When Economics Meets Hierarchy:

A Field Experiment on the Workings of the Invisible Hand

Erwin Bulte[a,d], Andreas Kontoleon[b], John List[c], Ty Turley[c] and Maarten Voors[b]

a Development Economics Group, Wageningen University, P.O. Box 8130, 6700 EW Wageningen, The Netherlands
b Department of Land Economy, University of Cambridge, United Kingdom
c Department of Economics, The University of Chicago, United States and NBER
d Department of Economics, Tilburg University, The Netherlands

Abstract:

Seminal work within experimental economics has shown the remarkable tendency for experimental trading markets to converge to neoclassical predictions. Yet, the extent to which neoclassical competitive market theory explains the equilibrating forces operating in extra-lab markets remains under-researched. In this study, we depart from the traditional experimental investigation of neoclassical competitive theory by using the tools of experimental economics in an actual marketplace. Our laboratory mimics a market in rural Sierra Leone, a region characterized by low levels of market integration and high levels of personalized trade. When participants interact with co-villagers, efficiency levels are much lower than found in the extant literature. By introducing treatments that increase anonymity between traders, we show that social hierarchies play a significant role in dampening efficiency. High-status individuals, when trading with their co-villagers, reduce overall efficiency by paying too much for items traded in the experiment. Upon eliminating status-related concerns, we find that overall efficiency levels approach those found in previous studies.

Keywords: efficiency, status, Africa, trade experiment

I. Introduction

A central tenet of neoclassical economics is that in equilibrium there are no unexploited gains to trade. The workhorse model within economics implies that in a perfectly competitive market, the first function of the equilibrium price is to efficiently allocate scarce resources to market participants. This principle represents the backbone of the measurement of the gains to trade, provides guidance into optimal tax policy, and embodies why market-based interventions are often proposed as a key element of policy reform agendas for developing countries.

Although Adam Smith laid the groundwork for understanding the power of the invisible hand, the extent to which neoclassical theory explains the equilibrating forces operating in actual markets remains under-researched empirically. This is not surprising in light of the difficulties associated with executing a clean empirical test, as too many theoretically relevant factors change simultaneously to permit a credible glimpse into the inner-workings of markets. Without an ability to observe demand and supply curves and manipulate actual markets directly, data from naturally-occurring markets provide little guidance on the empirical accuracy of Smith's invisible hand to efficiently allocate scarce resources (Blaug 1992).

Perhaps this was the impetus for Vernon Smith (1962), who fifty years ago used a laboratory experiment, with undergraduate students as market participants, to explore neoclassical competitive market theory. He used a double oral auction designed in the spirit of a stock exchange, in which buyers and sellers orally submit bids and asks. Empirical results from Smith's double auctions were staggering—quantity and price levels were very near competitive levels—and served to present important first evidence that market outcomes can approach neoclassical expectations.

List (2002, 2004) moved the analysis from the laboratory environment to a field experiment, wherein actual market participants engaged in market transactions in their natural setting. List's work changed the empirical test to one where agents engaged in face-to-face continuous bilateral bargaining in a multilateral market context. In these markets subjects set prices as they please, with no guidance from a centralized auctioneer. This design shifts the task of adaptation from the auctioneer to the agents, permitting trades to occur in a decentralized manner, similar to how trades are consummated in actual free unobstructed markets. In doing so, the market structure reformulates the problem of stability of equilibria to a question about understanding how and under what conditions the behavior of actual people (as opposed to abstract or impersonal markets) leads to efficient market outcomes. A key result of List is the remarkably strong tendency for exchange prices to approach the neoclassical competitive model predictions, especially in symmetric markets.

