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**HOW TO ORGANIZE SEQUENTIAL AUCTIONS
RESULTS OF A NATURAL EXPERIMENT
BY CHRISTIE'S**

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How to Organize Sequential Auctions Results of a Natural Experiment by Christie's¹

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Abstract

In empirical studies of sequential auctions of identical objects prices have been found to decline. We study auctions of ancient Chinese porcelain recovered from shipwrecks. In these auctions there are very long sequences of lots of identical objects. We find that the average price decline is smaller in long sequences. It is especially large for the first pair of lots auctioned; it is also larger when the price of the previous lot was larger than (the upper bound of the range of) the pre-sale estimate of the previous lot and when the number of items in lots that follow each other increases. As a consequence, it appears that sellers may have some control over the sequence of prices and therefore on their revenue. Our results point to the fact that a sequence of lots each of which contains the same number of items generates more revenue than lots with varying number of items.

JEL codes: D44

Keywords: sequential auctions, declining prices.

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1 Introduction

Auction theory² as well as the *law of one price* suggest that prices for identical objects should be identical at one point in time and one location. Declining prices in sequential auctions of identical objects is nevertheless a pervasive phenomenon, that has been observed for very different auctions mechanisms (English second price auctions, Dutch auctions in which the bid price falls until a bidder stops the auction, etc.) and various items that appear at auction, such as livestock (Buccola, 1982), wool (Burns, 1985), wines (Ashenfelter, 1989, McAfee and Vincent, 1993, Ginsburgh, 1998), prints (Pesando and Shum, 1996), or flowers (van den Berg, van Ours and Pradhan, 2001). The same observation holds for heterogeneous objects, such as flats (Ashenfelter and Genesove, 1992), jewellery (Chanel, Gérard-Varet and Vincent, 1996), or paintings (Beggs and Graddy, 1997).

Several explanations have been given for this phenomenon which, since it contradicts theory, literature came to call the *declining price anomaly*.³ Some authors also suggest that declining prices may be the result of the institutional setting in which auctions are held.⁴

Most of the theoretical results are obtained for constant quantity lots (often a unique item) of homogeneous objects. In many cases, however, the number of items per lot in a parcel⁵ varies. This is so in wine auctions where the number of bottles, or cases, in the sequence of otherwise identical lots

²Weber's (1983) classical result with symmetric, risk neutral bidders who have identically, independently distributed private values drawn from a uniform distribution and desire one unit, suggests that bidders should increase their bids over time (as the sale of identical lots proceeds), and that hammer prices should, on average, be equal. See also McAfee and McMillan (1987) or Wolfstetter (1996), or Laffont (1997).

³See among others, Milgrom and Weber (1982), Burns (1985), Ashenfelter (1989), Black and de Meza (1992), McAfee and Vincent (1993), Bernhardt and Scoones (1994), Burguet and Sakovics (1994), Engelbrecht-Wiggans (1994), Gale and Hausch (1994), Von der Fehr (1994), Branco (1997), Menezes and Monteiro (1997), Beggs and Graddy (1997).

⁴See Pesando and Schum (1996) or Ginsburgh (1998) for examples.

⁵In the sequel, we adopt the vocabulary used by Christie's for wine auctions, where a *parcel* consists of several lots of bottles of the same wine, vintage as well as *château*, sold in sequence. The term *item* is used for an object in a lot.

may vary.⁶ Costs are probably the main reason for lots with multiple items, since this reduces the time during which the auction room is occupied,⁷ as well as the time spent by the auctioneer, who is also often an art expert. Buyers may also lose their interest in a sale that takes too much time. Finally, professionals (restaurants and liquor shops in the case of wines, or antiquaries for objects that we deal with in this paper) who attend such auctions are often interested in buying several identical units.

In this paper, we analyze sequential auctions of shipwreck findings, organized by Christie's organized in 1986, 1992 and 1995. The interest here is that Christie's used different setups, varying both the number of lots in parcels and the number of items in sequential lots, but also selling parcels in which the number of lots contained constant, increasing or decreasing number of identical items. Though the declining price anomaly is pervasive, these sales have a "natural experiment" flavor that may be used to examine whether some sequences generate more revenue than others. If so, there may exist an "optimal" way (that maximizes the seller's revenue) of arranging the lots in a parcel.

The paper is organized as follows. Section 2 describes the three sales that are analyzed. As will be seen, the sequences of lots in specific parcels share different characteristics. There are cases in which lots contain the same number of items (including of course those with one item each); there are also instances in which the number of items increases or decreases. In section 3, we analyze whether these characteristics have an impact on the sequence of hammer prices in a parcel. Section 4 tries to exploit the "natural experiment" component of the three sales to infer whether some ways of organizing a parcel are better than others. Section 5 draws some conclusions.

⁶The setting in the flower auctions studied by van den Berg, van Ours and Pradhan (2001) is also different from the theoretical model. There it is the buyer who can decide to choose, at the price at which he stops the clock, how many (constant quantity) lots he wants to buy.

⁷One of the sales that we discuss in this paper was organized at the Hilton Hotel in Amsterdam, and took five days, though many lots consisted of several items, in some cases, up to several hundreds.

2 General characteristics of the sales

We analyze three sales of Chinese porcelain found in rescued ships that had sunk 150 to 300 years ago in the South China Sea. All three sales were organized by Christie's in Amsterdam.

