E C O N O M I C S   B U L L E T I N

Non-binding signals: are they effective or ineffectual?

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Abstract

Companies often send non-binding messages to their competitors, to consumers, to channel members and to various other recipients. When such messages are in the form of price signals, they tend to make antitrust authorities uneasy since it is widely believed that price signaling can and does serve as a collusion facilitating mechanism. We conducted experimental posted-offer markets with multiple competitive equilibria, and found that contrary to expectations, markets in which sellers could engage in cheap talk had lower contract prices than markets without cheap talk opportunities.

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1. Introduction

Companies often send non-binding messages to their competitors, to consumers, to channel members and to various other recipients. When such messages are in the form of price signals, they tend to make antitrust authorities uneasy since it is believed that price signaling can and does serve as a collusion-facilitating mechanism.

The theoretical literature on non-binding signaling games makes two opposing predictions. On the one hand, there exists the possibility that market outcomes may be improved when a non-binding signal is transmitted, especially when messages are self-committing (Farrell 1988). On the other hand, "cheap talk" can degenerate into noise because of the ubiquity of non-communicative equilibria: since each player knows that the message sent by the other is non-binding, there is a tendency to disregard the message, and all that is left under repeated play is uncommunicative "noise" wherein the opportunity to send messages does not facilitate collusion.

We used posted-offer markets in the tradition of experimental economics to evaluate, under laboratory conditions, which of these two effects of cheap talk would occur. To accentuate the effects of cheap talk, we used the simple yet elegant "box" market design with multiple competitive equilibria. We found that cheap talk did not serve sellers as a collusion-facilitating device. Instead, seller profits in markets with cheap talk were lower than in markets without cheap-talk opportunities. Contract prices too, were lower in cheap-talk markets. In our experiments, cheap talk did not facilitate collusion in posted-offer markets with real buyers; it was also ineffectual in markets where the demand was simulated.

We note that prior experimental studies on the effect of cheap talk have provided mixed results; see for example reviews by Haan, Schoonbeek and Winkel (2005) and Crawford (1998) on experimental results in cheap-talk games. For the present project, therefore, we used a market design that was meant to be conducive to the emergence of collusion in the presence of cheap-talk opportunities. In the box design (first used by Davis and Williams 1988, and shown in Figure 1), since supply equals demand, so long as sellers set prices lower than buyers' reservation price, all units can be sold. Thus, collusion in prices can readily emerge in this design when sellers have the opportunity to engage in cheap talk. Our experimental markets were thus designed to facilitate collusion; it is interesting to note that in spite of this, we found that contract prices were *lower* in markets with cheap talk compared to markets where cheap talk was not permitted.

2. Method

We used standard posted-offer market procedures (Davis and Holt, 1993) with the box market design. In each market, players interacted in a non-computerized face-to-face setting. Since we were studying the effect of non-binding messages on market outcomes, we had two experimental conditions: in the cheap-talk market condition, sellers were afforded the opportunity to send non-binding messages to each other prior to deciding on their own price; in the markets without cheap talk, sellers did not have this opportunity to pre-announce the price they intended to charge.

In every market, sellers had information on their cost structure and decided on the price they would charge. They were not given any information about the demand in the market.

We conducted two studies using this design with multiple competitive equilibria: Study 1 had real buyers, and Study 2 had simulated buyers.

In Study 1 with real buyers, two sellers and two buyers interacted with each other in each posted-offer market. Buyers were given information on how much they valued the commodity being sold, and each buyer independently decided on the quantity (s)he wanted to buy, the objective being to achieve as high a surplus as possible. Buyers had no knowledge of sellers' costs.

In Study 2, we studied the effect of non-binding messages in the context of simulated demand. In these markets, which had the same demand and supply schedules as the markets with real buyers, there were only sellers and no buyers. Instead, buyer behavior was simulated using the standard buying rule that assumes fully demand-revealing buyers: if a seller posts a price below the reservation price, all her units are sold. Since no buyer withholding is possible under simulated demand, we were able to study the effect of non-binding signals without the influence of strategic buyer behavior.

In all markets, we used standard posted-offer procedures which included trained and supervised research assistants, the reading of instructions at the beginning of each market, a short quiz to test subjects' comprehension of these instructions, and debriefing at the end of the game. Practice sessions were also conducted as trial periods in each market to ensure that there was no confusion about the posted-offer experimental procedure in subjects' minds.

3. Findings

3.1 Prices lower with cheap talk

We see from figure 2 that contract prices were significantly *lower* when sellers engaged in non-binding price signaling ($p^{contract}$=9.22, $p^{contract}_{signal}$=7.84, significantly different at $p < .01$). This result is quite contrary to what antitrust authorities are wary about. Similar results were observed when buyer behavior was simulated, as seen in figure 3 ($p^{contract}$=10.74, $p^{contract}_{signal}$=10.00, $p < 0.05$).

