

Squeezing Lemonade into Lemons: How Institutional Details can Make Efficient Markets with Asymmetric Information Inefficient*

Running Head: Squeezing Lemonade

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Abstract:

It is well known that asymmetric information is a catalyst for producing a lemons market. What is much less well known is how different institutional arrangements and their concomitant information conditions affect the lemons outcome. We conduct a laboratory experiment to examine the role that two market institutions, two-sided multilateral negotiations and posted-offer, play in an environment with sufficient conditions to yield a lemons outcome. We also investigate the impact that publicly available prices and advertisements have on buyers and sellers in a posted-offer institution.

Keywords: Asymmetric information, lemons market, laboratory experiment, two-sided multilateral negotiations, posted-offer

JEL codes: D82, C91

1 Introduction

As initially posed by Akerlof (1970), the lemons problem showed how asymmetric information will lead to either the complete disappearance of the market (death spirals) or an outcome where only the poor quality cars are traded (the lemons outcome), despite the fact that profitable trades could be made. Recently, Harford (2006) discusses the lemons problem in the context of health insurance markets.¹ The perception is that asymmetric information is a “problem” in that profitable trades that could occur do not occur. However, it may be that the market institutions in which products with asymmetric information are traded have arisen because they mitigate the lemons problem.

In this paper we report our exploration into how the lemons problem may be mitigated by institutional arrangements and their concomitant information conditions of the market. We conduct laboratory markets with two different institutional designs, two-sided multilateral negotiations (TSMN) and posted-offer (PO) markets. In TSMN, buyers are free to visit sellers and haggle with them over the price of the item. In our posted-offer institution, buyers may also visit seller stores, where sellers post a price at which they are willing to sell and may post an advertisement of quality level. In either institution, sellers are only restricted from selling below cost and are not restricted to truthful advertising. In some PO sessions posted-offers are viewed by all market participants and in others they are only viewed by buyers. The specifics of our experiment are discussed in Section 3.

Prior experimental research suggests two main results. First, repeated play with the same uninformed buyers allows informed sellers to develop reputations, which mitigates the lemons problem. Second, exogenously imposing either full information directly or

¹ He later restates his claims about the problems of asymmetric information in a column that is available, as of 11/19/2008, at <http://www.slate.com/id/2140743>.

rules that require full information alleviates the lemons market problem. Our experimental design differs from these earlier designs in two significant manners. Reputation formation by sellers is impossible due to the fact that buyers can purchase at most one unit of the good and that communication among buyers is not present. Also, the TSMN institution is distinct from those in previous lemons market experiments. A more thorough discussion of the prior experimental literature, as well as related theoretical literature, is contained in section 2.

At first blush, one may ask why bother conducting such an experiment if it appears that Akerlof's model would predict the rather straightforward lemons result. Indeed, we believed that and embarked on this research with the intent of replicating the traditional lemons result with TSMN as a baseline for another line of research. But we discovered another humbling example of the importance of institutions, information availability, and more fundamentally, how the experimental method sheds light on how we think about knowledge in economics. We find stark evidence that the buyer's uncertainty as to whether or not a seller is peddling a lemon can be counterbalanced by a corresponding uncertainty on the other side of the market as to what are the competing market prices. As experimental economics has demonstrated many times since Smith (1962), the devil is in the details of the market institution, and as our experiment demonstrates, countervailing devils of uncertainty can lead to more efficient outcomes.

The remainder of the paper is structured as follows. Related literature is discussed in section 2. In Section 3 we discuss the specifics of our experimental design and some hypotheses. Section 4 provides results about the prevalence of the lemons market

phenomenon, including evidence that the participants understand the buyers' problem. The paper concludes with a summary discussion in Section 5.

2 Related Literature

We provide a brief description of related theoretical, empirical, and experimental literature. Related theoretical literature includes the role that asymmetric information plays in determining equilibrium outcomes in markets under various information conditions and the bargaining literature. We note results from the bargaining literature because both the TSMN sessions and PO sessions we conduct may be viewed as bargaining. The TSMN sessions represent the conventional bargaining environment, while the PO sessions are closer to bargaining environments in many economic theories.

Wilson (1980) extends Akerlof's model by considering markets where a single price exists by way of a Walrasian auctioneer as well as markets where buyers or sellers set prices. He finds that a price distribution may emerge when buyers or sellers set prices rather than a single price as with the Walrasian auctioneer. Wilson discusses two equilibria when sellers set prices: a single price equilibrium where all sellers set the same price and a discriminating seller's equilibrium in which sellers set different prices. In the results section we often refer to the "ripoffs outcome", which is a pooling outcome akin to Wilson's single price equilibrium. While Wilson's model is not the basis for our experiments, our results are more akin to Wilson's equilibria than Akerlof's.

Levin (2001) and Kessler (2001) consider information asymmetries which are similar, but not exactly the same, as those in our experiments. In Levin buyers are uninformed while in Kessler some sellers are uninformed about the value of their item. In both of these models, additional information leads to ambiguous changes in the number of trades

and welfare. The sellers in our experiment face a different type of information condition than in the Levin or Kessler papers -- it is not that they cannot distinguish the types of goods, it is that they only have one type available to sell and only know their cost for that type of object in addition to knowing the buyer's average value for a unit of the object.

As an example of when this type of information condition may arise, consider an individual selling a used car. The individual knows his value/cost for the car. The individual might look up the estimated value (average buyer value) of the car in Kelley Blue Book. Alternatively, the seller could investigate what other sellers are choosing as the sales prices for their cars and form a price estimate based on that information. Our experimental design seeks to capture both cases.

