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An Experimental Study of Auction Behaviour

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Abstract

A laboratory simulation of property sales revealed that in a mildly optimistic market, auction prices returned premiums to the rational capitalised values, whereas tender sale did not. Results suggest that auction premiums may tend to peak near the middle of the auction, however, the properties were sold in order of diminishing value, so further research may be necessary in order to distinguish between these two factors.

The paper relates the experiment to the developing literature on the behavioural study of property auctions that tends to use analysis of actual auctions. One advantage of the experimental environment is that unlike actual auctions, the rational value of the property can be perfectly visible to all subjects. The shortcoming of experimental simulations appears to be that subjects may be less risk conscious.

The discussion raises several issues for future experimental design, including the manipulation of market sentiment and the sensitivity of the experimental situation to rewards and punishments in order to achieve external validity. The paper concludes with a summary of the usefulness of this type of property research and makes suggestions for its future direction.

KEY WORDS

Price formation; behavioural property; property cycles; experimental property research; auction behaviour

INTRODUCTION

Prices obtained at auctions have been thought to be the best indication of value since they result from the free interaction of market participants. Lusht (1994a) raised some queries concerning this conventional wisdom, citing the problem of what he referred to as the *winner's curse*. He

contended that in analysing the value of a property, some prospective purchasers would make errors in their appraisal, either through mis-allocation of risk or simple arithmetic error. He contended that the person who erred most optimistically might win the property, but eventually suffer financial hardship. It is also possible that the second last bid could be the rational price, on the basis that the final bid clears competition by exceeding the financial value of the asset. Lusht (1994b) found that bids at auctions were at discounts compared to rational valuations, as did Allen and Swisher (2000) and Mayer (1998).

These authors were also interested in the patterns of prices within an auction. Lusht (1994b) found that prices declined through the auction, while Allen and Swisher (2000) found they improved and Mayer (1998) found no significant price trend.

The peculiarity of auction price formation suggests extra-economic behaviours that produced unexpected pricing results. Their results indicate that real estate markets may be better understood using behavioural methods following the general suggestion of Earl (1983) and its property specific expression by Diaz (1999) or Hardin (1999). This study is an attempt to understand market behaviour by studying market participant behaviour experimentally. It seeks to better understand biases evident in the behaviour of actual bidders compared to its rational financial value computed by sober analysis of the asset's earning potential.

A shortcoming of this approach is that it leaves open important questions regarding the bidders' analysis. In actual property markets, potential purchasers have differing perspectives on a property's investment potential, as well as behavioural inclinations in response to the auction situation itself. The present work is aimed at controlling buyer analysis of potential properties in order to observe behavioural biases that emerge from the auction situation itself. It achieves this by using a simulated market environment to provide uniform market intelligence and valuation methodology. In this laboratory environment, behavioural tendencies that distinguish bidder's behaviour from purely rational bidding behaviour can be studied.

AIM:

To experimentally examine behavioural biases resulting from the property auction environment.

OBJECTIVES

1) To identify pricing differences between auctions and tenders in a controlled market.

2) To examine behavioural tendencies within an auction.

3) To test if the auction prices conform to rational expectations.

HYPOTHESES

1) True value should equal the rationally derived financial valuation.

2) Auction prices differ from tender prices.

3) The auction situation can influence bidding behaviour.

4) Earlier sales within an auction can influence bidding behaviour.

PROCEDURE

An experimental methodology was employed involving a simulated property market following generally accepted experimental design (Sarantakos, 1993). The experiment involved groups of subjects playing a game that simulated a property market. The simulation began with the competitive sale of a limited number of investment properties followed by simulated annual rental negotiations between property owners and tenants. The general description of the game and its rules is found in (Small and Oluwoye 1999).