While these and several other lab explorations (e.g. Holt 1995 and Roth 1995) serve to lend insights into the predictive power of the invisible hand, one might wonder how far their insights reach into the developing world, where exchange patterns often are organized via different mechanisms. Kumar and Matsusaka (2009) emphasize that exchange in developing countries often takes the form of repeated, personalized interaction, possibly embodied in kinship ties and patron-client relations (see also Kranton 1996, Fafchamps 2011). To reap the potential benefits from specialization and trade, it is argued, rural communities should make the transition from personalized to anonymous exchange (Fafchamps 2011, Kimbrough et al. 2008). However, complementarities in exchange modalities imply that such a transition might not occur—if most villagers opt for one exchange modality, it is in the interest of others to follow regardless of whether this modality is "globally efficient" because of network externalities. If so, communities may end up caught in a poverty trap (Kranton 1996, Kumar and Matsusaka 2009). The dominant

agricultural development paradigm in current policy circles to remedy such outcomes is to enhance the efficient operation of markets and to link producers (and consumers) to markets and value chains (Byerlee et al. 2009).

In this study, we seek to change the direction of the research on the efficiency of markets by conducting a market field experiment within a transitioning society—16 villages in eastern Sierra Leone, in western Africa. This may be seen as a fundamental test of the foundations of neoclassical theory, which traditionally have been criticized as being value-laden with Western ethical and behavioral underpinnings, lacking universal applicability. Our research site, characterized by self-subsistence and extremely limited integration into markets, provides a distinct alternative setting to test the working of the invisible hand.

In addition to relating to the literature on the efficiency of markets, our work also speaks to the literature on status (hierarchy). While most of the experimental papers on status and efficiency are based on randomly induced status *within* the experiment (e.g., Ball et al. 2001, Moxnes and van der Heijden 2003, Frey and Meier 2004, Kumru and Vesterlund 2010), we assess the impact of pre-existing or real-life status on behavior and aggregate outcomes. This logically captures a key feature of personalized exchange in the experiment. Importantly, across treatments we vary the extent to which status might interfere with trading patterns in the experiment. We explore variation in the efficiency of markets as we vary the degree to which real-life hierarchical relations can interfere with the exchange process.

Using data gathered from more than 700 trades, we report three key insights. First, earlier experimental findings reported in Smith (1962) and List (2002, 2004) do not automatically extend to our environment. Specifically, overall efficiency levels are lower than previously observed, aggregate behavior in experimental markets does not converge towards theoretical predictions, and market experience does not change behavior. Second, local hierarchies and associated "social roles" critically influence behavior. In contrast to

earlier experimental research on status and efficiency (Ball et al. 2001), we do not find that high-status individuals secure most of the surplus—in fact, the contrary is true in our environment. As discussed below, this finding is consistent with theoretical work on status seeking, and studies based on observational data.

Yet, a third result is that when we eliminate status considerations (by observing trade across communities or involving middlemen), overall efficiency increases dramatically—approximating efficiency in previous studies. This suggests that the initial results from our baseline treatment were neither due to experimental subjects failing to understand the workings of the experimental market nor to imperfections in the design of our market. Rather, together, the thrust of our results suggest that extant hierarchies can importantly hinder the efficiency of market institutions. The silver lining, however, is that when intra-group efficiency is frustrated, the use of middlemen can enhance market efficiency.

Overall, our results outline a departure from the canonical model. Market inefficiencies can arise regardless of the market institution, and these inefficiencies can importantly influence market clearing. For policymakers, this result suggests that when crafting development goals, not only the market institution, but also the social context of market participants is critical when evaluating market based solutions.

II. Experimental Design

Our test of competitive market theory is based on the experimental design of List (2004a,b), designed to "give neoclassical theory its best chance to succeed." Like List, we used double-sided oral auctions and multiple rounds (details below). Unlike List, we used subjects from African rural villages with very little access to outside markets or trading. We recruited 240 subjects from 16 villages in eastern Sierra Leone, close to the border of the Gola Forest. Our design slightly differed from List—we used 8 buyers and 8 sellers (rather

than 12) and used 10 rounds of trading (rather than 5) because we are especially interested in market convergence.

Our experimental design is as follows (detailed protocols are available on request). In the winter of 2010/11 we invited villagers to a central location in six Chiefdoms in Sierra Leone. Villagers were randomly selected during a pre-visit to the communities. Following an extensive introduction and training session (we took great care to ensure participants understood the experiment), participants were randomly divided in two groups—buyers and sellers. These roles were randomly re-allocated at the beginning of each trading round. Each trader received a reservation price, or induced value. Buyers were given a maximum budget and sellers were given a minimum selling price. Profits earned in the trade—the difference between reservation value and trading price—were for the subjects to keep.