Samuelson (1984) considers asymmetric information in the context of bargaining. Asymmetric information exists in that the seller knows his own cost as well as the buyer's value for the item, while the buyer is uncertain about both. He finds that the optimal bargaining strategy for the uninformed agent is to make a first-and-final offer. As for the informed agent, if the seller's optimal mechanism is single-stepped then it is also optimal for the seller to make a first-and-final-offer; however, if the optimal mechanism is double-stepped it cannot be implemented by a simple bargaining procedure. See Osborne and Rubinstein (1990) and Kennan and Wilson (1993) for a more thorough review of bargaining with private information.

Empirical evidence on the existence of the lemons problem is mixed. Bond (1982) provides an empirical test of the lemons model using data from the used-pickup truck market and finds no evidence for the lemons phenomenon. Rosenman and Wilson (1991) look at sales of cherries and find that buyers pay more for higher quality cherries

although they do not inspect the cherries prior to purchase. They attribute this result to the ability of buyers to recognize a signal of quality difference from the seller. Chezum and Wimmer (2000) show that homebred horses are favored more often than similar nonhomebred horses. Dewan and Hsu (2004) find that sales from online stamp auctions are lower than those from a well-established dealer and that reputation of the online seller has a small positive impact on sales price and probability of sale.

An early experimental test of the lemons market is Miller and Plott (1985) who use a double oral auction mechanism with informed sellers and uninformed buyers. Products have two grades, "super" and "regular". Sellers are exogenously assigned the type of good they will sell can add quality units to the good. "Supers" are more valuable to the buyers, but the cost of adding quality units to a "super" is more expensive. Their primary result is that as the difference between the cost of adding quality to "supers" and "regulars" decreases, the likelihood of a pooling equilibrium, where both grades sell for the same price, increases. Note that replication of our private information condition using a standard double auction experiment is impossible given the public revelation of information through bids and asks in an oral double auction, although using a design as in Cason and Plott (2005) would conceal information.

Using a principal-agent setting, Dejong, Forsythe, and Lundholm (1985) attempt to determine the conditions under which a lemons market, a ripoffs market, and a reputation formation market exist. They find that the lemons market occurs about 50% of the time, and is reduced by the desire to build reputation. They also find that some agents are able to take advantage of this reputation building by others and are able to rip off the principals. Forsythe, Lundholm, and Rietz (1999) investigate the impact of potential

Securities and Exchange Commission fraud rules. They find that efficiencies in when sellers must include the true quality somewhere in their statement are lower than predicted by theory, but are still higher than in their no communication and cheap talk treatments. Efficiencies in the cheap talk treatment are higher than predicted by theory and higher than those in the gag rule.

Holt and Sherman (1990) examine the impact of price and quality advertising of products in a posted-offer market. They have treatments with price and quality advertising, only price advertising, and neither price nor quality advertising. They find that price and quality are near the efficient levels when both price and quality are advertised, but that the price-only advertising treatment and the no advertising treatments have similar efficiencies of about 50% across all sessions. They find that the lemons market outcome occurs in about half of the periods. Davis and Holt (1994) examine a 3-player, 3-stage simultaneous move game as a stylized lemons game in which player A is the buyer and is choosing a product of unknown quality from player B or C, who are the sellers. They find that the lemons outcome is mitigated in their treatments with repeat dealings.

Cason, Friedman, and Milam (2003) and Milam (2006) study experimental posted-offer and haggling markets. Contrary to our findings, they find that posted-offer markets are more efficient than haggling markets. However, two key differences between their experimental designs and ours are worth noting: all of our markets feature goods of unknown quality and our haggling institution (TSMN) allows participants to exchange messages consisting of words and prices, not just prices. Thomas and Wilson (2002) empirically compare one-sided multilateral negotiations (of messages consisting of words

and prices) with traditional auction mechanisms with independent private values, but again their goods are of known quality.

Cason and Gangadharan (2002) investigate markets with asymmetric information using posted-offer treatments which allow for no reputation formation, reputation formation, cheap talk signaling, and certification. Overall, they find that reputations improve the amount of high quality units sold relative to the case of no reputations, there is little difference between the treatments with reputations and cheap talk signaling, and that third party certification provides the highest amount of high quality units sold and highest efficiency levels, even when the cost of certification is taken into account.

Finally, Cason and Plott (2005) study the performance of pairwise multilateral negotiations, similar to our TSMN except simultaneous negotiations are allowed, in which one side is more informed than the other. As in our private information condition, they do not publicly report transaction or offer prices. However, the information condition in their experiment is not one of asymmetric information, but one where one side of the market knows the values of the participants on the other side; thus, there is no opportunity for a lemons type outcome. They find that the side with more information has a pricing advantage, particularly during the initial equilibration phase of the double auction.

3 Experimental Design and Procedures

While we reference multiple theoretical models, we utilize the general environment from the canonical Akerlof model but do not confine the market price to be a single price. We are interested in the price formation process under different institutional arrangements when buyers face asymmetric information. Each experimental market

consists of 4 sellers and 16 buyers. Sellers are endowed with either super or regular units, which have a constant marginal cost of \$25 and \$1 respectively. All sellers have the capacity to sell up to 5 units. Two sellers are informed that they supply super units and the others are informed that they sell regular units.

