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Size Doesn't Matter!
Gift Exchange in Experimental Labor Markets

Jordi Brandts, Klarita Gërxhani, Arthur Schram, and Jolanda Ygosse-Battisti

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ABSTRACT

We study how the number of traders affects the interaction between a centralized exchange and bilateral negotiations in an experimental labor market with excess supply and incomplete contracts. Our large markets are three times as large as our small markets. In bilateral negotiations firms obtain information about employees' performance in previous jobs. Though market forces put a downward pressure on wages in large markets, reciprocal tendencies do not differ. Hence, the occurrence of bilateral negotiations increases overall efficiency for both market sizes.

Keywords: Worker Recruitment, Gift Exchange, Experiments, Market Size

JEL Classification Codes: C90, J30, J40

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1. Introduction

This paper studies how market size affects behavior in an experimental labor market with excess supply and incomplete contracts. In particular, we study how the number of agents in the market affects recruitment through the interaction between a centralized exchange and bilateral negotiations when moral hazard is a threat to market efficiency. Starting with Fehr et al. (1993) numerous papers have studied the case of a centralized exchange institution and have found considerable gift exchange and high efficiency levels. Gift exchange occurs when a firm shows trust in a worker by offering a high wage and the worker reciprocates this trust by exerting high effort. The original high wage offer may reflect a direct reciprocation of previous high efforts by the worker within the same firm (Fehr et al. 1993) or an indirect reciprocation of high efforts when previously employed by other firms (Schram et al. forthcoming). Only the latter type of gift exchange can occur in the recruitment of new personnel. It can be facilitated by the occurrence of bilateral negotiations in which firms obtain information about workers' performance in previous jobs. Schram et al. (forthcoming) find that, when firms can choose between a centralized market and bilateral negotiations, they frequently opt to recruit through the latter, which yields higher efficiency levels than the market.

These results were obtained with a relatively small market size involving two firms and five workers. In this paper we investigate how the results above are affected by increasing the size of the market. We think that this question is of substantial interest, since it is part of a larger issue of how market participation affects attitudes towards others and the ability to cooperate.[1] One may expect a larger market size to modify participants' perceptions about the interdependence between traders in the market. The complexity of exchange between more people may simply create an atmosphere of more anonymity and disconnectedness and induce more individualistic behavior (North, 1993). We think that this is a socially important but difficult to analyze issue on which our experiment sheds some light. Moreover, if the proportion of buyers to sellers is the same in both markets (as is the case in our experiments) then the excess supply is – in absolute terms - larger in the larger market. This increases the pressure on the marginal trade and implies that market forces may be stronger in larger markets. Together with the increased individualism this yields a prediction of less gift exchange and results

[1] See Bowles (1998) for a discussion of the possible effects of market participation on participants' preferences. For experimental papers investigating issues in this line see Brandts and Charness (2004) and Brandts et al. (2009).

closer to the market equilibrium in the large markets. In this paper we submit this hypothesis to empirical scrutiny.

The issue of market size and more generally number effects has been studied for other experimental environments. Isaac et al. (1994) study contributions to public goods with larger group sizes than the ones typically studied. Huck et al. (2004) analyze the effects of increasing the number of competitors in a quantity competition oligopoly setting. Both studies show that size matters. In the double auction of Smith (1962) the issue of numbers is also an important one. Here the important result is that even where numbers are "small" there are strong tendencies for the competitive equilibrium to be attained.

We compare markets with seven to markets with 21 trading agents. We feel that multiplying the market size by three is a meaningful increase and that therefore our results are of interest. Of course, whether our results are robust to even larger increases remains an empirical question. Nevertheless, our market size of 21 is much larger than almost all previously studied laboratory markets.

Our results show that market size does not affect reciprocal tendencies. For both market sizes effort levels react significantly positively to wages. In addition, the marginal effects of a higher wage offer on effort are very similar in small and large markets.

2. Design and Procedures

The situation is presented as a market in which an abstract good is traded between buyers and sellers. Our design consists of two treatments, varying in market size. Our (five) small markets have 5 sellers and 2 buyers and our (four) large markets have 15 sellers and 6 buyers. Given our focus on labor market recruitment, we will henceforth maintain the reference to 'firms' and 'workers' instead of buyers and sellers.

