets (Pessôa and Jank 2002), while in Peru commission agents promote long-distance trade (Scott 1985). In India, in the traditional marketing system, small land-holding farmers depend on intermediaries for credit (Lokanathan and de Silva 2010).

### 2.2. Brokers in Ethiopia

A study that deserves particular attention for the purpose of this paper is that of Gabre-Madhin (2001a). The study identifies the benefits the use of brokers can bring to wholesalers while also explaining why traders use brokers in the first instance. Using primary data collected in Ethiopia in 1996, Gabre-Madhin (2001a) demonstrated how the use of brokers by traders is positively related to transaction costs of search, defined as the shadow opportunity costs of search labor (defined as the number of employees engaged in search for market price information) and of working capital kept in the form of grain stocks, and inversely related to social capital availability.

However, Gabre-Madhin (2001a) based her analysis on strong hypotheses regarding the specification of the functional form representing the trader's profit function, which was used for the instrumental variable derivation of opportunity costs, while the assumed endogeneity of search labor and working capital was not tested. Gabre-Madhin also assumed that the probability that wholesalers use brokers in their main markets and the expected share of

brokered transactions are determined by the same set of variables (a consequence of the use of the Tobit model), which may not be the case. Furthermore, her approach assumes the impact of a given variable on both the likelihood to turn to brokers and the amount of brokerage use is in the same direction (Baum 2006).

### 2.3. Traders' attempt to minimize high transaction costs and the use of brokers

Gabre-Madhin (2001a) and the aforementioned studies suggest that traders' use of brokers is closely related to traders' attempts to minimize prohibitively high transaction costs.

Transaction cost economics essentially assert that market institutions minimize the transaction costs associated with market exchange and that markets evolve over time following changes in the nature and sources of transaction costs (Kherallah and Kirsten 2001). Jabbar et al. (2008) further argue that traders own different assets (such as physical, financial, human, and social capital) and adopt various trading practices, including the use of brokers, to reduce transaction costs. Among trading assets, the existing literature has given particular relevance to social capital.[2]

Traders' ability to minimize transaction costs is challenged by the environment in which they operate. For example, Gabre-Madhin (2001a) found that traders' use of brokers varies depending on whether they are located in a surplus or deficit production region. Following Chamberlin, Pender, and Yu (2006), a geographic disaggregation of Ethiopia is therefore specified in this paper that takes into account the heterogeneity of production and marketing contexts prevailing in the country.[3]

Staal, Delgado, and Nicholson (1997) and Gabre-Madhin (2006) found that, as well as location, travelled distance and physical infrastructure availability also have an impact on traders' ability to minimize transaction costs. The inadequacy of physical infrastructure (such as road networks, telecommunications, and storage facilities) pushes up searching, screening, and bargaining costs. Moreover, the farther wholesalers are from their main markets the more these costs rise. Schmidt and Shiferaw (2009) add that "The shortest route in kilometers may not always be the fastest route". Hence, in order to investigate wholesalers' use of brokers aimed at minimizing transaction costs, we considered Euclidean distance between traders' base and main market centers in connection with dummy variables assessing the quality of roads linking these markets.

Ownership of assets, implemented trading practices, location, travelled distance, and infrastructure availability mean that some traders are more able to reduce transaction costs than others. But do these variables affect wholesalers' decisions on whether and how much to use brokers? We test the hypothesis that their impact is relevant and statistically significant. The improved knowledge will contribute to the formulation of policy advice on and how the ECX could be most beneficial to the agricultural markets.

[2] In general terms, social capital refers to articulated networks linking human beings, based on mutual trust, reputation, and reciprocity (Gabre-Madhin 2006; Gabre-Madhin and Haggblade 2003). Fafchamps and Minten (1999b) distinguish between social capital collected unintentionally (through family connections, ethnicity or by belonging to a religion group) and social capital intentionally acquired through joining associations and actively looking for potential trading partners. Fafchamps and Minten (1998) provide evidence of the large and significant impact that social networks have on the performance of traders in Madagascar, while their research in Benin, Madagascar, and Malawi supports the beneficial impact of social capital on the productivity of agricultural traders (Fafchamps and Minten 2001).

[3] Chamberlin, Pender, and Yu (2006) analyze crop commercialization by farmers in Ethiopia, and classify smallholder-relevant agricultural domains based on agricultural potential, access to market (measured by the average travel time to the nearest town of 5,000 or more inhabitants) and population density. They define domains as "geographical locations sharing broadly similar rural development constraints and opportunities" (ibid.: vii).

## 3. Analytical framework

### 3.1. The model under the assumption of sample selection

We assume traders follow a sequential decision process with a discrete choice on 'whether or not' to use brokers and a subsequent continuous decision on 'how much' to use brokers.

Consider a latent continuous variable $\{\mathrm{Z}_i'\alpha + u_i\}$. When this variable is strictly positive, the marginal benefits of using brokers exceed the marginal costs (or lost profit due to brokerage fees). In this case, a trader chooses to use brokers and $\mathrm{T}_i$ (a brokerage-use binary variable) equals unity. On the contrary, when $\{\mathrm{Z}_i'\alpha + u_i\}$ is less than or equal to zero, $\mathrm{T}_i$ equals zero.

Hence, the selection equation describes whether a trader is or is not using brokers,

$$\mathrm{T}_i = \begin{cases} 1 \;\; if \;\; \mathrm{Z}_i'\alpha + u_i > 0 \\ 0 \;\; if \;\; \mathrm{Z}_i'\alpha + u_i \leq 0 \end{cases} \tag{1}$$

Only when the binary participation decision $\mathrm{T}_i$ equals unity is the 'brokerage-use intensity' $\mathrm{B}_i$ observed; in other words, the participation decision dominates the intensity decision.[4] $\mathrm{B}_i$ explains how much trader $i$ uses brokers and represents the share of brokered transactions out of total transactions. Therefore,

$$\mathrm{B}_i = \mathrm{B}_i^*, \qquad if \;\; \mathrm{T}_i = 1$$

$$\mathrm{B}_i \text{ not observed}, \;\; if \;\; \mathrm{T}_i = 0 \tag{2}$$

where $\mathrm{B}_i^*$ (the potential share of brokered transactions, a latent variable) corresponds to

$$\mathrm{B}_i^* = \mathrm{X}_i'\beta + \varepsilon_i \tag{3}$$

In order to estimate the parameters of the model and correctly interpret the model, we make the following assumptions

(a) $(\mathrm{X}_i, \mathrm{Z}_i, \mathrm{T}_i)$ are always observed;
(b) $(\varepsilon_i, u_i)$ is independent of $(\mathrm{X}_i, \mathrm{Z}_i)$ with zero mean, which means $(\mathrm{X}_i, \mathrm{Z}_i)$ are exogenous vectors of covariates for $i = 1, \dots, N$
(c) $u_i \sim N(0,1), \quad i = 1, \dots, N$
(d) $\mathrm{E}(\varepsilon_i | u_i) = \sigma_{\varepsilon u} u_i = \rho_{\varepsilon u}\sigma_\varepsilon u_i$ with $\rho_{\varepsilon u} = corr(\varepsilon_i, u_i) = \frac{\sigma_{\varepsilon u}}{\sigma_u \sigma_\varepsilon}$

### 3.2. Estimation methods

The sample selection model can be estimated through the Heckman (1979) two-step procedure or by maximum likelihood. In both cases, the presence of selection bias should be tested before proceeding with the estimation.

[4] This is the reason why the sample selection model first formulated by Heckman is also known as the first-hurdle dominance model (Madden 2008, 301-302; Moon, Balasubramanian, and Rimal 2004, 12-13). Whereas the Tobit model used by Gabre-Madhin (2001a) assumes the participation decision is irrelevant and treats as zeros those observations for which the shares of brokered transactions are zeros (that is, corner solutions or actual and fully-observed outcomes of a constraint optimization process), the Heckman model considers these observations to be unobserved or missing. In the words of Dow and Norton (2003, 6): "The non-zero values are assumed to be true observations of the potential outcome, but zero values indicate observations for which the potential outcome is missing (latent). The zeros do not represent zero values for the potential outcome."

### *3.2.1. LIML and FIML estimations and tests for selection bias*

***The two-step selection model*** (also known as Heckit model, adjusted Tobit model or the Limited Information Maximum Likelihood, LIML, selection estimator (Dow and Norton 2003, 8)) entails the estimation of the selection equation by Probit, using the entire sample of N observations (see Leung and Yu 1996, 201-202),

$$\mathrm{P}(\mathrm{T}_i = 1|\mathrm{Z}_i) = \Phi(\mathrm{Z}_i'\alpha),\ i = 1, \dots, \mathrm{N}, \tag{4}$$

where $\Phi(\mathrm{Z}_i'\alpha)$ is the standard normal cumulative distribution function evaluated at $\mathrm{Z}_i'\alpha$. The Probit estimate $\hat{\alpha}$ is obtained by means of maximum likelihood, and is consistent ($plim\ \hat{\alpha} = \alpha$) assuming that the model for $\mathrm{T}_i$ is correctly specified.

