Preliminary

Bargaining versus Posted Price Competition in Customer Markets

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Abstract:

We compare posted price and bilateral bargaining (or "haggle") market institutions in 12 pairs of laboratory markets. Each market runs 50-75 periods in a customer market environment, where buyers incur a cost to switch sellers. Costs evolve following a random walk process. Coasian and New Institutionalist traditions provide competing conjectures on relative market performance. We find that efficiency is lower, sellers price higher, and prices are stickier under haggle than under posted offer.

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1. Introduction

The ancient practice of price negotiation, or haggling, has largely been replaced in industrialized societies by posting of prices by sellers. Posted pricing saves on time cost of haggling, a tremendous advantage in retail markets. (Imagine having to negotiate individual prices for every item you purchased at the supermarket!) However, haggling has not entirely disappeared and, beyond time costs, it is not clear which institution better promotes efficiency. Nor is it clear how the two institutions influence the division of surplus. Such questions become increasingly relevant as electronic commerce transforms transaction costs, including time costs for negotiations, which can be conducted now by "shop bots" (e.g., Eisenberg, 2000).

Laboratory comparison of market institutions has a glorious history going back at least to Plott and Smith (1978). The laboratory is especially appropriate for our questions because it allows control of key features such as time costs that confound inferences from field data.

In the present paper we compare the efficiency, profit distribution and price dynamics of the two market institutions, seller posted offer and a bilateral bargaining institution called "haggle." In the haggle institution, as in the continuous double auction, each buyer and seller can continuously improve her own offer or accept a counterparty offer at any moment during a trading period of known duration. Unlike the continuous double auction, each offer in haggle is extended only to a single counterparty, not to all possible counterparties. In the posted offer institution, sellers post a single take-it-or-leave-it price each period, which buyers either accept or reject.

The laboratory environment is a "customer" market, a term coined by Okun (1981). Each buyer is attached to a particular seller and must pay a switch cost to transact with another seller. Switch costs are important in labor markets (where they include search, relocation and retraining) and in many intermediate and wholesale markets, and are present even in retail markets (think of the shopper's extra time cost in an unfamiliar supermarket). Customer markets are the natural habitat for haggle, since starting negotiations with a new counterparty normally entails some setup cost. The posted offer institution is also common in customer markets and has already been studied in the laboratory (e.g., Cason and Friedman, 2000).

Our laboratory study spotlights conflict between two popular views on what facilitates efficient trade. A strong oral tradition rooted in Coase (1960) holds that parties will find ways to exhaust mutual gains unless artificial barriers are imposed (De Meza, 1987). The continuous bargaining protocol in haggle imposes fewer barriers than the unilateral, one-shot, take-it-or-leave-it offer allowed in the posted offer institution, so haggle should be more efficient. By contrast, new institutionalists might see the posted offer institution as a solution to the "fundamental problem of commerce," the tendency of buyers and sellers to underreveal their willingness to transact in order to extract more favorable prices (e.g., Milgrom and Roberts, 1992). Posted offer constrains these tendencies more than haggle and hence should facilitate more efficient exchange. According to this view, sellers' commitment technology in posted offer should allow them to extract a larger share of the surplus than in haggle, where constraints and bargaining opportunities are more symmetric.

The two market institutions are of special interest from an historical or evolutionary perspective. Haggle spans the gap between pre-market gift exchange and early organized marketplaces. Historically it has tended to be displaced by more complicated or structured forms

of exchange like posted offer (North, 1991), but it still holds a major share in modern economies (e.g., procurement, car dealers, and wholesale transactions) as well as in traditional economies like Morocco (Geertz et al., 1979). In the field, transactors' time costs are higher for haggle than for posted offer. Time cost doubtless is an important reason why posted offer has gained share for small ticket standardized items, which are relatively prevalent in modern economies. But what else is at stake? For example, perhaps sellers favor posted offer because it allows them to extract a larger share of the surplus. In the laboratory we can equalize the time cost to test such conjectures and thus better understand the forces driving the evolution of market institutions.

The customer market environment also provides a non-trivial setting to study price dynamics.

Do transaction prices track competitive equilibrium prices when sellers' production costs change, or are transaction prices sticky? Early work by Scitovsky (1952) attributes price stickiness to switch costs based on a modified kinked demand model. This and later models don't clearly predict which market institution will have stickier prices. Do sellers price discriminate between attached customers and new customers? Theoretical work by Klemperer (1987) suggests that if sellers are unable to discriminate between attached vs. unattached customers (as with our posted price institution), they will compete vigorously early on and raise prices once they achieve a base of attached customers. Taylor (1999) examines subscription markets, such as banking and long-distance telephone service, and shows in a variety of settings that firms will offer lower prices to new customers. Our experimental framework provides a controlled setting in which to examine such price discriminatory behavior. We compare the two institutions in these important dimensions as well.

Laboratory researchers have studied the posted offer institution extensively; see Holt (1995) for a survey of work from see Plott and Smith (1978) and Ketcham et al. (1984) up through the early 1990s. These studies confirm that the posted offer institution does allow sellers to extract a greater share of the surplus than do more symmetric trading institutions such as the continuous double auction. Efficiency also is lower in posted offer, but both effects tend to decline over time in the repetitive stationary environments used in most of these studies. It isn't clear whether these results extend to customer market environments with switch costs and with changing seller costs each period.

Laboratory studies of pairwise bargaining (e.g., Roth and Murnighan, 1982) also have a long history, ably surveyed in Roth (1995). Almost no studies embed continuous bilateral bargaining in a multilateral market context, as we do in the haggle institution. One exception is Hong and Plott (1982). Motivated by a proposal that barge operators file rates with the Interstate Commerce Commission, this experiment compared free-form (telephone) negotiations with posted offer trading. The same 33 subjects (22 sellers and 11 buyers) participated in the four sessions, which were conducted in the trading institution sequence Negotiation—Posted Offer—Posted Offer—Negotiation. Hong and Plott's environment and institutions differ from ours in many ways, such as in the number of traders, demand shifts instead of variations in costs, few restrictions on the negotiation message space, and verbal instead of computerized negotiation. It is therefore not surprising that their results differ from ours. They find that relative to negotiation, price posted leads to higher prices, lower volume, and reduced efficiency.

A series of papers by Davis and Holt (1994, 1997, 1998) are also relevant for our comparison on posted offer and haggle, since they take a small step toward introducing negotiation in a standard posted offer, multilateral market context. Their posted offer markets

featured a single round of structured negotiation. Buyers could "request" a discount, and sellers could offer a single, private discounted price. As in haggle, this allows sellers to price discriminate. In order to limit buyers' incentive to cycle through sellers repeatedly, the authors introduce a small (5 or 10-cent) switching cost. Davis and Holt find that the opportunity to offer secret discounts increased the variance of market outcomes (1994), did not substantially improve market performance in a nonstationary environment (1997), and led to the breakdown of explicit cartel agreements (1998).

The next section describes our experiment, which includes twelve matched pairs of sessions for the two trading institutions. Each session has two or three runs of 25 trading periods. Sessions differ by switch cost (zero, low or high) and trader experience. The following section presents the results. It turns out that posted offer is (economically and statistically) significantly more efficient than haggle. A decomposition of efficiency losses shows that, consistent with the new institutionalist view, the dominant source of lower efficiency is low volume; that is, traders in haggle more frequently fail to complete mutually beneficial transactions.