Even if we consider stabilized prices in the terminal stages of the games, *lower* prices were observed when sellers were permitted to engage in cheap talk (see figure 3: $p^{c(terminal)}$=11.46, $p^{c(terminal)}_{signal}$=10.75, $p<0.05$). The finding that prices are lower when sellers engage in non-binding signaling is noteworthy from an antitrust point of view. Consumer advocates and antitrust authorities have often maintained that the posting of intended prices results in higher prices to consumers. Our research suggests the reverse appears to be true: affording sellers the opportunity to transmit non-binding messages resulted in significantly lower prices to the buyer.

One might wonder why the prices in figures 2 and 3 are below the unit production cost p_{sc} in the early stages of the games. This is because the prices shown are average *contract* prices and not *posted* prices. Average contract prices[1] were depressed for various reasons, as clarified through figure 4 which depicts a representative posted-offer market *PO*-211 with real buyers. Prices posted by both sellers in this market were well above the unit production cost p_{sc}=\$9.00. In period 4, Seller 1 posted a price of \$11.50, which corresponded to the buyers' reservation price[2] p_{ne}, so this offer was accepted, as indicated by the '+' sign in the figure. Seller 2 posted a price of \$12.00, which was higher than the buyers' reservation price of p_{ne}=\$11.50 so there was no sale, as indicated by the '-' sign. Thus, when sellers priced above buyer valuations, units were not traded, which resulted in depressed mean contract prices. Sometimes buyers refused to buy even at reasonable prices; such behavior too had the effect of depressing contract prices. For instance in period 16, both sellers posted a price of \$11.00, but there was no sale, even though the posted prices were lower than the buyers' reservation price p_{ne}=\$11.50. Reacting to this, Seller 1 immediately lowered his price in the next period and made a sale.

3.2 Volume traded lower with cheap talk

Interestingly, as seen in figure 5, fewer units were bought when sellers engaged in non-binding price signaling (v=3.96, v_{signal}=3.36, $p < 0.01$). This reflects an attempt by buyers to punish sellers in the signaling condition for setting higher prices in the first place.

Figure 6a provides more clarity to this issue. Posted prices were clearly higher when signaling opportunity was provided (p=10.73, p_{signal}=11.39, p<0.05). Sellers used the signaling opportunity and urged the other seller to price higher. As prices climbed higher, buyer withholding was more severe as buyers cut down on the number of units purchased. In figure 6b we see prices posted by a seller in a representative market *PO*-112. In the first period, the seller initially announced a price of \$20 but immediately reneged on his promise by posting a price of only \$15. This is what typically happened in every market, causing non-binding messages to lose their impact over time and deteriorate into meaningless "babbling". In subsequent periods, the seller can be seen urging his competitor to post higher prices by announcing in each period a price higher than the posted price of the earlier period.

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[1] We use the standard definition of contract price, namely the price at which the contract for a sold unit is struck in a market. It is computed as the total revenue generated in the market for any given period divided by the total number of units sold in that period. It is different from the posted selling price since it is meant to capture the average price of a *sold* unit.

[2] A price of \$11.50 also corresponds to the Nash equilibrium of the stage game in the box design since neither seller has an incentive to deviate from this price given that the other seller prices at p_{ne}. It is also the highest competitive equilibrium price. As mentioned earlier, in the box design with its constant marginal valuation and cost structure, sellers can use cheap talk to coordinate on any of the multiple competitive equilibria in the [p_{sc}, p_{ne}] range.

3.3 Buyer profits higher in cheap-talk markets

Buyer profits were *higher* when sellers were permitted to transmit non-binding price signals in markets with simulated buyers (π^{buyer}=0.92, π^{buyer}_{signal}=2.49, p<0.01). In markets with real buyers, buyer profits in the two conditions were not significantly different (π^{buyer}=4.14, π^{buyer}_{signal}=4.43, *ns*). Also, as seen in figures 7a and 7b, seller profits were lower when cheap talk was permitted (π^{seller}=11.70, π^{seller}_{signal}=9.56, p<0.01 in simulated-demand markets and π^{seller}=5.77, π^{seller}_{signal}=3.96, p<0.01 with real buyers). This could lead one to question whether such signaling can serve as an effective collusion-facilitating mechanism. These findings are contrary to the claim by consumer advocacy groups that allowing sellers to send non-binding signals is detrimental to consumers.