Thereafter, the estimates of $\beta$ and $\sigma_{\varepsilon u}$ are derived by running an Ordinary Least Squares (OLS) regression on the model

$$\mathrm{B}_i = \mathrm{X}_i'\beta + \sigma_{\varepsilon u}\lambda(\mathrm{Z}_i'\hat{\alpha}) + \mathrm{v}_i, \tag{5}$$

where $\mathrm{E}(\mathrm{v}_i|\mathrm{X}_i, \mathrm{T}_i = 1) = 0$, $\lambda(\mathrm{Z}_i'\hat{\alpha}) = \frac{\phi(\mathrm{Z}_i'\hat{\alpha})}{\Phi(\mathrm{Z}_i'\hat{\alpha})}$ is known as the estimated inverse Mills' ratio evaluated at $\mathrm{Z}_i'\hat{\alpha}$, and $\phi(\cdot)$ is the probability density function of the standard normal distribution.

The OLS estimation is conducted using all observations for which $\mathrm{T}_i = 1$, which means for the subsample of traders using brokers. The resulting OLS estimates of $\hat{\beta}$ and $\hat{\sigma}_{\varepsilon u}$ are $\sqrt{N}$-asymptotically normal and consistent ($plim\ \hat{\beta} = \beta$ and $plim\ \hat{\sigma}_{\varepsilon u} = \sigma_{\varepsilon u}$).

***Testing for selection bias: The t-test***

The conditional share of observed brokered transactions given that a trader is using brokers is:

$$\mathrm{E}(\mathrm{B}_i|\mathrm{T}_i = 1, \mathrm{X}_i, \mathrm{Z}_i) = \mathrm{X}_i'\beta + \sigma_{\varepsilon u}\lambda(\mathrm{Z}_i'\alpha) \tag{6}$$

As stressed by Wooldridge (2002a, 563), if the estimated inverse Mills' ratio $\lambda(\mathrm{Z}_i'\hat{\alpha})$ had a coefficient $\sigma_{\varepsilon u}$ significantly different from zero, the least squares regression of $\mathrm{B}_i$ on $\mathrm{X}_i$, omitting $\lambda$, would produce inconsistent estimates for $\beta$ because of the correlation between $\mathrm{X}_i$ and $\lambda$. It was Heckman (1979) who suggested that the sample selection problem is an example of omitted variable bias, which itself is a form of endogeneity.

Wooldridge (2002a, 564) suggests performing the following test for selection bias. Under the null of no selection bias,

$$\mathrm{H}_0\colon \sigma_{\varepsilon u} = 0 \tag{7}$$

We have $\mathrm{Var}(\mathrm{B}_i|\mathrm{T}_i = 1, \mathrm{X}_i, \mathrm{Z}_i) = \mathrm{Var}(\varepsilon_i) = \sigma_\varepsilon^2$

Therefore, homoskedasticity holds under $\mathrm{H}_0$. Additionally, the asymptotic variance of $\hat{\sigma}_{\varepsilon u}$ is not affected by $\hat{\alpha}$ when $\sigma_{\varepsilon u} = 0$. Hence, a standard t-test on $\hat{\sigma}_{\varepsilon u}$ is valid for the null hypothesis of no selection bias. The t-statistic of $\hat{\sigma}_{\varepsilon u}$ is $t \equiv \frac{\hat{\sigma}_{\varepsilon u}}{se(\hat{\sigma}_{\varepsilon u})} \sim t_{n-k-1}$, with $n$ number of observations, $(k+1)$ number of estimated parameters and $(n-k-1)$ degrees of freedom.

***Drawbacks of the LIML estimation procedure***

Whereas the Heckit procedure has the large-sample property of consistency, this estimation method is asymptotically inefficient. When the correlation coefficient $\rho_{\varepsilon u}$ is significantly

different from zero, the variance of $\mathrm{B}_i$, conditional on using brokers $(\mathrm{T}_i = 1)$, is not constant (Wooldridge 2002a, 564)

$$[\rho_{\varepsilon u}\sigma_\varepsilon \neq 0] \Rightarrow \{Var(\,\mathrm{B}_i|\mathrm{T}_i = 1, \mathrm{X}_i, \mathrm{Z}_i) \neq [Var(\mathrm{B}_i|\mathrm{X}_i) = Var(\varepsilon_i) = \sigma_\varepsilon^2]\}$$

Because of heteroskedasticity, the OLS estimator in the second step does not have the smallest variance among linear unbiased estimators (Wooldridge 2002b, 249). The use of heteroskedastic-robust standard errors for the least squares coefficients $\hat{\beta}$ and $\hat{\sigma}_{\varepsilon u}$ is thus a necessary adjustment.

Even after heteroskedasticity is accounted for, the standard errors and test statistics obtained in the second step remain invalid because the estimated $\hat{\lambda}$ is derived using data. The predicted $\hat{\lambda}$ is a generated regressor (Pagan 1984) entering the second regression with a sample variance or uncertainty in the estimation that is ignored by OLS (Wooldridge 2002a, 115). To obtain correct standard errors, either appropriate formulas shall be computed (which is done automatically by the Stata *twostep* option) or the whole two-step procedure shall be bootstrapped (Lemieux 2009, 4).

***The FIML estimation***

The FIML estimation[5] differs from the LIML procedure because it strengthens asymptotic inference by estimating the selection equation (1) and outcome equation (3) jointly (Bolwig, Gibbon, and Jones 2009, 1098), and produces likelihood ratio statistics and standard errors which can be used directly (Wooldridge 2002a, 566). The FIML estimator is not only consistent, but also asymptotically efficient. The efficiency of FIML holds under the hypotheses that the error terms in the two regressions are distributed bivariate normal with mean zero.[6] Assumptions (c) and (d) stated above are thus replaced with the stronger assumption that $(\varepsilon_i, u_i)$ is bivariate normal with mean zero $(i = 1, \dots, N)$, and that

$$\binom{\varepsilon_i}{u_i}|\mathrm{X}_i, \mathrm{Z}_i \sim N\left(\binom{0}{0}, \begin{pmatrix}\sigma_\varepsilon^2 & \sigma_{\varepsilon u}\\ \sigma_{\varepsilon u} & 1\end{pmatrix}\right). \tag{8}$$

Based on Imbens (2004, 3) and Wooldridge (2002a, 566), we derive the log-likelihood function for the Heckman model:

$$\begin{aligned} L(\alpha, \beta, \sigma_\varepsilon^2, \rho_{\varepsilon u}) = {} & \sum_{i=1}^{N} (1 - \mathrm{T}_i)\ln\big(1 - \Phi(\mathrm{Z}_i'\alpha)\big) \\ & + \mathrm{T}_i\left(\ln\Phi\left(\frac{\left(\mathrm{Z}_i'\alpha + \frac{\sigma_{\varepsilon u}}{\sigma_\varepsilon^2}(\mathrm{B}_i - \mathrm{X}_i'\beta)\right)}{\sqrt{\left(1 - \frac{\sigma_{\varepsilon u}^2}{\sigma_\varepsilon^2}\right)}}\right) + \ln\phi\left(\frac{\mathrm{B}_i - \mathrm{X}_i'\beta}{\sigma_\varepsilon}\right) - \ln\sigma_\varepsilon\right) \end{aligned} \tag{9}$$

Parameters' estimates are thus obtained by maximizing this function.

[5] Wooldridge (2002a, 566) specifies that a full conditional Maximum Likelihood Estimation (MLE) cannot be performed because $\mathrm{B}_i$ is only observed when $\mathrm{T}_i = 1$. Therefore, whereas it is possible to use the full density of $\mathrm{T}_i$ given $\mathrm{Z}_i$, we can only use the density of $\mathrm{B}_i$ conditional on $\mathrm{T}_i$ (and $\mathrm{X}_i$) when $\mathrm{T}_i = 1$. Accordingly, the partial MLE is instead performed.

[6] FIML appears to be less robust than LIML in cases where the joint normality assumption of $\varepsilon_i$ and $\mathrm{u}_i$ is violated (Bushway, Johnson, and Slocum 2007, 171). Apart from being highly sensitive to model specification, FIML's convergence to a solution (considering that it maximizes a specific likelihood function) might be difficult to obtain. Thus, computation complexity in the estimation procedure may arise.

As the coefficient estimates represent changes in the desired or potential quantities transacted, the variation in the observed and actual quantities can be derived through the following decomposition (Dow and Norton 2003, 8),[7]

$$\mathrm{E}[\mathrm{B}_i|\mathrm{X}_i,\mathrm{Z}_i] = \Pr[\mathrm{B}_i > 0|\mathrm{X}_i,\mathrm{Z}_i] \times \mathrm{E}[\mathrm{B}_i|\mathrm{B}_i > 0,\mathrm{X}_i,\mathrm{Z}_i] \quad (10)$$

As Hoffmann and Kassouf (2005) pointed out, the conditional marginal effect for the predictor $x_{ki}$ varies for each trader ($i = 1, \dots, N$) and depends on $\mathrm{X}_i$ and $\mathrm{Z}_i$. We thus follow the conventional practice to evaluate marginal effects at sample means of continuous variables.

***LR test for independence and the importance of introducing exclusion restrictions***

Yamagata and Orme (2005, 479-480) highlight how the standard regression-based t-test procedure (see the previous section, *Testing for selection bias: The t-test*), originally proposed by Heckman (1979) and Melino (1982) and robust to nonnormality, is recommended when the multicollinearity between the $\mathrm{X}_i$ and $\hat{\lambda}_i$ regressors in the second stage of the Heckman estimation is not severe. Otherwise, under the multicollinearity problem, "the Likelihood Ratio test, based on Maximum Likelihood estimation under the assumption of normality, remains powerful and has reasonable size properties" (Yamagata and Orme 2005, 479-480). The LR test statistic is distributed as a chi-square with 1 degree of freedom. In this paper, we thus estimate selection models à la Heckman by FIML, if sample selection is detected, and report the LR test statistics of independence between equations (1) and (3).

