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The role of intermediaries in enhancing market efficiency in the Ethiopian grain market

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Abstract

This paper investigates the impact of the institution of brokerage on the optimal search behaviour and the welfare gains and losses of traders in the Ethiopian grain market. Without brokers, the privately optimal search diverges from the socially optimal search due to the positive spill-over of individual search behaviour. Numerical analysis using the actual distribution of search costs and search efficiency obtained from primary data collected in Ethiopia reveals that this externality is partially internalised by the presence of brokers and that total welfare increases significantly due to a more efficient allocation of search effort.

JEL classification: D83; D40; D23

Keywords: Institutions; Intermediaries; Brokers; Search; Ethiopia; Grain market; Welfare

1. Introduction

For the past two decades, recognition of the critical role of markets in economic development has prompted sweeping market reforms across a number of developing countries. In spite of these reforms, symptoms of poorly functioning markets in much of sub-Saharan Africa are evident in the segmentation of markets, low investment in the market infrastructure, the persistence of high margins and of the market thinness, and the limited progression toward more complex market arrangements such as forward contracting (Beynon et al., 1992; Jones, 1996; Jayne and Jones, 1997). In recent years, there has been increasing recognition of the importance of institutions and transaction costs and their impact on trader behaviour (Palaskas and Harriss-White, 1993; Dercon, 1995; Fafchamps, 1996). [1]

Despite the increased attention to market institutions, relatively little institutional research has addressed the role of market intermediaries, such as brokers or commission agents, in facilitating exchange between anonymous trading partners. That is, little institutional analysis has been undertaken on the process by which economic traders *find* each other in the market. Likewise, very little attention has been given

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[1] Transaction costs, also referred to as co-ordination costs, are comprised of the costs of obtaining and processing information (Hayek, 1945; Alchian and Demsetz, 1972; Hoff and Stiglitz, 1990), negotiating contracts (Coase, 1937; Williamson, 1985), monitoring agents (Bardhan, 1989; Cheung, 1968; Eswaran and Kotwal, 1985), and enforcing contracts (North, 1990; Milgrom et al., 1990; Greif, 1993; Fafchamps, 1996). Institutions, such as courts, referral agencies, and information systems, emerge to reduce these transaction costs.

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to a critical transaction cost, the cost of searching for a buyer or a seller. Furthermore, very few empirical studies have attempted to quantify transaction costs, partly due to the difficulty in obtaining data on these costs. Finally, the literature generally overlooks the implications of institutions for behaviour in equilibrium. Most institutional analyses assume that an institution exists because it is cost minimising, without examining the implications of the presence of the institution for the welfare of the economy.

This paper aims to redress these gaps by empirically analysing the effect of brokers on the global economic efficiency of the Ethiopian grain economy, given the heterogeneous distribution of traders' search costs and capacities to conduct search in the market. Using primary data on individual traders' search costs, search behaviour, and use of brokerage collected by the author in a random survey of traders in 12 grain markets in Ethiopia, this study addresses how the presence of market intermediaries influences the search behaviour of market participants and whether their presence enhances economic welfare.

The paper reveals that the presence of brokers in the Ethiopian grain market not only influences whether traders engage in search themselves but also how much they search. Without brokers, traders' search has significant positive spill-over because higher search effort on the part of each individual trader leads to higher payoffs for all traders by increasing the probability that traders meet. This positive externality is not internalised into private decisions on optimal search effort. Thus, individually, optimal search strategies diverge from socially optimal choices, resulting in lower total welfare. With brokers, this externality is partly internalised as traders' search strategies must factor in whether other traders are using brokerage services. In welfare terms, traders who are less search-efficient gain from the higher efficiency of brokers. Numerical analysis of traders' returns from trade with and without brokers is undertaken using the observed distributions of transaction costs and search efficiency to determine empirically whether the total welfare effects of brokerage are positive.

