Markets Versus Negotiations: An Experimental Investigation*

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Abstract

We consider the consequences of competition between two types of experimental exchange mechanisms, a "decentralized bargaining" market, and a "centralized" market. The experiment demonstrates that decentralized bargaining is subject to a process of unraveling in which relatively *weak traders* (buyers with high willingness to pay and sellers with low costs) continuously find trading in the centralized market more attractive until almost no opportunities for mutually beneficial trade remain outside the centralized marketplace.

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1. Introduction

What determines buyers' and sellers' choices of how and where to trade? Existing answers typically presuppose that traders' choices are done within the context of some *single* specific exchange mechanism – that is, in most models, traders are typically not allowed to choose the mechanism through which to trade. The purpose of this experimental paper is to shed some light on the factors that affect traders' choices among different mechanisms.

Specifically, we consider the consequences of competition between two types of experimental exchange mechanisms, a "decentralized bargaining" market, and a "centralized" market. Competition assumes the following form: in every period, members of a heterogenous population of privately-informed traders who each wish to buy or sell one unit of some homogenous good may opt for trading through either (1) direct negotiations with other buyers and sellers (a decentralized bargaining market), or (2) a centralized market mechanism.[1]

It is important to emphasize that in order to predict the outcome of such competition it is not enough to analyze the properties of different exchange mechanisms in isolation. Because traders' choices of where to trade are endogenous, the very existence of a competing exchange mechanism may affect the outcome in any given mechanism. In other words, the question is what kind of exchange mechanisms is likely to flourish when traders are free to choose through which mechanism to transact. We demonstrate that the presence of a competing exchange mechanism introduces interesting dynamics into traders' choices of where to trade. One of the main insights presented in this paper is that different *types* of buyers and sellers generally prefer different mechanisms. Once traders are given the opportunity to express their preferences, the distribution of buyers' and sellers' types in the two competing mechanisms changes, which causes traders to change their preferences, and so on.

In a recent theoretical paper, Neeman and Vulkan (2000) suggest that for the case of homogenous goods centralized markets may come to dominate decentralized markets because of a process of "unraveling" in which relatively *weak* traders (buyers with high willingness to pay and sellers with low costs) continuously find trading in centralized markets more attractive until no opportunities for mutually beneficial trade remain outside the centralized

[1]Note that we retrict our attention to the case of homogenous goods only. If goods are not homogenous, then issues of quality and credibility might arise, which may further complicate traders' choices (Brown et al., 2002).

marketplace.[2] Intuitively, because a single trader's willingness to pay or cost hardly affects the price in a large centralized market, centralized markets protect weak trader types from paying high prices if they happen to be buyers, and accepting low prices if they happen to be sellers. In contrast, under direct negotiations, exactly because of their weakness, weak buyer types are likely to pay relatively high prices and weak seller types are likely to be forced to accept low prices. As weak types of both buyers and sellers opt for trading in the centralized market, the price in the centralized market remains relatively unaffected. In contrast, as weak types of buyers and sellers opt out of direct negotiations, the distribution of remaining buyers' and sellers' types puts relatively more weight on relatively stronger types, which again, forces those buyers and sellers with relatively weak types to pay higher prices and accept low prices, respectively. This unraveling eventually pushes all "serious" traders (i.e., traders who could potentially trade in the centralized market) towards trading in the centralized marketplace. Once all serious traders decline to engage in direct negotiations, no other trader can profitably trade through direct negotiations.

We examine experimentally the main insight contained in Neeman and Vulkan's work, namely that weak traders' types would be relatively better off in a centralized compared to a decentralized market, and should therefore also be relatively more inclined to trade in the centralized market. Our experimental decentralized bargaining market is meant to be an idealization of what takes place in a bazaar, or a Middle-Eastern Suq. It is operationalized as follows: traders are matched into pairs of one buyer and one seller and are asked to specify bid and ask prices. If the former is larger than or equal to the latter, then the two trade at a price equal to the average of the bid and ask prices. Generally, transaction prices in such a market vary across the different matches. In contrast, our experimental centralized market is a form of exchange with a single transaction price. It is operationalized as a sealed-bid double-auction: buyers and sellers specify bid and ask prices, respectively, from which market demand and market supply functions are constructed. A market clearing price is determined and the buyers who submitted bids above the market clearing price trade with the sellers who submitted ask bids below the market clearing price. This form of exchange

[2]Buyers with a high willingness to pay are called "weak" because they are relatively more flexible. In particular, they can beneficially trade at a relatively large range of prices compared to "strong" or "tough" buyers' types who have a low willingness to pay and therefore can only trade beneficially in a more limited range of possible prices. The same idea also suggests that sellers with low and high costs be can aptly referred to as "weak" and "strong," respectively.

resembles a *call market* which is used in many real exchanges around the world.