3.4 Efficiency lower in cheap-talk markets

We found that signaling led to a loss of efficiency in our experimental markets. Efficiency was computed as the percentage of maximum surplus extracted, and we found that markets devoid of signaling opportunities tended to be more efficient than markets with signaling opportunities, largely because of the trading loss in the signaling condition. This result was more pronounced in Study 1 where we had real buyers, since buyer withholding came into play (e^{real}=65.81%, e^{real}_{signal}=55.73%, p<0.01). It was not as pronounced for the simulated demand setting in Study 2; here, markets with and without signaling opportunities were not significantly different in terms of their mean efficiencies. ($e^{simulated}$=84.17%, $e^{simulated}_{signal}$=80.37%, ns).

4. Conclusion

In our markets, as hypothesized, the Nash equilibrium did seem to exert a gravitational effect on prices since prices tended to gravitate upwards with repeated play. When signaling opportunities were available, sellers appeared to urge the other seller to raise prices in an attempt to boost profits. However, these signals disintegrated into meaningless “noise” and lost their effectiveness as the game progressed. Fewer units were traded when sellers engaged in price signaling, reflecting an attempt by buyers to punish sellers for setting higher prices in the signaling condition.

While consumer advocates and antitrust authorities have feared that price signaling results in higher prices paid by consumers, the reverse effect was observed in our studies. Affording sellers the opportunity to transmit non-binding price signaling messages resulted in significantly lower prices to the buyer. An analysis of equity effects showed that the distribution of surplus was tilted in favor of buyers in the signaling condition, another finding noteworthy from the antitrust point of view. In both our studies, buyer profits were higher and seller profits lower, when sellers were permitted to engage in non-binding price signaling, which could lead one to question allegations that such signaling is a collusion-facilitation mechanism.

Of course, we do acknowledge that laboratory markets are far removed from real-world markets and extreme caution should be exercised in extrapolating findings from experimental studies to real life situations. Our study is, to use Roth’s words, meant to be "part of the dialogue that experimenters carry on with one another" rather than "whispering in the ears of princes." [3]

[3] Roth 1995 (p 22) uses "Whispering in the Ears of Princes" to refer to a dialog between experimenters and policymakers, i.e. experiments motivated to answer questions raised by regulatory authorities.