We also compare market power across institutions, measured as seller markup over the competitive equilibrium price. Contrary to the new institutionalist view, markups are significantly higher in haggle than in posted offer. Markups also increase with switch cost and experience.

The data show consistently higher markups for attached customers than new customers, consistent with the Taylor and Klemperer models, and this price discrimination is stronger in haggle. Prices are indeed sticky, and more so in haggle than in posted offer markets. Finally, we find that buyers switch to new sellers less frequently in haggle.

The last section summarizes the results, offers some interpretations and conjectures, and suggests new avenues of investigation. Instructions to subjects are attached as Appendix A.

2. The experiment

The main treatment variable is the market institution. In the posted offer treatment each seller enters a single take-it-or-leave-it price, and each buyer purchases at most one indivisible unit from one seller at that seller's posted price. In the haggle treatment each seller posts an opening "list" price that serves primarily as a starting point for negotiations with individual buyers. Each negotiating buyer-seller pair sends binding price offers to each other in a negotiation window. The negotiation window is a java applet, and only the two parties to the negotiation observe it. Negotiation is "free form" in the sense that either party can send an offer at any time, and either party can accept the other's offer at any time. We did restrict the message space to prices (dollars and cents), however, and sellers could not offer prices above their list price and could not raise subsequent offers within a negotiation period. Likewise, buyers could not lower subsequent offers within a negotiation period.

To create a customer market, we introduce attachments and switch costs. Each buyer begins each period attached to some seller, whose posted or list price she observes costlessly. In order to see other sellers' prices or initiate negotiations with a new seller she must sink a switch cost $C \geq 0$. If she does so she observes the offer or list prices for all sellers (who are not further identified). In the posted offer treatment she can then accept any of these prices; in the haggle treatment she can initiate negotiations with any one of the sellers. She enters the next period attached to the seller she purchased from most recently. Thus the switch decision is a more inclusive version of search. Switch cost C is constant across buyers and periods, and is publicly

announced before the first period. It is varied across sessions at three levels: zero (a baseline for comparison), low (20 cents) and high (50 cents, well over half the median surplus in a transaction).

Customer markets feature long term but impermanent attachments. To discourage permanent attachments, the experiment introduces random production cost innovations. In each session the production costs follow a random walk with a mean zero additive innovation to marginal production cost each period. In particular, seller *j*'s cost in period *t* evolves randomly according to $c_{jt} = c_{jt-1} + e_{jt}$, where the innovations e_{jt} are the sum of two components, one common to all sellers drawn from U(-15, 15) and one independent component drawn from U(-5, 5). The larger correlated component keeps sellers' costs closer together in later periods. To sharpen comparisons across institutions and across switch costs, we used the same sequence of random shocks e_{jt} for all sessions with the same experience and cost process conditions. The realized cost sequences are shown in Figures 1 and 2.

To summarize the two market institutions, consider the following timelines for each trading period.

Posted Offer	Haggle
Sellers learn own production cost *c*	Sellers learn own production cost *c*
Sellers post prices	Sellers post list prices
Buyers observe own seller's price	Buyers observe own seller's list price
Buyers may choose to switch (at cost *C*)	Buyers initiate negotiations with own seller; may choose to switch to negotiate with another seller (at cost *C*) at any time
Buyers accept or reject seller offers	Through bilateral negotiation sellers and buyers may reach transaction terms

Median transaction price announced to all	Median transaction price announced to all
Buyers forecast upcoming median price	Buyers forecast upcoming median price

In the posted offer treatment the period is over after each buyer has either rejected all available price(s) or else accepted one of the posted prices she sees (that of "her seller" if no switch, or all prices if she chose to switch). In the haggle treatment the period is over when the 60-second negotiation period ends.[1] Then the sellers and buyers view interim screens that summarize their own activity in that period and their own cumulative profit, as well as the median transaction price (across all sellers) for that period. We ask buyers to forecast the next period's median transaction price, at the same time that sellers are posting their prices for the period. The buyer with smallest absolute forecast error totaled over all periods earns a modest prize ($5.00).

Each session is divided into runs of 25 periods, and buyers and sellers are randomly re-matched to new trading partners at the beginning of each run. Each session has three sellers who produce to demand (i.e., no inventories) at a uniform (constant) marginal cost each period and no fixed cost. Each seller's capacity is 3 units, so the maximum quantity that sellers can supply in total is 9 units per period. Five buyers each demand only one unit per period.[2] Buyer values are constant over each session at 300, 275, 250, 225, and 200 cents. At the end of each 25 period run, assignments of buyers to these values are rotated and attachments are reinitialized. Figure 3 displays the supply and demand for an example period.

Table 1 summarizes the 24 sessions. The design is balanced, with equal numbers of sessions in each trading institution and switch cost treatment. Identical software was used at all

[1] In the first few periods of each session we let the negotiation period run for 90 or 120 seconds. The extra time allows subjects to "warm up" to the negotiation process that is structured by the computer program.

[2] If buyers try to accept more units than a specific seller has offered, then in the posted offer treatment the buyers who transacted most recently with that seller receive priority. Any remaining units are awarded first come first

sites. Experienced subjects participated in an earlier session listed in the table, at the same site and in the same trading institution. We were able to complete more periods in the experienced sessions because the experienced sessions required a significantly shorter instructional period. Subjects typically earned between $20 and $30 for these sessions, which lasted about two hours (including instructions). Half of the data (the posted offer treatment) were reported previously in Cason and Friedman (2000). This earlier paper focused on other research issues, such as the role of information differences and changes in random cost sequences on market outcomes.

3. Results

This section begins with an overview of the data, and then compares relative market efficiency, market power, and price stickiness. We can use sharp matched pair hypothesis tests for the comparisons because seller costs follow identical price paths in the two market institutions.

Figures 4 and 5 provide a summary of market behavior in the latter periods of sessions with 20 cent switch cost and experienced players for the posted price and haggle markets, respectively. Open circles represent unsold offers or list prices and filled circles represent completed transactions. A horizontal bar in each period shows the competitive equilibrium (CE) price. Transaction prices stay at a fairly constant level in both cases, remaining well above CE prices.

In the absence of switch costs with inexperienced traders, there is a sharper contrast across institutions. Figure 6 shows the latter periods of one such session for the posted price institution. Here transaction prices closely follow the CE price, with the exception of one buyer in periods 30-35 who accepted higher prices from his seller. In the corresponding haggle session

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served, and in the haggle treatment all units are always awarded first come first served.

shown in Figure 7, however, prices exhibit a much looser relationship with CE prices. Prices vary in the same range over periods 26-41 despite changes in costs, and most prices remain well above the CE price in all periods. Sellers in this market are able to negotiate substantial markups in spite of buyers' ability to switch freely among sellers.

3.1 Efficiency

Inefficiency, the loss of potential gains from trade, has two main sources in most markets. Volume (V) or undertrading losses occur when a buyer and seller who could profitably transact in competitive equilibrium fail to do so. Extramarginal (EM) losses occur when a buyer or seller transacts who would not do so competitive equilibrium, thereby displacing a more profitable trade (Cason and Friedman, 1996).[3] Customer markets open a third source of inefficiency, the switching costs incurred by buyers.