The experiments and their procedures are described in detail in Schram et al. (forthcoming). Here, we provide a brief description of the main features. Participants in the experiments interact during 30 market rounds; each subject has the constant role either of a firm or of a worker and can be involved in at most one trade per round. Hence, there can be at most two trades per market and round in the small markets and six in the large markets. Trade can take place in two ways: through a centralized market – i.c., a standard double auction (DA) – or through bilateral (private) negotiations (BN).

In the first 10 rounds firms and workers interact only through DA, creating a benchmark to which we can compare the effects of bilateral negotiations. Firms and workers may anonymously make public wage proposals at any time during a market period (which lasts 90 seconds). Bids and asks consist of an integer between 0 and 50, inclusive. If a wage proposal is accepted then a match between a worker and a firm is established and they trade at wage w_{DA}. After two such trades or 90 seconds (whichever comes first) the market closes. Then, the worker chooses an effort level (e) which can be either 'high' (e=1) or 'low' (e=0). This is communicated only to the firm and worker concerned. Participants know neither the identity of those making or accepting offers nor the history of any of the other market participants.

A firm's payoff (π_f) is equal to the revenue resulting from the worker's effort, $r(e)$, minus the wage paid, $\pi_f = r(e) - w_{DA}$, where the revenue levels resulting from high and low effort are $r(1)=50$ and $r(0)=10$, respectively. A worker's payoff (π_l) is equal to the wage received minus the cost of effort $c(e)$, $\pi_l = w_{DA} - c(e)$, which is 20 for high effort ($c(1)=20$) and 0 for low effort ($c(0)=0$). Note that high effort maximizes the surplus from trade.

After the 10 market rounds, subjects receive new instructions for the subsequent 20 rounds. At the beginning of each round of 90 seconds firms either enter the centralized market (the same DA as before) or propose bilateral negotiations. For every firm that proposes negotiations, one worker is randomly selected and asked whether (s)he wants to enter BN. After all workers have reacted BN and DA open simultaneously. All firms and workers that have not been paired for bilateral negotiations enter the centralized market.

In the firm-worker pairs engaged in BN each firm is informed about the number of times that the worker chose low effort and high effort in previous rounds. This information includes jobs initiated in DA but excludes the decisions of the first 10 rounds without BN. Firms are not informed of wages earned previously by the worker. Firms and workers do not learn their partner's identity in a matching.

After seeing the information about previous effort choices the firm makes a wage offer to the worker it is matched with, consisting of an integer between 0 and 50. Matched workers then accept wage w_{BN} or reject the offer. Those involved in BN can at all times observe the bids and trades made in the market. In contrast, participants in the market are not informed about what is happening in the negotiations; this represents the

transparency of a market and the lack of it in bilateral negotiations. The firms whose offers are rejected and the workers that have rejected immediately enter DA, joining those that have not engaged in BN. After trades have been determined the workers involved make their effort decisions. This yields payoffs as described above, where w_{DA} is replaced by w_{BN} for trades in BN.

The computerized experiments were run at the CREED laboratory of the University of Amsterdam and by CREED at the laboratory of the São Paulo School of Economics (EESP) and the School of Business Administration (EAESP), with sessions of approximately 90 minutes with 119 participants.

3. Results

Table 1 presents the key summary statistics of our results.

Table 1: Key Summary Statistics

		% of possible trades	% trades in BN	Average DA wage	Average BN wage	% high effort DA	% high effort BN
Small	R1-10	96.0	--	15.8	--	26.0	--
	R11-30	96.5	28.5	18.3	25.9	39.1	49.1
Large	R1-10	99.2	--	5.85	--	7.1	--
	R11-30	99.0	44.3	8.70	23.71	17.7	52.9

Notes. *R1-10:* first 10 rounds; *R11-30:* rounds 11-30. *% of possible trades:* #realized trades as %of possible trades. *% of trades in BN:* #bilateral deals as %of realized trades. *Average DA wage*: average wage realized in DA; *average BN wage*= average wage in BN. *% high effort DA*= #high effort choices after DA trade as %of DA trades*; % high effort BN*= #high effort choices BN trade as %of BN trades.

