Identity in a Second-price Sealed Bid Auction: An Experimental Investigation

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Abstract

Identity is a person’s sense of self, derived from her membership in a group. Previous experimental studies have shown that people take more favorable actions towards the members of their own group (in-group favoritism). This paper proposes a simple model of identity to capture this in-group favoritism in a private-value second-price sealed bid auction and reports the result of an experiment designed to test the predictions of the model. Consistent with the predictions, the data reveal that bids and seller revenue are higher when the seller belongs to the same group as the buyers compared to when the seller belong to a different group.

JEL Codes: C91, D03, D44.

Key Words: Identity, Auction, Experiments.

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1. Introduction

Identity is the sense of one’s self which she derives from her membership in a social group. Although the concept of identity is relatively new in economics, it is a key concept in explaining behavior in sociology, social psychology, anthropology and political science. The goal of the current paper is to propose a simple model of identity for a private-value second-price sealed bid (SPSB, hereafter) auctions and to test the predictions of the model in a laboratory experiment. Specifically, we test whether differences or similarities in identity between buyers and a seller has any effect on bidding behavior and seller revenue in a SPSB auction with private values.

The classic work of Tajfel and Turner (1979) introduced a group identity theory in order to explain discrimination between groups categorized by gender, ethnicity and occupation. Social categorization processes put people into different categories by labeling them according to some characteristics they possess. A social group consists of all the people who share some common characteristic. According to the group identity theory, members of one group compare their group (in-group) with other groups (out-group) with a predilection towards the members of their own group. This “in-group favoritism” leads people to behave differently towards the members of their own group compared to those in other groups. The psychological bias of in-group favoritism has explained phenomena such as racial conflict, human capital formation and political campaigns.

In the current paper, we study in-group favoritism in a SPSB auction in which all the buyers share the same group identity; the seller, however, may or may not have the same group identity as the buyers. In our model, the winning buyer receives a “utility bonus” when the seller belongs to her group. The model predicts that bids and seller revenue are higher when the seller and the buyers share the same identity.

We test the predictions of our model in a laboratory experiment where, following a method used in social psychology, we induce group identity by eliciting the subjects’ preferences for paintings by two artists. Based on their painting preferences, subjects are assigned to one of two groups, each consisting of five members. Subjects within each group are then randomly assigned the roles of four buyers and a seller; buyers within each group form a market and participate in a series of SPSB auctions with private
values. In one treatment, the seller is in-group while in the other he is out-group. The auction prices are the seller’s profit. Subjects’ assignment to groups and roles remained fixed throughout a session in our experiment.

Consistent with our model, we find that both bids and seller revenue are significantly higher when buyers and the seller are from the same group, than when the seller is from the other group. Buyers in both treatments bid higher than their values. The magnitude of overbidding is higher when buyers and the seller belong to the same group. Both bids and seller revenue are about 4% higher when buyers and the seller share the same group identity than when they do not. In our model, seller identity affects bidding behavior of the all the buyers the same way. As a result, the buyer with the highest value is expected to win in an auction regardless of the seller identity. Consistent with this expectation, we find no significant difference between the two treatments with respect to efficiency.

Akerlof and Kranton (2000) is the first study to formally and systematically model identity into an economic situation. In their model, social identity prescribes behavioral norms and deviations from these norms cause disutility for an agent. The effect of identity has since been tested experimentally in different non-market economic situations, utilizing both naturally occurring identities and also those that are induced in the lab. Croson, Marks and Snyder (2003) find a significant gender effect in contributions in public goods games. Using induced identities, Eckel and Grossman (2005) examine the effect of identity in public-good games. They find that contributions within a group increase when identities are enhanced by group activities.

Bernhard, Fehr and Fischbacher (2006) report results from an experiment on dictator games designed to study the effect of real group affiliation (among distinct native groups in Papua New Guinea) on altruism and enforcement by norms. The dictator games in their experiment have a third player (punisher) whose payoff is not determined by the proposer but can take costly actions to punish the proposer. The study finds strong in-group favoritism in the experiment. Specifically, the punisher shows higher altruism towards an in-group victim (a responder receiving less than 50% of the endowment) and

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1 A dictator game has two players – a proposer and a responder. The proposer chooses a division of the endowment for herself and the responder. The responder is inactive.
punishes less an in-group norm violator (a proposer choosing an allocation with more than 50% of the endowment for herself).