Buyers have a reservation value of \$36 for super units and \$12 for regular units. The instructions inform the buyers that they will not learn whether they have purchased a super or a regular unit after a purchase. Note that, given the marginal costs of the sellers, the possible surplus from each type of unit is \$11. We believe that having the same surplus from each type is more important than the relationship between the values and costs as different potential surpluses could lead to more transactions involving the type of unit for which more surplus is available simply because the gains from trade would be larger. However, it is still an open question as to how altering the ratio of costs would impact the outcome of the experiment.

Since there are two sellers of each type, and all sellers have the same quantity, the average value of a unit to the buyers is \$24, which is less than the cost of the super unit. Both buyers and sellers are not informed on the number of available super and regular units at the beginning of the experiment, but the participants are each told their private individual value or cost as well as the average value of a unit to a buyer. Sellers are provided with the average value to a buyer because this information is known in the Akerlof model. An important caveat is that sellers are uninformed as to the cost of the quality of the good that they do not possess. Thus, super sellers are unaware of the cost of regulars, and regular sellers are unaware of the cost of supers. Due to this, sellers may be

unaware they are selling "ripoffs" to consumers -- they simply know they posted a price and the consumer bought the item.

In all treatments buyers are given a shopping time of 5 minutes and may purchase at most one unit. Buyer shopping time is staggered, with one additional buyer allowed to enter the market after every minute of the experiment. At most 5 buyers are in the market at any time. Buyers may visit as many of the 4 sellers as they wish, although if another buyer is already shopping with that seller, then the buyer must join a queue to visit that seller. The queue for each store is shown to the buyers and the sellers. In order to offset potential losses which might arise due to rip off sales, buyers receive 0.92 cents for each second outside of their shopping time. We also include this payment to the buyer to lessen a buyer's impulse to make a purchase in an attempt to earn money beyond the show-up payment since the buyer is receiving other earnings. Each experiment lasts 25 minutes, so the buyers receive \$11.03 for the 20 minutes in which they are not shopping. If a buyer completes his transaction prior to the end of his shopping time, he does NOT receive his additional 0.92 cents until his 5 minutes of shopping time expires.²

We have two primary treatment variables. The first is the market institution, which is either TSMN or PO.³ We conducted 5 TSMN sessions and 8 PO sessions. In the TSMN treatment, buyers and sellers can engage in open ended discussions via a private chat window for a buyer-seller pair. Note that in all treatments buyers can solicit sellers, but sellers cannot solicit buyers. At any time during the conversation, a seller can submit an offer price to the buyer. The buyer can either accept or reject an offer. Only the seller can

² Should a buyer incur a loss greater than \$11.03 the buyer simply receives his show-up payment.

³ Note that TSMN differs from multilateral bargaining as defined in Krishna and Serrano (1996) and Mailath and Postelwaite (1990) as agents engaging in multilateral bargaining are attempting to determine how to split a fixed amount among themselves.

submit an offer, though the buyer is free to make suggested offers via the private chat window. Either the buyer or the seller can terminate the conversation by pressing a button labeled "Leave".

In the posted-offer treatment, sellers post a price for their good as well as an advertisement about the quality of their product. The seller chooses one of three forms of advertisement: "Advertisement: One Super Unit for xxxx", "Advertisement: One Regular Unit for xxxx", or "Advertisement: One Unit for xxxx". The advertisement is not restricted to a truthful revelation though the price must be above the seller's cost. A seller can update his advertisement at any time for the next buyer at the front of the queue, i.e., the seller cannot change the price to a buyer once the buyer is at the front of the queue.⁴

The second treatment variable within the posted-offer environment is the public availability of the seller offers. In 4 of the 8 PO sessions, each seller sees only his own offer and advertisement. We will call these 4 sessions the private information sessions, denoted by the label "PO-private". In the other 4 PO sessions, all offers and advertisements are public information, so that all sellers view the offers and advertisements at every instant. Buyers view all offers and advertisements only during their five-minute shopping window. We label these four public information sessions "PO-public".

While we could have conducted multiple rounds in the PO treatments, for consistency purposes we left the structure of the experiment exactly as it was in the TSMN sessions. As with any design choice, there are costs and benefits. We chose to implement a harshly unfavorable situation for the buyers, namely that there is no opportunity for the sellers to

⁴ Screen shots for buyers and sellers as well as instructions are available at ***insert web address here after double-blind process***.

develop a reputation to help the buyers out of their asymmetric information problem, to see how different institutional arrangements affect the problem of asymmetric information. Prior experimental research suggests that learning over multiple rounds in our PO-public environment may mitigate the ripoffs outcome we observe but that a lemons market would still occur roughly half of the time.

We first conducted the 5 TSMN sessions. When we failed to observe a lemons or ripoffs outcome, we then decided to replicate the lemons result in other experimental papers with two posted-offer sessions, without the line "The average value is 2400" in the legend, but with the private information conditions inherent in the TSMN treatment.⁵ Again observing a fairly efficient market with few ripoffs, we then placed a reminder of the average value in the legend for the four PO-private sessions reported here. Failing in this third design to observe the lemons or ripoffs result, we then conducted the PO-public treatment, and---voilà---we found evidence of a rampant ripoffs result so common in previous lemons market experiments. Given that the experimental design changed as we gained new insights, formal statements of hypotheses beyond the belief that we would find a lemons outcome in the initial TSMN and PO sessions would be ad hoc. Thus, we present the results to show how the changes in information conditions in these one-shot games for buyers generated outcomes which depart from the standard inefficient outcomes commonly found in experimental markets with asymmetric information. In addition, we present evidence on non-price actions which suggests that buyers and sellers understand the problem that buyers face.