2. A model of optimal bilateral search

The conceptual framework used to analyse the optimal search behaviour of traders builds on the search models of Rubinstein and Wolinsky (1987) and Yavas (1992, 1994). In Yavas (1994), the search intensity of traders is endogenous and based on differences in traders' price valuations. An important distinction from Yavas' model which is made here is that optimal search strategies are driven by differences in traders' search efficiency and costs, rather than by differences in price valuations, since market prices are known with certainty and the real constraint is finding a suitable buyer or seller at the market price. Within a single period, all traders are assumed to be risk-neutral price takers.[2] When sellers and buyers meet, they trade at the competitive market price. Thus, differences in net profits per unit transacted are due to search efficiency and search costs. Traders (sellers or buyers) face uncertainty regarding the outcome of their search. Thus, each trader has a probability Θ of meeting a partner, where $\Theta \in [0,1]$. Each trader chooses his or her profit-maximising level of search intensity, S for sellers and B for buyers, where $S, B \in [0, 1/2]$. Each trader has an exogenously determined and unique parameter of search efficiency, $\gamma \in [0,1]$. For a given transaction, the probability of matching faced by each trader is a linear function of both the buyer's and the seller's search effort (S, B) and search efficiency (γ). A simple linear specification of the probability of matching that accounts for differences in search efficiency between the two trading partners is given by $\Theta(S, B) = \gamma_S S + \gamma_B B$.

For a trader with search intensity S or B, the costs of employing labour C_L and of binding capital (C_K) during the search process are functions of the search intensity (S or B), labour (L) and working capital (K), the opportunity costs of labour (ω) and capital (ν), and the search time (t), such that $C_L(S) = S^2(\omega Lt)$ and $C_K(S) = S^2(\nu Kt)$.

2.1. Search without brokerage

A representative seller chooses S so as to maximise

[2] In the Ethiopian market, there exists a competitive market price which is determined exogenously as a function of the daily supply and demand in the central market. Prices are determined in a quasi-bidding process by brokers before the market opens. Price discovery by brokers can be viewed as another externality of the presence of brokers that is not addressed here.

$$\max_S V_S(S, \gamma_S, \omega, \nu) = \Theta(S, B)R_S - C_L(S) - C_K(S) = (\gamma_S S + \gamma_B B)R_S - S^2(\omega Lt) - S^2(\nu Kt) \quad (1)$$

where R_S and R_B represent the seller's and the buyer's net revenue from trading. Analogously, a representative buyer chooses B to maximise $V_B(B, \gamma_B, \omega, \nu)$.[3] The Bayesian–Nash equilibrium for the competitive economy is given by $\{S^*(\cdot), B^*(\cdot)\}$ such that

$$S^*(\cdot) \in \text{argmax } V_S(S, \gamma_S, \omega, \nu, B^*(\cdot)) \quad \forall \gamma_S, \omega, \nu \quad (2a)$$

$$B^*(\cdot) \in \text{argmax } V_B(S, \gamma_B, \omega, \nu, B^*(\cdot)) \quad \forall \gamma_B, \omega, \nu \quad (2b)$$

The optimal search intensity chosen by each type of trader is the level of search intensity that equates the marginal returns from search with the marginal costs of search. The optimal search intensities, S^* and B^*, are characterised by the solution of the first-order conditions of the competitive equilibrium. For the seller, these are:

$$S^*(\gamma_S, \omega, \nu) : \gamma_S R_S = C'_L(S) + C'_K(S) = 2St(\omega L + \nu K) \quad (3)$$

Thus, S^* and B^* increase with search efficiency, γ, and decrease with the opportunity costs of search, ω and ν. This reflects the intuition that traders with higher search efficiencies have higher expected net profits from searching and thus search more, while traders with high opportunity costs of searching have lower expected net gains from search.

2.2. *Externality effects of individual search behaviour*

A higher search intensity by *either* the seller or the buyer leads to a higher probability of matching and higher net profits for *both* traders. This gives rise to a positive externality of search behaviour that is not captured because individual traders do not consider the effects on their partners when making search intensity choices. Were there a Benthamite 'social planner' concerned with the most efficient allocation of resources in the economy, the seller's and the buyer's net profits would be maximised jointly, and the socially optimal choice of S^{**} and B^{**} would be based on the effects of this choice on both the seller's and the buyer's marginal revenues. In the socially optimal model, the choice of the seller's and the buyer's search intensities would be characterised as

$$S^{**}(\gamma_S, \omega, \nu) : \gamma_S(R_S + R_B) = C'_L(S) + C'_K(S) = 2St(\omega L + \nu K) \quad (4)$$

In a competitive equilibrium with no 'social planner', the allocation of the search intensities is less than the optimal, i.e. $S^* < S^{**}$ and $B^* < B^{**}$.