The results we obtain lend support to Neeman and Vulkan's (2000) main insight. Although the unraveling of trade outside the centralized market does not go all the way towards eliminating trade through direct negotiations, the relative willingness of different types of traders to trade through different forms of exchange is the same as predicted by the theory.

To the best of our knowledge, very little has been written on the endogenous formation of markets. Existing theoretical literature, for the most part, has confined its attention to the analysis of different market mechanisms in isolation. When comparisons between different market mechanisms were made, they were usually done from the perspective of the seller, asking which mechanism a single seller would prefer under the assumption that buyers have no choice but to participate in the chosen mechanism (as in, e.g., Milgrom and Weber, 1982). A small number of papers has considered the endogenous distribution of mechanisms (see, e.g., McAfee, 1993; Peters, 1994; and the references mentioned in Neeman and Vulkan, 2000) but in models where competing sellers choose a type of auction through which to sell and buyers select in which seller's auction to participate. That is, the implication of the assumption that traders are free to choose the exchange mechanism through which to trade on the outcome of competition between different mechanisms was mostly studied in asymmetric models that favor sellers over buyers. In contrast, we consider a model that treats buyers and sellers symmetrically.[3]

Likewise, the experimental literature also confined its attention to the analysis of different market mechanisms in isolation (see, e.g., Plott and Smith, 1978; Ketcham et al., 1984; Cason et al. 2003; and the references therein). Experimental literature on the endogenous choice among different market forms is almost non existent. Three notable exceptions are the papers by Campbell et al. (1991), Brown et al. (2002), and Kirchsteiger et al. (1999). Campbell et al. (1991) study the extent of off-floor trading in an open (not sealed-bid) double-auction market with a bid-ask spread. They show that off-floor trades inside the bid-ask spread are used to split privately the gain represented by the bid-ask spread without revealing publicly a willingness to make price concessions. Despite the superficial similarity of this paper's

[3]A number of papers have recently examined the consequences of competition between two *identical* market forms (see, Ellison and Fudenberg, 2002; Ellison, Fudenberg, and Möbius, 2002; and the references therein). These papers establish conditions under which there exists a "plateau" of equilibria with different market sizes. In this paper, rather than asking if and when two identical markets can co-exist, we examine conditions under which one market form is strictly preferred over another.

experimental setup to ours, off-floor trading is a form of direct negotiations, and an open double-auction seems like a centralized market, Campbell et al.'s (1991) result is different from ours. Because, unlike our sealed-bid double auction, their open double-auction admits a positive bid-ask spread, their traders, and especially those who are interested in trading large quantities, have a strong incentive to take advantage of the existence of a positive bid-ask spread and free-ride on the process of price discovery in the double-auction by privately negotiating some transactions outside the organized double-auction market. The other two papers are very different from ours. Brown et al. (2002) focus on principal-agent relations in markets. They show that in markets with complete contracts, employers and workers are indifferent with whom they transact and the majority of transactions are one-shot. In contrasts, in markets with incomplete contracts (with non-homogenous goods), contracting parties are concerned about the identities of their partners and consequently form long-term bilateral relations. Finally, Kirchsteiger et al. (1999) study the results of an experiment in which traders may choose to whom to communicate their price offers. They show that sellers communicate their price offers to all of the buyers but to none of the sellers, and vice-versa. They also survey the scant experimental literature devoted to endogenous market structure.

The rest of the paper proceeds as follows. In the next section, we describe a simple example of the unraveling of direct negotiations. In section 3, we describe the experimental design, and in Section 4 the results. We conclude in Section 5 with a discussion of the implications of our results.

2. Example

The following simple static example may clarify the structure of the traders' incentives and the phenomenon of unraveling of trade outside the centralized market. Consider an environment with four traders: two buyers and two sellers. Each trader wants to buy or sell one unit of some homogenous good. The buyers' willingness to pay for the good are 10 and 2, respectively; and the sellers' costs of producing the good are 8 and 0, respectively.

If all the traders opt for the centralized market where they behave as price-takers, then any price $p \in [2, 8]$ can serve as a market clearing price. Suppose, for simplicity, that the price that prevails in the market is $p = 5$. The buyer with the willingness to pay of 10 trades with the seller whose cost is 0, and both obtain a payoff of 5. The other buyer and seller do

not trade in the market, and obtain, each, a payoff of 0.