Additionally, in order to reduce multicollinearity between the $\mathrm{X}_i$ and $\hat{\lambda}_i$ regressors,[8] Wooldridge (2002a, 564) suggests making $\mathrm{X}_i$ a strict subset of $\mathrm{Z}_i$. Thus, there should exist at least one predictor in $\mathrm{Z}_i$ which does not simultaneously belong to $\mathrm{X}_i$, which implies that at least one variable, called the exclusion restriction or selection instrument, should explain a trader's decision to self-select him or herself into the group of wholesalers using brokers, but should have no partial effect on his or her chosen share of brokered transactions.

If sample selection is not detected (that is, the correlation $\rho_{\varepsilon u}$ between the error terms in the participation and outcome equations is not significantly different from zero), a hurdle or two-tiered estimation procedure is followed instead (Wooldridge 2002a).

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[7] If $x_{ki}$ is an arbitrary continuous *k*-th independent variable which enters both the selection and the outcome equations, the marginal effect of $x_{ki}$ on the expected actual share of brokered transactions $\mathrm{E}[\mathrm{B}_i|\mathrm{X}_i,\mathrm{Z}_i]$ is (omitting the condition on $\mathrm{X}_i$ and $\mathrm{Z}_i$for ease of notation):

$\frac{\partial \mathrm{E}[\mathrm{B}_i]}{\partial x_{ki}} = \frac{\partial \Pr[\mathrm{B}_i>0]\times \mathrm{E}[\mathrm{B}_i|\mathrm{B}_i>0]}{\partial x_{ki}} = \left(\Pr[\mathrm{B}_i > 0] \times \frac{\partial \mathrm{E}[\mathrm{B}_i|\mathrm{B}_i>0]}{\partial x_{ki}}\right) + \left(\mathrm{E}[\mathrm{B}_i|\mathrm{B}_i > 0] \times \frac{\partial \Pr[\mathrm{B}_i>0]}{\partial x_{ki}}\right)$

where $\Pr[\mathrm{B}_i > 0] = \Phi(\mathrm{Z}_i'\alpha)$ is the probability that trader *i* uses brokers in his or her main market;

$\frac{\partial \Pr[\mathrm{B}_i>0]}{\partial x_{ki}}$ is the marginal effect for the probability of using brokers;

$\mathrm{E}[\mathrm{B}_i|\mathrm{B}_i > 0]$ is the expected share of brokered transaction for trader *i*, conditional on the fact that the trader is currently using brokers in his or her main market; and

$\frac{\partial \mathrm{E}[\mathrm{B}_i|\mathrm{B}_i>0]}{\partial x_{ki}}$ is the conditional marginal effect.

[8] If $\mathrm{Z}_i'\hat{\alpha}$ does not vary much in the sample, the estimated inverse Mills ratio [$\hat{\lambda}_i \equiv \lambda(\mathrm{Z}_i'\hat{\alpha})$] can be approximated by a linear function of $\mathrm{Z}_i$. In the case of the two-step estimation, when $\mathrm{X}_i = \mathrm{Z}_i$ high multicollinearity between the $\mathrm{X}_i$ and $\hat{\lambda}_i$ regressors in the second stage of the Heckman estimation can lead to extremely large standard errors for the elements of $\hat{\beta}$. On the contrary, when $\mathrm{X}_i \neq \mathrm{Z}_i$, the identification of $\beta$ does not rest only on the nonlinearity of $\hat{\lambda}_i$ (Wooldridge 2002a, 564). Moreover, if $\mathrm{X}_i'\beta = \mathrm{Z}_i'\alpha$ (that is, $\beta = \alpha$), and $\varepsilon_i = u_i$, the Heckman model collapses down to the Tobit model.

### *3.2.2. Sample selection not detected: The double-hurdle model*

In double-hurdle models (or two-tiered or two-part models; Cragg 1971), zeros could be either corner solutions (as in the Tobit model) or abstentions (as in the selection model à la Heckman; see footnote 4), and the participation and intensity decisions are treated separately.

First, the selection equation (1) is estimated by Probit using the entire sample of N observations (see Leung and Yu 1996, 201-202) as in (4). Thereafter, the estimates of β are derived by running an Ordinary Least Squares (OLS) regression on the model,

$$\mathrm{B}_i = \mathrm{X}_i'\beta + \mathrm{v}_i \qquad (11)$$

with $\mathrm{E}(\mathrm{v}_i|\mathrm{X}_i, \mathrm{T}_i = 1) = 0$. The OLS estimation uses all observations for which $\mathrm{T}_i = 1$, which means the subsample of traders using brokers. Marginal effects for the Probit and OLS coefficient estimates from the two-part estimation are then reported.

## 3.3. Data and variables

The 'ECX Trader Survey 2007' (Gabre-Madhin, IFPRI, and EDRI 2007) was conducted in May–July 2007 before the launch of the ECX itself in April 2008. In this survey, 457 wholesalers in 21 markets around Ethiopia were asked to recall their activities from the start of the production year that ran from October and November 2006 until April and May 2007. Hence, the survey covered the main harvest seasons for 2006/07 (known as the 'Meher' and the 'Belg' seasons) when crop commercialization activities by farmers were thriving and trading opportunities for wholesalers were excellent.

For the purposes of the analysis, we consider buying and selling transactions separately (see footnote 1) and identify a 'main market' for each trader's purchases and sales: that is, the market she or he uses most frequently, which may be where the wholesaler is based or a long-distant market.[9]

The variables used in the estimations for buyers and sellers, their specifications and units of measurement, are presented in Appendix Tables A.1 (showing the exclusion restrictions, which have been chosen on the basis of economic reasoning and available evidence) and Table A.2. The reasons underlying the choice of selection instruments are reported in the Appendix A.3.

[9] We define 'regularity' according to the following criteria (the order in which they are mentioned dictates their priority):

1. The market in which the greatest percentage of the most purchased/sold agricultural product is traded (that is, the crop for which the wholesaler purchased or sold the greatest quantities during the last harvest year).
2. The market in which the trader has a stall.
3. The market where the trader has the greatest number of trading contacts.
4. The number of business-related journeys made to that market from the start of the production year.

### 3.4. Summary statistics

Table 3.1 reports descriptive statistics computed after eliminating outliers, leverages, unusual and influential observations,[10] and, from the sample of sellers, exporters (that is, the analysis focuses on transactions relevant for local markets only).

The overwhelming majority of traders are male sole-owners with an average of 12 years in the trading business, mostly located in moisture-reliable agricultural domains (more than 50 percent of them), in areas characterized by high market access and high population density (47 percent of them). They mainly trade cereals (on average, 69.5 percent of them).

The size of trading businesses varies remarkably, as indicated by available working capital and the capacity (in quintals) of storage facilities under exclusive control. Survey results indicate that wholesalers of cereals and pulses (food crops) have an average working capital four times smaller than that of traders of coffee and oil seed (cash crops). Moreover, storage facilities exclusively controlled by cash-crop wholesalers can store, on average, 9 percent more produce than the facilities controlled by food-crop traders. Given the heterogeneity in the size of the trading firms, observations for working capital and storage capacity are normalized through a logarithmic transformation to make them comparable, as in Fafchamps, Gunning, and Oostendorp (2000, 16).

The number of regular customers for an average wholesaler is more than double the number of regular suppliers and, as expected, the number of trading contacts is greater than that of regular partners. Surveyed wholesalers conduct on average 93 percent of their total transactions in their main markets, where the number of trading contacts (that is social capital) is the greatest. This helps minimize the transaction costs of obtaining and processing market information. As to infrastructure availability and access to credit, roads linking the base to main market centers are mainly asphalt and only 43 percent of all traders can access credit whether formal or informal.

Further data investigation shows that main markets are distant markets for a larger proportion of buyers than sellers (25 versus 20 percent), and that sellers tend to travel on average for longer distances (364 km versus 289 km for buyers). Moreover, buyers in drought-prone and pastoral areas travel on average 157 km more than buyers in moisture-reliable areas, and sellers in moisture-reliable domains travel on average 97 km more than sellers in drought-prone domains. The mean distance covered by cash crop wholesalers is 185 km greater than the distance covered by food crop wholesalers.

[10] An outlier is an observation with large residual, that is, "whose dependent-variable value is unusual given its value on the predictor variables" (UCLA 2010). A point with high leverage is an observation "with an extreme value on a predictor variable;" leverage measures how far an observation deviates from the mean of that variable (ibid.). Influence is the product of leverage and outlierness. We remove influential observations that substantially differ from all other observations because the presence of unusual observations can make a large difference in the results of the regression analysis (ibid.).