Table 2 reports mean efficiency losses by source for each treatment. Efficiency and efficiency losses are listed as percentages of potential surplus, so in competitive equilibrium efficiency would be 100 and all three losses would be 0. Efficiency is lower than in many laboratory markets, ranging from 78 percent in experienced high switch cost haggle sessions to 95 percent in experienced zero switch cost posted price sessions. As in previous experiments (e.g., Ketcham et al. 1984), efficiency increases with experience in the posted offer institution. Notably, average efficiency does not increase with experience in haggle. More importantly, with the exception of inexperienced zero switch cost session, efficiency is always lower in haggle than in

[3] Assigning inefficiency to these two classes is straightforward if no extramarginal units trade but trading volume falls short of the efficient level (V inefficiency), or if trading volume equals or exceeds the efficient level and efficiency is not 100 percent (EM inefficiency). If trading volume is less than the efficient level *and* any extramarginal units trade, however, both kinds of inefficiency arise and there is no unambiguous way to allocate losses to each class. In these circumstances (which are relatively rare in the data), and extramarginal unit has displaced an inframarginal unit (EM inefficiency) and another inframarginal unit has failed to transact (V inefficiency). The ambiguity arises because we cannot identify which inframarginal unit to assign to each class. We therefore assume that each of these units is equally likely to be displaced by the extramarginal unit, so we

posted offer, usually 5 to 10 percentage points lower. The trading institutions have no consistent difference in switch costs or EM losses, but there is a striking difference in V losses in experienced sessions: 1 to 3 percent in posted offer versus 8 to 10 percent in haggle.[4]

Table 3 confirms that the difference is statistically significant. It reports a very conservative test, the non-parametric signed rank test on paired session means. The paired sessions (one posted offer, the other haggle) have identical switch costs, experience and (where possible) site, and differ only in the trading institution. To ensure statistical independence, only one observation per session (the overall mean) is used for each (in)efficiency measure. Even with only 12 observations, these tests reveal that overall efficiency is lower for haggle at the one-percent level of significance. Extra-Marginal inefficiency is not significantly different by trading institution, but the switch inefficiency is marginally greater in the posted offer institution (the *p*-value slightly exceeds 10 percent). The most significant source of efficiency difference is volume inefficiency (p=0.1 percent), confirming that the lower efficiency in haggle is mainly due to trading volume losses.

Table 4 provides a parametric decomposition of the efficiency losses, based on a tobit model with separate observations for each period. The tobit specification accounts for the restriction that efficiencies are bounded above by 1 and inefficiencies are bounded below by 0. To model the dependence of a session's outcomes across periods, we employ a random-effects error structure, with each session-run as a random effect. The point estimates for the haggle dummy indicate that efficiency is 5 percentage points lower than with posted prices and volume losses are

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compute the EM inefficiency and V inefficiency using the average value of the untraded inframarginal units.

[4] Some of these haggle inefficiencies from low trading volume could be due to "deadline effects" in the bargaining (Roth et al., 1988). As in previous bilateral bargaining experiments, our subjects frequently reached agreement within the last few seconds of the trading period. Low volume could arise if sometimes traders hold out for their counterparty to concede in the last few seconds, but that concession does not materialize. We leave an analysis of

5 percentage points higher, while other losses differ insignificantly. These regression results also indicate that overall efficiency is 6 to 8 percent lower in the treatments with positive switch costs, not surprisingly due mainly to greater switch inefficiency. The point estimate indicates 3 percent greater efficiency in experienced sessions, but it is not statistically significant.

3.2 Market Power

Next we examine relative market power, measured as mean markup of transaction prices over the competitive equilibrium price. The results are reported in Table 5. In both institutions, markup increases with the switch cost and (perhaps surprisingly) with experience; the sole exception is the experienced, high switch cost sessions. In every treatment, markup is higher in haggle than in posted offer, and usually at least 50 percent higher. Another paired signed rank test (again with each pair of matched sessions contributing one statistically independent observation) confirms that markups are significantly higher in haggle (Wilcoxon sum of signed ranks=8, n=12, p=0.012).

Table 6 provides a closer examination of these effects, with correction for autocorrelated errors (i.e., for possible price stickiness as discussed below). The dependent variable is seller markup, mean transaction cost minus competitive equilibrium price. Both switch cost dummy variables are highly significant, indicating markups roughly 12 cents higher for positive switch cost treatments. The fact that the interaction terms are insignificant suggests that the impact of switch costs does not decline significantly later in the run. The significant haggle dummy confirms that markups are higher in this institution than in posted offer, by an average of 7 cents.

Are haggle markups higher because the institution allows sellers to price discriminate between attached buyers and new customers? Table 7, showing median markup for new vs.

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the dynamic haggling process to a later paper.

previously attached buyer-seller pairs in positive switch cost sessions, indicates that new customers receive a larger discount in haggle.[5] The evidence is strongest for low switch costs with inexperienced subjects. Here sellers in haggle average 7.5 cents higher prices with an attached customer than with new customers. The corresponding difference in posted offer markets is only 4 cents. This is typical. Except for high cost, inexperienced subjects where both differences are small, the markup to attached customers always exceeds that to new customers, and the difference is larger in haggle than in the posted offer institution. (The last finding is consistent with Klemperer, who emphasizes a seller's tradeoff between attracting new customers and the extracting of attachment rents in a posted offer market.)

3.3 Sticky Prices

Cason and Friedman (2000) argue that price stickiness is best measured by comparing the median change in period-to-period transaction prices to the corresponding change in competitive equilibrium prices. To maintain comparability across the two trading institutions, here we look at transaction prices for each continuing buyer-seller pair. Table 8 shows that prices are sticky in both institutions, since the median CE price change is always 7 or 8 cents while the median transaction price change is 3 to 6 cents and is 4 or 5 in most treatments. This stickiness increases with switch cost in all instances except for low switch cost in haggle. Median transaction price changes are generally a bit smaller (and thus prices stickier) with haggle than with posted offer.

To sharpen the comparison, we classified an individual seller as "sticky" if her absolute cost changes exceed her absolute price change in at least half of the periods. Overall, for the

[5] Since in haggle sellers negotiate individual transaction prices with each buyer, classifying transactions into "new" and "attached" categories is straightforward. In posted offer a particular offer price might be accepted both by new and attached customers, since the institution does not permit price discrimination. In these cases the price contributes observations to both the new and attached categories, with the number of observations determined by the number of accepting buyers of each type.

posted price market 24 of 36 sellers were "sticky" vs. 34 of 36 under haggle, a very significant difference according to Fisher's Exact Test (p-value<0.01).[6]

3.4 Buyer Behavior

Not surprisingly, Table 9 indicates that switch rates are lower in higher switch cost sessions. More interestingly, switch rates seem lower for haggle when switch costs are positive—for both inexperienced and experienced sessions and for both low and high switch costs. The difference in switch rates is greatest when inexperienced subjects face low switch costs. We formally test whether the switch rate differs across trading institutions by pairing all matched 25-period runs with positive switch costs in the two trading institutions and determining if the distribution of switch rate differences is significantly different from zero. When treating each pair of 25-period runs as an independent observation, the data reject the null hypothesis that switch rates are the same in the two institutions in favor of the alternative that switch rates are lower for haggle (Wilcoxon sum of signed ranks=39, n=20, p=0.011).[7] This lower observed switch rate is consistent with the earlier result that seller market power is greater under haggle.