2.3. *Search with brokerage*

In the presence of a representative risk-neutral broker, who does not trade on his or her own account, traders choose whether to use a broker or not, and if they opt to search on their own, they choose the optimal level of search intensity. Each trader has a unique probability, μ, of using a broker in a given transaction. Since other traders in the market do not know this probability, each trader makes conjectures about the probability that others will choose the services of brokers. An important feature of this economy, observed directly in the Ethiopian grain market, is that a trader who has opted to search *without* a broker can only search for a partner among the pool of traders who are similarly searching on their own. Conversely, once a trader has chosen to use the broker, he or she exits from the direct search market. This phenomenon of segmentation into a 'direct search market' and a 'brokered search market' is observed in the Ethiopian grain market, where traders who opt for brokerage physically ship grain to their broker and stop searching on their own, while brokers who have received grain from clients tend to contact brokers who represent distant clients. This segmentation results from self-selection by traders into either personalised or anonymous exchange.

The optimal search intensity choice depends on the size of the search market and on the search intensities of other traders. A trader i (either seller or buyer) who factors in the possibility that a possible partner j (either

[3] From here on, to avoid repetition, mathematical expressions will only be presented for the seller, with the understanding that expressions for the buyer are exactly analogous.

seller or buyer) will drop out of the search market and use a broker has a probability of matching equal to $\Theta_i(S, B) = (1-\mu_j)(\gamma_S S+\gamma_B B)$. When a trader uses a broker, his or her probability of matching depends on the broker's search efficiency (γ_M) and search intensity (M), and is adjusted by the probability that the corresponding partner is using brokerage or not. Thus, for a seller, $\Theta_S^M(M, B) = (1 - \mu_B)(\gamma_M M + \gamma_B B)$.

The seller or buyer now maximises the expected net profit with brokerage, W_S or W_B:

$$\begin{aligned}\max_S W_S = {} & \mu_B(\gamma_M M + \gamma_B B)R_S(1 - k) - C_K^M(M) \\ & +(1 - \mu_B)(\gamma_S S + \gamma_B B)R_S \\ & -C_L(S) - C_K(S) \qquad (5)\end{aligned}$$

where k is the brokerage fee, the trader's cost of capital with brokerage is $C^M(M) = M^2(\nu K t')$, and the broker's search time is given by t'. Again, the optimal search intensity chosen by each type of trader is that which equates the marginal returns from search with the marginal costs of search. In the presence of the possibility of brokerage, the optimal search intensities S^{M*} and B^{M*} depend on the probability of the brokerage choices of other traders:

$$S^{M*}(\gamma_S, \omega, \nu) : (1 - \mu_B)\gamma_S R_S = C_L'(S) + C_K'(S) \qquad (6)$$

Thus, brokers' presence introduces a strategic interaction term between the optimal search intensities of traders. Although search intensities still do not depend on the partner's payoff from trade, as is the case for the socially optimal model, traders' optimal search strategies now depend on the proportion of traders that use brokers (μ), which partly internalises the externality of individual search. The externality is only partially internalised because the trader's choice does not depend on the partner's revenue, R, as in the socially optimal model.

In contrast, a search economy with both brokerage and an 'efficient' social planner would maximise the sum of the seller's and the buyer's net profits. The first-order condition that would optimise a seller's or a buyer's choice of search intensities under these conditions is:

$$\begin{aligned}S^{M**}(\gamma_S, \omega, \nu) : {} & (1 - \mu_B)\gamma_S R_S + (1 - k\mu_S)\gamma_S R_B \\ & = C_L'(S) + C_K'(S) \qquad (7)\end{aligned}$$

Traders factor in the possibility that the search market is reduced by the use of brokerage by their potential partners and also factor in the effects of their own choice of brokerage on their partner's net returns. It can be seen in Table 1 that for $0 \leq \mu \leq 1$, $S^* \geq S^{M*}$ and $S^{**} \geq S^{M**}$. Hence, under competitive equilibrium, the presence of brokers unequivocally lowers the optimal search intensity. Furthermore, socially optimal search intensities are higher than under competitive equilibrium, both with and without brokerage. The former confirms that a positive externality still remains under brokerage.

3. Data and results

A large majority of Ethiopia's grain traders, up to 85%, regularly use brokers, known as *delala*, for their long-distance transactions.[4] Brokers fulfill a purely intermediary role of matching geographically dispersed buyers and sellers and, in return, receive a fixed commission. There are approximately 40 established brokers in the central market of Addis Ababa, compared to a total of 2,500 grain wholesalers in the country (Lirenso, 1993; Amha, 1994). In 1996, brokers handled approximately 40% of the total marketable grain surplus (Gabre-Madhin, 1998).