⁵ The results from these two sessions are not reported here. Note that there were no ripoffs, and that buyers purchased the regular units prior to the super units because the offered surplus on the regulars was much greater than the offered surplus on the supers. In the reported treatments there were no instances where a regular item sold and yielded more surplus ex-post than a super item available for purchase at the same time.

We conducted all thirteen sessions using undergraduate students recruited at large at George Mason University in the fall of 2006. Subjects were seated at visually-isolated computer carrels and read instructions on their screens as the same monitor for each session read them out loud. Each session lasted one hour and no subject participated twice, though many but not all had prior experience in another unrelated economic experiment. Average earnings for participants in the experiment, including the \$7 show-up payment, were approximately \$22.20 in the TSMN treatment and \$22.60 in the PO treatments. A further discussion of participant profits is in Section 4.

4 Results

The lemons outcome is defined as only low quality goods selling at prices below the buyers' value for the low quality good. A slight variant is the ripoffs market, where low quality sellers pass their goods off as high quality products and charge a price high enough so that buyers pay more than it is worth to them ex post. The ripoffs outcome is essentially a pooling equilibrium with prices of all goods near the buyer's average value for a unit. Finally, it is possible that a separating outcome occurs where *regulars* sell at prices low enough that buyers receive positive consumer surplus from the purchase ex post and *supers* also sell.

We determine which of the aforementioned outcomes occurs in our treatments. As stated above, our initial belief was that a lemons or death spiral outcome would occur in the TSMN session. While our results suggest this is not the case, we examine possible features of our experiment which may hinder the occurrence of these outcomes. Due to the capacity constraints on sellers, a *super* seller may be the only option when the *regular* sellers have stocked (but, of course, this does not mean that the buyer still must

involuntarily purchase from the potentially lying *super* seller). Finally we examine seller profits to determine if either institution yields a substantial difference in profits for sellers of *supers* and *regulars*. If so it might be expected that as markets evolve the institutional arrangements that allow for the existence of sellers of high quality goods in the presence of asymmetric information are naturally selected.

4.1 Which market outcome is attained?

Result 1: *In the PO-private and TSMN sessions we observe a separating outcome. In the PO-public sessions we observe the ripoffs outcome.*

FIGURE 1 ABOUT HERE

[sales_picture.jpg]

[Super, Ripoff, and Regular sales by session]

It is clear that the lemons outcome does not occur. Figure 1 shows the number of *regular*, ripoff, and *super* sales by session. A ripoff sale is defined as a *regular* sale that occurs at a price greater than \$12. In the TSMN treatments only 3 of the 44 *regular* sales are ripoff sales, all by the same seller. In the PO-private treatments, 6 of the 37 *regular* sales are ripoff sales, and these sales are made by 4 different sellers. In the PO-public treatments, 35 of the 36 *regular* sales are ripoff sales. Clearly the publicly available offers and advertisements have an effect on the rate of ripoff sales. Across all 13 sessions, there are 9 sessions in which 16 units sell, 3 sessions in which 15 units sell, and 1 session in which 14 units sell. However, in 10 sessions the number of *regular* sales is greater than the number of *super* sales and in 7 sessions the *regular* units sold out. In Result 2 we examine how the capacity constraint might have lowered the possibility of observing the lemons outcome.

FIGURE 2 ABOUT HERE

[sales_price_pic.jpg]

[Sales prices by treatment in ascending order]

Figure 2 shows the distribution of sales prices across all sessions for each treatment. These are ordered from lowest to highest without regard to unit type. The pictures show a clear difference in the distribution of sales prices across treatments. In particular, the sales prices in the PO-public treatment tend towards a pooling outcome while the sales prices in the PO-private and TSMN treatments reflect a separating outcome. Using session average prices we use a two-sample Mann-Whitney U test for equality of the medians of the distributions. We reject the equality of the TSMN and PO-public price distributions (p -value < 0.05), reject the equality of the PO-public and PO-private price distributions (p -value < 0.05), and fail to reject the equality of the price distributions for TSMN and PO-private (p -value > 0.05).⁶

Result 2: *Regular sales occur earlier on average than super sales, but most super sales occur before regulars have sold out.*

TABLE 1 ABOUT HERE

[Average position of super and regular sales across sessions]

Given the capacity constraints some of the sales of *super* units may have been driven by the lack of an alternative. This would cause the possibility of a lemons outcome to be diminished. Although purchasing a unit at a high price is still a risky strategy in that the seller of the unit could be masquerading as a *super* seller, it might explain why some

⁶ For the TSMN and PO-public comparison as well as the PO-private and PO-public comparison the $U_{4,5}=0$ as the session average prices are perfectly separated.

supers sold. If this were the case, then we would expect the order of the sales to reflect this, and sales of *supers* would occur later in the session.

Table 1 shows the average sales position for *supers* and *regulars* by session. The lower the average position of the sales order, the earlier the units sold. In 11 of the 13 sessions, including all 8 of the PO sessions, *regulars* sold earlier than *supers*. In the 7 sessions in which *regulars* sold out, there were 39 sales of *supers*. Of these 39 *supers*, approximately 36% of them occurred after the *regulars* sold out. Given that 86 *supers* sold across all 13 sessions, only 16% of all *super* sales occurred when there were no available *regulars*. Thus, while *regulars* sell earlier than *supers*, it does not appear that sales of *supers* would dry up without a binding capacity constraint.