Suppose on the other hand that the traders engage in direct negotiations with each other, and furthermore this negotiation assumes the following form: a first stage of random matching between the buyers and sellers, followed by a second stage of split-the-surplus bargaining. In this case, the expected payoff to the buyer whose willingness to pay is 10 is

$$\frac{1}{2}\left(10-\frac{10+8}{2}\right)+\frac{1}{2}\left(10-\frac{10+0}{2}\right)=3,$$

since with probability $\frac{1}{2}$, the buyer is matched with the seller whose cost is 8, trades at the price 9, and obtains a payoff of 1, and with probability $\frac{1}{2}$, the buyer is matched with the seller whose cost is 0, trades at the price 5, and obtains a payoff of 5. The expected payoff to the buyer whose willingness to pay is 2 is

$$\frac{1}{2}\left(2-\frac{2+0}{2}\right)=\frac{1}{2},$$

since when this buyer is matched with the seller whose cost is 8 no trade can take place. Similarly, the expected payoff to the seller whose cost is 8 is $\frac{1}{2}$ and the expected payoff to the seller whose cost is 0 is 3.

Obviously, the buyer with the high willingness to pay and the seller with the low cost (the *weak* types) are better off in the centralized market compared to direct negotiations. They would still be better off even if they alone switch to trading through the centralized market, as they can still trade at the competitive equilibrium price $p=5$. However, once they switch, the remaining buyer and seller become worse off since they lose the ability to trade. They, too, may switch to the centralized market, but this will not improve their situation, since they do not get to trade in the centralized market either.

Intuitively, what makes the centralized market more attractive to the buyer with the high willingness to pay and the seller with the low cost is that, relative to direct negotiations, the extent to which their high willingness to pay and low cost are translated into higher and lower prices, respectively, is smaller. Consequently, the weak types of the buyer and seller are led into trading in the centralized market, which in turn, leads to the unraveling of trade through direct negotiations.

We emphasize that the purpose of this example is not to catch the full complexity of the situation, but rather to provide a simple illustration of the main insight. The example relies on strong simplifying assumptions regarding the number and behavior of the traders.

Although the conditions in real life (and in our experiment) are more complex, including a larger number of traders who interact repeatedly in an environment with aggregate uncertainty, the basic insight that is illustrated by the example continues to hold in more general environments as well. For details, see Neeman and Vulkan, (2000).

3. The Experiment

In the experiment, traders can choose between a centralized market and direct negotiations. The centralized market is constructed as a sealed-bid double auction (or a call market), where the price is determined according to the rules of supply and demand. In the direct negotiations buyers and sellers are matched into pairs and trade if an agreement over the price is reached.

We compare the traders behavior under two treatments: one in which the population of buyers and sellers is each divided into two groups that are distinguished by their average willingness to pay and cost, respectively, and the other in which all buyers and seller have the same ex-ante expected willingness to pay and cost, respectively. We predict that trade under direct negotiations will unravel under both treatments, but that this unraveling will be faster in the first treatment where buyers and sellers draw their types from two distributions rather than the second treatment where they draw their types from only one distribution. That is, we expect that the percentage of traders opting for trading in the centralized market will increase more rapidly in the first treatment than in the second. This prediction is motivated by Neeman and Vulkan's (2000) main insight, namely, that weaker traders' types should switch to trading through the centralized market relatively more quickly. Presumably, in the treatment where the population of buyers and sellers is divided into two groups that are distinguished by their average willingness to pay and cost, buyers and sellers who on average have higher willingness to pay and lower costs, respectively, should learn faster to recognize the advantage in switching to the centralized market than buyers and sellers in the second treatment who have fewer chances to experience the consequences of having high willingness to pay and low costs, respectively. Moreover, in line with the theoretical model, in the first treatment, we expect to find that the process of unraveling starts with the group of buyers who have a high average willingness to pay and the group of sellers who have a low average cost because these are the groups where buyers' and sellers' types are weaker on average.

We also expect that the unraveling of these weaker on average types would be followed by unraveling of the stronger on average traders' types in later periods.

We proceed to describe the experimental design.

3.1. Participants

200 undergraduate students from the Hebrew University took part in the experiment. They were recruited by campus advertisements promising monetary reward for participation in a group decision-making task. Participants were divided into 10 cohorts of 20, and were paid according to their and others' decisions as specified below.