This study uses primary data collected in Ethiopia in 1996 on 169 randomly selected wholesale grain traders and brokers in 12 markets. The study markets (Nekempte, Jaji, Assela, Sagure, Bahir Dar, Bure, Dessie, Kombolcha, Mekele, Harar, Dire Dawa, Addis Ababa) were selected on the basis of their representativeness by the type of grain, geographical distribution and importance to the national grain flows. Although every trader, by definition, buys and sells grain, the analysis distinguishes between traders in surplus regions (sellers) and traders in deficit regions (buyers).

[4] Descriptions of brokerage elsewhere exist for grain markets in northern Nigeria (Gilbert, 1969; Jones, 1972), Hausa markets in western Sudan (Cohen, 1969; Meillassoux, 1971), livestock and grain markets in the Sahel (Thomas, 1908; Amselle, 1969), Kumasi food markets (Hill, 1966), livestock markets in Somalia (Little, 1995), grain markets in rural India (Lele, 1971), potato markets in Peru (Scott, 1985), and rural markets in Indonesia (Hayami and Kawagoe, 1993). These earlier studies reveal the similarity of the institution of brokerage across countries, with the same word used to refer to brokers in several countries: *delala* in Ethiopia, *dillali* in Nigeria and the Sahel, *dalal* in India, and *delaal* in Somalia.

Table 1
Optimal search intensities under four search models

	Sellers	Buyers
Competitive, no broker	$S^* = \gamma_S R_S/2(\omega L + \nu K)$	$B^* = \gamma_B R_B/2(\omega L + \nu K)$
Socially optimal, no broker	$S^{**} = \gamma_S(R_S + R_B)/2(\omega L + \nu K)$	$B^{**} = \gamma_B(R_S + R_B)/2(\omega L + \nu K)$
Competitive, broker	$S^{M*} = \gamma_S R_S(1 - \mu_B)/2(\omega L + \nu K)$	$B^{M*} = \gamma_B R_B(1 - \mu_S)/2(\omega L + \nu K)$
Socially optimal, broker	$S^{M**} = \gamma_S R_S(1 - \mu_B) + \gamma_S R_B(1 - k\mu_S)/2(\omega L + \nu K)$	$B^{M**} = \gamma_B R_B(1 - \mu_S) + \gamma_B R_S(1 - k\mu_B)/2(\omega L + \nu K)$

For the purposes of this analysis, traders located in the central market were omitted, resulting in a sample of 47 sellers and 33 buyers. Data were obtained on each trader's search time, search labour, working capital, average net returns per transaction, trading contacts, and the use of the brokerage over 6 months. The transaction costs of search labour and capital were derived as shadow costs from each trader's profit maximisation and the number of trading contacts is used to represent traders' search efficiency.

In order to calculate net profits (V_S and V_B) per trader in comparable units, traders' net returns (R) are expressed as returns per transaction, and costs per transaction of search labour and capital (C_L and C_K) are expressed as the product of the shadow costs per unit of labour and capital per day, the number of days of the search, and the number of units of the labour and the capital. Since the actual levels of the search labour and the working capital chosen by traders are not independent of their choice of brokerage, the opportunity costs of the traders' search labour and the working capital are derived as shadow costs from each trader's profit function. The parameter of search efficiency, γ, is an index ranging from 0 to 1 that is constructed by dividing each trader's number of trading contacts by the maximum number of trading contacts attained by a trader in the economy.

3.1. Individual versus socially optimal search without brokerage

Numerical analysis using GAMS is undertaken to solve for traders' optimal search intensities without brokerage in the competitive equilibrium and socially optimal models. The behaviour of sellers and buyers are analysed separately. As revealed in Fig. 1a and b, search intensities in the competitive model, due to the presence of the positive externality noted earlier, are substantially below socially optimal levels.[5] Moreover, sellers' search behaviour under competitive equilibrium appears to be closer to the socially desirable search intensity level than that of buyers. In the competitive model, buyers have very low search intensities, with an average search intensity parameter of 0.08, compared to 0.15 for sellers. This difference could be either due to higher search costs faced by buyers of grain in Ethiopia, given the lack of product standardisation, classification and a public market information system, or due to lower search efficiency on the part of buyers. The former seems to be the more plausible reason given that buyers have average labour and capital costs of 231 and 172 Ethiopian Birr per transaction, respectively, compared to 207 and 154, respectively, for sellers. These cost differences may be due to the longer time required to purchase than to sell grain (an average of 3.6 days for buyers and 1.9 days for sellers).