4. Discussion

The laboratory comparison of haggle (bilateral bargaining) markets with posted offer markets produced the following results:

1. Haggle is less efficient at extracting potential gains from trade, mainly because mutually beneficial trades are more often missed ("V losses"), and not because of inefficient customer

[6] The breakdown by switch costs is 7/12, 7/12, and 10/12 sticky sellers for posted price and 10/12, 12/12, and 12/12 for haggle for the zero, 20 cent, and 50 cent switch cost cases, respectively.

[7] A more conservative test that treats each pair of sessions (rather than each pair of runs) as the unit of observation marginally fails to reject this null hypothesis of no difference across institutions (p=0.117). This could be attributed in part to the small sample size of only 8 pairs of sessions with positive switch costs.

search or extramarginal trades. This is consistent with the new institutionalist view and inconsistent with the Coasian view. Unlike most other market institutions studied in the laboratory, efficiency does not increase with experience in haggle.

2. Sellers obtain a larger share of realized gains with haggle than with posted offer. This is contrary to the new institutionalist view that giving sellers the commitment technology in posted offer should increase their share of the gains. It is consistent with the view that haggle encourages classic market power with its deadweight (V) losses.
3. Sellers price discriminate in favor of new customers in haggle, a finding consistent with the theoretical work of Taylor and (indirectly) Klemperer.
4. Prices are sticky in both institutions, and especially in haggle.
5. Switches are less frequent in positive search cost sessions with haggle than with posted offer.

After thinking about our results we noticed a possible explanation for many of the performance differences based on a subtle informational difference between the two market institutions. A switching buyer in posted offer sees his actual alternative opportunities because posted prices are committed. By contrast, a switching buyer in haggle only sees a weak signal of alternative opportunities because list prices are not committed, and so the switch option is less valuable. Therefore in haggle buyers are less inclined to switch and sellers are better able to exercise traditional market power via larger markups and lower trading volume.

More experiments are necessary to test this explanation and other possible theories. One could interpolate new market institutions with information and negotiation procedures between haggle and posted offer. For example, bargaining could follow a strict two or three round alternating offers protocol, and/or switching buyers could observe sellers' transaction price history.

The findings even from the experiments reported here highlight the need for better theories of market microstructure. In a later draft we hope to write down explicit toy models of the two market institutions, haggle as a variant of the Nash demand game and posted offer as a variant of the ultimatum game and derive predictions. These toy models assume a single isolated trading period and no switching, so they are quite limited. We fondly hope that someday someone will construct more serious microstructure models that build on the theoretical work of Taylor and of Klemperer and that are guided by our empirical results.