Result 3: *Earnings for sellers of supers and regulars in TSMN are more equal than earnings in the posted-offer markets.*

FIGURE 3 ABOUT HERE

[Profit_figure.jpg]

[Aggregate profit by session and participant type]

Figure 1 shows that the number of sales of *supers* and *regulars* across the TSMN and PO institutions are similar, but one institution may allow sellers to extract more of the surplus from the market than the other. The number of ripoff sales is one indicator that some sellers in the PO markets may earn more than the sellers in the TSMN markets.

Figure 3 displays profits by treatments for buyers and sellers. Across all sessions, average profits per seller for *regular* sellers are \$49.13 whereas those for *super* sellers are \$7.87. However, in the TSMN treatments, *regular* sellers average \$19.79 while *super* sellers average \$13.17. When the institution changes to the posted-price, *regular* sellers

earn far more than *super* sellers. In the PO-private treatments *regular* sellers earn \$34.09 compared to \$6.80 for *super* sellers. As dramatic as that change in relative profits is it is dwarfed when compared to the change in relative profits in the PO-public treatment. *Regular* sellers in the PO-public treatment average \$100.85 in profit whereas *super* sellers average \$2.30. Thus, while the posted-offer institution itself lowers profits to *super* sellers, the addition of public offers and advertisements all but eliminates *super* seller profits from the market. This occurs because the *super* sellers price near marginal cost in the PO-public sessions in order to compete with the *regular* sellers who are passing their goods off as high quality and setting prices well above their own cost.

These results provide evidence as to how information availability and institutions affect market outcomes in the single shot markets with asymmetric information. First, only 11% of the total *regular* sales in the 9 TSMN and PO-private sessions are ripoffs. This is a low percentage when compared to the results in the partial information treatments of Holt and Sherman and the treatments in Miller and Plott in which the cost of adding quality to a "super" and a "regular" was not that large. However, a much larger percentage, 97%, of the *regular* sales in our PO-public sessions are ripoffs. We conjecture that our continuous time market allows sellers to incorporate information from other sellers faster than the other market experiments and this allows sellers to take more advantage of buyers who only get one-shot to purchase a unit. Second, while result 2 shows that the lemons outcome may have been slightly hindered by our design, it does suggest that some *supers* would have sold in the TSMN and the PO-private institutions.

Finally, *regular* sellers in the PO environment earn substantially larger profits than *regular* sellers in the TSMN environment, and those in the PO-public session earn

substantially more than the *regular* sellers in either the TSMN or PO-private sessions. The difference between institutions may be due to the more personal nature of the TSMN environment than the PO environment, as buyers are able to obtain more credible signals from the negotiation process than from the advertisement and price signals. The difference between information availability suggests that *regular* sellers are much more advantaged when they have information about the prices of other sellers.

However, the amount of *super* sales and the lack of ripoff sales in the TSMN and PO-private sessions lead to a second question: Are non-price actions consistent with the underlying problem buyers face in the presence of asymmetric information?

4.2 Examining Non-Sales Price Actions

In this section we examine advertising in the PO treatments and buyer-seller chats in the TSMN treatments. If sellers in the PO treatment are unaware or unwilling to pass their low quality goods off as high quality goods, then advertisements should reflect true quality. However, if the sellers set advertisements that misrepresent quality, this is consistent with an understanding that buyers cannot distinguish between *regulars* and *supers* until after purchase. Similar information can be gleaned from the buyer-seller chat, in which the seller can misrepresent the quality level of the unit in negotiations with the buyer. It is more difficult to obtain evidence about the buyers' understanding of their own problem, but the buyer-seller chat can be used for that purpose as well.

Result 4: *Advertising levels in both the PO-private and PO-public treatments suggest that sellers understand buyers cannot determine the quality level until a purchase is made.*

FIGURE 4 ABOUT HERE

[ads_picture.jpg]

[Advertisements by session and seller type]

Figure 4 shows the total amount of advertisements by session and seller type in each of the PO sessions. There are 3,000 seconds of available advertising for each session and seller type. In the PO-public treatments 84% of the advertisements are for *supers*, while only 8.8% are for *regulars*. In the PO-private treatments, 64.5% of the advertisements are for *supers*, while 21.8% are for *regulars*. These advertisements provide some evidence that sellers understand that buyers cannot determine quality until after a purchase is made.

Examining advertisements by seller type, in the PO-public treatments *super* sellers submit advertisements stating their goods are *regulars* only 3.6% of the time, while *regular* sellers submit advertisements stating their goods are *supers* 80.2% of the time. In the PO-private treatments, these percentages are 3.8% and 42.8% respectively. The "blank" advertisement accounts for 17.5% of the *regular* seller advertisements in the PO-private treatments. In the PO-public treatments there is overwhelming evidence that sellers use their advertisements to mask quality. In the PO-private treatments the evidence is not as strong, but over 42% of the *regular* seller advertisements are untruthful and another 17% are ambiguous. While there are some instances of *super* sellers advertising units as *regulars*, the overall percentage (3.6%) is small across all sessions. We speculate that the *super* sellers are trying to establish a separating outcome in advertising where the *supers* are advertised as *regulars* while the *regulars* are advertised as *supers*.

Given that the advertisements reflect some understanding of the disadvantageous position that buyers face in the PO-private treatment, why then do we observe trades that are unambiguously profitable for the buyer? The likely reason is that sellers, being uninformed about the distribution of costs, are posting prices which they believe to be "high" but which really are not. The information that buyers on average have a value of 2400 for a unit of the good seems to play little to no role in price setting in the PO-private treatment. Thus, the posted-prices are typically below the buyer's redemption value for a *regular* good. Only 26.4% of the posted prices by the 8 *regular* sellers in the PO-private treatment are greater than the buyer's *regular* redemption value of \$12. In the PO-public treatments the corresponding percentage is 93.8%.