3.2. Design

The experimental design includes two treatments:

(1) The *weak on average/strong on average types* treatment (W/S treatment). In this treatment, the groups of buyers and sellers where each divided into two equal subgroups of buyers and sellers with weak and strong types on average, respectively. Every buyer and seller could then trade through either a centralized market or by direct negotiations in every period.

(2) The *uniform average types* treatment (U treatment). In this treatment all buyers and sellers had the same expected willingness to pay and cost, respectively, at the beginning of each round of the experiment.

Five independent observations were obtained for each treatment.

3.3. Procedure

The experiments were held in the RatioLab – a computerized laboratory for interactive decision research in the Hebrew University of Jerusalem. Upon arrival to the laboratory participants were seated in a single room and randomly assigned to one of the following:

(1) The W/S treatment: the 20 participants cohort was randomly divided into two roles: buyers and sellers, and then equally split into two groups, one consisting of traders that are weak on average and another where traders are strong on average.

(2) The U treatment: the 20 participants cohort was randomly divided into two roles: buyers and sellers.

The role and average type of each participant were held constant throughout the experiment.

The participants were given verbal instructions concerning the rules and the payoffs of the game, followed by a quiz to test their understanding. Participants were assured in advance that their decisions and their eventual payment would remain confidential. In both treatments the stage game was repeated eighty times.

The games were fully computerized enabling data collection and online information concerning the previous rounds' results and each participant's total earnings. Each participant was seated in front of a personal monitor on which decisions were made and information presented.

At the beginning of each round every participant was notified of his or her personal value of the object to be bought or sold in the current round. This valuation (type) was private information, and was randomly drawn from known noisy distributions.[4] In the first treatment, the values of weak-on-average buyers and strong-on-average sellers were drawn from distributions with supports on the interval $[25, 100]$, while the values of strong-on-average buyers and weak-on-average sellers were drawn from distributions with supports on the interval $[0, 75]$. In the second treatment the valuations (types) of both buyers and sellers were drawn from distributions with supports on the interval $[0, 100]$.[5] After being notified of the realization of his or her type for each round, each participant was asked to choose the institution through which he or she prefers to trade in the current round, and then to specify his or her bid for selling or buying the object. After all participants made their decisions, the computer summed up the results and declared the profits as explained bellow, allowing the next round to begin. At the end of the experiment participants were debriefed as to the intention of the experiments, and paid according to their profits.

[4]In a pilot study we conducted, buyers' and sellers' types were independently drawn from two fixed distributions. Convergence to the centralized market was very fast, and in every round, the centralized market price was very close to the expected market clearing (Walrasian) price. In the debriefing, participants told us they opted for the centralized market because they realized they can trade there at "an almost constant price." In order to make the outcome in the centralized market more unpredictable, in both treatments, we drew buyers' and sellers' types from distributions that followed a simple Markov process. This introduced a significant amount of aggregate noise into the experiment, and in particular, caused the price in the centralized market to vary widely accross different rounds.

[5]The distributions were chosen in such a way that the aggregate distributions of traders' willingness to pay and cost in the two treatment were equal.

The centralized market was operationalized as a sealed-bid double-auction (a call market), where the transaction price is given by the intersection of the constructed demand and supply curves. All buyers with a bid higher than the price, and all sellers with a bid lower than the price were able to trade. The payoffs for each was the difference between the market price and the private value of the traded object. Buyers with a lower bid than the price and sellers with a higher bid than the price did not trade, and earned nothing in that round.

Direct negotiations assumed the following form: Buyers and sellers opting to trade in direct negotiation were matched into pairs of one buyer and one seller. Participants who were not matched were not able to trade in that round. In any given match, if the buyer's bid was higher than the seller's bid, then the buyer and seller traded at a price equal to their average bid. Each was given a payment equal to the difference between the price and his or her private value of the object. If the buyer's bid was lower than the seller's bid the buyer and seller did not trade and their payoffs were zero at that round. Given the buyers' and sellers' bids, the matching between buyers and sellers was designed to maximize the numbers of transactions, and, having fulfilled this requirement, to maximize the surplus. Calculation based on traders' bids in the first five and ten rounds of the experiment reveals that compared with one round of random matching, the matching we used generated an expected payoff per-round to traders that was about twice as large for every trader's type in the first five and ten rounds of the experiment. In addition, such matching, that would arise naturally if organized by intermediaries that are paid a small fraction of transaction prices, or per transaction, or a combination of both, obviates the need for re-matching.[6]

4. Results

The results can be described by at least three different interesting measures. First, we describe the change in the volume of trade through the two exchange mechanisms. Second, we describe the change in traders' choices of the exchange mechanism through which to trade. And third, we describe the resulting change in the efficiency.