In the first sale held in April 1986, over 100,000 pieces of blue and white porcelain (as well as gold ingots) were offered at auction during several sessions which took about a week (from Monday April 28, to Friday May 2). These objects (including some 170 dinner services, 63,000 teacups and saucers, 600 vomit pots, etc.) came from the so-called *Nanking* cargo,⁸ chartered by the Dutch East India Company, en route from Nanking to Holland, and which contained some 700,000 pounds of tea, a much more valuable cargo than the china that was on board only to provide the weight necessary to "balance" the ship. The contents of the shipwreck belonged to, and were sold by, Captain Hatcher who had discovered and salvaged the ship.

The second sale was organized a few years later, on April 7-8, 1992. The objects auctioned during four sessions came from the recovery of another ship, the *Vung Tau*,⁹ en route from Jakarta to Holland with 28,000 pieces of Chinese porcelain (decorative wares, such as vases). The contents of the ship belonged to the North Vietnamese government.

The third sale, the *Diana* cargo was held on March 5-6, 1995. The 1,319 lots needed six sessions to be sold. The *Diana* was a ship licensed to trade between India and Canton, carrying cotton and opium to China and returning with porcelain to India. She sunk in 1817, off the coast of Malacca, and was salvaged in 1994 by Dorian Bell, managing director of a private company, the Malaysian Historical Salvors. The cargo contained over eleven tons of porcelain, 24,000 pieces, comprising 200 different shapes.

All three sales, especially the first one, were big hypes (see Beckett, 1995,

⁸The name *Nanking* stems from the port of origin of the ship, the true name of which was probably *Geldersmalen*.

⁹In this case the name stems from the town off the Vietnamese coast where the ship was found.

pp. 91-104), and this obviously sheds some doubt about the “real” value of the china, which sold for five to ten times over pre-sale estimates. In the second sale for example, a dinner service estimated at £1,500 sold for £3,000. Two days later, the dealer who had bought the vessel sold it for £7,000, bought it back a week later for £15,000 and sold it for twice that price. Today, it might fetch £4,000-5,000.¹⁰

Since in all three cases, the number of identical objects was very large, these had to be sold in parcels some of which contained up to 91 different lots of one to 1,000 identical items. In Figure 1, we illustrate one typical case of a sequence of 55 lots (no. 1515 to 1569 in the Nanking 1968 sale) of “peony pattern in cylindrical mugs.” The first 15 lots consist of a unique mug; the next lots contain 2 mugs, a number that was subsequently increased to 4, 6, 8 and 12. The figure shows that the price per mug decreases very rapidly from about 4,500 Dutch guilders to 2,000 guilders after lot number five. It stabilizes to decrease somewhat again when the number of mugs per lot is increased from one to two. After the further increase in the number of items per lot, the price goes down to a level of about 500 guilders. The stylized facts are thus the following. There is a strong price decline in the beginning of the sequence, when the quantity per lot is constant. This is followed by a further price decline as the quantity of items per lot increases.

Figure 2 gives the evolution of quantities and prices for the parcel of 27 lots (lots 894 to 920, containing “provincial blue and white saucers”) in the second sale. As can be seen, the first four lots contain 200 items each. Then, the number drops to 120 and to 100, while the last lot contains 24 items. Prices fluctuate substantially over the sequence of lots. Some of the price increases coincide with a drop in the quantity of items per lot, other price increases do not.

Table 1 gives some general characteristics describing the three sales.¹¹

¹⁰See *The Art Newspaper* 107, p. 66 (October 2000).

¹¹In order to calculate a price change, we only use information concerning parcels in which at least two lots were sold.

The first sale consists of 86 parcels auctioned in 2,102 lots, leading to an average lot number of 24.4 per parcel and an average number of 1,100 items per parcel. The other two sales are substantially smaller, with 6.5 and 11.8 lots per parcel, and a much smaller number of items per parcel. The first and the third sales feature a large number of cases with increases in the number of items between lots in a parcel, and only very few declines. In the second sale, there are many cases in which the number of items decreases between successive lots. On average, in the first auction there is a quantity increase of 7.3%, while in the second sale there is an average decline of 8.0% in the number of items. The lower part of Table 1 shows that there were both price increases and decreases, the latter dominating the former. The average price decline between two lots that follow each other within a parcel ranges from 4.0% in the first sale to 1.7% in the second one. The declines in the second and third sales are not thus as large as in the first one.

The results of Table 1 show that there exist interesting differences between the three sales. In sales 1 and 3, lots within a parcel have a tendency to become larger: The number of items increases 269 times in sale 1 and 54 times in sale 3, while it decreases only 9 and 6 times. The reverse is observed in sale 2 (7 increases and 122 decreases). These differences can be exploited to check whether (a) changing the number of lots within a parcel, (b) changing the number of items across lots within a parcel, and (c) increasing or decreasing this number, may have different effects on the price decline. If so, then there may be possibilities to design multiple-object sales in order to maximize the revenue of the seller.

3 Declining prices

Declining prices seem to be the rule. However, the size of the price change may depend on particular situations, such as the total number of items or of lots in a parcel, on whether a lot is auctioned in the beginning or in the end of the parcel, on whether the number of items in a lot is larger or smaller

than the number of items in the lots that were sold before, on whether the price of the last auctioned lot was above or below the pre-sale estimate, etc. We illustrate the possible relationships between price changes and some of the other variables in Figures 3 to 5.