Chen and Li (2009) examine the effect of induced identity in dictator games and response games, and find support for in-group favoritism. Using the experimental data, they estimate a utility function in which an agent’s utility is the weighted sum of her own payoff and the payoff to the other agent she interacts with. Their results reveal that, when an agent has a higher payoff than the other agent, her utility increases as the payoff to the other agent increases (i.e. charity) and she puts a 47% larger weight on the other agent’s payoff in her utility function when the other agent is an in-group rather than an out-group member. On the other hand, when an agent has a lower payoff than the other agent she interacts with, her utility decreases as the payoff to the other agent increases (i.e. envy); the rate of decrease is, however, 93% less when the other agent is an in-group rather than an out-group member.

Fershtman, Gneezy and Verboven (2005) study the effect of ethnic and religious identity on behavior in trust games. They find that both the amount a first-mover sends and the amount a second-mover returns are higher when two in-group subjects are matched than when subjects from two different groups are matched.

These experiments have shown that subjects behave differently based on the identity of the subject she interacts with – she takes a more favorable action when matched with an in-group rather than an out-group member. In markets, the in-group favoritism mentioned above, if present, may affect the possibility of a successful transaction and the transaction price. To our knowledge, Li, Dogan and Haruvy (2009) is the only study that examines the effect of identity in a market. Their experiment considers a market with three buyers and three sellers where sellers make price offers to buyers; buyers decide whether to accept or reject the offers they have received. Before the subjects participate in the market, their group identities are induced by eliciting their painting preferences or by priming their identities of being certain college majors. The paper finds that sellers are more likely to make offers to in-group buyers, and buyers are

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*2 A response game is a two-player game in which one of the players moves first and chooses between “stay-out” or “enter”. If she chooses “stay-out”, then the game ends and both players receive some payoffs. But if she chooses “enter”, then the second player moves to choose between alternative allocations which determines the payoffs to both players.*
more likely to accept offers from an in-group seller. The effect of whether the seller is in-group on the probability of acceptance of an offer by a buyer, however, diminishes as the subjects become experienced. The paper also reports that seller behavior is not completely consistent with in-group favoritism; sellers offer higher prices to in-group buyers than to out-group buyers.

The results, therefore, as the authors suggest, reveal that buyers show in-group favoritism while sellers don’t as much; the sellers behave opportunistically as they take advantage of buyers’ in-group favoritism by offering higher prices to in-group sellers. Since buyers take less favorable actions towards in-group sellers as they become experienced, an alternative explanation for buyers’ behavior can be “reciprocal motives” – buyers favor in-group sellers at the beginning based on the belief that the sellers favor in-group buyers, and as the buyers see that the in-group sellers don’t reciprocate, they revise their beliefs and reduce their favoritism towards in-group sellers.

The current paper complements the existing experimental studies on identity and SPSB auctions. With the exception of Li et al. (2009), none of the prior studies of identity consider the effect of identity in a market environment. In this paper we find that the in-group favoritism found in the literature extends to SPSB auctions as well. Since the seller is inactive, in contrast to Li et al. (2009), our results cannot be explained by reciprocity; in-group favoritism is the only explanation of the treatment differences in our data. Experimental studies of private-value SPSB auctions have tested whether subjects follow their weakly-dominant strategy (i.e. they bid an amount equal to their values) and have found that bidders tend to bid higher than their values (Kagel, Harstad and Levin, 1987; Kagel and Levin, 1993; Harstad, 2000). These studies examined the effects of varying the parameters of the underlying auction model and the content of the feedback subjects were given at the end of each auction round, but have never considered the effect of identity. Our paper contributes to this literature by showing that the tendency to overbid is present regardless of whether the seller is in-group or out-group. The magnitude of overbidding is higher when both the buyers and the seller belong to the same group.

The rest of the paper is organized as follows. Section 2 describes a model of a private-value SPSB auction with identity. Section 3 discusses the experimental design
and procedures and Section 4 presents the results. Section 5 makes some concluding remarks.

2. The Model

$N$ buyers participate in an auction to buy an item from a seller. Suppose that buyer $i$’s value for the item is $v_i$ which is distributed according to a distribution function $F$. In the auction, each buyer submits a bid; the highest bidder wins and pays a price equal to the second highest bid. In the absence of identity, it is a weakly dominant strategy to bid $v_i$.