As a (homogenous and indivisible) trading commodity we used a simple block of wood (on which we artfully drew a moustache). Each trading round lasted 5 minutes. Traders were instructed that after each trade contract, the buyer and seller had to approach a "trade master" (one of our research assistants) who recorded the trade and publicly announced the agreed price to all participants. Buyers (sellers) could not trade above (or below) their own reservation values. After the trading sessions we implemented short exit surveys recoding age, gender, years of school attendance, a simple 7 question math test, farm size (number of acres), family size and prior trading experience (a simple binary variable in our analysis below, indicating whether the respondent has ever traded in a market, but qualitatively similar results eventuate when we use the number of market visits per year, or exogenous variation in experience instilled by an extra two-hour trading session for a random sub-sample of our respondents).

To gauge social status we asked participants to line up in order of social status in their experimental group, providing us with a respondent-specific ordinal measure of his/her

position in the local hierarchy. Higher scores indicate relatively low status. In addition, we collected information about our respondents' formal or informal positions of authority within the community (village chief, youth leader, women leader, religious leader). We create a binary variable to indicate whether respondents hold such a position.

Figure 1 summarizes the reservation prices in our basic market experiments. The upward sloping supply curve essentially lines up reservation prices for the sellers in the experiment—from low to high. The downward sloping demand curve does the same for buyers. Market equilibrium occurs at a price of 4500-5500 Leones and 5 units traded. Importantly, in each round some buyers and sellers received induced values that should place them "out of the market"—the induced value for 3 sellers is too high to profitably sell at the equilibrium price. The reverse is true for 3 buyers, with reservation values too low to profitably purchase at the equilibrium price. Since reservation values are randomly assigned at the beginning of each round, the identity of subjects who are "in" or "out" of the market varies from one round to the next, and anchoring effects should be minimized.

Our experiment involves three different treatments. In our base treatment we match buyers and sellers from the same (small) village, so all subjects know each other well. If status or one's position in the local hierarchy matters for the allocation of goods, and if people bring this knowledge into the market place, then deviations from the competitive market equilibrium might occur. In this case, if bargaining reflects social roles, then prices and the allocation of goods across individuals might be distorted. Our second treatment attenuates the potential impacts of local hierarchies by introducing middlemen (individuals from third villages—unknown to the trading agents), brokering between buyers and sellers. The buyers and sellers are now kept in separate rooms. Our third treatment makes use of individuals from different villages. We made sure to invite people from villages relatively far

away, so that buyers had to interact with sellers unknown to them (this was confirmed by our exit survey). In total we organized 15 trading sessions. Table 1 summarizes the design.

We ask whether deviations from the competitive market equilibrium evaporate, or not. Are villagers able to better capitalize on potential gains from trade as local hierarchy considerations are neutralized? Or will gains from markets remain elusive for this sample of respondents? Our design uniquely allows us to explore the pattern and speed of market convergence across different experimental set ups that entail differential impacts on behaviour of pre-existing exogenous local hierarchal structures. Further, the design allows for the investigation of the impacts on market behavior from introducing institutional reforms (such as middlemen). Finally, the experimental set up allows us to observe how market participants of *different* social status behave in "the market."

III. Experimental Results: Efficiency in Trading

Our first set of results is summarized in Table 2. Trading results for the base treatment, matching co-villagers, are contained in Panel A. Results for the "middle-men" and "inter-village" treatments are contained in Panels B and C, respectively. The Table summarizes aggregate trade statistics per round, from round 1 to 10, enabling us to explore how the efficiency of trading evolves over time. Aggregate statistics are the average price and standard deviation of that price, quantity traded, profits for buyers and sellers, and the efficiency of that trading round. Trading efficiency is defined as realized rents divided by potential rents (17000 Leones). Hence, in trading round 1 of the base treatment, 4 blocks of wood were traded at an average price of 4432 Leones (SD=721). Villagers captured 84% of the available rents, and buyers profited more than sellers (earning, respectively, 9000 and 5286 Leones in this round). We also document the number of trades as well as the number of trades at an efficient price (trades in the core).