Figure 3 illustrates the relationship between price changes and the location of a lot in a parcel. On average, the price of the second lot is some 10% lower than the price of the first one. As the sale proceeds, prices keep declining, but the average changes fluctuate substantially (between -2% and - 8%); there is even a price increase between lots 20 and 21.¹²

Figure 4 relates price changes and total number of lots in a parcel. As can be seen, the average price decline between two neighboring lots can be as large as 20% for parcels consisting of two lots only. In larger parcels, the decline varies between 2% and 10%. When it comes to the large price decline associated to small parcels, there is of course an overlap between Figures 3 and 4. For parcels consisting of two lots only, there is only one price change. Therefore, whether the large price decline in these small parcels is related to the parcel or to the second lot having a substantially lower price in larger parcels as well is something that we will consider later.

In sales 1 and 3, lots within a parcel have a tendency to contain more objects than in sale 2. It turns out that price and quantity changes are strongly related. To illustrate this, we split lots into seven groups, according to the change in the number of items between two lots belonging to the same parcel. In 67 cases, the decrease is larger than 50%, while in 187 cases, the increase is larger than 50%. The details are given in Figure 5, which relates changes in quantities to changes in the average prices computed over all lots within a parcel. Small variations in the number of items are associated with

¹²Because of the difference in length of sequences, the average prices in Figure 3 are based on different numbers of lots in a parcel, since there are less parcels with a large number of lots. For example, the average price change between the first and the second lot is based on 284 observations, while there are only 58 such observations on lots 20 and 21. As will be seen later, smaller parcels (i.e. with a smaller number of lots) have a larger price decline than larger parcels. Therefore, the average price decline is somewhat exaggerated.

small price declines, but there is a clear negative relationship between the two variables: quantity increases (declines) are associated with price declines (increases).

All these observations convey the feeling that the hammer price dynamics in a parcel can be partly explained, and the results used in designing a sale.

In particular, we illustrated that (given the number of lots in a parcel, the number of items in each lot and the pre-sale estimate) the price decline between two neighboring lots in a parcel is larger for the first lots, for parcels with a small number of lots, for parcels in which the number of items in the sequence of lots is increasing and for lots in which the upper bound of the pre-sale estimate of the previous lot is substantially below the hammer price. This leads to estimate the following relation:

$$\Delta \ln p_{it} = \beta_0 + \beta_1 d_{t_i=2} + \beta_2 T_i + \beta_3 pse_{it} + \beta_4 \ln q_{it}^* + \beta_5 \ln q_{it}^{up} + \epsilon_{it},$$

where the β_k , $k = 0, 1, \dots, 5$ are parameters, ϵ_{it} is the error term, p_{it} is the hammer price of lot t (the lot number) in parcel i ,¹³ $d_{t_i=2}$ is a dummy variable that takes the value one for lots sold second in a parcel, T_i is the total number of lots in parcel i , $pse_{it} = p_{i,t-1}/p_{i,t-1}^{max} - 1$ ($p_{i,t-1}^{max}$ is the upper bound of pre-sale estimate), $q_{it}^* = q_{i,t}/q_{i,t-1}$ and $q_{it}^{up} = q_{it}/q_{i,t-1}$ if $q_{it} > q_{i,t-1}$. The three last variables need some comments. First, pse_{it} measures by how much the hammer price of the previous lot in a parcel deviates from the upper bound of the pre-sale estimate; it can be thought of as representing over- or under-shooting, which will be “corrected” when the next lot is sold. Second, q_{it}^* tries to capture the effects of changing (increasing or decreasing) the number of items in the lot that is auctioned, with respect to the previous one; adding q_{it}^{up} to the model, makes it easy to test whether the effect of increasing or decreasing the number of items is asymmetric.

Results are reported in Table 2. In constant quantity lots (in which case q^* and q^{up} are absent) the decrease of the price of the second lot is some 8% larger than for other lots in the same parcel. The total number of lots

¹³Lots are numbered in the sequence in which they are auctioned.

in a parcel has a negative, but rather small, effect on prices: The larger this number, the larger the price decrease. Finally, “presale” has a negative effect: The larger the difference between the ratio “hammer price/upper bound of the pre-sale estimate” of the previous lot, the larger the decrease of the hammer price of the lot which is auctioned next.¹⁴ Over-shooting (and under-shooting) is thus partially corrected.

For parcels in which the number of items in lots varies, the size and the direction of the effects are very close to those described for lots of identical size. Of course here, we also have the size effects of the previous lot (q^* and q^{up}), which appear to be significantly asymmetric: If the number of items increases, the price goes down more than it goes up when this number decreases. The pooled results (identical lots and quantity varying lots) convey the same qualitative results.¹⁵

A peculiarity of the sales that we study is that, in many cases, the hammer price is higher than the upper bound of the pre-sale estimate. It is very likely that since the objects were uncommon, the auctioneer could hardly find previous sales on which to base his pre-sale estimates. But this in turn could imply that the probability of underestimating an item (or a lot) is similar to the probability of overestimating it. This appears to be wrong, since there are only 11 parcels out of 284 for which the hammer price of the first lot sold is below the upper bound of the pre-sale estimate (and thus 273 for which this price is above). Likewise, there are only 294 lots out of 3,794 for which the hammer price is lower than the upper-bound of pre-sale estimate range. This does not conform to the theoretical prediction that in order to maximize his revenue, the seller should convey unbiased information to the buyers,¹⁶ but can be explained by the hype that was pervasive in the three sales.