3.2. Search behaviour with brokerage

In a market in which traders are differentiated by search efficiency and transaction costs, the presence of intermediaries, such as brokers, in the market lowers the optimal search intensities chosen by traders. The higher search efficiency of brokers leads to increased gains from trade for both buyers and sellers for traders with low search efficiency. Traders with relatively high search efficiency may continue to search without brokers. However, in a market with brokerage, traders who search on their own face a lower probability of matching with a partner since a subset of potential partners has gone to brokers. The presence of

[5] In these and subsequent figures, to ease comparison between the models, the search intensities of sellers or buyers in the competitive equilibrium model are ranked in ascending order. The pattern of the search intensities under the socially optimal model reflects neither seasonal nor clustering effects.

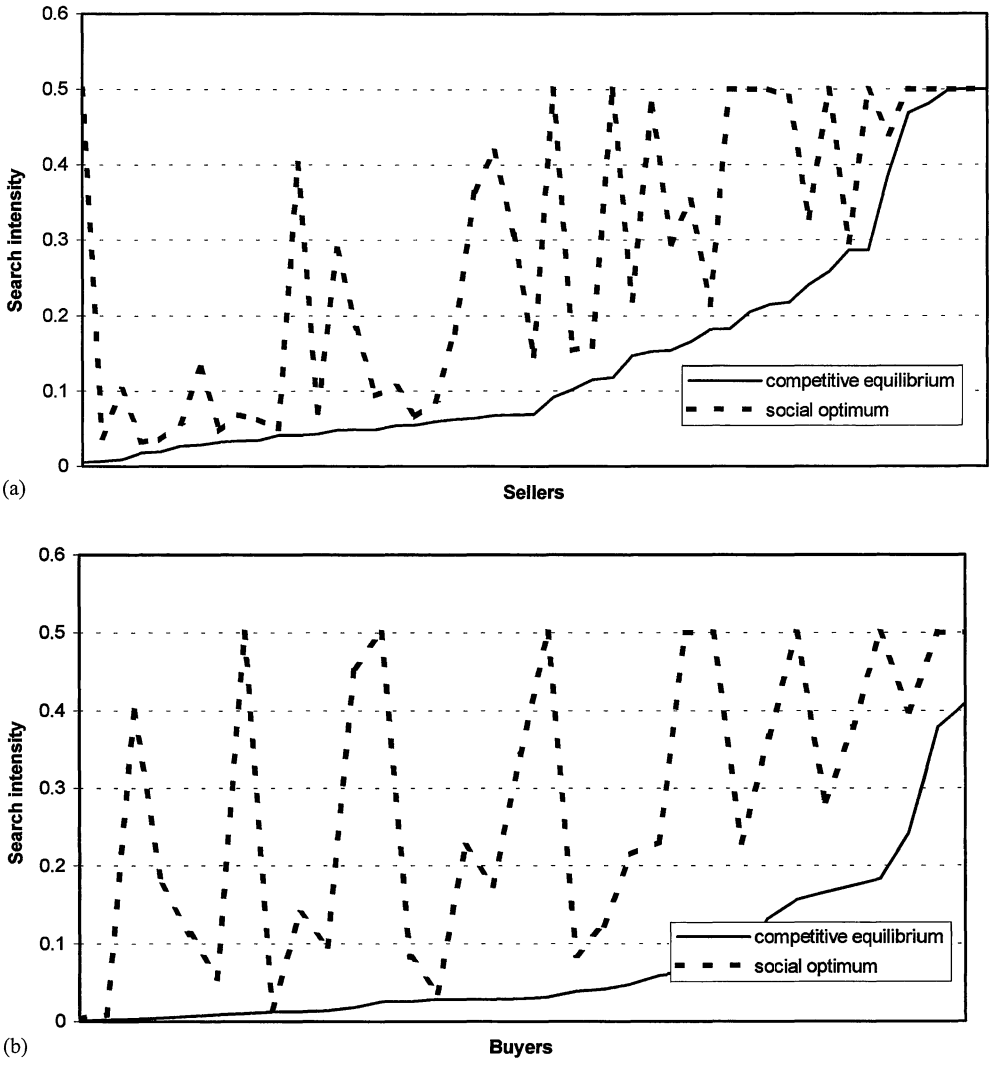


Fig. 1. (a) Sellers' search behaviour in competitive and socially optimal models without brokerage; (b) Buyers' search behaviour in competitive and socially optimal models without brokerage.

brokers in the economy implies that each trader's optimal choice of the search effort must have a influence in whether other traders have decided to use a broker or to search themselves.