[6]In any case, Neeman and Vulkan's (2000) theoretical result holds for any matching and re-matching function that is continuous in the traders' types.

4.1. The Change in the Volume of Trade

We compare the number of transactions in the centralized market and in direct negotiations for each treatment. To facilitate presentation and to minimize the effects of round-to-round fluctuations, the eighty rounds were divided into eight blocks of ten rounds each. The mean number of transactions in each institution for each block of rounds is reported in Figure 1 below.

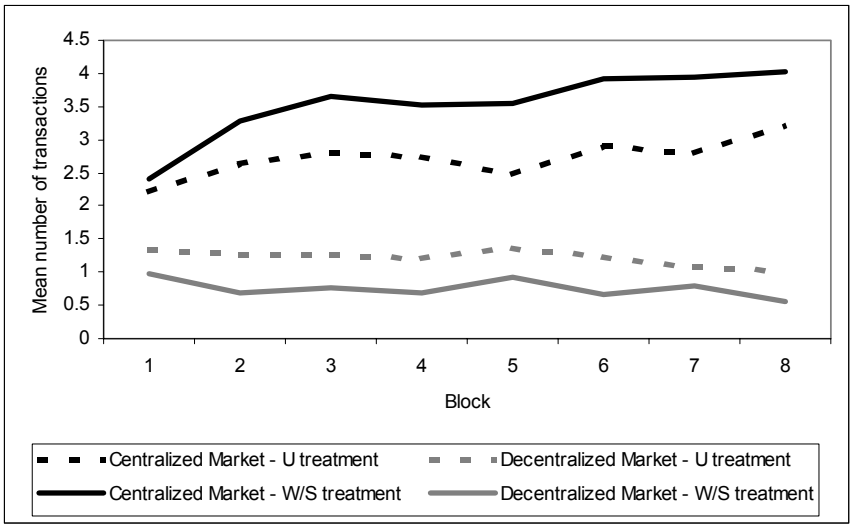

Figure 1: The change in the volume of trade

Figure 1 shows a clear pattern of unraveling of direct negotiations: as time progresses, the number of transactions in the centralized market increases, while the number of transactions in direct negotiations decreases. Furthermore, as predicted, the unraveling occurs faster in the first, W/S, treatment.

The number of transactions in the centralized market was analyzed in a two-way mixed ANOVA[7] with one between-subject (experimental treatment) factor, and one within-subject (block number) factor. The analysis reveals:

1. A significant effect of treatment ($F(1,7) = 6.85$, $p < .05$). That is, the mean number of total transactions in the first treatment is larger than in the second treatment.

2. A significant block effect ($F(7,49) = 12.75$, $p < .001$). That is, the overall number of transactions increases as time progresses.

[7]ANOVA (analysis of variance) is a statistical technique designed to check whether differences in means between experimental conditions are significant. In particular, it allows us to test whether it is possible to reject the hypothesis that the means in the two treatments are equal.

3. No significant interaction ($F(7, 49) = 1.96$, n.s.). That is, the increase in the volume of trade over time does not depend on the experimental treatment.

Figure 2 below depicts the change over time of the total number of transactions that is generated by the experiment.