¹⁴We also investigated whether the effect was asymmetric, i.e. whether the coefficients for negative and positive “presale” values were different, but we could find no such effect.

¹⁵Adding a variable representing the lot number that situates the lot in a parcel, does not alter the results.

¹⁶This argument is made formal in Milgrom and Weber (1982) who show that in most auction settings—first-price, second-price and English auctions—, “honesty is the best policy” for the seller in the absence of reserve prices.

4 Organizing parcels

It seems clear than the seller can hardly avoid declining prices. One can nevertheless wonder whether he has some control over the total revenue generated by a parcel. He faces three decisions:

- (a) Set pre-sale estimates for an item (or for a lot). In most cases, prices of items in a parcel are identical, irrespective of the size of a lot in the parcel; prices vary only if the quality of items changes across lots;¹⁷
- (b) Choose in how many lots he will regroup the Q_i identical items;
- (c) Decide whether the lots in a parcel will contain the same number of items (e. g. 3 lots of 24 items each) or whether this number will vary (e.g. 12, 24 and 36), and if so, in which order the lots will be auctioned.

We assume that the pre-sale estimate is based on the intrinsic value of the item, and is given before the two remaining decisions are made. We also assume that these are made sequentially. The number of lots is set first, and only then, the auctioneer decides how the lots in a parcel will be organized.

Therefore, we first look at decision (b), given that the auctioneer knows the total number of items Q_i in parcel i , and the pre-sale estimate (We use the upper bound of the range of the pre-sale estimates). Our assumption is that, given Q_i , the more an item is valued, the smaller the number of such items per lot, and thus, the larger the number of lots in a parcel. This leads to a model in which the average number of items \bar{q}_i in a lot i is explained by Q_i and p_i^{max} (the upper bound of the range of the pre-sale estimate). Since the three sales were organized differently, we also include a Sales dummy.

Estimation results, reported in Table 3, are very satisfactory, since we are able to explain some 80% of the variance of the average number of lots in the 284 parcels. Eq. (1) shows that when the total number of items increases with one percent, the average lot size increases with 0.4%. This

¹⁷Such items or lots were eliminated from the data.

may be interpreted as a consequence of the cost of organizing a sale, which increases with the number of lots that are put up, since this increases the effort of the auctioneer, and takes more time. The results also show that, as expected, the number of items in a lot will decrease with the price of the item, since otherwise, lots may become too expensive. Since the quadratic term in Eq. (2) is positive, this effect is stronger for low pre-sale estimates. Finally, conditional on Q_i and p_i^{max} , the average lot size is smaller in the first (Nanking, 1986) sale than in the two others.

As suggested by the numbers given in Table 1, the shapes of the three sales are quite different. If these shapes matter, they should have an impact on the average price of a parcel, other things being held constant.

We discarded twenty parcels containing lots in which the number of items was both increasing and decreasing from one lot to the next, and concentrate on those containing lots with only constant, only increasing or only decreasing number of items. This led us to the numbers reported in Table 4, which make apparent that Christie's did run some experiments. In particular, the proportion of parcels containing lots with identical number of items ("constant" in Table 4) increases from 17% in sale 1 to 48% in sale 2 and 68% in sale 3. This suggests that the seller must have noted that constant quantity lots raise more revenue.

To verify this assumption, we estimate equations in which \bar{p}_i , the average hammer price over lots in parcel i , is explained by the pre-sale estimate p_i^{max} , the total number of lots in a parcel T_i , and the shape of the lots, captured here by a dummy variable (cld) that takes the value one for parcels in which all the lots include the same number of items. The equation is specified as:

$$\ln \bar{p}_i = \gamma_0 + \gamma_1 \ln p_i^{max} + \gamma_2 cld + \gamma_3 T_i + \epsilon_i.$$

The results, given in Table 5, point to two conclusions that are present in all the equations. First, the coefficient of the pre-sale estimate variable (here, the upper bound of the range of the pre-sale estimate, p_i^{max}) is always significantly smaller than one. Second, the total number of lots hardly has a significant

effect (0.3% per lot). Finally, the constant quantity dummy always picks positive coefficients, though the coefficient is not significantly different from zero at the usual 5% level in two cases. The three sales can however be pooled (the LR-test statistic is equal to 9, while the critical value with 5 degrees of freedom is 11.1), and the γ_2 coefficient turns then out to be significantly positive. This suggests that parcels that contain lots with a the same number of items (say, 24, 24, 24) pick average hammer prices that are some 30% larger than other, “non constant” parcels (12, 24, 36).¹⁸ This is consistent with Christie’s behavior to increase, over time, the number of constant quantity lots.

The fact that lots with the same number of items do better comes as a surprise insofar as this is almost never the case for wine auctions, where the number of bottles in the sequence of lots of the same wine is very often increasing. Indeed, one may think that if buyers are heterogeneous (some willing to buy more items than others), it should be better to vary the number of items, since this will generate more competition for each (differentiated) lot. This is obviously not the case, and may be due to the possibility buyers have to trade after the auction. But even this is not beneficial since they pay more per item than in the case of lots of varying number of items. In addition to the *declining price anomaly* there also seems to be a *constant number of items anomaly*.

5 Conclusions

We analyze a large number of some very long sequences of auctions of lots including varying quantities of identical items (parcels). In Section 3, we focus on whether price changes within such a parcel can be explained. In Section 4, we study price (and therefore, income) differences between parcels.