In the competitive model, the introduction of a broker into the search economy has the expected effect of significantly reducing traders' optimal search intensities (Fig. 2a and b). On average, sellers' search intensities fall by one-third from 0.15 to 0.10 and buyers' search intensities fall by more than half from 0.08 to 0.03.

Although brokerage introduces strategic interaction between the search behaviour of traders, optimal search intensities in the competitive model continue to diverge from the socially optimal intensities. The key difference between the two models is the addition of a second term in the first-order conditions for the socially optimal problem (see Eqs. (6) and (7) and Table 1). This term adjusts search intensity upward to take into account the effect of each trader's own probability of choosing a broker on the reduced payoff to the searching partner.

As noted in the case without brokers, the divergence between private and social optimal search is more pronounced for buyers than sellers (Fig. 2c and d).

3.3. The welfare effects of brokers' presence in the market

Traders with low search efficiency and high costs will always choose to use a broker if they are made marginally better off, resulting in increased welfare. However, traders who continue searching on their own may lose welfare due to the shrinking of the search market. Therefore, the direction of the impact of brokerage on total welfare is not a general theoretical result, but rather an empirical question.

Numerical analysis of traders' total welfare gains and losses in the presence of brokers sums the expected net profits of all buyers and sellers (W_S and W_B). Compared to the situation without brokerage (V_S and V_B), the presence of brokers raises the sum of net profits by 64% (Table 2). However, this aggregate