Now, suppose that there is some exogenous process which categorizes buyers and the seller according to the characteristics they possess and that, based on this categorization, all the buyers belong to the same group; the seller belongs either to the same or a different group. Assume that buyers are homogeneous in their in-group preferences. When a buyer wins and pays a price $p$, her payoff is $(v_i - p) + \alpha I_s$ where $I_s$ is an indicator function of seller identity ($I_s = 1$ when the buyer and the seller belong to the same group; otherwise, $I_s = 0$) and $\alpha \geq 0$ is the effect of an in-group seller on the buyer’s payoff.\footnote{Since $I_s = 0$ for an out-group seller, $\alpha$ is the effect of an in-group seller compared to that of an out-group seller.} The buyer’s payoff is 0 when she doesn’t buy the item. Clearly, it is a weakly dominant strategy for buyer $i$ to bid $v_i$. A buyer thus bids higher when the seller is an in-group member and $\alpha > 0$.

Let $Y_2^{(N)}$ be the second highest of $N$ values drawn from $F$. Then, expected seller revenue is $E[Y_2^{(N)} + \alpha I_s]$. Hence, seller revenue will also be higher when the seller belongs to the same group as the buyers and $\alpha > 0$.

Notice that the over-bidding mentioned above does not result from a buyer with $\alpha = 0$ best-responding to other bidders with $\alpha > 0$. When $\alpha = 0$, it is optimal for a buyer to bid her value regardless of her rivals’ responsiveness to seller identity. Therefore, any difference in bidding behavior that we observe when $I_s = 1$ is due to the buyers’ responsiveness to seller identity. Seller identity doesn’t affect efficiency in our model; the buyer with the highest value wins the auction.
We recognize that bidding behavior can be affected by the identity of the rival buyers. A buyer can show favoritism towards another buyer in her own group by bidding less. Our predictions mentioned above, nevertheless, remain unaffected by such favoritism. Since all the bidders in our model share the same identity, a change in bidding behavior resulting from whether the seller belongs to the same group as the buyers will only show buyers’ response to seller identity. For this reason, as our main goal is to model the effect of seller identity on bidding behavior, we have suppressed the effect of rival buyers’ identity on bidding in our model.

3. Experimental Design and Procedures

We conducted two treatments – an “in-group seller” (IGS) and an “out-group seller” (OGS). Each treatment consisted of three sessions. In each session, there were two phases. The first phase was exactly the same in both treatments. The second phase, however, differed across treatments.

In the first phase of each session, a group of 16 subjects were recruited. Upon arrival at the lab, the subjects were randomly assigned registration numbers. In order to induce group identity, following Tajfel et al. (1971), the subjects were shown five pairs of paintings by two modern artists – Wassily Kandinsky and Paul Klee. The subjects were only told that each pair consisted of paintings by two artists but weren’t told the names of the artists. For each pair, each subject chose the painting that he or she preferred and thus ended up choosing at least three paintings by the same artist after looking at all five pairs. Based on this information, subjects were then divided into two groups – the Klee group and the Kandinsky group. The Klee (Kandinsky) group consisted of all the subjects who chose at least three Klee (Kandinsky) paintings.

After the subjects were divided into groups, each subject was privately informed of her group membership. The subjects were not told exactly how many members were in each group. In each of our sessions, we had at least 5 subjects in each group. In order to

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4 The same technique for inducing group identity has been used in Chen and Li (2009) and Li, Dogan and Haruvy (2009). The following five pairs of paintings were used in the experiment. Pair-1: Gebirgsbildung (Klee), Subdued Glow (Kandinsky); Pair-2: Dreamy Improvisation (Kandinsky), Warning of the Ships (Klee); Pair-3: Dry-Cool Garden (Klee), Landscape with Red Splashes I (Kandinsky); Pair-4: Gentle Ascent (Kandinsky), Hoffmannesque Tale (Klee); Pair-5: Development in Brown (Kandinsky), The Vase (Klee). I am thankful to Yan Chen for sharing the images of the paintings used in Chen and Li (2009).
have exactly 5 members in each group to participate in the second phase, the registration numbers of the members within each group were put in an urn and five numbers were randomly drawn from the urn. After this procedure was conducted for both groups, the subjects whose registration numbers were not drawn were then paid their show-up fee of $5 and were asked to leave before the second phase began. The subjects remaining in the lab were not told whether the subjects who left belong to their own or the other group. At this point, the registration numbers of the five members within each group were made public by writing them on a whiteboard.

In the second phase, the five members in each group were randomly assigned the roles of four buyers and a seller. In a session in the IGS treatment, buyers in each group participated in a series of 30 private-value SPSB auctions to buy from the seller in their own group. In a session in the OGS treatment, buyers participated in a series of similar auctions to buy from the seller in the other group. Subjects’ assignments to groups and roles remained unchanged throughout the session.