## Table 3.1—Summary statistics for buyers and sellers

| | BUYERS | | SELLERS | |
|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** |
| ***Gender*** of the owner of the trading business (=1 if female) | 0.09 | | 0.09 | |
| **Main traded agricultural product** | | | | |
| *Cereals* (=1 if the wholesaler buys/sells cereals) | 0.67 | | 0.72 | |
| *Coffee (=1 if the wholesaler buys/sells coffee)* | 0.13 | | 0.11 | |
| *Oilseeds (=1 if the wholesaler buys/sells oilseeds)* | 0.11 | | 0.09 | |
| *Pulses (=1 if the wholesaler buys/sells pulses)* | 0.1 | | 0.08 | |
| **Trading practices** | | | | |
| ***Trading firm ownership*** | | | | |
| *Sole-ownership of the trading business* (=1 if sole-ownership; 0 otherwise) | 0.96 | | 0.99 | |
| ***Distance*** between the base and main markets (Km) | 289 | 271 | 364 | 223 |
| **Assets** | | | | |
| ***Human capital*** | | | | |
| *Number of years of operation of the trading business* | 12 | 11 | 12 | 10 |
| *Number of people authorized to buy and/or sell for the trading business* | 1 | 2 | 1 | 2 |
| *Number of employees engaged in price search* | 2 | 1 | 1 | 1 |
| ***Social capital*** | | | | |
| *Number of trading contacts in the main market* | 44 | 158 | 43 | 135 |
| *Number of regular suppliers/customers in the main market* | 13 | 73 | 30 | 202 |
| ***Financial assets & access to credit*** | | | | |
| *Working capital* (National Currency Unit: '000 Ethiopian Birr) | 1,478 | 10,600 | 250 | 611 |
| *Access to credit* (=1 if the wholesaler had access to in/formal credit since the start of the production year; 0 otherwise) | 0.44 | | 0.42 | |
| ***Physical capital/access to physical infrastructure*** | | | | |
| *A storage facility is under the trader's exclusive control* (=1 if yes; 0 otherwise) | 0.97 | | 0.97 | |
| *Capacity of storage facility/ies under the trader's exclusive control* (ql.) | 6,525 | 28,033 | 2,898 | 13,725 |
| **Contractual performance** | | | | |
| ***Costs*** | | | | |
| *Annualized Physical Marketing Costs ('000 Ethiopian Birr)* | 291 | 1,914 | 57 | 214 |
| *Fixed/Operational Costs ('000 Ethiopian Birr)* | 67 | 351 | 27 | 93 |
| **Market where the trader is based** | | | | |
| ***Location: Agricultural potential*** | | | | |
| *Drought-Prone Area* (=1 if the trader is based in a drought-prone area) | 0.28 | | 0.27 | |
| *Moisture-Reliable Area* | 0.51 | | 0.53 | |
| *Pastoral Area* | 0.06 | | 0.05 | |
| *Central Market* | 0.15 | | 0.15 | |
| ***Location: Access to market and population density*** | | | | |
| (=1 the market where the trader is based has the following characteristics) | | | | |
| *Low Market Access & Low Population Density* | 0.35 | | 0.34 | |
| *Low Market Access & High Population Density* | 0.18 | | 0.19 | |
| *High Market Access & High Population Density* | 0.47 | | 0.47 | |
| **Main market** | | | | |
| ***Relevance & competition*** | | | | |
| *Share of total purchases/sales in the trader's main market* (Percentage) | 0.91 | 0.18 | 0.95 | 0.13 |
| ***Availability of infrastructure & telecommunications*** | | | | |
| *Type of road linking the trader's main market to the market where s/he is based* | | | | |
| (=1 if road is as indicated; 0 otherwise) | | | | |
| *Asphalt Road* | 0.5 | | 0.76 | |
| *Dry-Weather Road* | 0.2 | | 0.14 | |
| *All-Weather Road* | 0.3 | | | |
| ***Financial institutions' availability*** | | | | |
| *Availability of a bank in the trader's main market* (=1 if yes; 0 otherwise) | 0.89 | | 0.98 | |
| **Number of observations** | 449 | | 414 | |

# 4. Research findings and discussion

## 4.1. Endogeneity and selection bias issues

Before reporting estimation results, we conduct a series of tests to check for

- The exogeneity of the variables search labor and working capital
- The presence of sample selection

### *4.1.1. Testing for the exogeneity of search labor and working capital*

In her analysis of traders' use of brokers in Ethiopia in 1996, Gabre-Madhin (2001a, 55) noticed that the use of directly observed search labor and working capital to describe wholesalers' use of brokerage would cause endogeneity bias because the chosen levels of working capital and search labor depend on traders' choice of brokerage. Gabre-Madhin defined working capital as the "average amount of funds that the trader has at his or her disposal for the purpose of buying and marketing grain" and search labor as the "number of persons in the trading firm who are engaged in searching for buyers and sellers" (Gabre-Madhin 2001a, 56).

Accordingly, we test for the exogeneity of the variables search labor (defined as the number of employees engaged in search for market price information), and working capital. We derive potential instruments from Fafchamps and Minten's analysis (2001). Valid, relevant, and non-redundant instruments are identified through a testing procedure. We then run a two-step instrumental variable robust probit estimation, reporting a Wald test of endogeneity for both buyers and sellers.

Exogeneity test results reject the endogeneity of both search labor and working capital.[11]

### *4.1.2. Testing for selection bias*

For buyers, the t-test on $\hat{\sigma}_{\varepsilon u}$ rejects the null hypothesis (7) of no selection bias at the 5

percent significance level. Similarly, the LR test of independent equations rejects the null hypothesis

$H_0: \rho_{\varepsilon u} = 0$

with a p-value of 0.0586 (chi-square test statistic of 3.58).[12] For buyers, we thus fit a sample selection model à la Heckman by FIML.

For sellers, the t-statistic of $\hat{\sigma}_{\varepsilon u}$ is -0.97 and the p-value is 0.335. Additionally, the LR test statistic is 1.72 and the p-value is 0.1893. Because we reject the hypothesis of sample selection, we conduct for sellers a two-part estimation procedure.[13]

[11] We did not report these results here, so as to save space. But they are available from the corresponding author upon request.

[12] If the *vce(robust)* option was specified while estimating the buyers' model à la Heckman in Stata 10.1, the likelihood-ratio test would be presented as a Wald test of independent equations ($H_0: \rho_{\varepsilon u} = 0$), distributed as chi-square with 1 degree of freedom. The Wald test statistic (5.49) and the corresponding p-value (0.0191) would lead to a rejection of the null at the 5 percent significance level. The conditional marginal effects for the probability of using brokers and for the share of brokered transactions from the FIML estimation with Huber-White heteroskedasticity-robust standard errors (*vce(robust)* option specified) are very similar to those obtained without the *vce(robust)* command. Hence, we report in the paper marginal effects for buyers computed without calling the *vce(robust)* (that is, without imposing the sandwich estimator of the covariances of the regression coefficients).

## 4.2. Results and discussion

Table 4.1 reports the marginal effects for the selection model for buyers in Columns 1 and 2. For sellers, marginal effects for the estimated probability of brokerage use are listed in Column 3, while OLS coefficients for the share of brokered transactions are given in Column 4. Results are discussed based on the categories for independent variables: Asset availability (social, human, and working capital), contractual performance (physical marketing costs and fixed costs), access to credit and presence of banks in main market centers, external environment (base market—the market where a trader is based—characteristics, in terms of market access, agricultural potential and population density, travelled distance to the main markets, and road quality) and traded crops.

### *4.2.1. Buyers*

***Asset availability***

*Social capital*—A negative relationship is found between the number of regular suppliers and the share of brokered transactions for buyers currently using brokers (significant conditional marginal effects of -0.096 in Column 2). The more regular partners that buyers have, the less they rely on brokers to buy crops.[14] A similar negative relationship is found for the number of trading contacts in the main market; thus, holding all the other variables constant, a 1 percent increase in this number is associated with a 0.00039 unit decrease in the probability that traders use brokers, when the probability is measured in the range [0,1]. Alternatively, if predicted probabilities are expressed as percent (which is the case for our data), a 1 percent increase in the number of trading contacts reduces the predicted probability that buyers turn to brokers by 0.039 percentage points (p.p.) (Column 1).[15] These results are in line with the evidence found by Gabre-Madhin (2001a) for Ethiopia, and by Fafchamps and Gabre-Madhin (2001) for Benin and Malawi. Social relationships allow agricultural traders to get information on price trends and grain flows, which helps them to minimize the risks associated with contractual disputes and maintain regularity in their trading activities. By providing similar services, brokers are a substitute for missing social networks.

*Human capital*—The number of employees who collect price information (that is, search labor) represents an indicator for human capital availability as well as a proxy for the cost of searching for market information. Thus, the higher this number, the greater the cost of gathering information on market prices. For buyers, a 1 percent increase in search labor increases the predicted probability of engaging brokers by 0.246 p.p. (Column 1). Similarly, a 1 percent increase in the number of people authorized to buy for the trading firm increases this probability by 0.144 p.p. (Column 1).

*Capacity of storage facilities under exclusive control*—Together with negotiation and information costs, wholesalers bear the cost of storing stocks for the time it takes to complete a transaction. Estimation results reveal that a 1 percent increase in the capacity of

[13] The Wald test statistic for sellers is 1.12 and the p-value is 0.2898, which also does not reject the null hypothesis of independence between the selection and the outcome equations.

[14] Even though there seems to be a positive and significant (at 10 percent level) marginal effect equal to 0.036 for the probability that buyers use brokers relative to the number of their regular suppliers, this result should be considered cautiously. To check for the results' robustness, the model for buyers was also estimated by FIML with the *vce(robust)* option in Stata 10.1 (see footnote 12 for an explanation of what the vce(robust) command entails for the estimation). This particular estimate was then found insignificant.