¹⁸Adding a dummy for lots with decreasing (or increasing) number of items in the pooled regression did not turn out significant. The coefficient is -0.02 with a *t*-statistic equal to 0.2. Other coefficients do not change.

Like in previous studies, we find evidence of declining prices in sequences of identical objects. The large number of items, the large number of lots in many parcels as well as the fact that in some sequences, the number of items in neighboring lots is decreasing, constant or increasing, makes it possible to estimate the effects of various underlying characteristics. In particular, we find that (a) the average price decline is smaller in long sequences; (b) it is especially large for the first pair of lots auctioned; (c) it is larger when the price of the previous lot was larger than (the upper bound of the range of) the pre-sale estimate; (d) it is larger when the number of items in the sequence of lots increases.

Therefore it looks as if the seller may have some control over the sequence of prices and, consequently, on the total income of a parcel, by deciding on the pre-sale estimate, the number of lots in a parcel, the number of items in the sequence of lots as well as the changes in the number of items across lots. It is hard to assess the influence of the pre-sale estimate, and the only reasonable assumption we can make is that it represents the fundamental value of the item. It also appears that the number of lots has almost no influence on the average price. The only important effect is generated by the number of items in a lot: Lots which contain an identical number of items generate more revenue.

The contribution of our findings is twofold. First, there seems to be no way of avoiding declining prices, though the auctioneer may have some control over the magnitude of the decline. Second, the auctioneer does also have some control over the total income of a parcel, by splitting it into constant quantity lots. This simple setup increases his income, and this was indeed the strategy followed by Christie's who, over time, decided to increase the proportion of such lots.

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Table 1
 Characteristics of the sales

| Sales | No. of parcels | No. of parcels with 10 lots at least | No. of lots | No. of lots per parcel | No. of items per parcel |
|----------|----------------|--------------------------------------|-------------|------------------------|-------------------------|
| Sale 1 | 86 | 60 | 2,102 | 24.4 | 1,100 |
| Sale 2 | 121 | 21 | 783 | 6.5 | 162 |
| Sale 3 | 77 | 34 | 909 | 11.8 | 217 |
| Together | 284 | 115 | 3,794 | 13.4 | 461 |

| Sales | No. of quantity increases | No. of quantity declines | Av. quantity change (%) |
|----------|---------------------------|--------------------------|-------------------------|
| Sale 1 | 269 | 9 | 7.3 |
| Sale 2 | 7 | 122 | -8.0 |
| Sale 3 | 54 | 6 | 2.7 |
| Together | 330 | 137 | 3.4 |

| Sales | No. of price increases | No. of price declines | Av. price change (%) |
|----------|------------------------|-----------------------|----------------------|
| Sale 1 | 490 | 850 | -4.0 |
| Sale 2 | 255 | 287 | -1.7 |
| Sale 3 | 198 | 366 | -3.7 |
| Together | 943 | 1,503 | -3.5 |

Table 2
 Estimation Results. Price Changes within Parcels

| | Constant quantity lots | Varying quantity lots | All parcels |
|----------------------------------|---------------------------|--------------------------|-----------------|
| Intercept | 0.031 (1.4) | -0.020 (2.2) | -0.013 (1.7) |
| Second lot sold ($d_{t=2}$) | -0.084 (3.0) | -0.072 (3.5) | -0.071 (4.4) |
| Total no. of lots (T) | -0.0020 (1.7) | 0.0006 (4.1) | 0.0005 (3.5) |
| Pre-sale estimate (pse) | -0.012 (3.5) | -0.007 (3.8) | -0.008 (4.7) |
| Quant. change ($\ln q^*$) | - | -0.386 (9.8) | -0.382 (9.7) |
| Quant. increase ($\ln q^{up}$) | - | 0.059 (2.3) | 0.055 (2.2) |
| Adjusted R^2 | 0.040 | 0.182 | 0.147 |
| No. of observations | 753 | 2,757 | 3,510 |

The dependent variable is $\Delta \ln p_{it}$. The t -statistics which appear between brackets under the coefficients, are based on robust regression techniques.

Table 3
 Estimation Results. Average Number of Items in a Lot

| | Equation (1) | Equation (2) |
|---|----------------|----------------|
| Intercept | 0.87 (5.2) | 5.14 (6.5) |
| Sale 2 dummy | 0.19 (3.2) | 0.27 (5.6) |
| Sale 3 dummy | -0.08 (1.3) | 0.06 (1.4) |
| No. of items ($\ln Q_i$) | 0.37 (13.5) | -0.11 (2.8) |
| No. of items squared ($\ln Q_i^2$) | - | 0.07 (11.6) |
| Pre-sale estimate ($\ln p_i^{max}$) | -0.19 (8.2) | -1.23 (6.0) |
| Pre-sale estimate squared ($\ln (p_i^{max})^2$) | - | 0.07 (5.2) |
| Adjusted R^2 | 0.766 | 0.859 |
| No. of observations | 284 | 284 |

The dependent variable is $\ln \bar{q}_i$, the (log of the) average number of items in a lot of parcel i . The t -statistics which appear between brackets under the coefficients, are based on robust regression techniques.

Results are obtained by weighted least squares regressions, where the weights used are the number of lots in a parcel. OLS results are very similar.