In the PO-public treatments, *regular* sellers post initial offers consistent with those of initial offers of *regular* sellers in the PO-private treatment. A Mann-Whitney U-test shows that the median of these initial price distributions are not statistically different ($U_{8,8}=18$, p -value=0.161). However, upon observing other sellers' offers the *regular* sellers in PO-public increase their offers substantially and quickly. In three of the four PO-public sessions all seller offers are at 1900 or above prior to any buyer entering the market, and in the fourth session one seller prices at 1200 for the first 100 seconds of the experiment, then raises his offer to 2100. Thus, the public posting of prices greatly facilitates the ripoffs outcome in that it gives *regular* sellers the knowledge of *super* sellers' prices/costs.

Result 5: *Buyer-seller chat in the TSMN treatment suggests that buyers and sellers understand the problem the buyers face.*

The buyer-seller chats in the TSMN treatment provide some direct evidence as to whether or not the participants understand the asymmetric information problem. There are 20 direct quotations that refer to either the trustworthiness of the seller or the uncertainty of the quality of the unit. While we have not conducted formal content analysis these are very conservative estimates based upon the chats. Examples of such quotes are:

1. TSMN session 1 (Buyer 11 to seller 3): hmmm... more like how much am I willing to loose
2. TSMN session 2 (Buyer 13 to seller 1): how do I know that you are telling the truth, if i accept, and its a reg item i lose almost 2000
3. TSMN session 2 (Buyer 12 to seller 2): oh okay. im just gonna accept right now, i hope its a super but i believe its *regular*
4. TSMN session 3 (Buyer 2 to seller 3): and how do i know you're telling the truth/
5. TSMN session 4 (Buyer 9 to seller 2): umm can i trust you?
6. TSMN session 5 (Buyer 4 to seller 3): u're not lying right

While not all buyers engage in discussion about truth and uncertainty, some buyers directly ask the seller whether or not they have *supers* or *regulars*. There are at least 14 direct instances of this question, most of which fall into one of two categories, "What are you selling" and "Super or Regular". It is interesting to note that after the first few buyers enter their store, sellers of *supers* do not wait for the question, but state immediately that they are selling *supers*. In contrast, sellers of *regulars* rarely make explicit statements concerning quality unless asked and except for 3 instances *regular* sellers do not lie about their quality when directly asked. In accordance with Rosenman and Wilson, this

behavioral difference between *regular* and *super* sellers may be the cue that buyers use to determine which sellers have *supers* and which have *regulars*.

5 Conclusion

Our results indicate that the existence of a lemons market is rather sensitive to the market institution and prevailing information condition. When buyers and sellers engage in our two-sided multilateral negotiations, the market process itself tends to diminish seller ability to sell the buyer a low quality product for a high price. When a posted-offer institution is used, sales of low quality units increase as buyers are now less able to obtain (perhaps tacit) information from the sellers. However, neither the lemons market nor the ripoffs outcome obtains in posted-offer markets unless offers and advertisements are made publicly available to all participants. Thus, we find that asymmetric information is more harmful only when the uncertainty of competitors' prices is resolved. *In other words, seller uncertainty of market prices offsets the asymmetric information problem of the buyers.*

Given that we observe the ripoffs outcome when offers and advertisements are publicly available, it is possible that communication between buyers would lower the amount of ripoffs. In essence, even if buyers are only allowed to purchase one item, it is possible that gossip about a seller would prevent the seller from taking advantage of a buyer due to the buyer network. Indeed, buyers and sellers in our experiment seem to recognize that reputation building could occur in this manner, as there are references in the buyer-seller chat in the TSMN treatments to previous sales to one's "neighbor". Also, it is possible, as practicing advertisers are aware, that if buyers had the choice of purchasing a high quality good or a low quality good with certainty that the buyers may choose the *super* good

simply because it is called a *super*, even though the surplus from the two types of goods is equal. If a buyer network is introduced, it may be that *supers* sell prior to *regulars*.