Figure 1: Cost Draws for Inexperienced Sessions

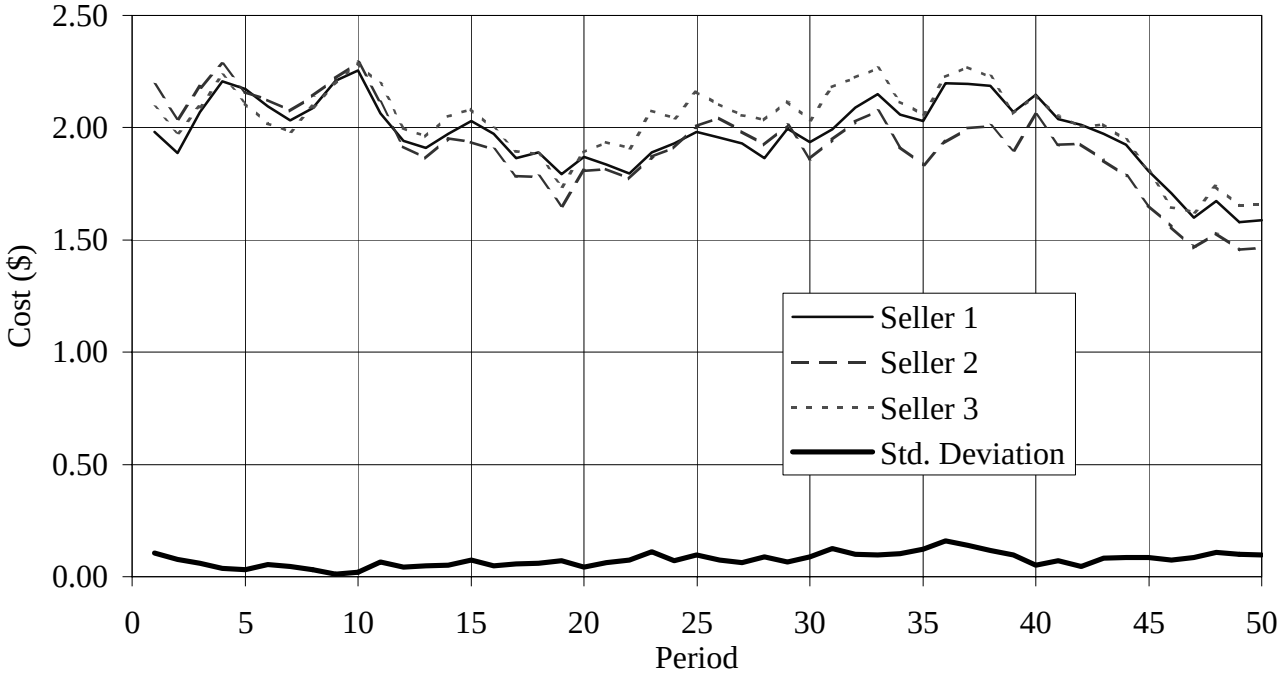

Figure 2: Cost Draws for Experienced Sessions

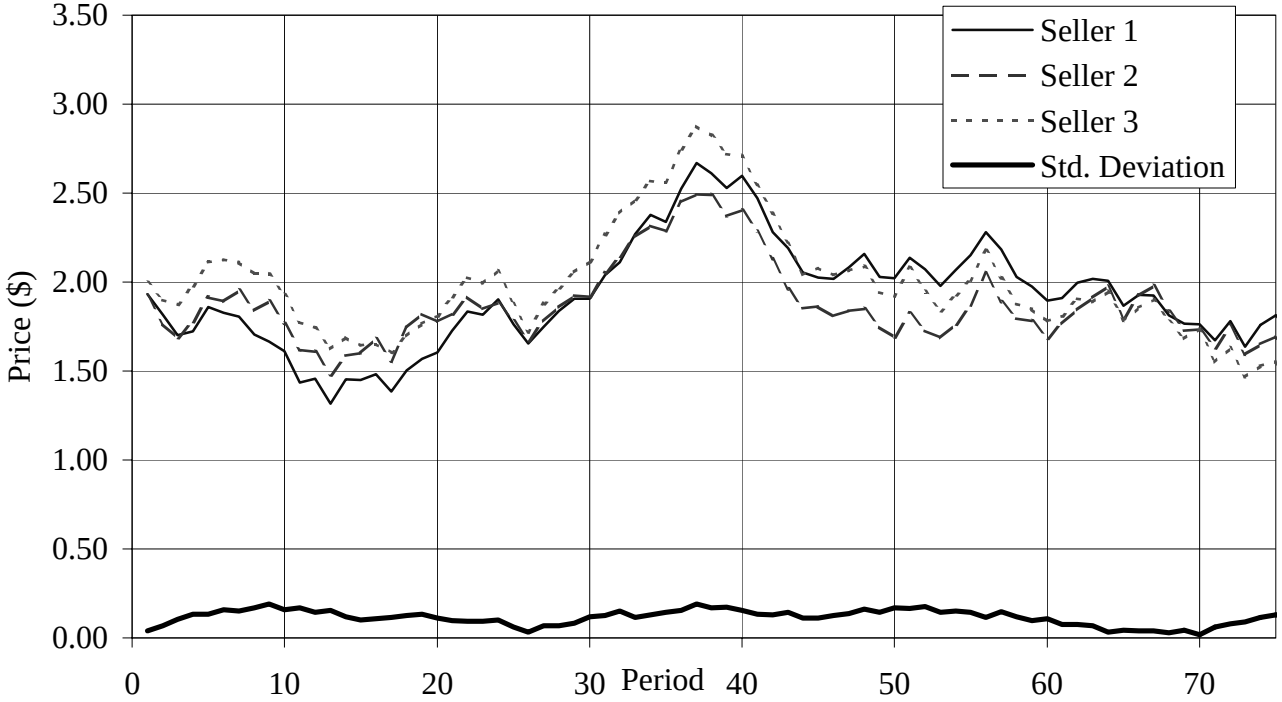

Figure 3: Example Supply and Demand (Period 28, Inexperienced)

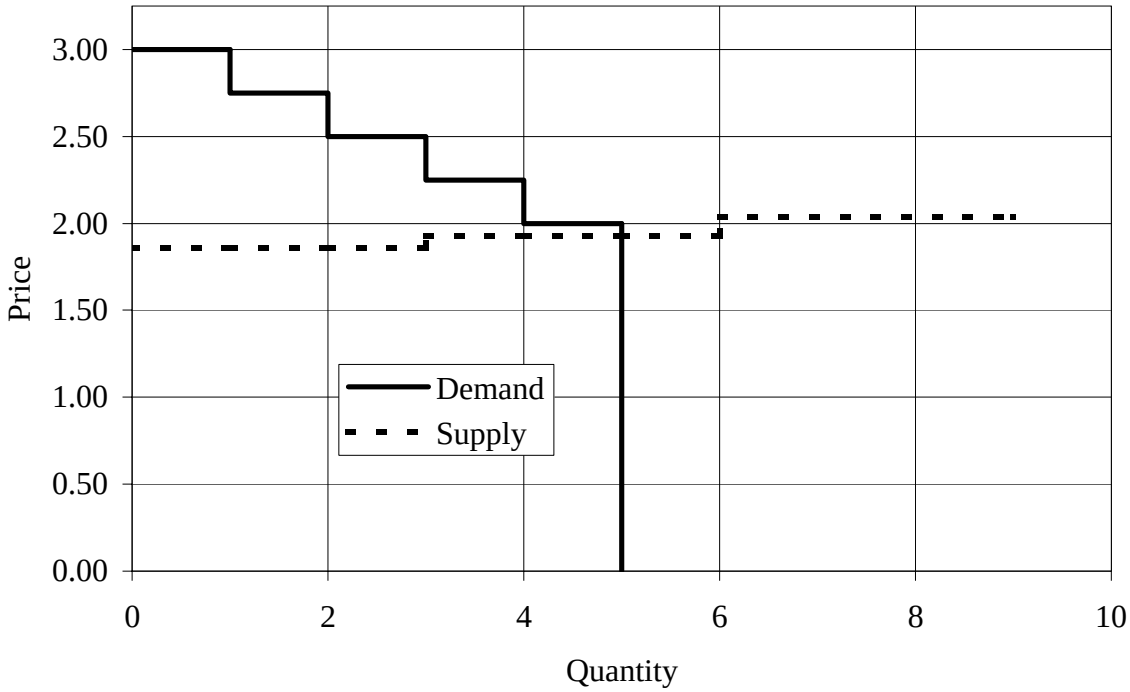

Figure 4: Posted and Transaction Prices
Posted Offer Session USC203cx (Experienced, $0.20 Search)