Table 4
Number of identically organized parcels in each sale

| No. of items/lot | Sale 1 | Sale 2 | Sale 3 | Total |
|------------------|--------|--------|--------|-------|
| Constant | 13 | 55 | 50 | 118 |
| Increasing | 64 | - | 23 | 87 |
| Decreasing | - | 59 | - | 59 |
| Total | 77 | 114 | 73 | 264 |

Twenty parcels that appear in Table 1 have been discarded.
See text for the details.

Table 5
Estimation Results. Average Prices

| | Sale 1 | Sale 2 | Sale 3 | All sales | |
|---------------------------------------|---------------|----------------|---------------|-----------------|-----------------|
| Intercept | 2.79 (5.4) | 3.53 (9.0) | 3.48 (6.6) | 3.54 (16.2) | 3.61 (15.6) |
| Pre-sale estimate ($\ln p_{max,i}$) | 0.81 (9.7) | 0.69 (14.1) | 0.58 (8.4) | 0.69 (22.3) | 0.69 (22.0) |
| Constant quantity lots dummy | 0.35 (1.6) | 0.29 (3.5) | 0.15 (1.3) | 0.27 (4.0) | 0.24 (3.5) |
| Sale 3 dummy | - | - | - | -0.99 (15.5) | -0.99 (15.4) |
| No. of lots (T_i) | - | - | - | - | -0.003 (1.7) |
| Adjusted R^2 | 0.664 | 0.694 | 0.577 | 0.739 | 0.741 |
| Log. likelihood | -49.2 | -74.3 | -40.9 | -168.9 | -167.7 |
| No. of parcels | 77 | 114 | 73 | 264 | 264 |

The dependent variable is $\ln \bar{p}_i$, the (log of the) price of a standardized lot in each parcel (we chose as standard lot in the parcel the one that contained the smallest number of items).

The t -statistics which appear between brackets under the coefficients, are based on robust regression techniques.