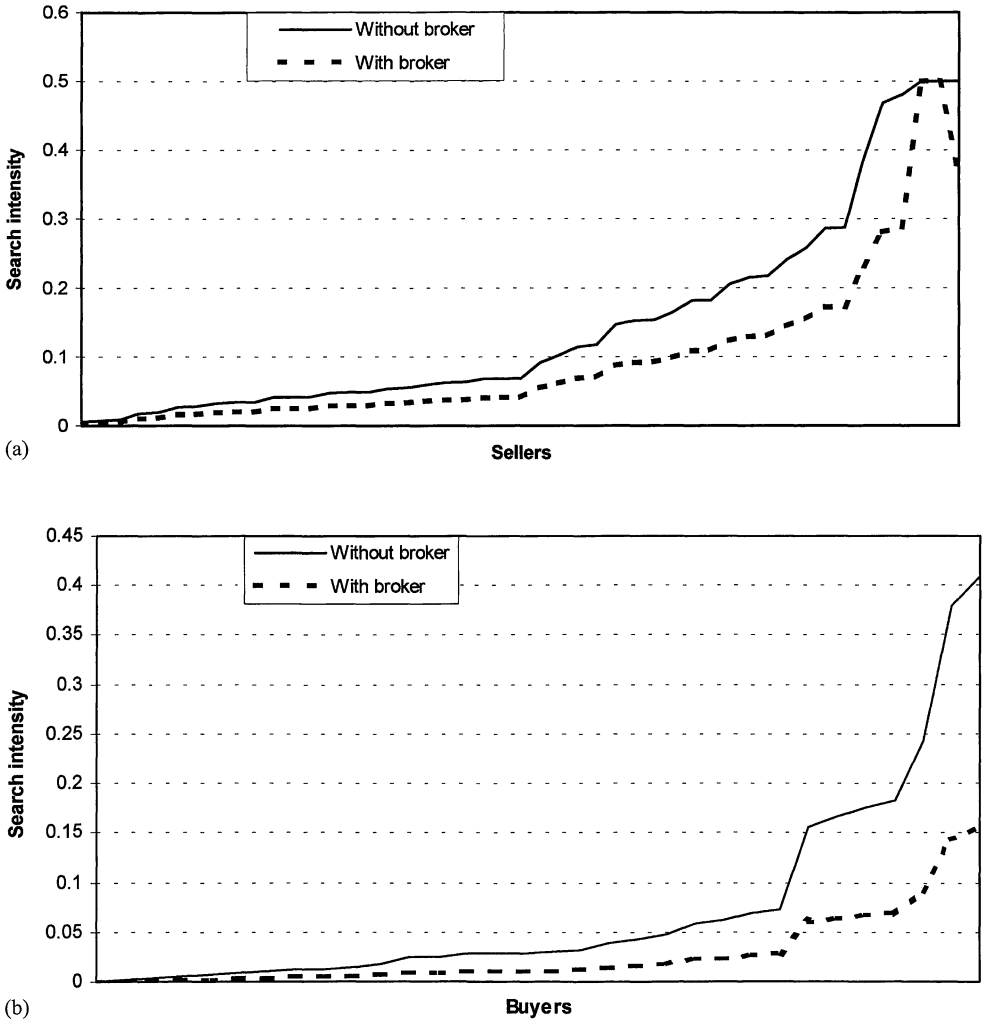
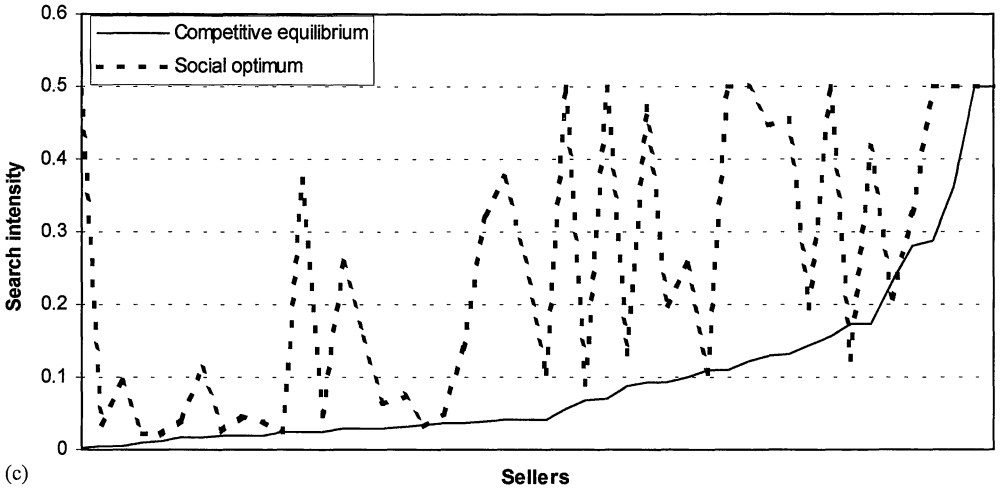
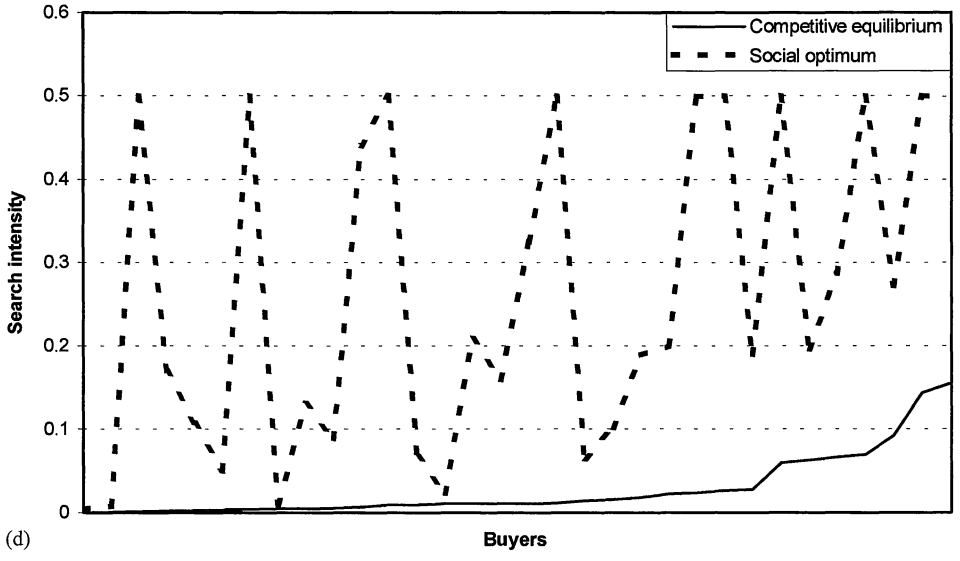


Fig. 2. (a) The effect of brokerage on sellers' search under competitive equilibrium; (b) the effect of brokerage on buyers' search under competitive equilibrium; (c) Sellers' search behaviour in competitive and socially optimal models with brokerage; (d) Buyers' search behaviour in competitive and socially optimal models with brokerage.