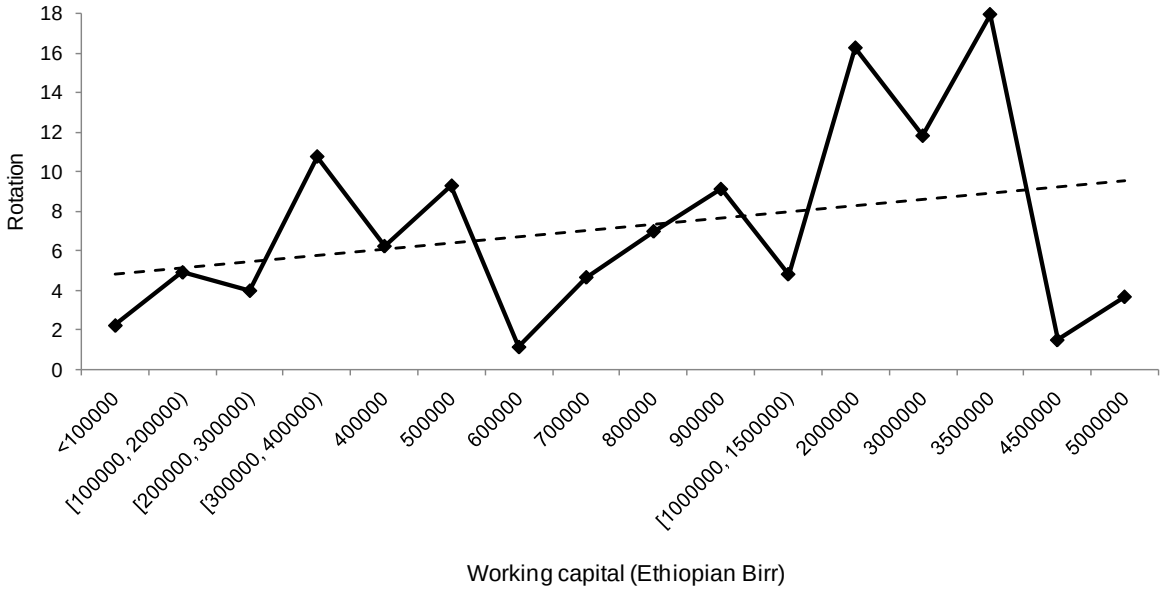
[15] Coefficient interpretation is based on the usual interpretation for level-log models, where the dependent variable is in level terms and the independent variable under consideration is in log form.

storage facilities (in quintals) under buyers' exclusive control reduces the predicted probability that they use brokers by 0.049 percentage points (Column 1). This negative marginal effect outlines how a commodity exchange, formalizing the activities of the brokerage institution and supported by warehouses, might benefit small-size trading businesses that cannot afford to have storage facilities with adequate capacity.

*Working capital* —Working capital, an indicator of the size of the trading business, is the quantity of funds regularly used for trading purposes. Gabre-Madhin (2001a) found an inverse relationship between working capital and brokerage use, such that the smaller the working capital, the higher the opportunity cost of tying it up in unsold stocks, the higher the associated transaction costs, and the more traders use brokers. Nonetheless, evidence also shows that large Ethiopian wholesalers do not rotate their working capital faster than smaller ones, as is the case for traders in Madagascar, for example (Fafchamps and Minten 1999a, 7). In other words, the rotation (that is, the ratio between working capital and monthly sales) does not fall as working capital and firm size increase (Figure 4.1).

The rotation follows an upward trend for Ethiopian wholesalers. This suggests that big trading businesses may also suffer from liquidity constraints, which explains the apparent contradiction that the greater the working capital the greater the share of brokered purchases (conditional marginal effect of 0.048 in Column 2, Table 4.1). Buyers who do not want to tie up their working capital in stock may engage the services of brokers in order to minimize rotation time and the related transaction costs.

**Figure 4.1—Rotation: Ratio between current working capital and monthly sales in May 2007**




Source: Authors' compilation
Note: 'Current working capital' refers to funds available while the ECX Traders' Survey (Gabre-Madhin, IFPRI, and EDRI. 2007) was being conducted (May–July 2007).

**Table 4.1—Estimation results for the probability of using brokers and the shares of brokered transactions for buyers and sellers**

| **BUYERS** *Sample Selection Model Estimation* | Unit | 1. Marginal Effect[a] for $Pr(B > 0)$ | 2. Conditional Marginal Effects[a] |
|---|---|---|---|
| **ASSETS** | | | |
| **Social Capital** | | | |
| No. of Regular Suppliers | ln(x+1) | **0.036*** | **-0.096***** |
| | | (0.022) | (0.020) |
| No. of Trading Contacts in the Main Market | ln(x+1) | **-0.039*** | |
| | | (0.022) | |
| **Human Capital** | | | |
| No. of Employees Engaged in Search | ln(x+1) | **0.246***** | |
| | | (0.057) | |
| No. of Trader's Substitutes | ln(x+1) | **0.144**** | |
| | | (0.066) | |
| **Financial Assets & Access to Credit** | | | |
| Working Capital | ln | -0.021 | **0.048**** |
| | | (0.023) | (0.019) |
| Credit Access | yes=1 | **-0.096*** | -0.082 |
| | | (0.054) | (0.050) |
| **CONTRACTURAL PERFORMANCE** | | | |
| Annualized Physical Marketing Costs | ln | -0.006 | |
| | | (0.018) | |
| Fixed/Operational Costs | ln | **0.073***** | |
| | | (0.023) | |
| **TRADING PRACTICES** | | | |
| Distance from the Base to the Main Market | ln(x+1) | 0.042 | **0.092**** |
| | | (0.056) | (0.045) |
| **ACCESS TO PHYSICAL INFRASTRUCTURE** | | | |
| Storage Capacity | ln(x+1) | **-0.049***** | -0.007 |
| | | (0.018) | (0.014) |
| Asphalted Roads | yes=1 | -0.275 | **-0.595**** |
| | | (0.178) | (0.278) |
| Dry-Weather Roads | yes=1 | -0.016 | **-0.602***** |
| | | (0.303) | (0.229) |
| All-Weather Roads | yes=1 | 0.053 | **-0.667***** |
| | | (0.331) | (0.246) |
| **ACCESS TO FINANCIAL INSTITUTIONS** | | | |
| Bank | yes=1 | **0.310***** | |
| | | (0.059) | |

| **SELLERS** *Two-Part Model Estimation* | Unit | 3. Marginal Effect[a] for $Pr(B > 0)$ | 4. OLS Estimation Coefficients |
|---|---|---|---|
| **ASSETS** | | | |
| **Social Capital** | | | |
| No. of Regular Customers | ln(x+1) | 0.019 | **-0.082**** |
| | | (0.013) | (0.032) |
| No. of Trading Contacts in the Main Market | ln(x+1) | 0.002 | |
| | | (0.017) | |
| **Human Capital** | | | |
| No. of Employees Engaged in Search | ln(x+1) | **-0.067*** | |
| | | (0.037) | |
| No. of Trader's Substitutes | ln(x+1) | 0.053 | |
| | | (0.046) | |
| **Financial Assets & Access to Credit** | | | |
| Working Capital | ln | 0.021 | 0.015 |
| | | (0.018) | (0.041) |
| Credit Access | yes=1 | **0.075*** | 0.000 |
| | | (0.040) | (0.087) |
| **CONTRACTURAL PERFORMANCE** | | | |
| Annualized Physical Marketing Costs | ln | 0.018 | |
| | | (0.012) | |
| Fixed/Operational Costs | ln | **-0.030*** | |
| | | (0.017) | |
| **TRADING PRACTICES** | | | |
| Distance from the Base to the Main Market | ln(x+1) | -0.003 | 0.054 |
| | | (0.013) | (0.049) |
| **ACCESS TO PHYSICAL INFRASTRUCTURE** | | | |
| Storage Capacity | ln(x+1) | -0.013 | 0.028 |
| | | (0.011) | (0.020) |
| Asphalted Roads | yes=1 | 0.021 | -0.056 |
| | | (0.088) | (0.271) |
| Dry- & All-Weather Roads | yes=1 | 0.022 | -0.005 |
| | | (0.139) | (0.353) |
| **ACCESS TO FINANCIAL INSTITUTIONS** | | | |
| Bank | yes=1 | **0.114***** | |
| | | (0.033) | |