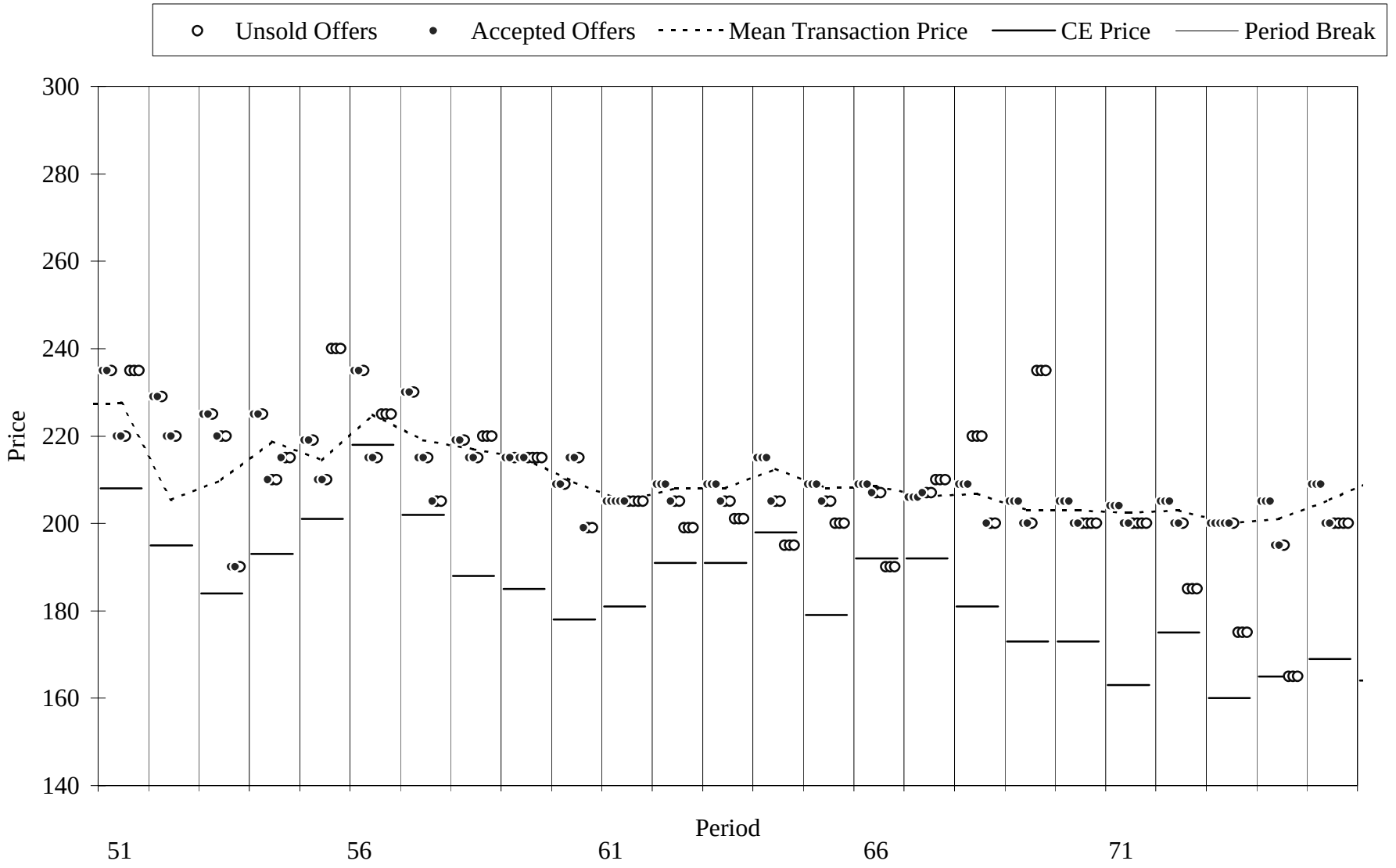

Figure 5: List and Transaction Prices
Haggle Session PU203hx (Experienced, $0.20 Search)

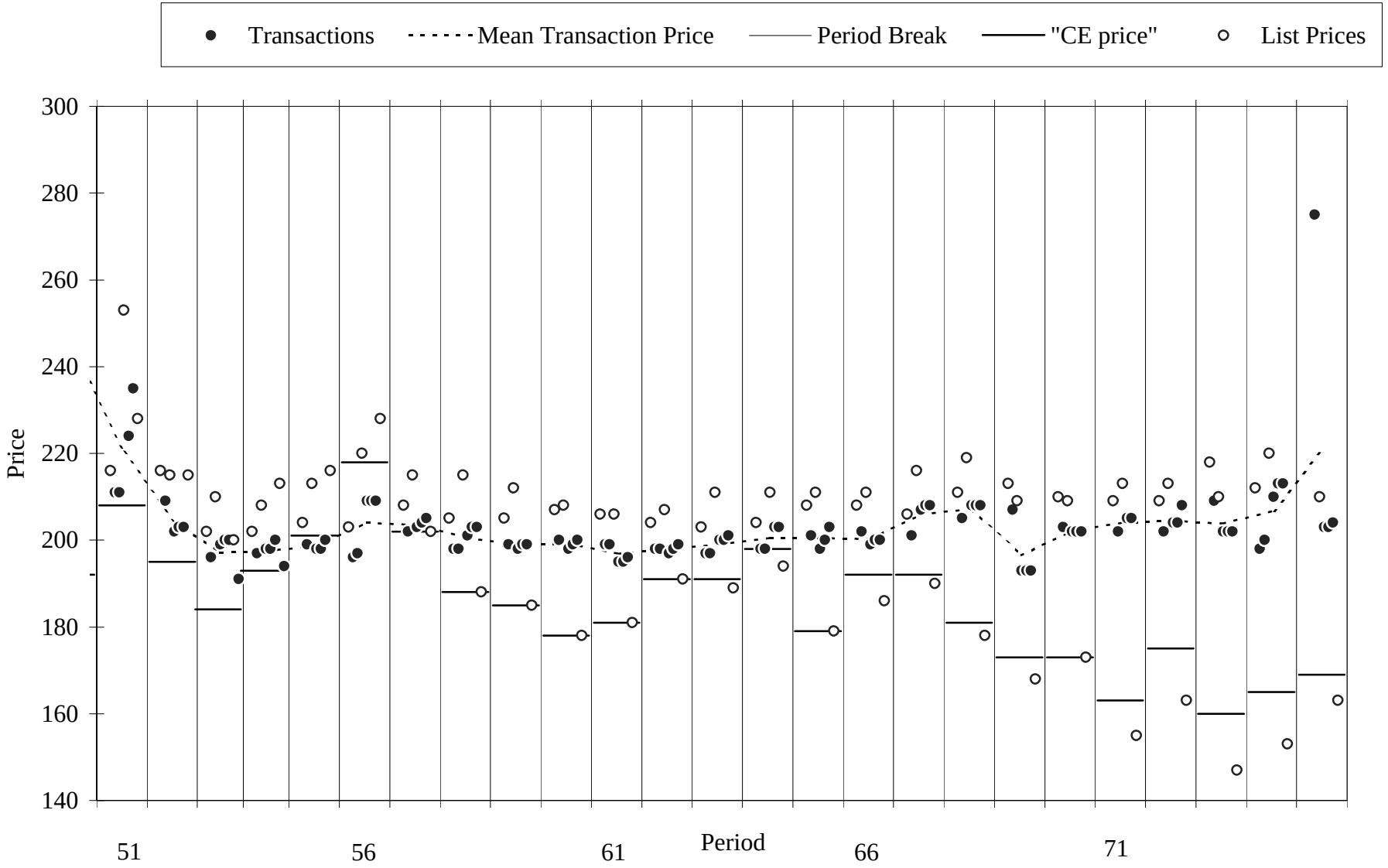

Figure 6: Posted and Transaction Prices
Posted Offer Session USC001c (Inexperienced, $0.00 Search)