These trading data lead to a first result:

Result 1: Within our subject pool, the market does not efficiently allocate scarce resources to market participants in the base treatment.

Evidence for this comes from Panel A, which indicates that some 10-20% of the available rents are not captured by trading partners. While securing some 80-85% of available rents is considerable, the percentage of untapped rents is larger than in other empirical tests of market theory. Moreover, and unlike earlier studies, we find no evidence that efficiency increases over the rounds. That is, we do not obtain evidence of convergence towards equilibrium conditions—both aggregate efficiency levels and the number of trades in the core are statistically indistinguishable in rounds 1-5 and in rounds 6-10. As a comparison, List's field study, focusing on sports card trading, yielded an efficiency level starting at 89% and jumping up to 97% in the 4^{th} and 5^{th} rounds (there is no such trend during the first 5 periods in our experiment). The standard theory of competitive markets does not predict behavior of our subjects as well in our base treatment where village identities and hierarchies are salient.

A second result slightly modifies this first finding:

Result 2: Market efficiency increases (somewhat) when middle-men conduct market transactions.

Panel B summarizes trade patterns in the presence of a broker. Average efficiency has increased by 3.3% (or 561 Leones), an increase that is only statistically significant at the $p < .15$ level.[1] This result suggests that once we remove the trader identities, efficiency is significantly improved. However, this treatment potentially confounds the effect of anonymity between trading partners (removing the effects of social hierarchy) with additional effects, such as increased transaction costs due to longer waiting times. In another treatment, involving experienced brokers (our research assistants), we find that average efficiency increases further—the gain equals 4.83%, which is statistically significant at the 5% level

[1] For this p-value, and the ones reported below, we report the outcome of a one sided matched pair t-test with unequal variances (Welch approximation). Note we do not cluster standard errors due to our low number of clusters (g = 11), see Angrist and Pischke (2009).

(details available on request). A cleaner, and more realistic, evaluation of the effect of social hierarchy eventuates when comparing intra- and inter-village trading, which leads to our next result:

Result 3: Market efficiency is at its highest when trade occurs across villages.

We find that efficiency is the greatest when we examine inter-village treatment—an additional 5.1% (or 866 Leones) of the rents are captured by the participants compared to the market with middlemen trading (or 9.9% higher than in the baseline scenario). This increase is significant at the $p < .03$ level, and reveals the power of moving from intra- to inter-village trading.

Interestingly, in this treatment prices are similar (but the spread is smaller), and the division of the surplus between buyers and sellers is more equal than in the baseline treatment. Moreover, efficiency increases over the trading rounds, so we do obtain some evidence of market convergence (efficiency increases by 4.7%, significant at the $p < .05$ level). For example, the number of trades in the core in trading rounds 6-10 is significantly greater than the number of trades in the core in the first five trading rounds (significant at the $p < .05$ level).

We, therefore, conclude that low efficiency and lack of convergence towards equilibrium values in the baseline treatment does not reflect a lack of understanding on the part of our respondents. Rather, it appears they consider multiple margins—outcomes within and outside the experiment—when deciding about how to behave in the game. Statements about "overall efficiency" should therefore be made with care; while anonymous market exchange may improve trading efficiency, it could be at the detriment of personalized exchanges within the village, such as informal insurance. Combining these insights, leads to our preferred interpretation of the overall data patterns:

Conjecture 1: In a context of personalized exchange, subjects consider multiple margins and deviations from market efficiency occur as a result. When placed in a context of anonymous exchange, the same subject population behaves more in accordance with neoclassical theory. Also, market efficiency can be manipulated with structural interventions.

IV. Hierarchy and Trade

To complement the unconditional analysis of the raw data, we explore the efficiency of trade in more detail using a regression approach. In a series of models we explain individual profits of participants, in their roles as buyers or sellers, for the three different treatments. Following List (2004), we estimate a two-step Heckman model, and distinguish between the decision to enter into trade (recall some participants receive induced values that place them outside of the market), and performance in the market conditional on having entered it. We report results of the performance model in Table 3, and suppress results of the participation model to economize on space (a buyer's decision to enter the market depends on his induced value and we also document (weak) evidence of a round and gender effect—details available on request). Unfortunately, the two-step Heckman model does not allow us to cluster standard errors.

