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

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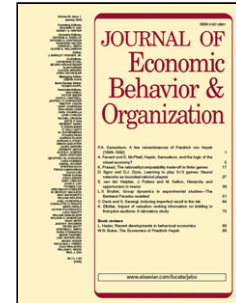
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## Size Doesn't Matter! Gift Exchange in Experimental Labor Markets

Jordi Brandts, Klarita Gërkhani, 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.<sup>1</sup> 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

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<sup>1</sup> 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.e., 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 ( $\pi_f$ ) 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 ( $\pi_w$ ) is equal to the wage received minus the cost of effort  $c(e)$ ,  $\pi_w=w_{DA}-c(e)$ , 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;  $p=0.46$ ).<sup>2</sup> 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-

<sup>2</sup> 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.<sup>3</sup>

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**

Variable	Small markets		Large markets	
	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)**	--
(round-10) <sup>2</sup> /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  $\beta$  in  $Pr_i^{ij} = \Phi(X_i^{ij'}\beta + \mu^j)$  where  $Pr_i^{ij}$  gives the probability that  $i$  of  $j$  chooses high effort in  $t$ .  $\Phi$  denotes the cumulative normal distribution and  $X$  is the vector of independent variables.  $\mu^j$  is a (white noise) market-specific error that corrects for the dependencies across individual decision in the 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

<sup>3</sup> This figure is available from the authors.

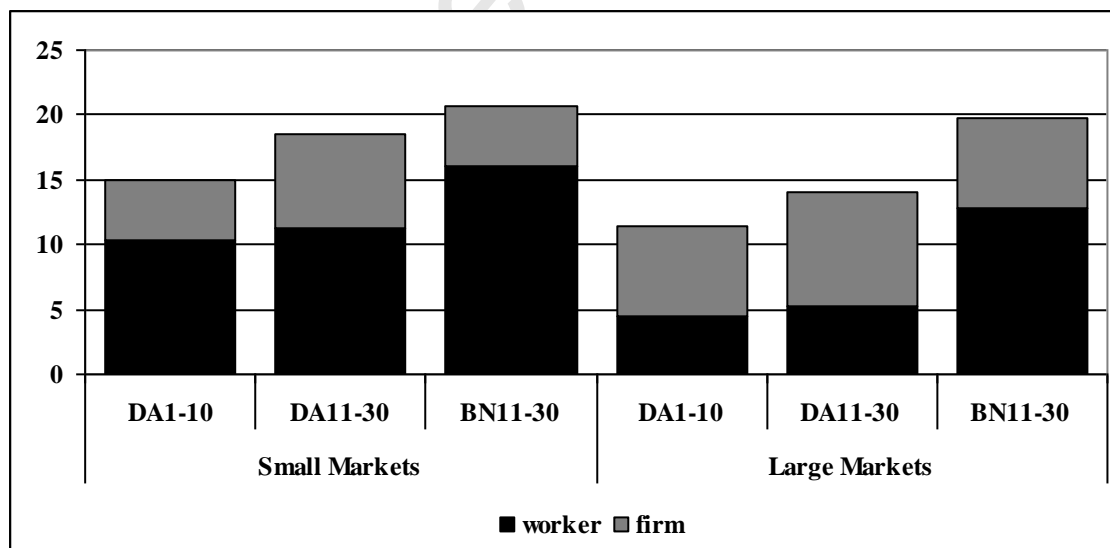


similar for small and large markets.<sup>4</sup> Though we cannot estimate the regressions for table 2 separately for each of the small markets (due to low numbers of observations), we can do so for large markets. The results show that the marginal effect is larger for DA than for BN in two of these 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**



<sup>4</sup> 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.e., 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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## Appendix A – Instructions for the small markets

This appendix gives the English translation of the original Dutch instructions for the sessions small markets. The instructions were programmed as html pages. Horizontal lines indicate page separations.

### At the start of the experiment:

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#### Welcome

You are about to participate in a decision-making experiment. The instructions are simple. If you follow them carefully, you may earn a substantial amount of money. Your earnings will be paid to you in euros at the end of the experiment. This will be done privately, one participant at a time.

The monetary unit in the experiment is ‘**experimental francs**’. At the end of the experiment francs will be converted to euros at a rate of **1 euro for 15 francs**.

These instructions consist of 8 pages like this one. During the instructions you can page forward or backward by clicking with your mouse on ‘previous page’ or ‘next page’. Sometimes a page will not fit on your screen. In that case you can use the scroll bar to view the whole page.