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Tables and Figures

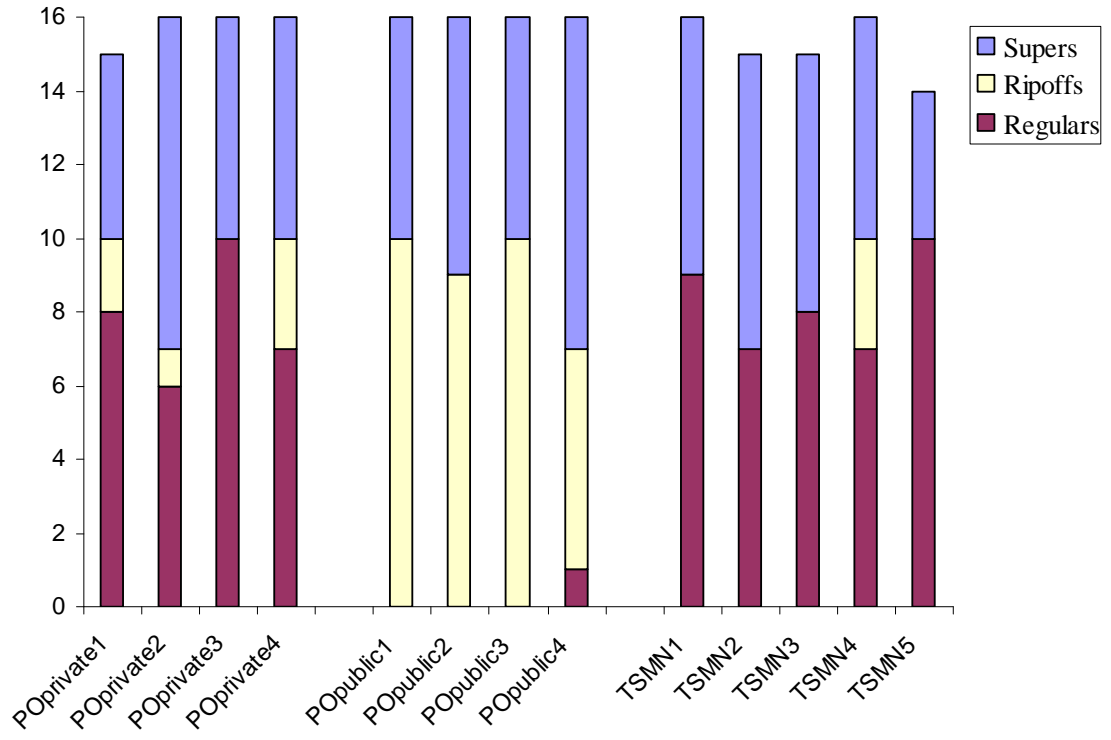
TABLE 1

Average order of sales of super and regular sales across sessions

TSMN	PO-private	PO-public
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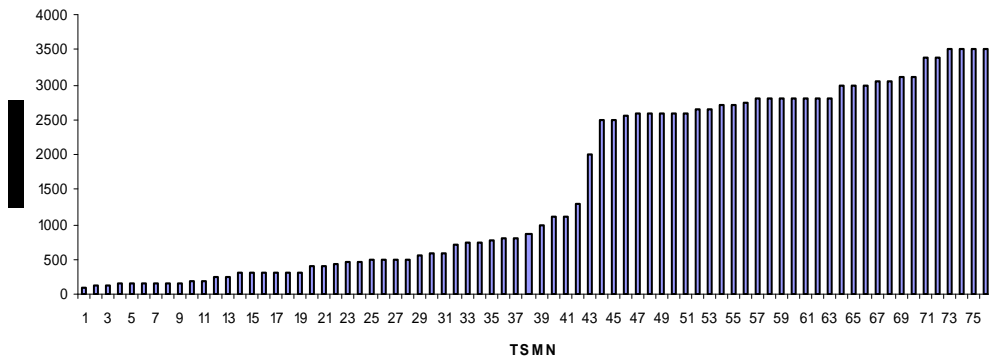
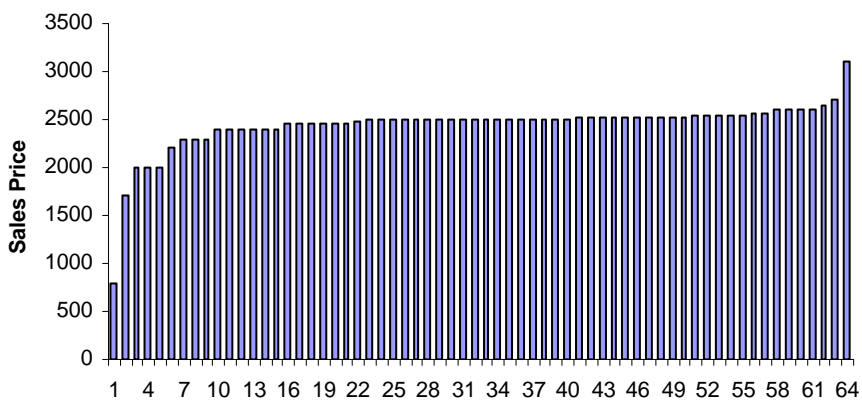
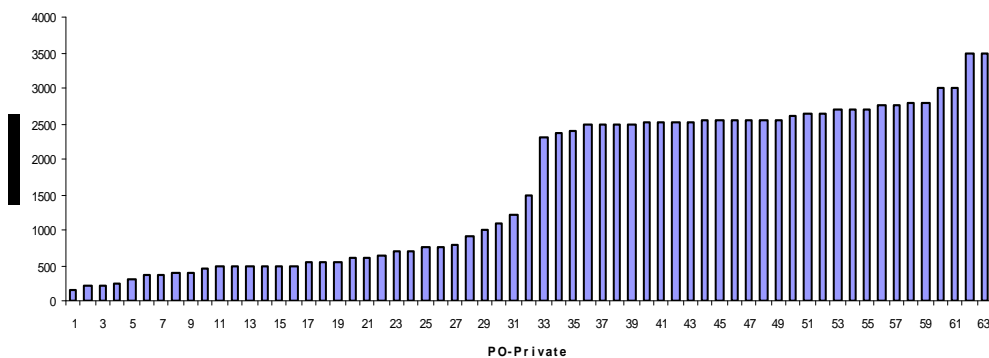
Session	Regular	Super	Regular	Super	Regular	Super
1	8.6	8.4	6.5	11.0	6.3	12.2
2	8.9	7.3	7.7	9.1	5.7	12.1
3	7.4	8.7	7.5	10.2	7.2	10.7
4	6.5	11.8	6.5	11.8	6.1	10.3
5	5.8	11.8	--	--	--	--