*(Continued over)*

**Table 4.1—continued**

| **BUYERS** *Sample Selection Model Estimation* | Unit | 1. Marginal Effect[a] for $Pr(B > 0)$ | 2. Conditional Marginal Effects[a] |
|---|---|---|---|
| **MAIN CROP BOUGHT** | | | |
| Cereals | yes=1 | -0.114 | **0.291***** |
| | | (0.099) | (0.091) |
| Pulses | yes=1 | -0.098 | **0.222**** |
| | | (0.104) | (0.108) |
| Coffee | yes=1 | **-0.207**** | **0.198*** |
| | | (0.082) | (0.117) |
| **LOCATION** | | | |
| Moisture-Reliable Areas | yes=1 | **0.291***** | **-0.222**** |
| | | (0.086) | (0.102) |
| Drought-Prone Areas | yes=1 | **0.593***** | -0.055 |
| | | (0.079) | (0.100) |
| Pastoral Areas | yes=1 | -0.012 | -0.203 |
| | | (0.152) | (0.171) |
| Base Market: Low-Market Access & High-Population Density | yes=1 | -0.037 | **-0.168**** |
| | | (0.078) | (0.070) |
| Base Market: High-Market Access & High-Population Density | yes=1 | -0.046 | -0.016 |
| | | (0.074) | (0.060) |
| | | Psel=0.323 | Ycond=0.703 |
| Number of observations | | 449 | |
| Of which uncensored | | 162 | |
| Log pseudolikelihood | | -241.673 | |
| LR test of indep. eqns. (rho = 0)/χ^2 (1) | | 3.58 | |
| p-value for the LR test | | 0.0586 | |
| /athrho | | 0.450** | |
| | | (0.224) | |
| /lnsigma | | -1.261*** | |
| | | (0.074) | |
| rho | | 0.422 | |
| sigma | | 0.283 | |
| lambda | | 0.120 | |

| **SELLERS** *Two-Part Model Estimation* | Unit | 3. Marginal Effect[a] for $Pr(B > 0)$ | 4. OLS Estimation Coefficients |
|---|---|---|---|
| **MAIN CROP SOLD** | | | |
| Cereals | yes=1 | **-0.165**** | 0.109 |
| | | (0.084) | (0.124) |
| Pulses | yes=1 | **-0.098**** | 0.093 |
| | | (0.043) | (0.201) |
| Coffee | yes=1 | **-0.112***** | 0.231 |
| | | (0.035) | (0.178) |
| **LOCATION** | | | |
| Moisture-Reliable Areas | yes=1 | **0.170**** | -0.223 |
| | | (0.085) | (0.331) |
| Drought-Prone Areas | yes=1 | **0.298**** | -0.300 |
| | | (0.136) | (0.333) |
| Pastoral Areas | yes=1 | 0.135 | 0.063 |
| | | (0.193) | (0.396) |
| Base Market: Low-Market Access & High-Population Density | yes=1 | -0.013 | **-0.216*** |
| | | (0.048) | (0.126) |
| Base Market: High-Market Access & High-Population Density | yes=1 | -0.022 | 0.048 |
| | | (0.047) | (0.116) |
| Constant | | | 0.424 |
| | | | (0.469) |
| | | Psel=0.126 | Yhat=0.587 |
| Number of observations for the Probit estimation | | 414 | |
| Number of observations for the OLS estimation | | 69 | |
| Breusch-Pagan/Cook-Weisberg heteroskedasticity test, χ^2 (1) | | 0.78 | |
| p-value for test for homoskedasticity | | 0.3767 | |
| Z-statistics for Shapiro-Wilk W test for normality | | 0.771 | |
| p-value for normality test | | 0.22038 | |

Notes: Standard errors in parentheses.
a. For a binary variables, the conditional marginal effect (dy/dx) is for discrete change of the dummy from 0 to 1.
* p < 0.10, ** p < 0.05, *** p < 0.01
Unit: ln(x+1) means that the regressor is computed as ln(x+1) to avoid losing observations which original value is zero.
Ycond (at the bottom of Column 2) stands for predicted conditional shares of brokered transactions; Yhat (at the bottom of Column 4) stands for predicted shares of brokered transactions; Psel (at the bottom of Columns 1 and 3) stands for predicted probability to use brokers.
The Breusch-Pagan/Cook-Weisberg tests the null hypothesis of constant error variances for the OLS estimation of the shares of brokered sales. The test statistic has a chi-square distribution with 1 degree of freedom. The chi-square value is small, indicating that heteroskedasticity is not a problem. The Shapiro-Wilk W tests the normality of the residuals of the OLS regression for sellers. The statistic is positive and close to one; we thus fail to reject the null hypothesis that data are normally distributed.

***Contractual performance***

Buyers' decisions about whether or not to use brokers seem to depend not only on transaction costs, but also on contractual performance as represented by fixed costs. Thus, the probability that buyers use brokers increases by 0.073 p.p. after a 1 percent increase in operational costs (Column 1).

***Presence of banks in the main markets and access to credit***

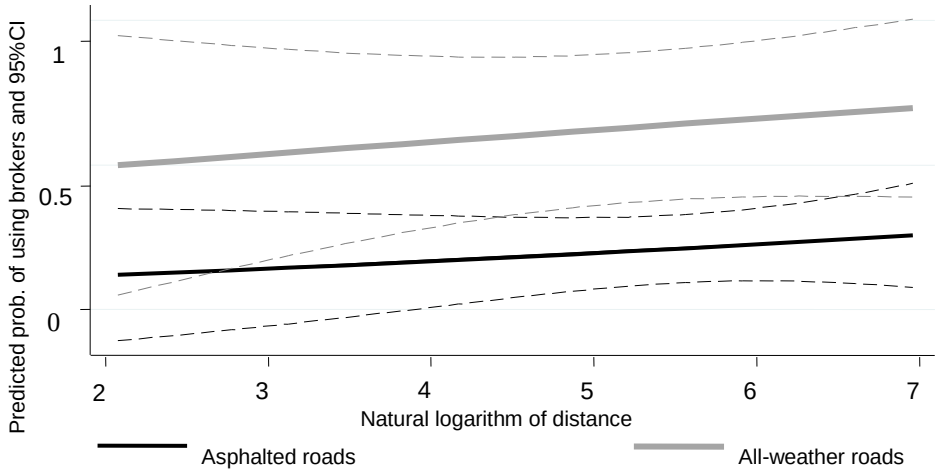
In addition to physical infrastructure, we find that traders' choices regarding whether or not to employ brokers depend on the availability of formal financial institutions in their main markets, the presence of which induces buyers to use brokers with 0.310 predicted probability (Column 1).

Nonetheless, the availability of financial institutions does not necessarily imply traders' access to credit, and this is particularly the case for small trading businesses that may lack adequate collateral. Focusing instead on access to credit sources (whether formal or informal), that may help buyers face liquidity constraints, the marginal effect of -0.096 in Column 1 indicates that those buyers who can access credit are less likely to turn to brokers (who may extend credit to their clients).

***External environment and traded crops***

*Road quality*—The quality of available physical infrastructure is measured by the kind of roads (either asphalt, dry-weather, or all-weather roads[16]) linking base markets to main distant markets. As Figure 4.2 shows,[17] as travelled distance increases, the predicted probability that buyers use brokers is more than double when roads are all-weather than when they are asphalt. The predicted probability for all-weather roads significantly exceeds that of asphalt roads for distances between 80 and 660 km, as shown by the non-overlapping 95 percent confidence intervals of the two predicted probability lines.

**Figure 4.2—Predicted probability of brokerage use as a function of distance and 95 percent CI; traders accessing asphalt versus all-weather roads**



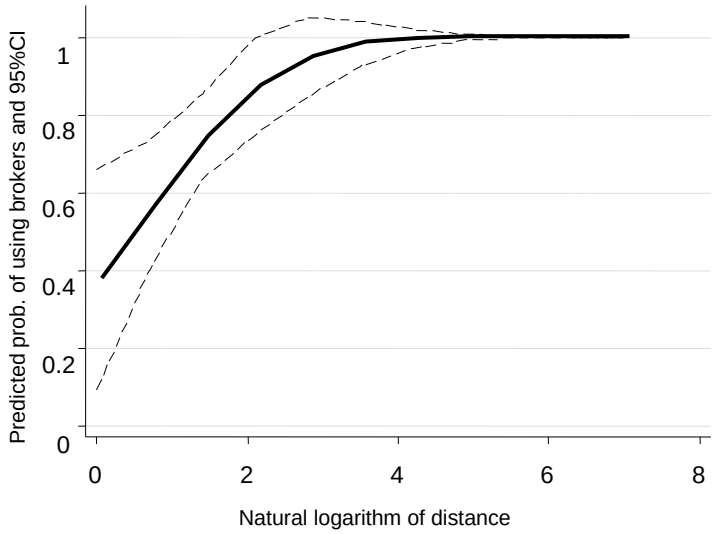

Source: Authors' compilation

[16] Both all-weather roads and dry-weather roads (that is, dirt roads) are unpaved roads; the difference between them is that dry-weather roads are likely to create mud during rainfall, and may become impassable.

[17] Predicted probabilities in Figures 4.2, 4.3, and 4.4 are evaluated at the means of all explanatory variables, apart from the natural logarithm of distance.

*Travelled distance between base and main markets*— The conditional marginal effect of distance on brokered purchases is positive and significant (see the 0.092 value in Column 2), indicating that buyers who have to travel longer distances assign to brokers a bigger share of their transactions. Distance seems to particularly affect the decision process of buyers of cereals in drought-prone areas. As depicted by Figure 4.3, when the travelled distance exceeds around 160 km, all buyers of cereals based in these domains are likely to ask brokers to manage (some or all of) their long-distance transactions.