Unlike earlier work, we find that "trading experience" does not matter considerably—it does not enter significantly in any model (nor do alternative proxies of trading experience). Two variables mainly explain buyer profits: the induced value and social status of the player, or an individual's location in the local hierarchy. This analysis leads to our next result:

Result 4: Local high authority people earn *lower* trading rents when they are buyers and are bargaining with a co-villager.

While average prices paid are close to equilibrium prices, high-status individuals consistently pay more than other market participants for the wood blocks they acquire. Additional

analysis reveals that this result is not due to low-status buyers paying less—upon comparing behavior across treatments we find that the high-status traders pay more in the intra-village treatment than in the other treatments, and low-status traders do not pay less.

This result is not explained by age, education, or income, because we control for these variables separately. Rather, one's position in the local hierarchy matters independently. It does not matter whether we gauge social status by the ordinal variable, or the binary "position of authority" measure (columns 1 and 2, respectively).[2] Interestingly, we also do not find that high-status individuals charge less when acting as sellers (column 3).

These results may be compared to those of Ball et al. (2001) who also find that status matters for market efficiency in an experimental setting. However, they find that high-status subjects capture *more* of the surplus—rather than less. This divergence rests on the differences between the subject pool and on how status is introduced in the two experiments. Not only is the Ball et al study undertaken in a developed world context (using students), status is introduced artificially *within* the experiment (either through random assignment or based on performance in a task). This marks a considerable difference to our study which overlays control on an environment wherein our variable of interest arises naturally. It is not surprising that real-life status has differential and more complex impacts.

Interestingly, our results are consistent with a theoretical and empirical literature arguing that the pursuit of status seeking may be socially inefficient. When individuals compete for high status, socially wasteful contests may be invited in the form of excessive positional spending (Robson 1992, Fershtman et al 1996 Brown et al. 2011). For example, Hopkins and Kornienko (2004, p. 1086) analyze outcomes where "*everyone increases conspicuous consumption in order to improve status, but any gain in status is cancelled out by the similarly increased expenditures of others*". Such an economy can be described as a

[2] P-value for the F-test of joint significance of the four status variables in Column 2 is 0,07.

Lewis Caroll 'Red Queen' economy, in which "*it takes all the running you can do to keep in the same place*".

A recurring question in this literature is whether status seeking has instrumental value (Postlewaite 1998), in which case narrowly-defined inefficiencies (such as deviations from certain trading axioms) might be privately efficient on a grander scale. For example, confirming status roles may fortify existing patron-client relationships. While earlier work focuses on spending patterns, specifically the purchase of so-called "positional goods," our results are consistent with a "broader" interpretation, where status may not only derive from the goods on which money it is spent, but also on the *way* money is spent. This introduces a natural bridge to the literature on gift-giving.

Our main result, that existing status relations inhibit efficiency in markets, is consistent with at least two explanations. First, high-status individuals may be more altruistic towards fellow villagers. Indeed, their status may derive from generosity. However, such an interpretation flies in the face of other evidence, which highlights the exploitative and feudal nature of agrarian relations in rural Sierra Leone (e.g., Mokuwa et al. 2011). Also, we would then expect such altruistic sentiments to emerge in other treatments.

Second, it may be that village norms with respect to redistribution within existing patron-client relations are affirmed in the experiment. Finnegan (1963) discusses the moral economy of chieftaincy in Sierra Leone, and the ensuing privileges and responsibilities of local elites. This explanation explicitly recognizes that play in the experiment is part of a larger process of "giving and taking" so that trading efficiency should not be confused with global efficiency—the overall generation and distribution of surplus within the agrarian network. The interpretation that existing patron-client relations matter is consistent with the finding that the impact of hierarchy on efficiency (nearly) disappears in treatments involving

middlemen (columns 4-5) or inter-village trade (columns 6-7).[3] Further, closer inspection of the data reveals that high-status individuals favor trading with low-social status types, and that some high-status individuals traded at zero profits (roughly 11% of all trades). In the baseline treatment, we find that the status of "zero profit" individuals is strongly and negatively correlated (significant at 1%) with the status of their trading partner. This result disappears in the other treatments (not reported, available on request), further corroborating our preferred interpretation.