(c)



(d)

Fig. 2. (*Continued*).

result masks individual gains and losses. Forty-seven percent of the sellers experience welfare losses of 41% of net profits, on average, while 61% of buyers experience losses of 62% of net profit, on average. However, these losses are amply offset by the large gains experienced by the remaining 53% of sellers and 39% of buyers, who gain an average of 206 and 232%, respectively.

In general, traders who gain from the presence of brokers are those with relatively low search efficiency and high search costs. Comparing the average profile of losers and gainers, traders who gained from brokerage had average search efficiency parameters 26–42% lower than the average of those who lost from brokerage. The differences in transaction costs are even more striking in the case of sellers. Sellers who gained from brokerage had search costs between 93 and 94% higher than those who lost, while buyers who gained had 33–34% higher transaction costs than those who lost (Table 2).

Table 2
The welfare effects of brokers in the competitive equilibrium model

	Without brokers	With brokers
Total surplus (Ethiopian Birr)	1677	2748
Average sellers' search intensity (S)	0.15	0.10
Average buyers' search intensity (B)	0.08	0.03
	Welfare loss	Welfare gain
Sellers		
Share of traders (%)	47	53
Net welfare effect (% of profits without brokerage)	41	206
Average search efficiency	0.33	0.21
Average labour costs (Ethiopian Birr)	156	301
Average capital costs (Ethiopian Birr)	116	225
Buyers		
Share of traders (%)	61	39
Net welfare effect (% of profits without brokerage)	62	232
Average search efficiency	0.19	0.14
Average labour costs (Ethiopian Birr)	203	272
Average capital costs (Ethiopian Birr)	152	203

4. Conclusions and policy implications

This paper has investigated the impact of the institution of brokerage on the optimal search behaviour and welfare gains and losses of traders in the Ethiopian grain market. The theoretical expectations are broadly confirmed by the numerical data analysis.

Results suggest that without brokers, private search behaviour in equilibrium widely diverges from the socially optimal strategies that would capture the positive spill-over of individual search. The presence of brokers appears to partially internalise this externality by forcing traders to make conjectures about the probability that potential trading partners may have switched to using a broker. The results show that, with brokers, there is less overall search intensity on the part of most individuals. Hence, brokers have a positive effect on total surplus by enabling a more efficient allocation of search effort. An important result from a policy perspective is that traders who were doing well without brokers stand to lose from the presence of brokers because of the shrinkage of the search market that ensues. Thus, higher overall welfare is obtained at the expense of substantial losses by the relatively 'search-efficient' members of the trader population. In the socially optimal model with brokerage, this welfare loss is avoided by maximising the search intensity of those who search well while less efficient traders switch to using a broker. As a result, all traders are better off with brokers and total surplus is 60% higher than in the competitive equilibrium with brokerage.

The policy challenge being faced by the Ethiopian policy makers, and more broadly, those concerned with strengthening market institutions in recently liberalised developing countries, remains then how to devise market policies that best achieve the socially optimal solution. In this context, policies must be devised that encourage the specialised function and search efficiency of brokers without adversely affecting the outcomes of relatively efficient traders. This might be achieved by increasing the search efficiency of brokers relative to all traders so that all traders would gain from switching to brokerage and the adverse effects of the shrinkage of the direct search market would not be felt. Some policies that could enhance the specialised role of brokers would be the formalisation of their role in the market (at present, brokers are not distinguished from traders in the eyes of the state), setting up rules of conduct and standards for entry of brokers (similar to those governing brokers on organised commodity exchanges), and strengthening their search capacity through training and improved access to market information and telecommunications.

Finally, while this study provides important insights into the implications of the optimal search behaviour and the heterogeneity of traders with respect to search costs and search efficiency, further research could be envisaged that extends the welfare implications to include the effects of the market search behaviour and the presence of brokers on producer and consumer welfare, in addition to that of traders.

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