In each auction round, a buyer’s value was drawn independently from the $U[0,10]$ distribution. After learning her value, each buyer submitted a bid via the computer terminal. There was no reserve price in the auction. The highest bidder in a group won the auction and paid the price equal to the second highest bid in the group. At the end of an auction round, each buyer was told whether she won, the winning bid and the purchase price in that round in her group. Buyers in one group were not informed of the auctions results in the other group. The winning buyer’s earnings was her value minus the price. All other buyers earned $0. The seller’s earnings was the price. At the beginning of the second phase, each buyer was given a starting balance of $10.

At the end of the second phase, the subjects were paid their earnings in cash. Each session lasted for less than an hour and the average earnings were about $17. All the sessions were run at the San Diego State University using zTree (Fischbacher, 2007).

The research hypotheses of the study were:

**Hypothesis 1**: Bids are higher in the IGS treatment than in the OGS treatment.

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5 Subjects were not told in the first phase how their participation in the second phase would be determined.

6 The same set of 120 value draws (4 buyers per auction round and 30 rounds per session) was used for each group and all the sessions in the experiment. The average of these 120 draws was $5.06. The average per-round highest and the second highest values were $8.12 and $6.19, respectively.

7 Buyers and sellers were paid 50% and 5% of their earnings in the experiment, respectively.
Hypothesis 2: Seller revenue is higher in the IGS treatment than in the OGS treatment.

Hypothesis 3: Auction efficiency is the same in both treatments.

4. Results

A buyer in the OGS and the IGS treatments bid, on average, $5.42 and $5.63, respectively; in both cases, it is higher than $5.06, the average of the value draws used in the experiment. Figure 1 shows, for each value draw used in the experiment, the difference between the average of 6 bids (2 bids from each of the 3 sessions) for that value and the value. The diagrams reveal some aspects of bidding that are common in both treatments. First, buyers tend to bid above their values. Second, except for one instance in each treatment, the average overbid is less than $2.00. Third, the average deviation doesn’t seem to vary with the value draws. In both treatments, buyers are overbidding even when they have low valuations and the size of the deviation doesn’t change noticeably when the valuations are higher. Although, not immediately apparent from Figure 1, there are some differences between in these deviations across treatments: (1) the variance of the deviation is slightly higher in the IGS treatment (0.40 and 0.36 in the IGS and the OGS treatments, respectively), and (2) the extent of overbidding is higher in the IGS treatment than in the OGS treatment. For 79 of the 120 value draws used in the experiment, the average (across groups and sessions) bid for each of these value draws is higher in the IGS treatment than in the OGS treatment.

(Figure 1 goes here.)

To take a closer look at the bidding behavior, we regress bids on values. Table 1 reports the results of three OLS regressions. Regressions (1) and (2) are for the OGS and the IGS treatments, respectively. The estimated coefficients of these regressions show that, in both treatments, bids are higher than values. This result is similar to the previous experimental findings for SPSB auctions.\(^8\) It is, however, interesting to see that the

\(^8\) Kagel et al. (1987) find that, on the average, bids are 11% above the weakly-dominant strategy prediction of value-bidding. Kagel and Levin (1993) report that 62% of all the bids are above value.
tendency to overbid is present even when the seller is an out-group member (OGS). Consistent with our hypothesis, we find that the magnitude of overbidding is higher in the IGS treatment; the difference is arising mainly from a larger constant term in the IGS treatment. To further investigate the difference in bidding across treatments, we run regression (3) which pools the data from the two treatments and includes one extra independent variable – the indicator function for seller identity ($I_s$). Recall that $I_s$ equals 1 when the seller is an in-group member (i.e. the IGS treatment). The estimated coefficient of $I_s$ in Table 1 shows that buyers bid $0.21 more in the IGS treatment than in the OGS treatment and this difference is statistically significant.

All the results discussed above support our hypothesis regarding bidding (Hypothesis 1) and are consistent with the buyers receiving a “utility bonus” when they transact with an in-group seller.

<table>
<thead>
<tr>
<th>Table 1: OLS Regression of Bidding Functions.</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>OGS</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>$v_i$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>$I_s$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Obs.</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
</tr>
</tbody>
</table>

Notes: 1. Standard errors of the estimates are reported within parentheses. 2. ** denote significance at 1% level in a two-tailed t-test.

Next, we analyze seller revenue and efficiency in the two treatments. The average per-round seller revenue in the OGS treatment is $6.50 while it’s $6.74 in the IGS treatment. Conditional on the values used in the experiment, had the subjects bid their values, the expected per-round seller revenue would be $6.19 (the average per-round second highest value) which is lower than the average per-round seller revenue in both
treatments. This, once again, shows that buyers bid higher than their values; the magnitude of overbidding is higher in the IGS treatment.