To start, consider wage patterns and reciprocal behavior. First, after the introduction of BN, the DA wage increases slightly but the BN wage is (much) higher than the DA wage. It can be easily seen that this pattern is the same in large markets as in small markets. Moreover, wages in BN are more or less independent of market size (the difference is statistically insignificant; p=0.46).[2] In DA, as would be expected with excess supply, market forces seem to push wages down. They do so more in large markets than in small markets (until round 10 the difference is not significant, p=0.46; after round 10 wages are significantly lower in large markets; p=0.09).

In BN (both for large and small markets), firms indirectly reciprocate the worker's previous effort choices. If a worker previously chose low effort more often than high effort, wages are low (below 6). If both levels were chosen equally often wages are much higher (25-30) and if high effort was chosen more often, wages are highest (30-

[2] Unless indicated otherwise we use Mann-Whitney test with the market as unit of observation (N=9).

35). There is also evidence of a direct reciprocal response (a high effort choice) to a high wage offer, as we will see shortly.

In both small and large markets the average effort level in DA increases after the introduction of BN. Moreover, the average effort level in BN is higher than the level reached in DA that takes place at the same time. Analyzing average effort levels over time separately for small and large markets shows that effort in BN is for both cases always above the one for DA.[3]

To test the origins of the differences in effort levels, Table 2 presents random effects probit regressions of effort choice on the relevant exogenous variables separately for small and large markets. The results show clearly that in both cases effort levels react significantly positively to wages. Bilateral negotiations as such do not have significant effect, their influence works through the positive effect on wages.

Table 2: Random effects probit for effort choice

	Small markets		**Large markets**	
Variable	**Coefficient (z-value)**	**Marginal effect**	**Coefficient (z-value)**	**Marginal effect**
Constant	-7.670 (1.92)	--	-1.908 (8.00)**	--
(round-10)/10	-0.889 (3.07)**	--	-1.072 (5.61)**	--
$(\text{round-10})^2/100$	-0.221 (0.40)	--	-0.932 (2.63)**	--
BN	-5.625 (1.41)	--	0.747 (1.43)	--
DAwage/10	2.429 (2.08)*	0.76	0.862 (8.78)**	0.74
BNwage/10	4.053 (3.30)**	0.78	1.099 (6.66)**	0.83

Notes. The table gives the estimated maximum likelihood coefficient vector β in $Pr_t^{ij} = \Phi(X_t^{ij\prime}\beta + \mu^j)$ where Pr_t^{ij} gives the probability that i of j chooses high effort in t. Φ denotes the cumulative normal distribution and X is the vector of independent variables. μ^j is a (white noise) market-specific error that corrects for the dependencies across individual decision in te same market. Absolute z-values are in parentheses. The marginal effect measures the change in the probability of high effort if a wage of 35 is offered instead of a wage of 5 (both calculated for round 20). * (**)=statistically significant 5%-(1%-)level.

Table 2 also shows the marginal effects of higher wage offers on the probability of exerting high effort. This is separately estimated for trades in DA and BN. Note that a unitary wage increase is not relevant for the setup described here. A firm contemplating a high wage aimed at inducing high effort is not deciding between wages 5 and 6 (or 35 and 36). Instead, she is considering offering a wage that will allow the worker to afford the costs of high effort (i.e., higher than 20) versus one that will not do so, but will be covered by revenue if the worker chooses low effort (i.e., a wage lower than 10). For the marginal effects, we therefore compare a wage midway the low surplus range (5) to one midway the high surplus range (35). The predicted marginal effects are remarkably