**Figure 4.3—Predicted probability of brokerage use as a function of distance and 95 percent CI; subset of buyers of cereals based in drought-prone areas**



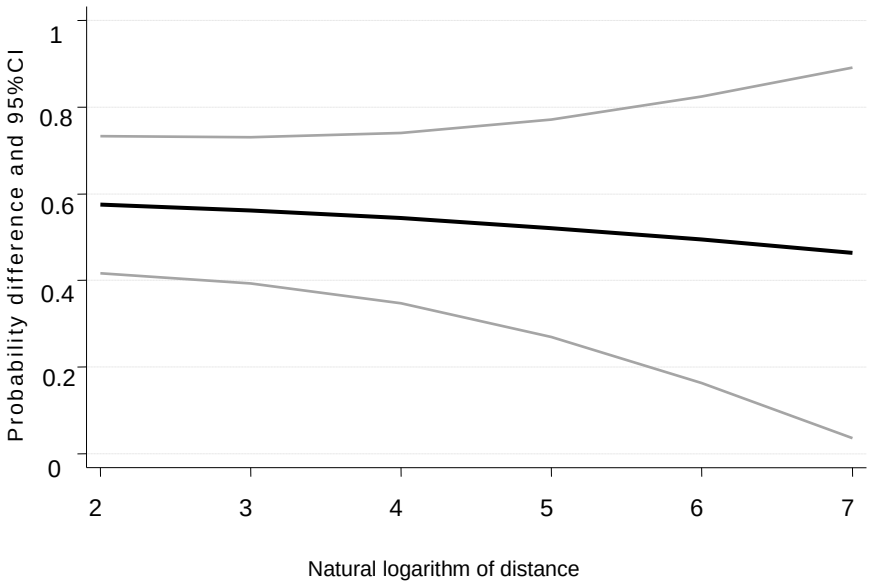

Source: Authors' compilation

*Traded crops*—Independently from distance, the greatest share of brokered purchases are found for buyers of cereals and pulses (conditional marginal effects of 0.291 and 0.222, Column 2). Coffee buyers are less likely to use brokers than oilseed buyers (marginal effects of -0.207 for buyers of coffee, Column 1). This is most probably because coffee is marketed in Ethiopia through cooperatives that organize transportation from producers to city warehouses (Chamberlin, Pender, and Yu 2006, 17), whereas oilseed commercialization is mainly conducted in less densely populated domains (ibid.: 33, 34) where wholesalers are more prone to use brokers.

*Agricultural domains*—The agricultural domains where buyers are based affect their decisions regarding brokerage use. The predicted probability of using brokers is 0.593 greater if buyers are located in drought-prone areas and 0.291 greater if they are based in moisture-reliable domains than in Addis Ababa (Column 1).

Reintroducing travelled distance into the analysis, as distance increases we observe a decrease in the gap between the greater predicted probability that buyers based in drought-prone areas use brokers, versus the smaller likelihood for buyers located in other areas (Figure 4.4). However, the confidence interval for the estimated probability gap becomes larger as the distance approaches 150 km, which indicates greater uncertainty in the reliability of the estimates.

**Figure 4.4—Variation with respect to distance in the gap between the predicted probabilities of brokerage use, for buyers based in drought-prone versus other areas, and 95 percent CI**




Source: Authors' compilation
Note: Other areas are moisture-reliable and pastoral areas, and the central market of Addis Ababa.

*Base market access and population density*—The significant conditional marginal effect of -0.168 reported in Column 2, Table 4.1, suggests that an average buyer based in a low-access market with high population density has a share of brokered purchases smaller than a buyer based in a low-access market with low population density (base category). Thus, high population density in the markets where buyers are based reduces their need to use brokers. Moreover, given that food crop commercialization is generally higher in areas of medium-to-high population density (Chamberlin, Pender, and Yu 2006, 33), we may infer that the more smallholder farmers sell their surplus food crop production on the market, the more buying opportunities arise, and the less it is likely that traders buying those crops need to hire brokers.

### *4.2.2. Sellers*

Compared with buyers, fewer results are statistically significant for sellers. This is in line with Gabre-Madhin's conclusions (2001b, 69). Gabre-Madhin hints that this may be due to greater transaction costs involved in purchases than sales, because "buyers must ensure that the quality and quantity of the contracted grain will conform to their expectations and that delivery will occur in the appropriate time frame" (ibid.).

#### *Asset availability*

*Social capital*—As in the case of buyers, the more sellers have access to regular partners, the less they rely on brokers; thus, a 1 percent increase in the number of regular partners reduces the share of brokered sales by 0.082 p.p. (Column 4).

*Human capital*—A 1 percent increase in the number of employees engaged in price search is followed by 0.067 p.p. reduction in the predicted probability that sellers use brokers (Column 3). This suggests that sellers view search labor as the amount of human capital at their disposal rather than a proxy for the cost of searching for market information.

***Contractual performance***

Sellers who can afford to rent shops and/or storage facilities, as well as maintain and insure vehicles and the like tend to use brokers less (marginal effect of -0.030 in Column 3). This emphasizes that sellers are less concerned than buyers about minimizing trading costs, and that they do not rely as much on hiring brokerage services to achieve this aim. This is the case not only for traders that are only sellers[18] but also for wholesalers who buy and sell products on their own account. In this last instance, the results indicate that the perception of transaction costs varies according to what a trader is doing (that is, buying or selling), and possibly according to the relative importance that selling transactions have compared with buying transactions (that is, whether selling transactions represent a greater share of the overall conducted transactions).

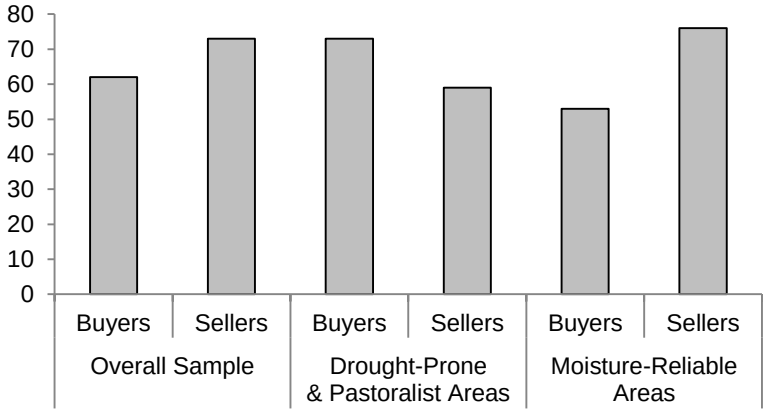
***Presence of banks in the main markets and access to credit***

Similarly to the result found for buyers, the presence of at least one bank operating in the sellers' main markets means they are more likely to use brokers (predicted probability of 0.114 in Column 3). This supports the idea that the existence of formal financial institutions throughout the country would benefit the functioning of the ECX. Interestingly, the more sellers have access to credit (either formal or informal) the more they engage brokers (predicted probability of 0.075 in Column 3), which is the opposite of the result for buyers.

***External environment and traded crops***

*Travelled distance between base and main markets*—While travelled distance does not seem to have an impact on sellers' choice to engage brokers, further analysis has been conducted on the subsample of wholesalers whose main markets are distant. Figure 4.5 shows that the shares of distant brokered transactions, out of all distant transactions, were 73 percent for buyers and 59 percent for sellers based in drought-prone and pastoral areas in 2006/07; while for traders located in moisture-reliable domains, the corresponding figures were 53 percent for buyers and 76 percent for sellers. These results highlight the brokerage institution's role in facilitating the movement of crops throughout Ethiopia's agricultural markets located in different agricultural domains.

**Figure 4.5—Shares of distant brokered transactions as a part of total distant transactions for buyers and sellers and by agricultural domains in 2006/07**




Source: Authors' compilation

[18] This may happen when traders act as consignment or selling agents and sell products deposited with them on behalf of others in exchange for a fee or a share of the price.

*Traded crops*—In general, the predicted probability that sellers of either food or cash crops use brokers is negative, and this is particularly the case for sellers of cereals (marginal effect of -0.165 in Column 3, as compared with -0.112 for coffee sellers, and -0.098 for sellers of pulses).

*Agricultural domains*—As with buyers, sellers based in drought-prone areas are more likely to use brokers than sellers elsewhere. In fact, the predicted probability that they use brokers is 0.298 greater than that of sellers based in Addis Ababa (Column 3), and 0.128 greater than that of sellers in moisture-reliable domains (difference between 0.298 and 0.170). This result does not take into consideration travelled distance.

*Base market access and population density*—As with buyers, the higher the population density in the base markets, the smaller the share of brokered sales (value of -0.216 for the estimated OLS coefficient in Column 4).

## 5. Conclusions and policy recommendations

There has been a considerable shift in policy direction regarding agricultural markets over the past fifteen years. “As the weaknesses of reformed agricultural markets in developing countries became evident, development agencies’ and governments’ focus began to shift from merely ‘getting prices right’ to ‘getting institutions right’ so as to address market failures arising from imperfect information, contract enforcement and property rights, and insufficient provision of public goods” (Barrett and Mutambatsere 2008, 8).

In Ethiopia, this new generation of ‘getting-markets-right’ reforms was introduced in the late 1990s. In contrast to the earlier generation of ‘getting-prices-right’ policies associated with IMF- and World Bank-sponsored Structural Adjustment Programs, these reforms, though still market-oriented, focused on non-price policy measures and gave particular emphasis to the ability of private and public market institutions to increase market efficiency and reduce high transaction costs and business risk (Barrett and Mutambatsere 2008; Reardon and Timmer 2005).

Of these market institutions, research has indicated that the informal brokerage institution can play a pivotal role in getting agricultural markets right. Several studies, especially on Sub-Saharan African countries, outline the benefits that the use of brokers can bring to agricultural traders; however, very few have analyzed the variables affecting traders’ decisions regarding whether or not to use brokers. To our knowledge, only Gabre-Madhin (2001a) attempts to estimate econometrically equations to explain traders’ decision processes, and her analysis was based on restrictive assumptions and excluded important regressors.