Hence, our subjects adapt their trading behavior depending on the (social) context. When trading with local villagers — personalized, reciprocal exchange — multiple margins appear relevant, and local hierarchies impede market efficiency. This is fully consistent with key assumptions by Kranton (1996) and Kumar and Katsusaka (2009). However, when our sample of African farmers is placed in another context, where trade is more or less anonymous, they quickly slip in the role of *Homo Economicus* and market efficiency improves. The ability to switch behavior sheds new light on an important assumption underlying the (theoretical) literature studying the transition from personalized to anonymous exchange. These earlier contributions assume traders are of a specific type—flourishing in *either* personalized or anonymous exchange. For example, Kranton (1996) assumes agents choose to become a reciprocal trader or an anonymous trader—but not both. Similarly, Kumar and Matsusaka (2009) assume agents can use one of two types of human capital: local capital (facilitating personalized exchange) or market capital (facilitating anonymous exchange). Such specialization in specific trade modalities combined with complementarities in trade (the gain from being a personalized trader increases as the share of personalized traders in the population goes up) implies scope for so-called "lock-in effects." As a result, inefficient equilibria might persist. Our results cast new light on this assumption, attenuating

[3] P-value for the F-test of joint significance of the four status variables in Column 5 is 0.01 and Column 7 is 0.52

concerns about such lock in phenomena. When opportunities for beneficial anonymous trade emerge, even reciprocal traders endowed with large stocks of local human capital may be quick to adapt their behavior and seize the gains from trade.

V. Epilogue

In this study, we depart from a traditional experimental investigation of neoclassical competitive theory by using the tools of experimental economics in a market setting in the developing world to wed two disparate literatures. First, we try to extend the testing of competitive market theory in the field. Unlike earlier field experiments, our results are based on a subject pool of subsistence farmers from a remote region in Sierra Leone, Africa. While our respondents (occasionally) exchange goods and services, their exchange patterns are based on repeated and personalized interaction, and rarely involve cash prices. Second, we introduce market trading in a village environment to study the interaction between market efficiency and hierarchy, and relate our findings to the literature on status and efficiency.

We believe our results not only speak to tests of neoclassical theory, but are also relevant for development policy makers. For example, although the literature often discusses the power of market institutions in encouraging development, our results highlight that understanding social relationships of market participants is critical when evaluating market-based solutions. While economists routinely recognize that trust is a precondition for trade (e.g. Arrow 1972), and willingly accept that repeated interactions is one mechanism to foster trust, we have demonstrated that other cultural factors importantly affect the efficiency of markets. Obviously this also implies it is difficult to draw general conclusions about overall efficiency: if the social context affects exchange modalities then, in turn, market integration may affect extra-market outcomes – for better or for worse. We leave this for future research.

Notwithstanding this caveat, we believe our results are useful for policy makers interested in enhancing market efficiency. Although intra-group trading frustrates market

efficiency, more distant transactions are more efficient. Importantly, inter-group trading is found to be quite efficient among subsistence farmers. This finding – i.e., that market efficiency varies with the social context due to respondents "switching" behavior – has implications for our understanding of the transition from personalized to anonymous exchange. While earlier studies emphasized agents specialize in one exchange modality, resulting in "lock in effects" in case of strategic complementarities in trade, we find that at least some citizens can adapt their trading behavior depending on the social context. If structural features of rural markets can be adjusted, for example by introducing agents of change (brokers) linking rural producers to regional markets, trading efficiency could improve rapidly.