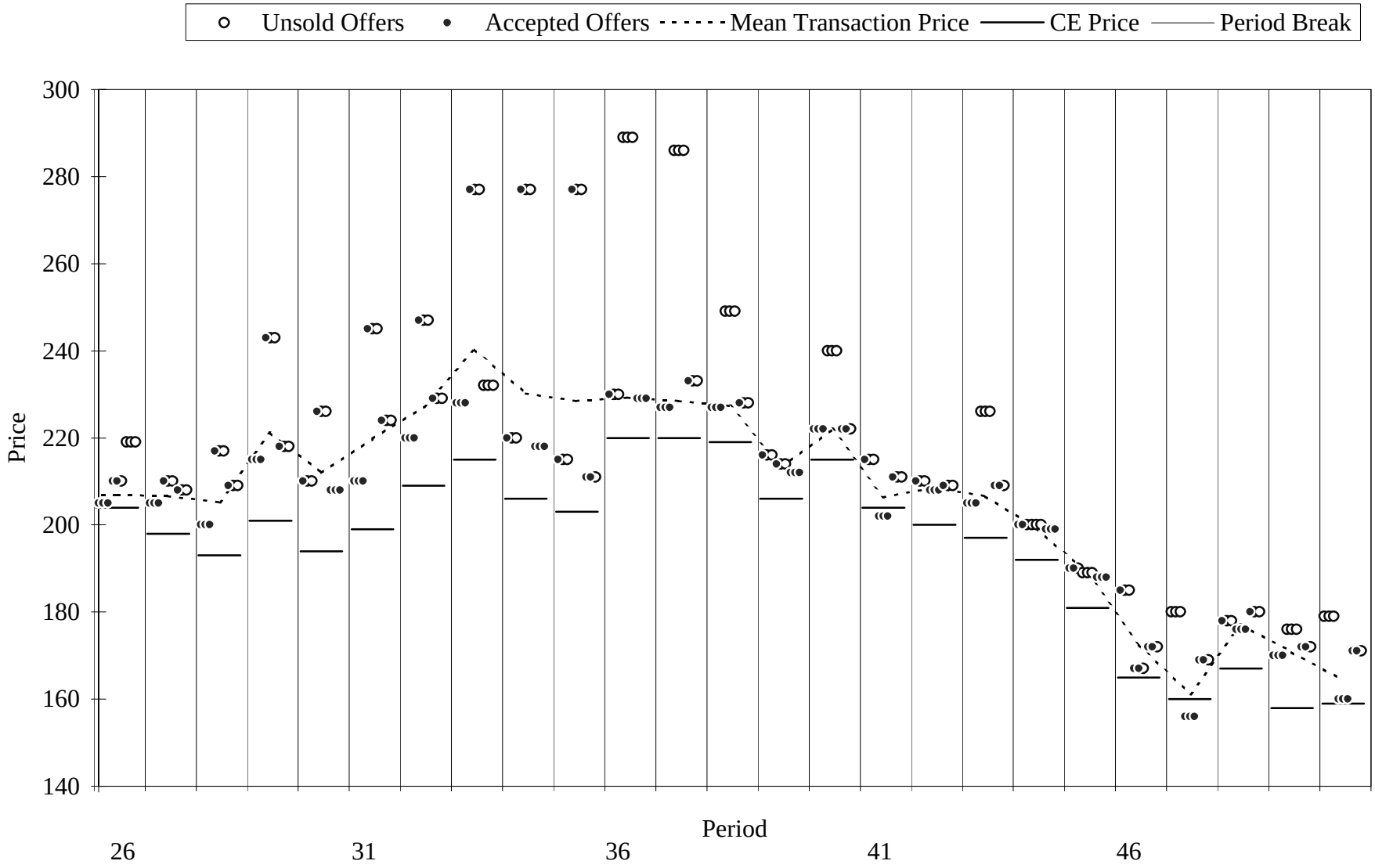

Figure 7: List and Transaction Prices
Haggle Session PU001h (Inexperienced, $0.00 Search)

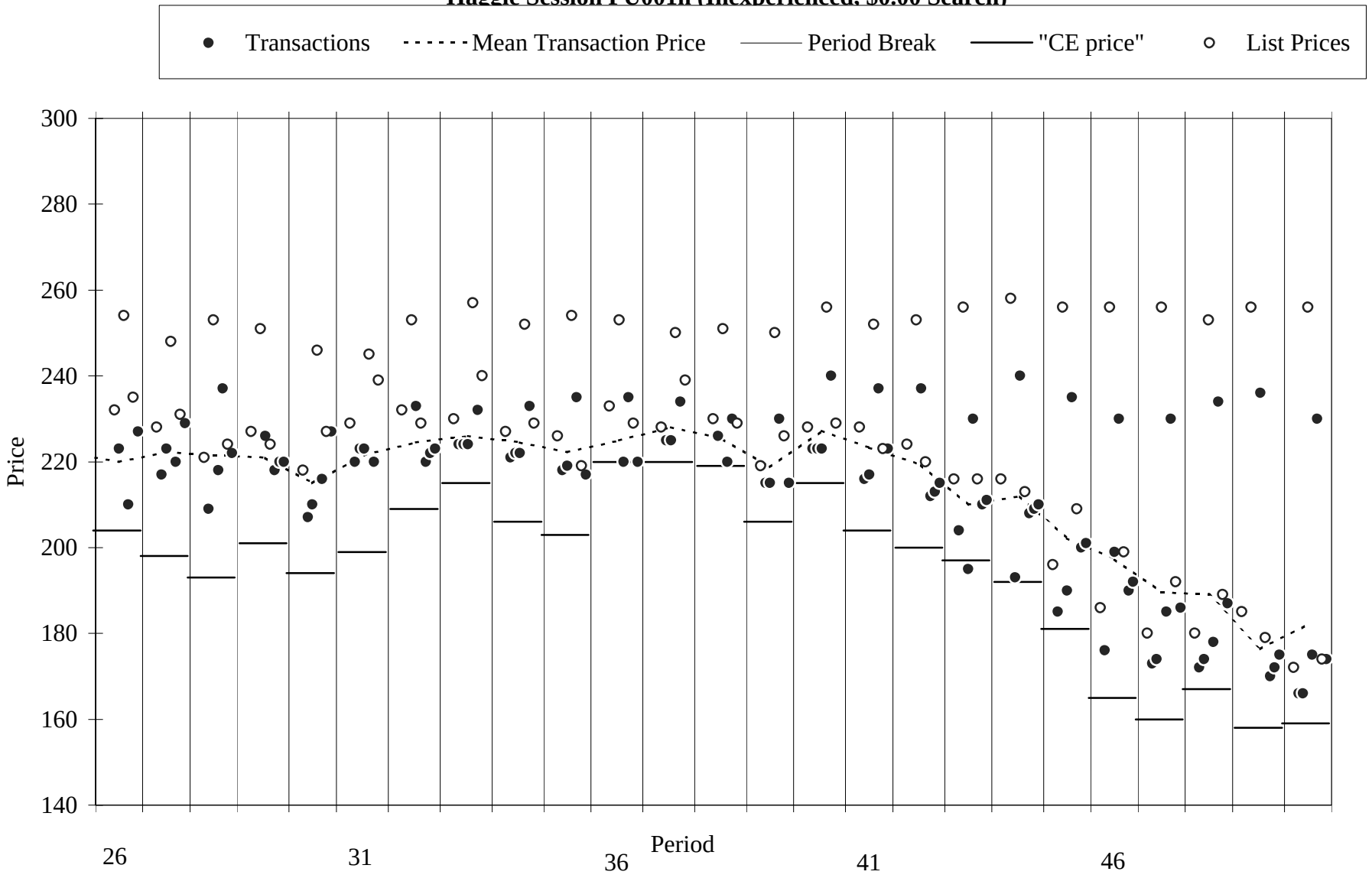

Table 1:

Summary of 24 Sessions

Session Name	Trading Institution	Switch Costs	Experience Level	Site	Trading Periods
USC001c	Posted Offer	$0.00	Inexperienced	Univ. Southern Calif.	50
UC002c	Posted Offer	$0.00	Inexperienced	Univ. Calif.-Santa Cruz	50
USC201c	Posted Offer	$0.20	Inexperienced	Univ. Southern Calif.	50
UC202c	Posted Offer	$0.20	Inexperienced	Univ. Calif.-Santa Cruz	50
USC501c	Posted Offer	$0.50	Inexperienced	Univ. Southern Calif.	50
UC502c	Posted Offer	$0.50	Inexperienced	Univ. Calif.-Santa Cruz	50
USC003cx	Posted Offer	$0.00	Experienced	Univ. Southern Calif.	75[a]
UC004cx	Posted Offer	$0.00	Experienced	Univ. Calif.-Santa Cruz	75
USC203cx	Posted Offer	$0.20	Experienced	Univ. Southern Calif.	75
UC204cx	Posted Offer	$0.20	Experienced	Univ. Calif.-Santa Cruz	75
USC503cx	Posted Offer	$0.50	Experienced	Univ. Southern Calif.	75
UC504cx	Posted Offer	$0.50	Experienced	Univ. Calif.-Santa Cruz	75
PU001h	Haggle	$0.00	Inexperienced	Purdue University	50
UC002h	Haggle	$0.00	Inexperienced	Univ. Calif.-Santa Cruz	50
PU201h	Haggle	$0.20	Inexperienced	Purdue University	50
UC202h	Haggle	$0.20	Inexperienced	Univ. Calif.-Santa Cruz	50
PU501h	Haggle	$0.50	Inexperienced	Purdue University	50
UC502h	Haggle	$0.50	Inexperienced	Univ. Calif.-Santa Cruz	50
PU003hx	Haggle	$0.00	Experienced	Purdue University	75
UC004hx	Haggle	$0.00	Experienced	Univ. Calif.-Santa Cruz	75
PU203hx	Haggle	$0.20	Experienced	Purdue University	75
UC204hx	Haggle	$0.20	Experienced	Univ. Calif.-Santa Cruz	75
PU503hx	Haggle	$0.50	Experienced	Purdue University	75
UC504hx	Haggle	$0.50	Experienced	Univ. Calif.-Santa Cruz	75