Figure 1 Prices and quantities
Cylindrical mugs - sale 1

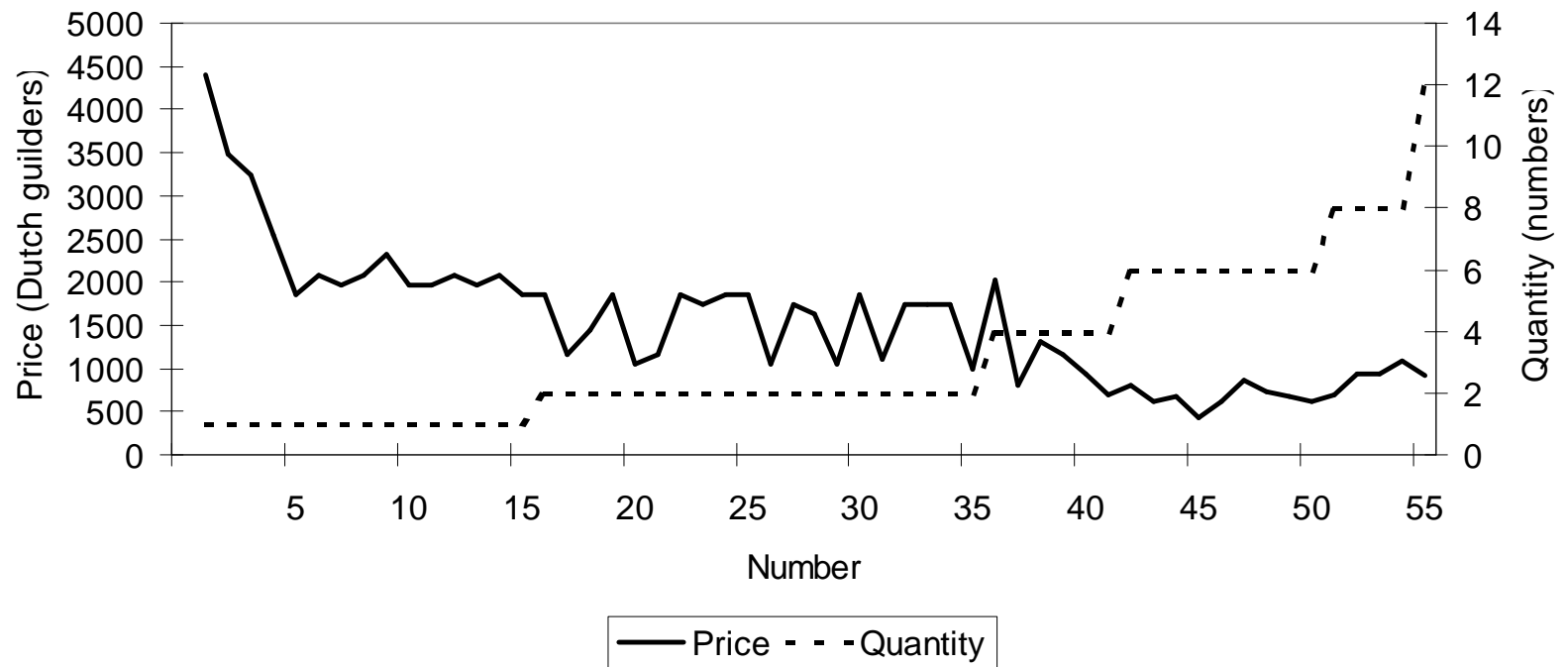


Figure 2 Prices and quantities;
Blue and white saucers - sale 2

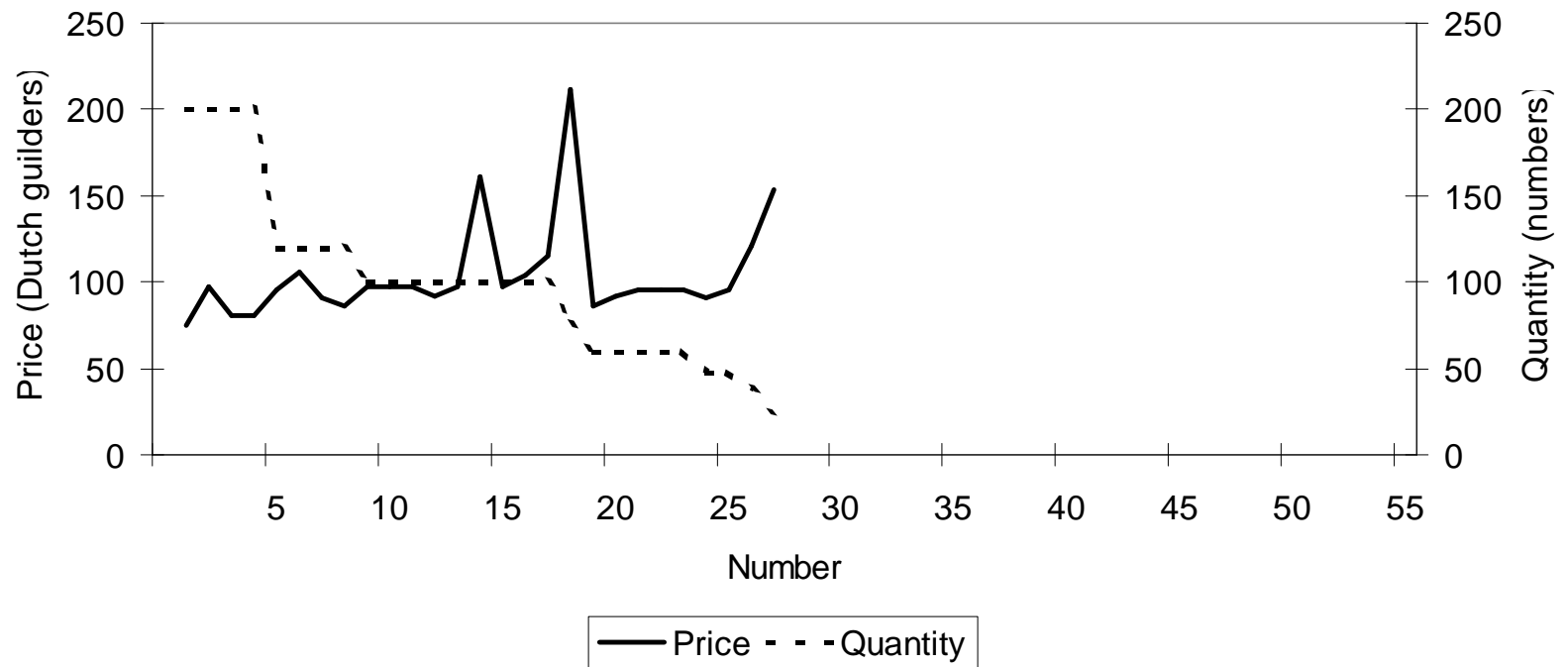