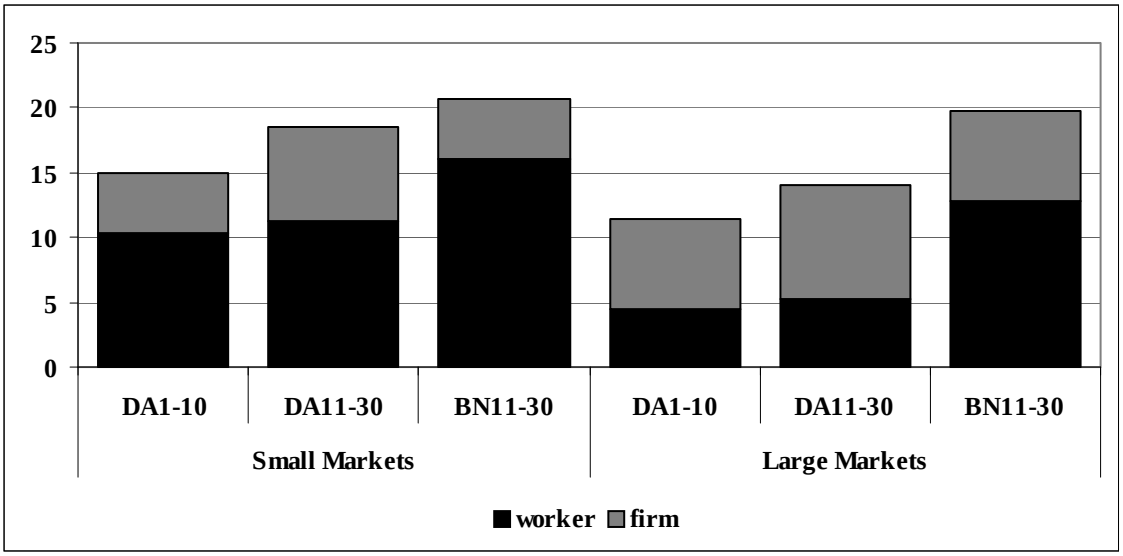
[3] This figure is available from the authors.

similar for small and large markets.[4] Though we cannot estimate the regressions for table 2 separately for each of the small markets (due to low numbers of observations), we can do so for large markets. The results show that the marginal effect is larger for DA than for BN in two of these markets and vice versa in the two other markets. We conclude that the aggregate difference is not statistically significant. Hence the difference in effort choices in BN compared to DA is not so much caused by distinct marginal reciprocal responses to wages but more by the differences in wages offered in BN and DA (see table 1). All in all, there do not appear to be differences in direct reciprocal responses to wages in DA and BN, but indirect reciprocity of previous effort choices in BN lead to higher wages than in DA and therefore to higher effort in BN.

Finally, consider the efficiency effects of the introduction of bilateral negotiations. The analysis of the efficiency of market institutions has a long tradition (Plott and Smith 1978). We are interested in how the bilateral trading channel that is effectively present in labor markets affects efficiency. Here efficiency depends directly on effort levels. Because almost all possible trades (cf. Table 1) are realized, any differences in efficiency would be caused by distinct effort choices.

Figure 1 shows surplus and its division for the two market sizes, in rounds 1-10 and 11-30.

Figure 1: Surplus division



[4] Standard asymptotic assumptions underlying significance tests do not hold for such large steps. Hence, we cannot determine the significance of the differences between markets. Even if the marginal effect were to be statistically larger in one size market than in the other, the difference is still economically small, however. Moreover, note that for DA the effect is larger in small markets than in large markets whereas the reverse holds for BN.

Across all (nine) markets, aggregate surplus in rounds 11-30 is significantly higher than in rounds 1-10 at the 5% level for both the centralized market and the bilateral negotiations (MW, p=0.02 for both tests). Workers earn significantly more in bilateral negotiations than in markets with (p=0.02) and without (p=0.01) the presence of the bilateral negotiations. Differences between small and large markets are not significant at the 10% level.

4. Conclusion

We find that behavior is basically unaffected by the size of the market. Though market wages are suppressed by market forces in the large markets, neither indirect reciprocal responses (i.c., the way wage offers respond to a worker's reputation) nor direct reciprocal tendencies (the way effort levels respond to wage offers) differ. As a consequence, the introduction of bilateral negotiations leads to similar efficiency increases for both market sizes. For the range of market size variation we consider, our evidence is, therefore, contrary to the notion that larger markets are characterized by more disconnectedness and less reciprocal behavior. Both gift-exchange as such and the enhanced gift-exchange that takes place in bilateral negotiations are robust to the market-size variations we investigate.

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