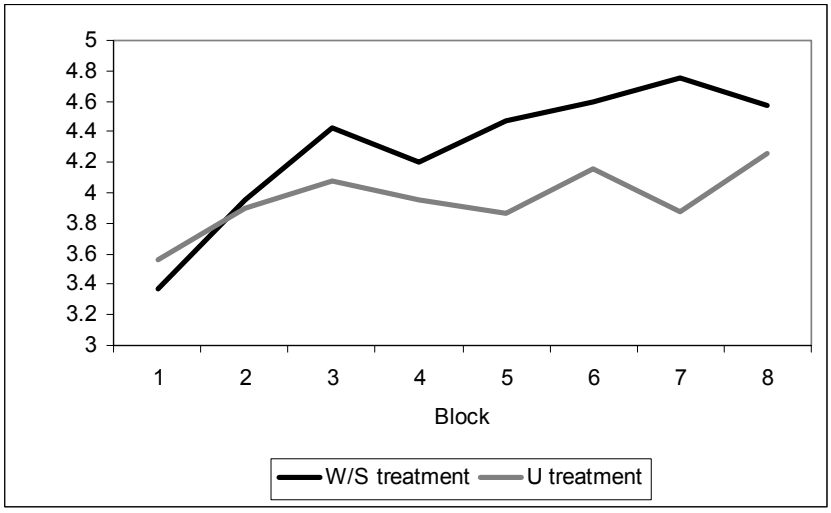

Figure 2: The change in the number of transactions by treatment

As can be seen from Figure 2, the W/S treatment induces a larger number of transactions overall. A two-way mixed ANOVA with one between-subject (experimental treatment) factor, and one within-subject (block number) factor reveals a marginally significant effect of treatment ($F(1, 7) = 3.76$, $p = .09$) (The W/S treatment more efficient than the U treatment), a significant block effect ($F(7, 49) = 6.43$, $p < .001$) (efficiency increases with time), and no significant interaction ($F(7, 49) = 1.74$, n.s.).

To summarize, in both treatments the number of transactions, which is slightly higher in the first (experimental) treatment than in the second (control) treatment, increases with time. This change can be explained as follows. In the first periods of the game the participants experiment with both trading institutions, and therefore not all beneficial transactions take place. As the game progresses, the number of traders in the centralized market increases. Consequently, more transactions take place there. This tendency is more pronounced in the W/S treatment because convergence there is faster.

4.2. The Change in Traders' Choices

In line with the theoretical model, we expect to find that the process of unraveling starts with weak traders' types. We thus expect both that (1) weak-on-average traders in the W/S

treatment would opt for the centralized market faster than strong-on-average traders in this treatment, and faster than traders in the U treatment; and (2) that weaker traders' types (values) in both treatments would opt for the centralized market faster than stronger traders' types (values) in both treatments. The second prediction is an immediate consequence of the Neeman and Vulkan's (2000) theoretical model as explained above. The first is due to our belief that because weak-on-average traders have more experience with being weak, they should learn faster that switching to the centralized market would indeed be in their benefit.

Figure 2 below shows the proportion of traders who opt for trading in the centralized market by average type.

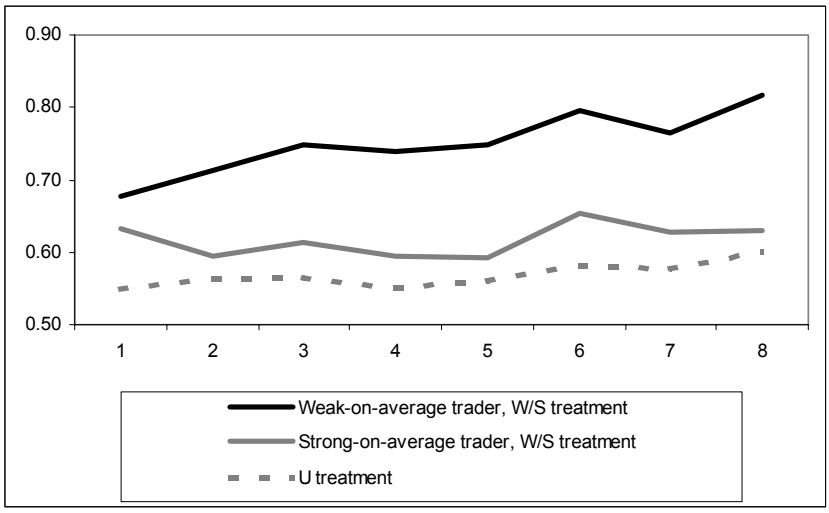

Figure 3: The change in traders' choices by average type

We analyze the data with a two-way ANOVA with one between subject (average trader's type) factor, and one within subject (block number) factor. Upon inspection of the figure and the analysis several conclusions emerge:

1. The proportion of all three average-types who opt for trading in the centralized market is above $\frac{1}{2}$. That is, all average-types prefer trading in the centralized market to trading in direct negotiations.

2. The proportion of all three average-types who opt for trading in the centralized market increases over time. This block effect is marginally significant ($F(7, 49) = 2.39$, $p < .08$).

3. In line with our first prediction, weak-on-average traders exhibit the strongest preference for the centralized market over direct negotiations. This results in a significant

effect of average-type ($F(1,7) = 4.33$, $p < .05$). The interaction effect is not significant ($F(7,49) = .62$, n.s.).