Figure 1

Multiplicity of Equilibria Design

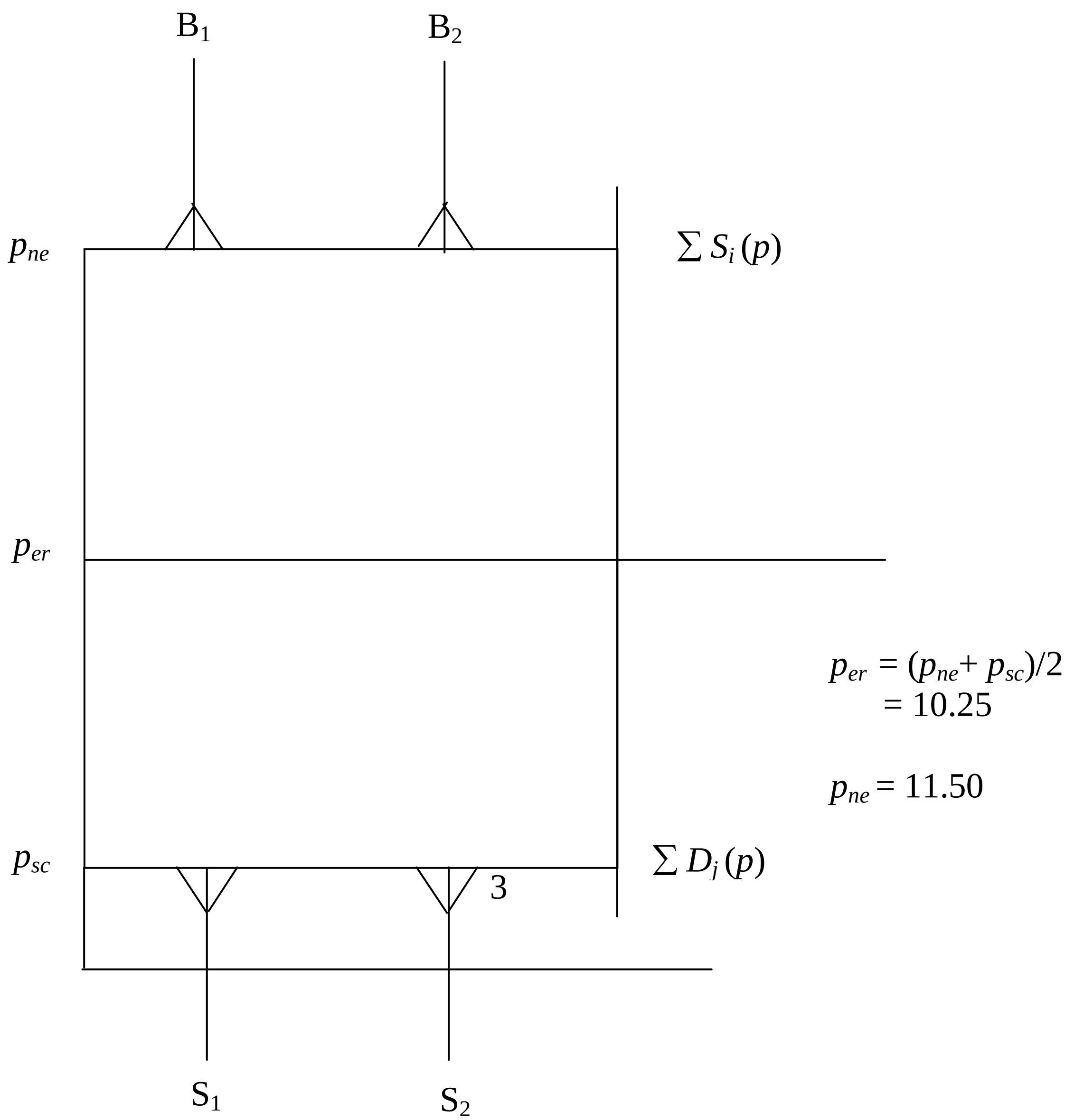


Figure 2
MEAN CONTRACT PRICES - REAL BUYERS