The current study therefore addresses two related research questions; namely, which covariates affect wholesalers’ decisions to use brokers, and which traders would benefit the most from the Ethiopia Commodity Exchange’s (ECX’s) recent attempts to formalize brokerage functions? We estimated traders’ decisions (regarding whether or not and how much to use brokers) using a sample selection approach or, when appropriate, a two-part estimation procedure. The analysis makes use of original data collected in 2006/07 by Gabre-Madhin, EDRI, and IFPRI.

Regarding the first question, we found significant marginal effects and regression coefficients for the predicted probability that wholesalers would use brokers and for the (conditional) shares of brokered transactions for certain regressors. These regressors indicate the ownership of human, working, and social capitals, the kind of transacted crops, contractual performance of the trading business (that is, the amount of fixed costs), the external environment where wholesalers operate (in terms of characteristics of the base markets, travelled distance and quality of accessed roads), the availability of financial institutions, and access to formal and informal credit sources.

These results in turn inform the second question. The evidence suggests that the ECX could particularly benefit many kinds of traders—those who lack social capital, those who suffer from liquidity constraints while their working capital is tied up in unsold stocks, those who cannot afford to pay for storage facilities under their exclusive control, those who are based in drought-prone areas, and those who conduct long-distance purchases and rely upon non-asphalt roads. To allocate its available resources as efficiently as possible, the ECX should give such traders priority over those for example, who are based in moisture rich areas, who trade over relatively short distances (including those operating in the vicinity of Addis Ababa) or who can take advantage of asphalt roads, who trade solely in coffee or oilseeds, or who are already relatively prosperous and well connected in terms of social capital.

The ECX by itself cannot solve the problem of market failure in Ethiopia, nor overcome all the problems that the country's agricultural traders are facing. It cannot, for example, radically improve the rural road network or increase the number of rural banks. However, this study does hold some important lessons for the future direction of the ECX. In particular, given that buyers of cereals and pulses seem to be the wholesalers who rely on brokers the most, the number of commodities traded by ECX could be enlarged to include teff, which is one of the most widely commercialized grains in Ethiopia and very important in terms of food security. The provision of credit facilities to ECX clients through warehouse receipt financing would also be beneficial, especially for those who lack collateral and have difficulty accessing formal loans. Likewise, buyers based in sparsely populated drought-prone areas would find ECX support especially valuable. Thus, the ECX should consider further developing its network of warehouses throughout the country.

# Appendix

## Appendix Table A.1—Exclusion restrictions

| | VARIABLE | DESCRIPTION | UNIT |
|---|---|---|---|
| **ASSETS** | **No. of Trading Contacts in the Trader's Main Market** (SOCIAL CAPITAL) | The trader engages with trading contacts in conversations about market conditions. Trading contacts could be local officials, the Ethiopia Grain Trade Enterprise etc.; it is not necessary for trading contacts to conduct a trading business. | ln(x+1) |
| | **No. of Employees engaged in price search** (HUMAN CAPITAL & SEARCH COST) | Number of people in the trading business who participate in collecting price information. | ln(x+1) |
| | **No. of Trader's Substitutes** (HUMAN CAPITAL & COST OF THE HUMAN CAPITAL) | Number of people (among family helpers, permanent workers and manager, apart from the owner) who are authorized to buy and/or sell in the name of the enterprise. | ln(x+1) |
| **CONTRACTUAL PERFORMANCE, Costs** | **Annualized Physical Marketing Costs** | Annualized sum of variable costs for all transactions realized in a twelve-month period (such as costs for bagging and sewing, loading and off-loading, transport, bribes and tips at road stops, storage etc.). | ln |
| | **Fixed/ Operational Costs** | Annual operating costs (such as. costs for renting shops and/or storage facilities, maintenance and insurance of vehicles, inland revenue tax for trading business etc.). | ln |
| **ACCESS TO FINANCIAL INSTITUTIONS** | **Bank** | Availability of at least one financial institution in the wholesaler's main market. | yes=1 |

**Appendix Table A.2—Other regressors, apart from exclusion restrictions**

| | VARIABLE | DESCRIPTION | UNIT |
|---|---|---|---|
| **ASSETS** | **Regular Suppliers/ Customers** (SOCIAL CAPITAL) | Number of people from whom the wholesaler purchases/sells regularly in his/her main market (regularity entails a number of interactions greater than three over a production year). | ln(x+1) |
| | **Working Capital & Access to Credit** | Working Capital: Amount of funds at the trader's disposal for the purpose of buying and marketing grain. | ln(x) |
| | | Access to Credit: Since the start of 2006/07 production year, the trader got access to any form of credit (including informal sources) AND/OR if s/he needed additional funds for the trading business, s/he knew whom to ask for a loan AND/OR s/he belongs to an ekub (rotating savings and credit association). | yes=1 |
| **TRADING PRACTICES** | **Distance** | Euclidean distance (in km) between the trader's main market and the market where s/he is based. | ln(x+1) |
| **ACCESS TO PHYSICAL INFRASTRUCTURE** | **Storage Capacity** | Maximum quantity storable (in quintals) in one or more storage facilities under the trader's exclusive control. | ln(x+1) |
| | **Road Type:** Asphalt Dry-Weather All-Weather Non-Relevant | Type of road linking the trader's main market and the market where s/he is based (non-relevant=omitted category, in case the two markets coincide). All-weather and dry-weather represent one category of roads for sellers. | yes=1 (categorical variable) |
| **MAIN TRADED CROP** | **Cereals Beverages (coffee) Pulses Oilseeds** | The produce for which the trader purchased/sold the greatest quantities during 2006/07 production year is identified and classified based on crop-specific dummies (oilseeds=omitted category). | yes=1 (categorical variable) |
| **AGRICULTURAL DEVELOPMENT DOMAINS FOR THE BASE MARKET (Smallholder-relevant Domains)** | **Agricultural Potential:** Drought-Prone Area Pastoralist Area Moisture-Reliable Area Central Market (Addis Ababa) | Binary variables indicating where the trader's base market is located (central market=omitted category). | yes=1 (categorical variable) |
| | **Access to Market & Population Density:** The trader's base market is characterized by: Low Market Access & High Population Density; High Market Access & High Population Density; Low Market Access & Low Population Density (=omitted category). | | yes=1 (categorical variable) |

## Appendix A.3—Reasons underlying the choice of selection instruments

*Number of trading contacts in the trader's main market*—The number of trading contacts could affect the probability that a trader uses brokers. Yet, once a trader has decided to use brokers, we assume that the share of brokered transactions will depend on the number of current (regular) trading partners only. This is because trading contacts do not necessarily conduct a trading business, but they are people with whom wholesalers discuss market conditions. In fact, they could even be local officials, the Ethiopia Grain Trade Enterprise and the like.

*Number of employees engaged in price search*—Evidence shows that 88 percent of traders rely on personal observation (seeing and/or eavesdropping) to get information on market partners, market flows and price patterns for grain products or coffee. Only 4 percent of all wholesalers consider speaking with intermediaries (including buying agents, selling agents and brokers) as their primary source of information (Gabre-Madhin, IFPRI, and EDRI 2007). Thus, it seems that traders mostly decide their share of brokered transactions based on services offered by brokers other than the provision of information on market prices. In other words, there seems to be no trade-off between the share of brokered transactions and the number of employees engaged in price search.

*Number of trader's substitutes*—Trader's substitutes are family helpers, permanent workers and manager (apart from the owner) who are authorized to buy and/or sell in the name of the enterprise. From the ECX Traders' Survey 2007 (Gabre-Madhin, IFPRI, and EDRI 2007), we can infer that substitutes are particularly important when the owner/manager is absent and their role is limited to contract negotiation. It is not the primary responsibility of substitutes to conduct a series of activities that brokers usually perform as part of their services to traders (to mention a few, searching for buyers and sellers, offering credit, buying/selling goods if no match is found). Therefore, we suspect that the presence of trader's substitutes could determine the probability of brokerage use, but is less directly related to the share of brokered transactions.

*Annualized physical marketing costs and annual fixed/operational costs*—Both costs are indicators for contractual performance. Evidence shows that 97 percent of brokers were reimbursed for their services with a flat fee per quantity transacted in 2008 (Gabre-Madhin, IFPRI, and EDRI 2008), and physical marketing costs (as well as the search cost associated with the number of employees engaged in search) are variable costs. As the quantity transacted increases, the variable costs and/or the brokerage fees increase. We assume that traders cover brokerage fees (as well as variable costs) with their working capital. Thus, the amount of working capital, and not the amount of variable costs, will eventually determine the share of brokered transactions that each trader can afford (that is, the determination of the share of brokered transactions does not depend on a tradeoff between bearing more variable costs versus paying more brokerage fees). The potential role of the working capital in covering marketing costs is supported by the evidence of limited, imperfectly competitive behavior in the Ethiopian agricultural markets. In fact, buyers generally reduce the purchase cost they pay to farmers (in order to cover variable costs) by a modest 3 percent and only in small and remote agricultural markets, not in larger market centers centrally located (Osborne 2005; Rashid and Minot 2010). Similarly, 67 percent of sellers determined their sale price following the prevailing market prices in 2006/07; this implies that it was less likely for the sale price to be equal to the purchase price increased by marketing costs (Gabre-Madhin, IFPRI, and EDRI 2007). Fixed costs are also assumed not to affect the chosen share of brokered transactions.

*Bank*—The availability of a bank in any wholesaler's main market could make that trader more prone to using brokers; yet, we assume that the share of his/her brokered transactions will eventually depend on his/her actual access to credit.

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