Figure 3 Price changes by number within a parcel

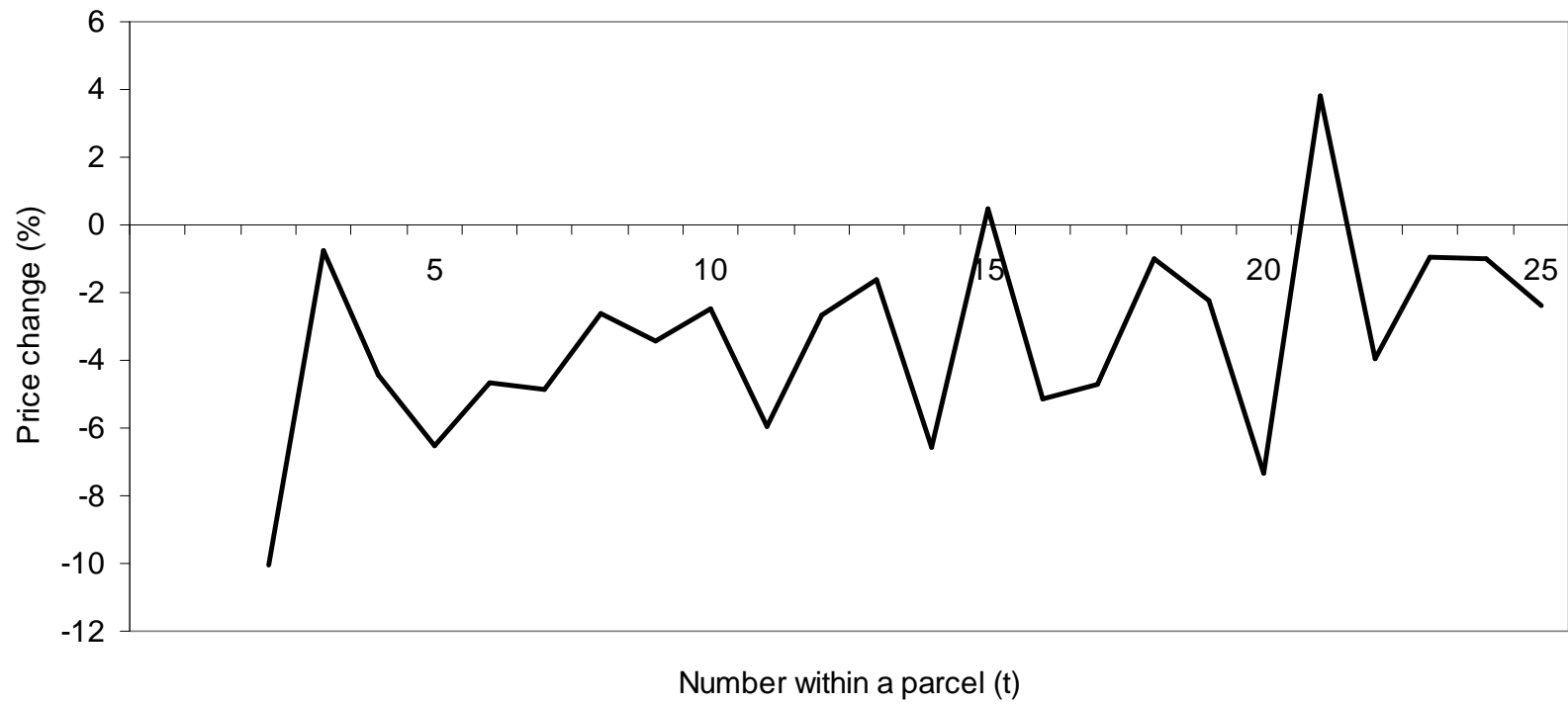


Figure 4 Price changes by number of lots in a parcel

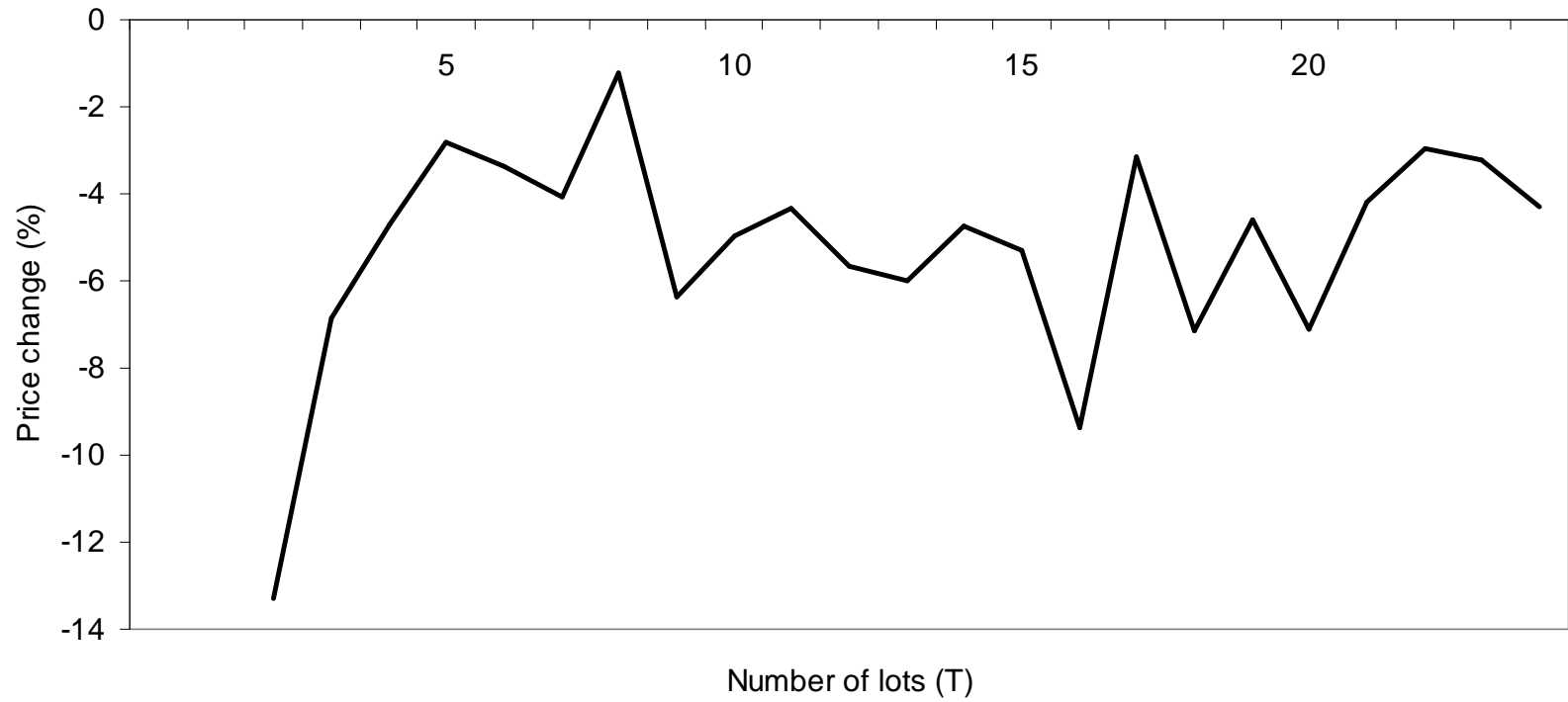


Figure 5 Price changes and quantity changes