[a] The experienced posted offer sessions actually ran for 100 periods, but here we report only the first 75 periods in order to be comparable to the haggle sessions.

Table 2:

Decomposition of Gross Inefficiency

		Inexperienced				Experienced			
Switch Cost	Institution	Mean Efficiency	Switch Cost Losses	Extra-Marginal Losses	Volume Losses	Mean Efficiency	Switch Cost Losses	Extra-Marginal Losses	Volume Losses
Zero	Posted Price	84.1 %	0 %	6.1 %	9.8 %	95.0 %	0 %	4.0 %	1.0 %
	Haggle	88.7 %	0 %	4.3 %	7.0 %	86.9 %	0 %	3.4 %	9.7 %
Low	Posted Price	86.6 %	7.5 %	2.9 %	3.0 %	88.0 %	3.2 %	6.4 %	2.4 %
	Haggle	80.9 %	5.4 %	4.9 %	8.8 %	81.8 %	3.8 %	6.1 %	8.3 %
High	Posted Price	82.7 %	4.4 %	5.6 %	7.3 %	85.5 %	8.0 %	3.9 %	2.6 %
	Haggle	80.9 %	5.6 %	4.1 %	9.4 %	77.8 %	6.3 %	7.3 %	8.6 %

Table 3:

Pooled (In)Efficiency Differences: Paired Wilcoxon Signed-Rank Tests

	Overall Efficiency (i)	Switch Inefficiency (ii)	Extra-Marginal Inefficiency (iii)	Volume Inefficiency (iv)
Paired Difference	-0.045	-0.016	-0.004	0.059
Sum of Signed Ranks	6	6	35	0
Number of pairs	n=12	n=8[a]	n=12	n=12
(p-value)	(0.007)	(0.109)	(0.791)	(0.001)

***H_0 :** Posted price efficiency = haggle efficiency (paired differences shown as Haggle – Posted price)

[a]Switch inefficiency comparison is based only on the positive switch cost sessions, since switch inefficiency is by definition zero when switch costs are zero.

Table 4:

Efficiency Tobit Regression

		Efficiency		Volume Inefficiency		EM Inefficiency		Switch Inefficiency	
	Variable	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
(1)	Intercept	0.93**	0.019	0.05**	0.017	0.04**	0.008	0.01**	0.030
(2)	=1 if Switch Cost=$0.20	-0.06**	0.023	-0.007	0.020	0.01**	0.010	0.04	0.030
(3)	=1 if Switch Cost=$0.50	-0.08**	0.025	-0.005	0.018	0.004	0.004	0.06*	0.030
(4)	=1 if Experienced Subjects	0.03	0.024	-0.18	0.017	0.006	0.009	-0.01	0.008
(5)	=1 if Haggle Institution	-0.05**	0.017	0.05**	0.017	-0.001	0.008	-0.005	0.007
(6)	Observations	1618		1618		1618		1618	
(7)	Log-likelihood	473.88		1427.49		2120.88		1752.12	
(8)	Restricted Log-likelihood	428.83		1362.60		2058.72		1730.06	

Note: ** denotes significantly different from zero at 1 percent , * denotes significantly different from zero at 5 percent. Estimates are based on a random-effects error structure $u_{it} = \tau_i + \varepsilon_{it}$, where the term τ_i reflects the session-run specific random effect.

Table 5:

Mean Markup (Transaction Price – CE Price)

Switch Cost		Inexperienced	Experienced
Zero	Posted Price	6.6 ± 0.6	8.3 ± 0.4
	Haggle	11.7 ± 0.9	12.6 ± 0.7
Low	Posted Price	11.0 ± 1.0	18.0 ± 0.6
	Haggle	17.4 ± 0.7	22.6 ± 0.8
High	Posted Price	14.6 ± 0.8	13.2 ± 0.4
	Haggle	25.6 ± 1.0	24.7 ± 0.9

Note: Values are point estimates ± standard errors.

Table 6:

Price Markup Regression Model

(Dependent Variable = Mean Transaction Price – CE Price (in cents))

	Variable	Coefficient	Std. Error
(1)	Intercept	0.295	3.2
(2)	=1 if Switch Cost=$0.20	12.64**	4.1
(3)	=1 if Switch Cost=$0.20 * Periods Left	-0.18	0.1
(4)	=1 if Switch Cost=$0.50	11.84**	4.2
(5)	=1 if Switch Cost=$0.50 * Periods Left	-0.16	0.1
(6)	=1 if Experienced	1.57	2.2
(7)	Periods Left	0.17*	0.07
(8)	=1 if Haggle Institution	7.27**	2.2
Observations: 732 R^2: 0.643			

Note: ** denotes significantly different from zero at 1 percent; * denotes significantly different from zero at 5 percent (all two-tailed tests). Estimates are corrected for autocorrelation.

Table 7:

Median Markup by Attachment Length

		Inexperienced			Experienced		
Switch Cost		Previously Unattached	Attached for One or More Periods	(Attached – Unattached)	Previously Unattached	Attached for One or More Periods	(Attached – Unattached)
Low	Posted Price	7	11	4	14	17	3
	Haggle	9.5	17	7.5	16	24	6
High	Posted Price	9	13	4	7	13	6
	Haggle	25	26	1	16	22	6

Table 8:

Median Absolute Changes in Mean Transaction Price and Competitive Equilibrium Price (cents)

	Posted Price Market	Haggle Market	
Treatment	Median Absolute Transaction Price Change	Median Absolute Transaction Price Change	Median Absolute Change in CE Price
All Data	5	4	8
Zero Switch Cost	5	6	8
Low Switch Cost	5	3	8
High Switch Cost	4	4	8
Inexperienced	5	4	7
Experienced	4	4	8

Table 9:

Switch Frequencies (percent)

Treatment		Inexperienced	Experienced
All Data	Posted Price	28	25
	Haggle	26	31
Zero Switch Cost	Posted Price	56	57
	Haggle	60	78
Low Switch Cost	Posted Price	18	10
	Haggle	12	8
High Switch Cost	Posted Price	7	8
	Haggle	6	6

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