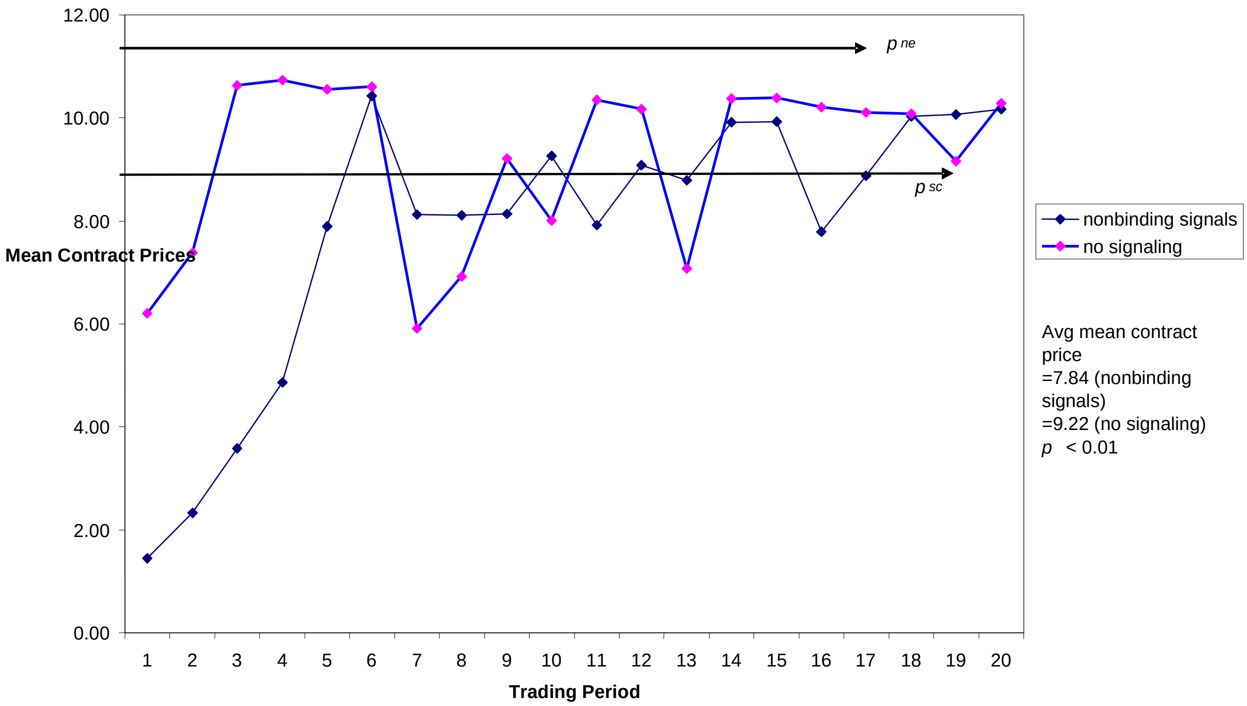


Figure 3
MEAN CONTRACT PRICES FOR SIMULATED BUYERS

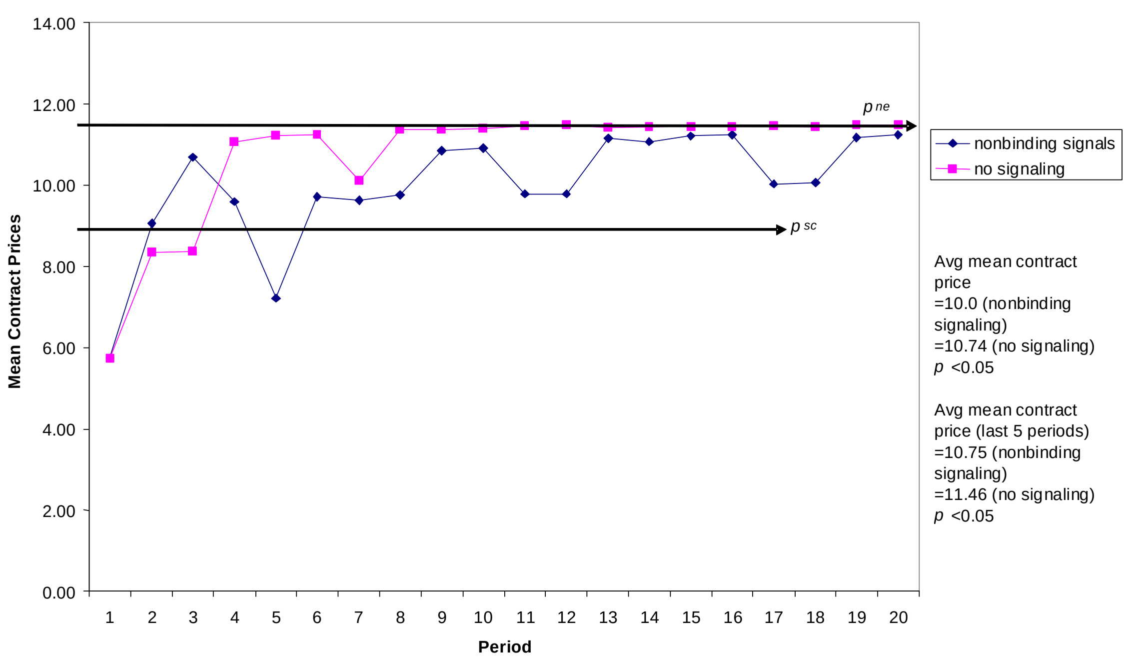


Figure 4
PO-211 MARKET