Figure 3 below shows the proportion of traders who opt for trading in the centralized market by realized valuation per round, or type. For the purpose of this figure, define a buyer's type as weak, intermediate, and strong if its willingness to pay is between $\{67, ..., 100\}$, $\{34, ..., 66\}$, and $\{0, ..., 33\}$, respectively; and define a seller's type as weak, intermediate, and strong if its cost is between $\{0, ..., 33\}$, $\{34, ..., 66\}$, and $\{67, ..., 100\}$, respectively. The conclusions derived from Figure 3 are similar to those that were derived from Figure 2. Namely, weak and intermediate types opt for the centralized market faster than strong types (there is a significant effect of type $F(2,7) = 23.52$, $p < .01$ reflecting the fact that weak types opt for the market more often, and a marginally significant interaction effect $F(3,7) = 1.94$, $p = .08$ capturing the fact that weaker types opt for the centralized market relatively faster than intermediate types). Strong traders' types are unlikely to trade in the centralized market because their costs and willingness to pay are likely to be above and below, respectively, of the centralized market price. They are therefore indifferent between direct negotiations and the centralized market. As time progresses, they find it more and more difficult to trade through both mechanisms (significant effect of time, $F(3,7) = 3.37$, $p < .05$).

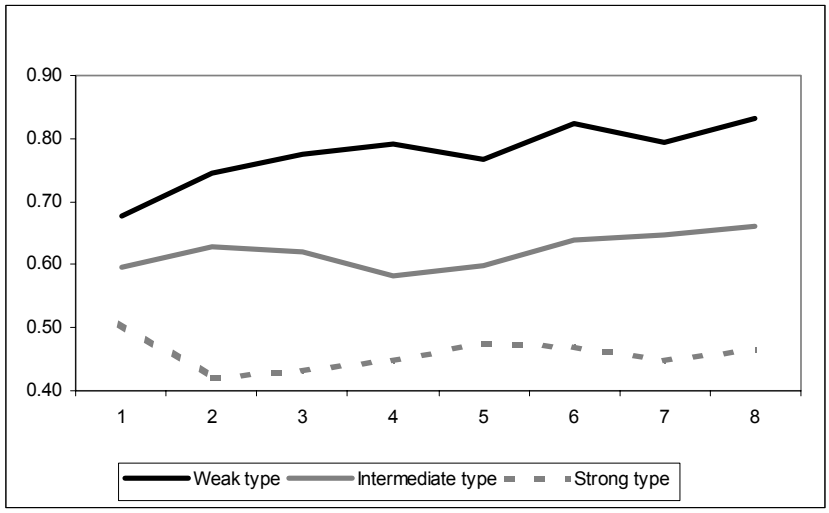

Figure 4: The change in traders' choices by type (value)

To summarize, the proportion of traders who opt for the centralized market as a function on their realized valuation (type) and average-type in the last 20 rounds of the game are presented in table 1.

average type/type	W	S
W	.85	.68
S	.83	.53
U	.73	.45

Table 1: Traders' choices by average type and type (value)

As can be seen from the table, both weak and weak-on-average types have a relatively stronger preference for the centralized market than strong and strong-on-average types. And, moreover, this effect is stronger for participants in the W/S treatment than for those in the U treatment.

5. Conclusion

The question of what form of exchange is likely to attract large volumes of trade is an important theoretical and practical problem, especially in light of the recent growth in business e-commerce. As more and more companies are using the Internet to trade with their clients and suppliers, both centralized and decentralized electronic markets are becoming increasingly popular for trading all kinds of goods and services. In particular, many firms can now purchase raw materials such as metal, cement and steel via a Web-based market, in a number of auction sites, or by directly negotiating with a number of suppliers. Understanding the forces that determine the consequences of competition between exchange mechanisms may shed some light on the development of actual market mechanisms.[8]

Our experiment examined trader's preference to trade either in direct negotiations or in a centralized market. As predicted, we find that trade under direct negotiations unravels, and that both weak and weak-on-average traders opt for trading in the centralized market faster than others. The process of unraveling starts with the group of traders who have weak and weak-on-average types, and is followed by the unraveling of stronger and stronger-on-average traders' types in later periods. These findings are consistent with the predictions derived from Neeman and Vulkan's (2000) work.

Our results are also consistent with anecdotal evidence from e-commerce: A recent study of a large data set of transaction prices for new cars purchased both online and off-line by Morton, Zettelmeyer, and Silva-Risso (2001) concludes "the Internet is disproportionately

[8]For a full discusion of economic issues related to business e-commerce see chapter 4 in Vulkan (2003).

beneficial to those who have personal characteristics that put them at a disadvantage in negotiations." (See also Zettelmeyer, Morton, and Silva-Risso, 2001.) These disadvantaged traders are our 'weak' traders' types.