(Figure 2 goes here.)

Figure 2 analyzes the effect of seller identity and overbidding on revenue. It shows, for each round, the deviation of average (across sessions) seller revenue from the second highest value draw in that round. If buyers bid their values, then this deviation equals zero. As Figure 2 shows, in most rounds, seller revenue is higher in both treatments than what would be obtained under value bidding. It also shows that, in 20 (out of 30) rounds, the deviation is higher in the IGS treatment than in the OGS treatment. Averaging across all the rounds, the per-round deviation in the IGS treatment is $0.57 which is higher than that of $0.31 in the OGS treatment.

<table>
<thead>
<tr>
<th>Session</th>
<th>OGS Revenue</th>
<th>IGS Revenue</th>
<th>OGS Efficiency</th>
<th>IGS Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$6.34</td>
<td>$6.92</td>
<td>0.949</td>
<td>0.971</td>
</tr>
<tr>
<td></td>
<td>$6.41</td>
<td>$6.68</td>
<td>0.958</td>
<td>0.932</td>
</tr>
<tr>
<td>2</td>
<td>$6.42</td>
<td>$6.80</td>
<td>0.992</td>
<td>0.934</td>
</tr>
<tr>
<td></td>
<td>$6.67</td>
<td>$6.77</td>
<td>0.956</td>
<td>0.961</td>
</tr>
<tr>
<td>3</td>
<td>$6.44</td>
<td>$6.49</td>
<td>0.960</td>
<td>0.994</td>
</tr>
<tr>
<td></td>
<td>$6.72</td>
<td>$6.79</td>
<td>0.946</td>
<td>0.920</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>$6.50</td>
<td>$6.74</td>
<td><strong>0.960</strong></td>
<td><strong>0.952</strong></td>
</tr>
</tbody>
</table>

Recall that we have three sessions of each treatment, and within each session there are two groups. Table 2 lists the average per-round seller revenue and efficiency in the two groups in each of the sessions of the IGS and the OGS treatments. Efficiency is defined as the ratio of realized surplus to the maximum total surplus attainable in an auction round and calculated by dividing the winner’s valuation by the highest value draw in that round. As Table 2 shows the highest average per-round revenue obtained in an OGS session ($6.72) is lower than the average per-round revenue in all but two of the
IGS sessions. Applying the Mann-Whitney U test to the two samples (each with six independent observations), we can reject at the 1% level the hypothesis that seller revenues in the two treatments are drawn from the same distribution ($U = 3$ and $p$-value = 0.016 for a two-tailed test). Our revenue results thus support Hypothesis 2.

If all the buyers receive the same utility bonus when the seller they interact with is an in-group member, it will affect bidding of all the buyers the same way. As predicted by our model, the buyer with the highest value draw wins the auction regardless of seller identity. As a result, we don’t expect that the treatments in our experiment will differ with respect to efficiency. The average per-round efficiency given in Table 2 looks very similar across treatments. On average (across sessions), we achieve 0.960 and 0.952 efficiency in the OGS and the IGS treatments, respectively. Applying the Mann-Whitney U test to the two samples (each with six independent observations), we cannot reject the hypothesis that the average per-round efficiency numbers in the two treatments are drawn from the same distribution ($U = 16$ and $p$-value = 0.818 for a two-tailed test). The results from the experiment are, therefore, consistent with Hypothesis 3.

5. Conclusion

The goal of the paper was to study the effect of identity on SPSB auctions. A simple model is developed in which the buyers share the same group identity; the seller belongs to either the same or a different group. A buyer in our model receives a utility bonus when she buys from an in-group seller. The model predicts that both bids and seller revenue will be higher when the seller is an in-group member. The results from the experiment support these predictions. In our experiment, identity was induced by eliciting subjects’ painting preferences.

Previous experimental findings have shown that agents take more favorable actions when they interact with in-group members. The current study complements the literature by showing that in-group favoritism exists in SPSB auctions as well. Several existing experimental studies on SPSB auctions find overbidding in these auctions. This

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9 Since buyers within each group formed a separate market and there was no interaction between the buyers across the two groups in a session, and buyers in one group were not informed of the sale prices in the other group, observations across groups within the same session are independent of each other.
paper supplements these studies by showing that overbidding persists even when the seller is an out-group member.

**References**


Figure 1: Bid Deviations from Values.

(a) OGS Treatment

(b) IGS Treatment
Figure 2: Deviation of Seller Revenue from Second Highest Value.