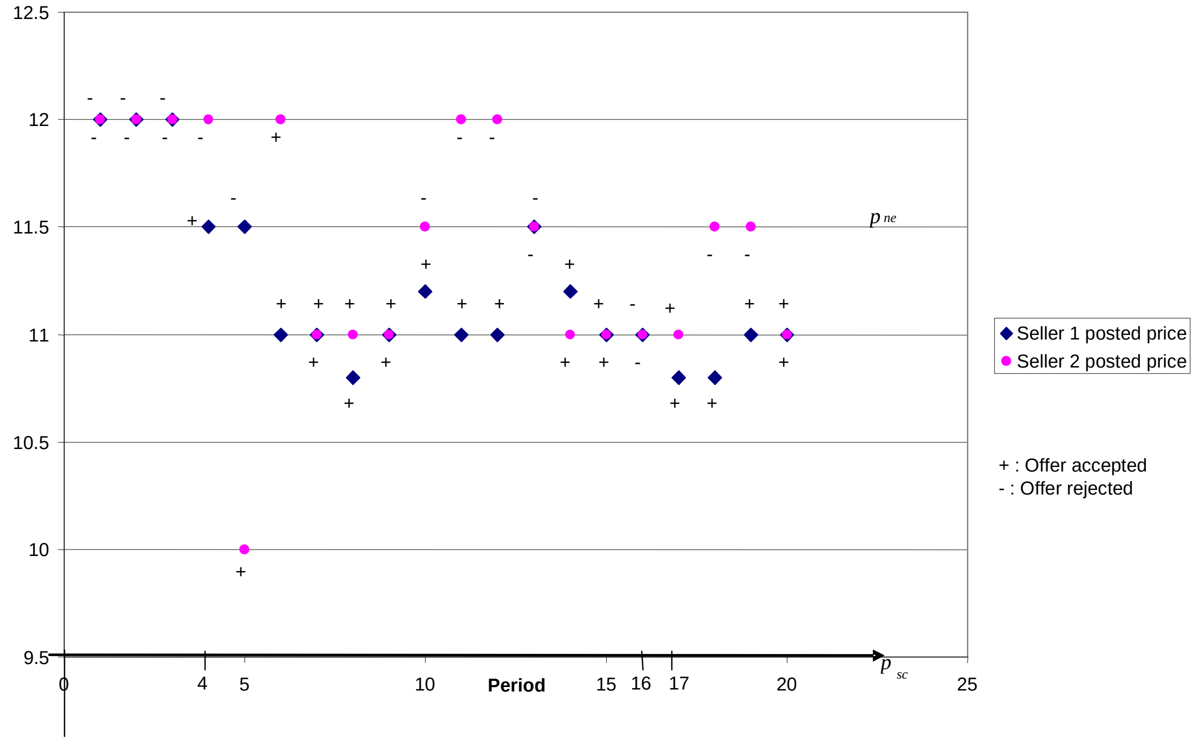


Figure 5
Volume Traded

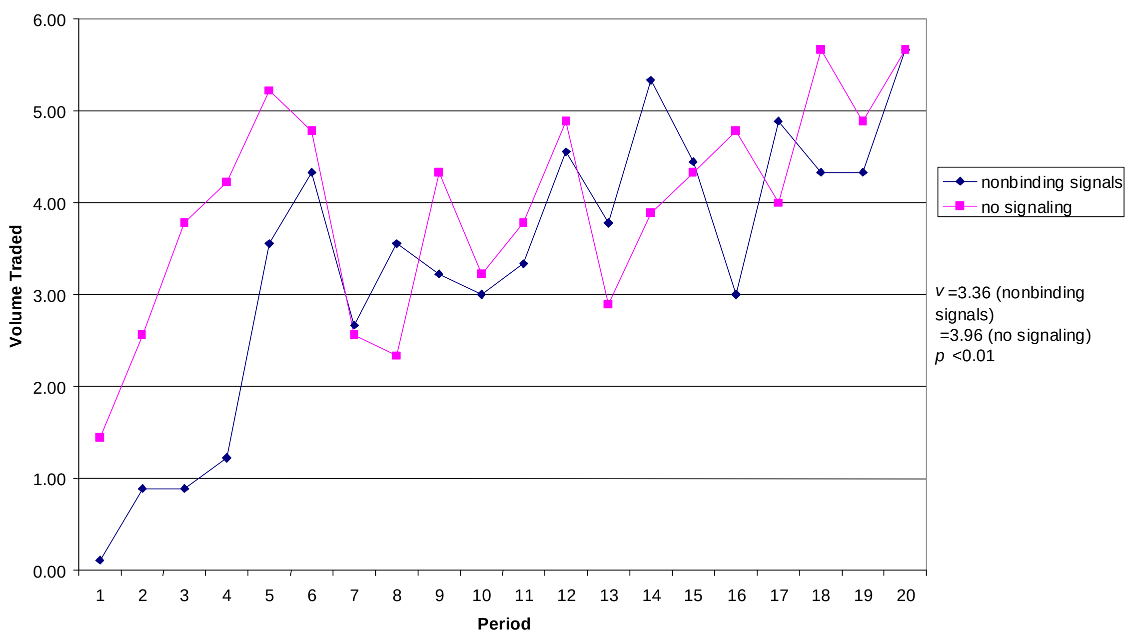


Figure 6a
Posted Prices (real buyers)