FIGURE 1



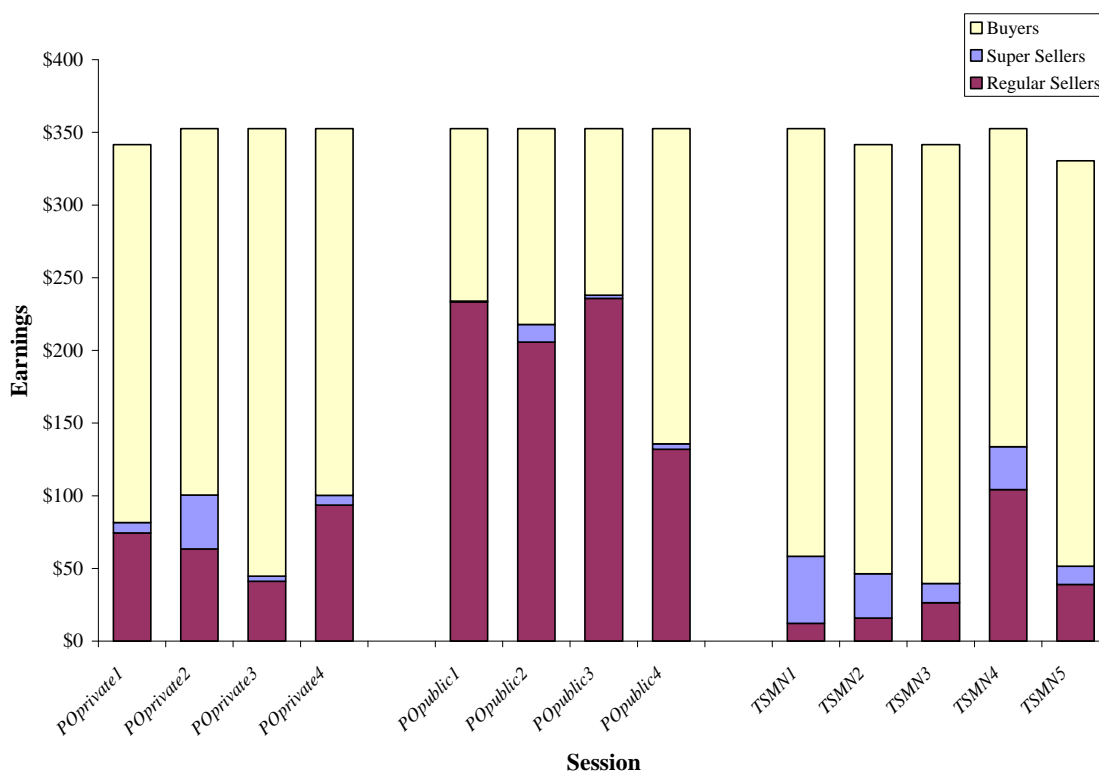
Super, Ripoff, and Regular sales by session

FIGURE 2



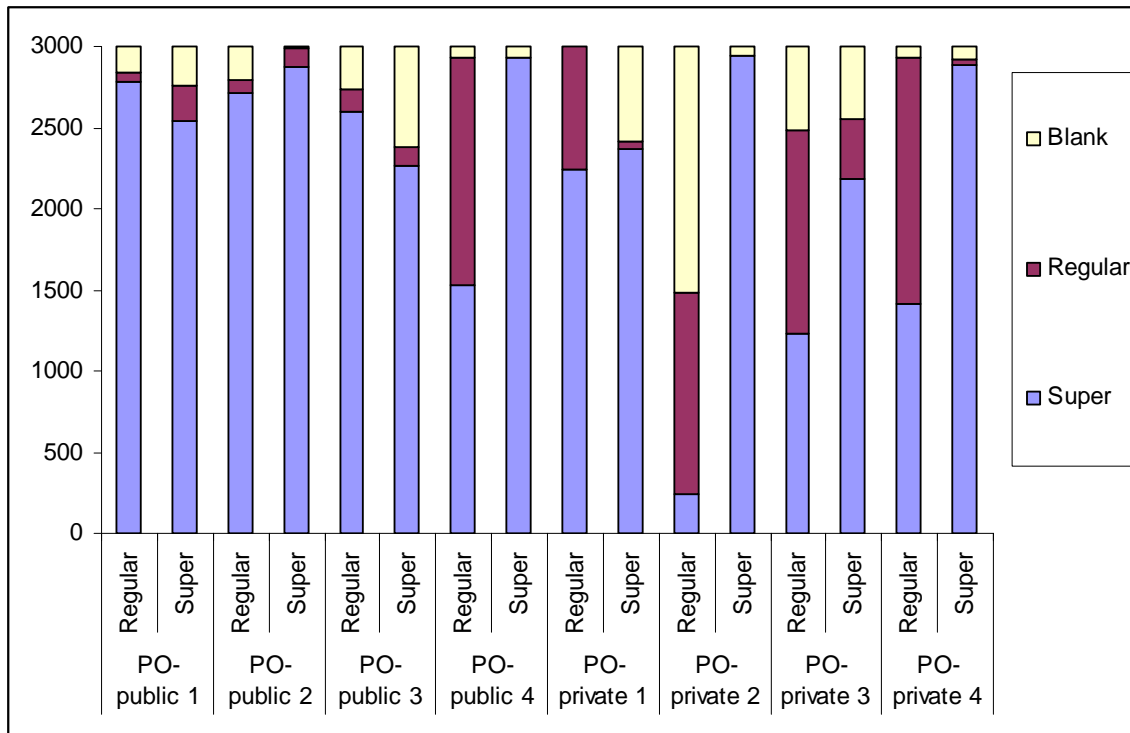
Sales price by treatment in ascending order.

FIGURE 3



Aggregate profits by session and participant type

FIGURE 4



Advertisements by session and seller type