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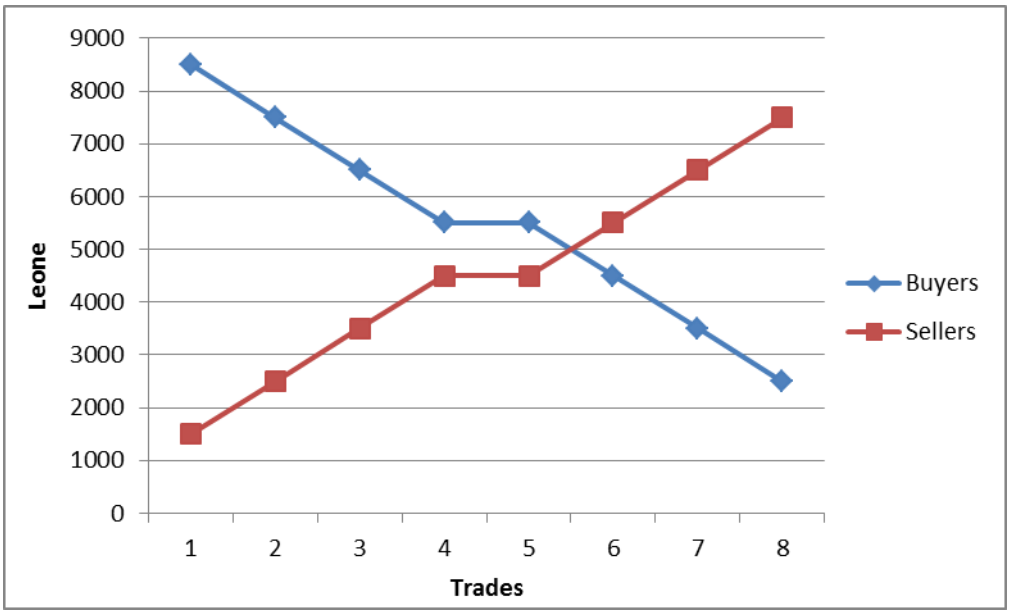

Figure 1. Experimental Market

Table 1. Descriptive Statistics Trading Sessions

	Sessions	Number of Participants	Total Observations (Participant-Rounds)	Total Trades Executed (Trade-Rounds)
Control	7	112	480	314
Middlemen	3	48	224	154
All strangers	5	80	360	246

Table 2. Trading behavior across the three treatments

Market period	1	2	3	4	5	6	7	8	9	10
Panel A: Base treatment: trade with co-villagers										
Average price	4432	5062	4844	4809	4937	4802	5006	4877	4765	4822
SD	721	442	515	521	230	463	182	360	491	400
Buyer Profit	9000	6429	8357	7286	7643	7800	7300	7900	7200	8500
Seller Profit	5286	6000	6357	5429	7071	6000	6500	6900	6200	6500
Trades (N)	4.1	4.7	5.0	5.0	5.9	5.8	6.0	5.2	5.8	5.4
Trades in core	2.0	1.9	2.6	2.3	3.4	3.0	2.8	3.0	2.6	3.0
Efficiency	84%	73%	87%	75%	87%	81%	81%	87%	79%	88%
Panel B: Middlemen treatment: trade through middlemen										
Average price	5278	5050	4800	4889	4983	4883	4472	4833	4936	4642
SD	385	136	346	96	275	375	413	382	192	625
Buyer Profit	6000	7500	7833	7833	8333	8167	9333	7333	7750	8500
Seller Profit	6333	6500	6833	7167	7667	7500	5667	6333	5750	6500
Trades (N)	4.0	5.7	5.7	5.7	5.3	5.7	5.3	6.3	6.0	5.5
Trades in core	1.3	2.7	3.3	2.7	4.0	3.3	3.3	3.0	2.0	3.5
Efficiency	73%	82%	86%	88%	94%	92%	88%	80%	79%	88%
Panel C: Inter-village treatment: trade with individuals from other villages										
Average price	4730	5016	4848	4823	4880	4992	5013	4608	4671	4788
SD	179	341	509	284	295	232	401	79	513	25
Buyer Profit	8400	7700	6900	8400	7600	7750	7500	8875	9750	8500
Seller Profit	6800	6700	6700	6400	6600	7500	7250	5875	6500	6750
Trades (N)	5.2	5.8	5.2	5.8	5.4	5.3	5.5	5.8	5.5	5.3
Trades in core	2.8	3.0	2.6	2.8	2.8	3.8	3.0	3.0	3.0	3.5
Efficiency	89%	85%	80%	87%	84%	90%	87%	87%	96%	90%

Table 3. Trading behavior along the forest edge (2nd stage Heckman model).