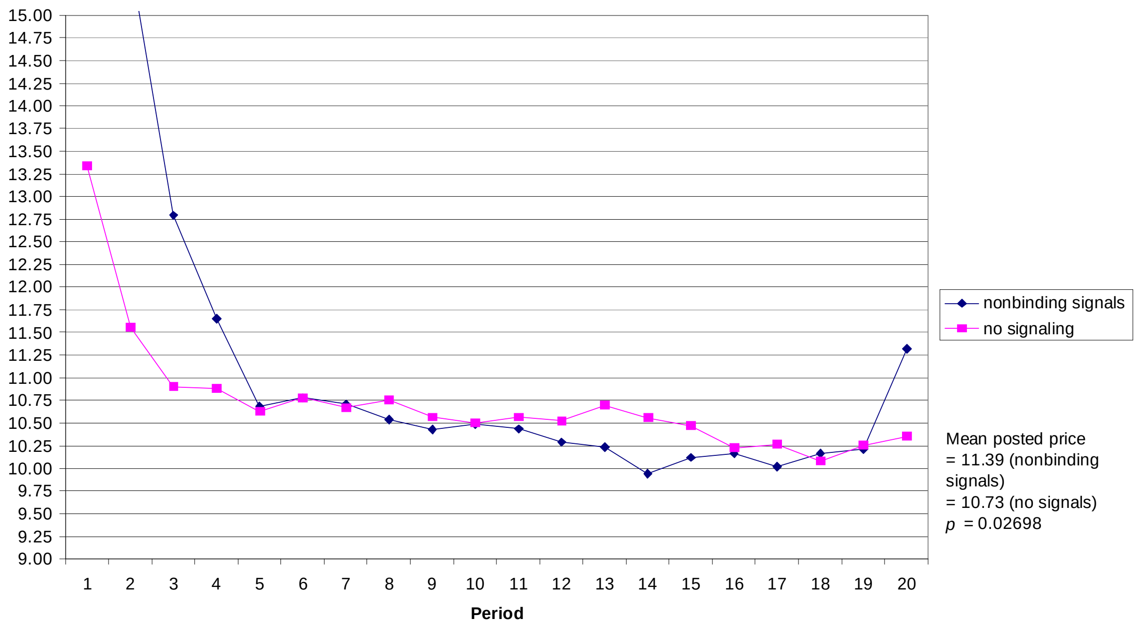


Figure 6 b
PO-112 MARKET, S2

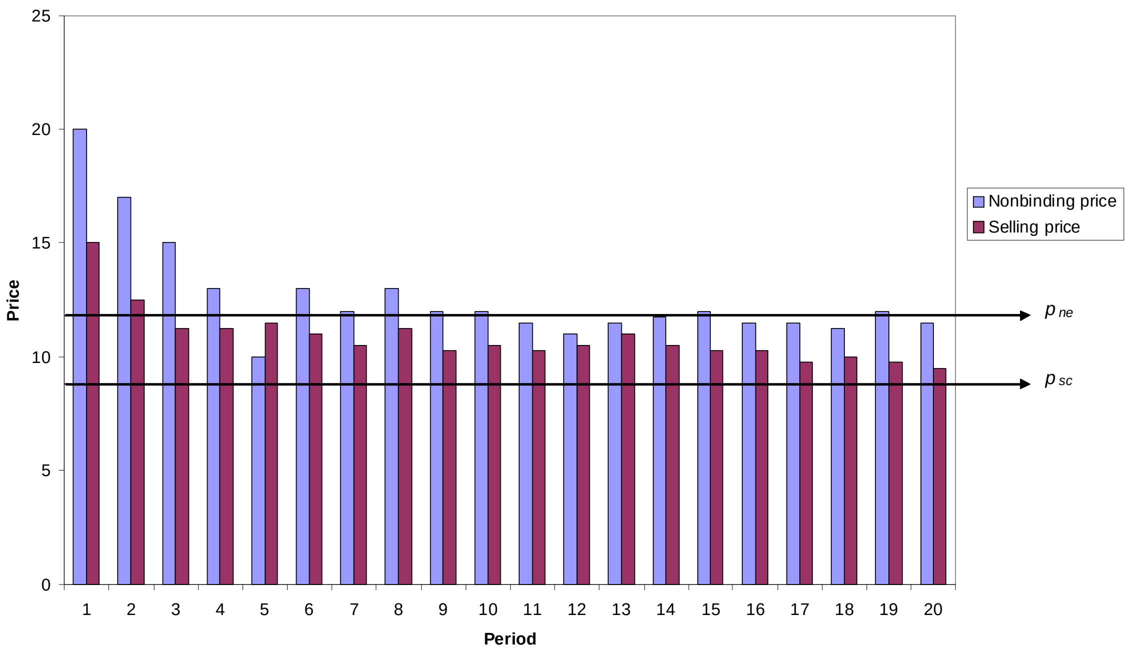


Figure 7a
Seller Profits for Simulated Buyers