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#### Rounds and Groups

The experiment consists of 30 rounds, preceded by 3 practice rounds. After round 10 additional instructions will be given before we proceed.

In every round you will participate in a market where hypothetical goods are traded. Buyers can buy at most one good and sellers can sell at most one good. How you can make money by trading will be explained below.

In total 7 people participate in the market. There are 2 buyers and 5 sellers.. You will have the same role in every round: either buyer or seller. That will be determined before the first practice round. The other buyers and sellers in your market will be the same other participants in every round. You do not know who they are, however. Because there are more sellers than buyers in each round at least three sellers will not be able to sell the good.

The composition of markets is anonymous. You do not know with whom you are in the market. Others do not know whether they are with you.

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#### Buying and Selling the Good

If the buyer buys from a seller s/he pays an agreed upon price. How the price is determined will be explained below.

To deliver the good, the seller may endure costs. There are two possibilities. If the seller delivers a **low quality** good, there are **no costs**. If the seller delivers a **high quality** good the costs are **20 francs**.

If a buyer gets the good s/he receives a revenue in francs. If the buyer buys a **low quality** good this revenue is **10 francs**. For a **high quality** good the revenue for the buyer is **50 francs**. This allows you to calculate earnings in a round, dependent on the quality.

**1. The good has low quality:**

Earnings for the **seller** = agreed upon price

Earnings for the **buyer** = 10 – agreed upon price

**2. The good has high quality:**

Earnings for the **seller** = agreed upon price – 20

Earnings for the **buyer** = 50 – agreed upon price

**If you do not buy or sell anything your earnings are 0.**

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## Phases

Each round consists of two phases.

In the **first phase** of a round buyers and sellers participate in a public market where each buyer can respond to an offer by any seller and vice versa.

In the **second phase** it is determined whether the good has **low** or **high** quality. This is determined by the **seller**.

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## Phase 1

Participation in the public market proceeds as follows. Buyers may post an offer for the good and this offer holds for every seller in the market. Sellers may post an ask price and this holds for every buyer.

On the lower half of your screen you will see two rows of boxes. In the top row there is a box for each buyer. In the lower row there is a box for each seller.

You will recognize your own box by its yellow color.

**BEWARE: buyers and sellers are randomly reallocated to boxes in every round. Therefore, you cannot keep track across rounds of what specific other participants are doing.**

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## Phase 1

If a buyer or seller places an offer on the public market, this appears in her or his box.

If you are a seller you will see a button ‘accept’ next to each buyer’s box. By clicking this you indicate that you will sell the good to that buyer at that price. You can only click the button if the buyer concerned is still active on the market. If the buyer has already bought from another seller you

can no longer click 'accept'. You can still see at what price that buyer bought the good (and you will see the same price in the box of one of the sellers).

**If you enter an ask price lower than the highest bid by any buyer, you will automatically sell the good at the price offered by that buyer.**

If you are a buyer you will see a button 'accept' next to each seller's box. By clicking this you indicate that you will buy the good from that seller at that price. You can only click the button if the seller concerned is still active on the market. If the seller has already sold to another buyer you can no longer click the button. Again, you will still see the price.

**If you enter a bid higher than the lowest ask price by any seller, you will automatically buy the good at the price asked by that seller.**

You may change your bid or ask as often as you like. It does hold that **a buyer may only increase the own bid. A seller may only decrease the own ask.**

The public market will remain open for 90 seconds. You will see the time count down on your screen. Whoever has not bought or sold when the market closes does not buy or sell the good in that round. When no more sales are possible (2 goods have been sold) the clock automatically jumps down to 5 seconds.

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## Phase 2

In phase 2 the seller determines the quality of the good. S/he does this by clicking either 'high' or 'low' and confirming the choice.

As mentioned before: if the quality is low, the revenue for the buyer is 10 and the costs for the seller are 0. If the quality is high, the revenue for the buyer is 50 and the costs for the seller are 20.

When everyone has finished, the next round starts.

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## End

This brings you to the end of these instructions. When everyone is ready we will start the first of three practice rounds. These will not affect your earnings. At the start of the practice rounds we will distribute a summary of the most important parts of these instructions.

When the first practice round starts you will see at the top of your screen whether you are a buyer or seller.