The dynamics suggested by the theory and confirmed by the experiments are also consistent with trading patterns in some financial markets. In a related paper (Neeman and Vulkan, 2003) we look at trading on the London Stock Exchange (LSE). In October 1997, the LSE introduced SETS, the Stock Exchange Electronic Trading Service, to complement the existing SEAQ (Stock Exchange Automated Quotation System). SEAQ is a quote-driven dealership market, in which transaction prices are subject to direct negotiations. SETS is an order-driven trading mechanism, which closely resembles our treatment of a centralized market. We study the number and volume of trades in SETS and SEAQ between January 1998 and July 2002, and find that while trade is continuously moving to SETS, large trades are still being routed via SEAQ. Moreover, the average trade size in SEAQ is continuously increasing while in SETS it is continuously decreasing.

We believe that this provides strong evidence for the existence of strategic considerations of the type discussed in this paper in the decisions of traders of which exchange mechanism to use since the underlying costs structures or information available to traders do not change during this period. Furthermore, if we interpret having a large quantity to trade as being of a strong type, then the theory presented in Neeman and Vulkan (2000) and the findings of this paper are also consistent with the change in the average trade sizes in SEAQ and SETS as described above.

Advances in Information Technology reduce the costs of creating new trading mechanisms and make access to such mechanisms easier for large number of potential buyers and sellers. An understanding of the likely evolution of trading patterns in a world where traders repeatedly choose between trading mechanisms is therefore important. The experiments described in this paper lend support to the theory developed in Neeman and Vulkan (2000), which states that weaker-than-average types will generally want to switch from trading in markets with direct negotiations to trading in large markets where everyone is a price-taker. This suggests that in the long run most trade in homogenous goods may be routed via single-price markets, where all traders are price-takers.

References

Campbell, J., S. LaMaster, V. Smith, and M. Van Boening (1991) "Off-floor trading, disintegration, and the bid-ask spread in experimental markets," *Journal of Business* 64, 495-522.

Cason, T. N., D. Friedman, and G. H. Milam (2003) "Bargaining versus posted price competition in customer markets," *International Journal of Industrial Organization* 21, 223-51.

Brown, M., A. Falk, and E. Fehr (2002) "Incompleteness and the nature of market interactions," unpublished manuscript, University of Zurich.

Ellison, G., and D. Fudenberg (2002) "Knife-edge or plateau: when do market models tip?" unpublished manuscript, MIT and Harvard University.

Ellison, G., D. Fudenberg, and M. Möbius (2002) "Competing auctions" unpublished manuscript, MIT and Harvard University.

Ketcham J., V. Smith, and A. Williams (1984) "A comparison of posted-offer and double-auction pricing institutions," *The Review of Economic Studies* 51, 595-618.

Kirchsteiger, G., M. Niederle, and Y. Potters (2001) "Public versus Private Exchanges," unpublished manuscript, University of Vienna, WWW http://mailbox.univie.ac.at/~kirchsg8/pubprivex.pdf.

McAfee, P. R. (1993) "Mechanism design by competing sellers," *Econometrica* 61, 1281-1312.

Milgrom, P. and R. Weber (1982) "A theory of auctions and competitive bidding," *Econometrica* 50, 1089-1122.

Morton, F. S., F. Zettelmeyer, and J. Silva-Risso (2001) "Consumer Information and Price Discrimination: Does the Internet Affect the Pricing of New Cars to Women and Minorities?" NBER discussion paper w8668.

Neeman, Z. and N. Vulkan (2000) "Markets Versus Negotiations: the Predominance of Centralized Markets," unpublished manuscript, Boston and Hebrew Universities, WWW http://www.bu.edu/econ/faculty/neemanpapers/unpublished/BB21.pdf.

Neeman, Z. and N. Vulkan (2003), "Markets Versus Negotiations: an empirical investigation," unpublished manuscript, Hebrew University.

Peters, M. (1994) "Equilibrium mechanisms in a decentralized market," *Journal of Economic Theory* 64, 390-423.

Plott, C. and V. Smith, (1978) "An experimental examination of two exchange institutions," *The Review of Economic Studies* 45, 133-53.

Vulkan, N. (2003), *The economics of e-commerce: A Strategic Guide to Understanding and Designing the Online Marketplace*, Princeton University Press, Princeton, NJ.

Zettelmeyer, F., F. S. Morton, and J. Silva-Risso (2001) "Cowboys or Cowards: Why are Internet Car Prices Lower?" NBER discussion paper w8667.