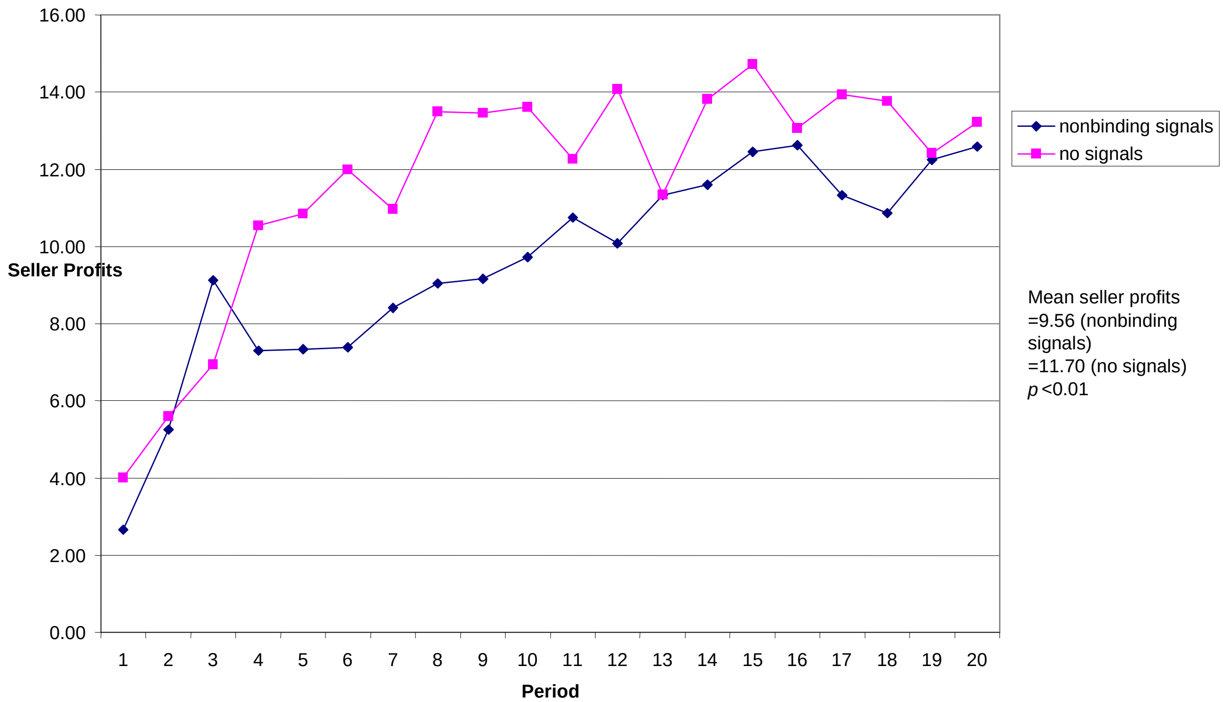
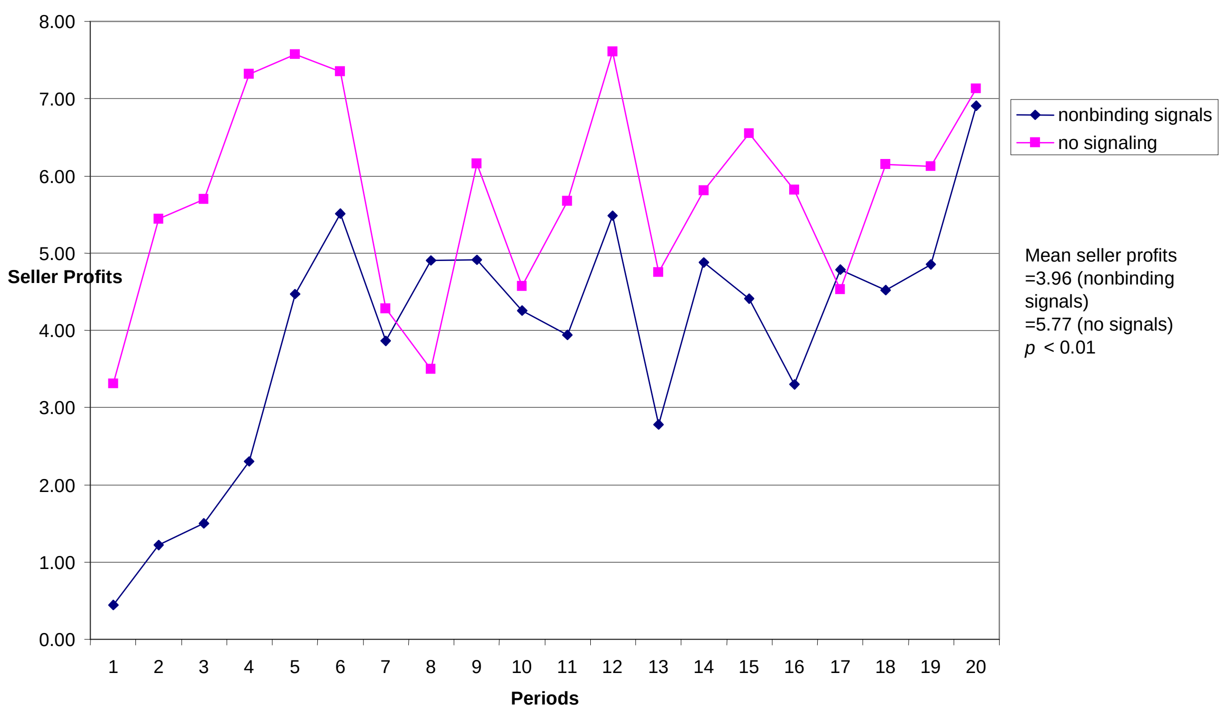


Figure 7b
Seller Profits for Real Buyers



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