If you have finished these instructions, please indicate this by clicking the button 'ready' (at the bottom of this screen). Then please wait quietly until everyone is ready. That may take a little while, so we ask for your patience.

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## Before Round 11:

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An Additional Phase

We add a third phase to each of the 20 rounds that will follow.

Therefore, from now on each round will consist of three phases. We will first give a brief overview and then provide more details about each phase.

In the **first phase** each buyer can propose to one seller to **negotiate** a price for the good **separately** from the other participants. The seller will be given an opportunity to indicate whether or not s/he is willing to negotiate bilaterally. The seller may also decide in phase 1 not to negotiate bilaterally with any buyer (but to only participate in the public market, instead).

In the **second phase** of a round buyers and sellers negotiate about a price for the good. If a buyer and seller have agreed to participate in bilateral negotiations, they negotiate privately. Any participant not involved in bilateral negotiations participates in a **public market** like the one in rounds 1-10. Thus, the market is opened at the same time as the private negotiations take place. Those negotiating bilaterally will see what is happening on the public market but cannot participate in it. If the negotiations do not lead to an agreement the buyer and seller concerned can switch and participate in the public market.

No one participating in the public market can observe anything that is occurring in any private negotiations.

In the **third phase** the quality of the good (**low** or **high**) is again determined by the **seller**.

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### **Phase 1**

In phase 1 buyers first indicate whether they want to immediately proceed to the public market or first want to privately negotiate with a seller. This is done using the buttons ‘market’ and ‘negotiate’.

By clicking on ‘market’ the buyer indicates not wanting any private negotiations.

By clicking on ‘negotiate’ the buyer indicates a wish to negotiate bilaterally with a seller. Because there are more sellers than buyers, not every seller will be invited to negotiate. **A random lottery will be used to determine which seller (*buyer*) will be linked to a buyer.**

**BEWARE: in every round the sellers are randomly allocated to buyers who wish to negotiate. A buyer can therefore not know whether or not s/he has previously negotiated with a seller and a seller cannot know whether s/he has previously negotiated with a buyer.**

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### Phase 1

If a seller is offered private negotiations with a buyer s/he must indicate whether or not s/he is willing to participate in them. This is done by clicking 'yes' or 'no' and confirming the decision.

If a buyer and seller thus agree to negotiate bilaterally the buyer is given **information about the seller** before the negotiations start.

This information is **the number of times that the seller chose low quality and the number of times that the seller chose high quality in previous rounds**.

**BEWARE: the count of the numbers of low and high quality starts now. No information will be given about choices in rounds that have at this point been finished.**

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### Phase 2

In phase 2 buyers and sellers negotiate the price of the good.

In the market, things proceed precisely as in the first 10 rounds. The only difference is that sometimes not everyone is participating. Recall that those involved in private negotiations are not participating in the market. For these buyers and sellers you will see empty boxes in the market.

Here we explain what happens when buyers and sellers negotiate bilaterally. During these negotiations they can continuously see at the bottom of their screen what is happening in the public market.

The negotiations proceed as follows. After the buyer has seen the sellers choices in previous rounds the buyer places a bid for the good. This number is entered in the location provided after which the button 'confirm' must be clicked.

Next, the seller must indicate whether or not s/he accepts the bid. This is done by clicking 'yes' or 'no' and confirming.

**If the seller accepts the bid**, the buyer and seller must wait until all participants are ready before proceeding to phase 3. Participants in the market only notice this by the fact that the corresponding boxes are never activated. Therefore, no one in the market knows the results of private negotiations.

**If the seller does not accept the bid**, then the buyer and seller can both participate in the public market, if it has not been closed yet. On your screen you will directly enter the market.

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### Phase 3

In phase 3 the seller determines the quality of the good. S/he does this, just like in the first 10 rounds, by clicking 'high' or 'low' and confirming.

It still holds that a low quality means that the revenue for the buyer is 10 and the costs for the seller are 0. A high quality means a buyer revenue of 50 and seller costs of 20



When everyone has finished, the next round starts.

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### **End**

This brings you to the end of these instructions. When everyone is ready we will proceed with round 11 of the experiment. We point out once more that we will start counting sellers' quality choices now. This information will be made known to buyers if they bilaterally negotiate with the seller concerned.

First, we will distribute a summary of the most important parts of these instructions.

If you have finished these instructions, please indicate this by clicking the button 'ready' (at the bottom of this screen). Then please wait quietly until everyone is ready. That may take a little while, so we ask for your patience.

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