	Base			Middleman			Inter-village treatment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Buyer	Buyer	Seller	Buyer	Buyer	Seller	Buyer	Buyer	Seller
Profit									
Age	0.790	-2.130	-7.966	-11.24	2.253	-3.620	-4.837	-8.091	1.337
	(6.473)	(6.842)	(5.044)	(12.37)	(8.235)	(8.969)	(11.26)	(11.53)	(6.672)
Male	-133.2	-83.83	-115.7	-277.6	-595.0**	359.6	237.7	228.9	-499.2*
	(196.8)	(280.8)	(164.4)	(409.0)	(258.5)	(294.5)	(424.5)	(265.3)	(263.2)
School years	-0.778	-16.22	39.29	7.022	42.87	-5.171	2.697	-36.02	18.32
	(38.77)	(39.82)	(26.83)	(59.55)	(43.62)	(47.81)	(48.94)	(32.11)	(30.21)
Math test	5.566	116.1**	-60.35	47.30	-50.78	-62.41	106.9	84.47	-24.86
	(50.95)	(55.89)	(52.79)	(106.1)	(59.43)	(84.49)	(108.9)	(71.44)	(57.56)
Farm size	39.83	91.74	24.34	-14.41	122.1*	-139.1	60.33	70.26	-0.493
	(54.64)	(56.92)	(49.45)	(122.3)	(65.48)	(97.53)	(95.11)	(85.59)	(60.82)
Family size	33.28	28.13	-55.39	253.5	-117.4	75.81	-65.04	-83.68	-24.21
	(130.0)	(128.6)	(116.7)	(246.1)	(137.4)	(166.9)	(156.4)	(108.8)	(98.87)
Never trade	25.91	126.7	18.25	800.6	676.0	112.6	-756.7	-760.7	-67.10
	(341.1)	(403.6)	(269.9)	(891.7)	(474.2)	(610.3)	(1045.8)	(688.1)	(459.3)
Card value	0.614***	0.598***	-0.505***	0.949***	0.604***	-0.770***	0.914***	0.761***	-0.715***
	(0.111)	(0.106)	(0.0857)	(0.242)	(0.105)	(0.152)	(0.218)	(0.140)	(0.110)
Round	-5.731	-28.23	25.09	12.58	-22.76	-12.41	28.64	43.87	7.702
	(27.17)	(26.83)	(25.33)	(63.09)	(31.58)	(47.87)	(49.54)	(34.89)	(29.99)
Social line up	60.80***		-2.061	-7.122		-13.71	53.82		77.34
	(20.20)		(17.36)	(25.05)		(17.41)	(87.15)		(58.24)
Village Traditional		-590.4***			-867.5***			-195.7	
Authority		(228.0)			(255.3)			(356.4)	
Female Traditional		-579.4*			48.27			101.7	
Authority		(309.9)			(379.3)			(691.4)	
Youth Authority		-585.4**			-124.8			-48.02	
		(263.7)			(299.4)			(299.7)	
Religious Authority		-838.9**			-660.0**			-123.3	
		(357.4)			(293.4)			(488.7)	
Constant	-3225.8***	-2513.0**	3325.8***	-4649.7**	-1741.6*	4122.3***	-6000.7***	-4229.3***	3917.6***
	(1055.8)	(1008.7)	(496.2)	(1921.9)	(902.5)	(826.4)	(2058.1)	(1383.9)	(724.6)
mills									
lambda	955.5*	698.7	579.0	1811.9*	667.6	1343.9**	2017.8**	1273.9**	1169.3**
	(488.0)	(470.7)	(365.6)	(988.4)	(453.9)	(574.6)	(924.3)	(564.9)	(463.8)
N	283	208	276	174	128	179	257	215	264

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$