Subjects were given an outline of a market where the currency unit was the bag of gold (**Ƀ**) and the highest and best use of the property assets were publicly known. Subjects aimed to achieve the greatest wealth by either occupying property as tenants, or earning rent from it as landlords over a number of simulated years of negotiating annual rents. All subjects could bid to purchase property parcels at the beginning of the game/simulation. Each parcel consisted of five identical units, although the productivity of the units varied by parcel as shown in Exhibit 1. Property purchases had to be paid for out of the rent earned over four years. Since the productivity of the units and the cost structure of tenants was public knowledge, this meant that it was possible to compute the value of the land very easily using a simple capitalisation calculation.

Land Market

Grade	Parcels	Lots	Product	Notional Rent
1	1	5	150	100
2	1	5	140	90
3	1	5	130	80
4	1	5	120	70
5	1	5	110	60
6	1	5	100	50
7	1	5	90	40
8	1	5	80	30
9	1	5	70	20
10	1	5	60	10
11	*state*	***5***	50	*commons*
12	*state*	***5***	45	*commons*
13	*state*	***5***	40	*commons*

Exhibit 1

The game has been found to be an effective teaching device as well as an experimental tool (Small, 1999). The running of the simulation as a teaching exercise had the additional advantage that rewards and penalties could be easily set as a consistent part of the simulation. The exercise was allocated 5% towards the final subject grade, with bonuses for outstanding performance enabling the winners to score up to 9 marks towards their final grade. As well as proving to be a successful behavioural experiment, it has proven to be very popular with students who tend to rate it as one of the outstanding exercises in the subjects in which it is run.

The simulation is structured to include observation of the formation of both rents and sale prices. Small and Oluwoye (1999) found that it was a consistent and valid experimental tool that yielded useful insights into the operation of rental theory. Those studies focused on the rental market. That study found that the simulation returned results consistent with rental theory operating within a near-perfect market. On that basis, the rental estimation and capitalisation valuation can be adopted as reliable for this study.

The ownership and property value formation were a necessary part of the total simulation. By allowing subjects to competitively bid for land, the prices were expected to absorb the marginal value of the different parcels and therefore place property owners on an equal footing. In that way it was expected that they would all be similarly motivated to seek optimum rents, which was what was found in Small and Oluwoye (1999).

Property sale was competitive so that the subjects themselves formed the market. In each run of the simulation either auction of tender bidding was used. The properties were all sold in order of diminishing value. Future trials may consider reversing this order. Each subject could enter the bidding, though ownership was limited to one parcel per subject. Subjects were not obligated to bid if they considered the risks too great.

The experiment was run a total of eight times between March 1995 and March 2001, usually on different groups of subjects. Runs 3, 5, & 7 were second year students who had experienced the game also in their first years as runs 1, 2, & 4 respectively. The effect of market learning was considered in Small and Oluwoye (1999) who found that learning had little influence on rental market formation, as both were highly efficient. The impact of learning on price formation will be considered in this study. Runs 1 & 2 used auctions, while the remainder used closed tenders.

Subjects in simulation 3 were told that *"productivities would increase sometime after year one"* before they computed their tenders. This was to create optimism by introducing an unspecified expectation of future opportunity. The simulation typically ran for five or six simulated annual rental cycles, of which the first four were critical for landlords since they were placed in receivership if they failed to pay for their property in that time and were punished with a zero grade for he exercise. Since the productivity increase was not specified, and could happen in years five or six, a prudent bidder was not expected to place great value on it, especially in view of the penalty that over-ambitious expectation would have on final subject

grades. Simulation 5 was used as a control for this run as both it and simulation 3 were second year students with experience of the exercise.

SUBJECTS

Subjects were first and second year undergraduate real estate students. They were considered an appropriate sample because of the following:

1) Their interest in real estate could be expected to be greater than the average and representative of lay investors/tenants.
2) Their knowledge of real estate could be expected to be reasonably uniform, though not well developed. In this they could be expected to reasonably mirror the profile of the majority of small real estate investors and tenants. Their behaviour could be expected to follow rational economic utility optimisation.
3) By incorporating performance in the exercise into subject assessment, meaningful rewards and punishments could be incorporated into the game.
4) Their attention and continuous availability was reasonably assured.
5) Their motivation could be confidently expected on the basis of the game's learning potential and the competitive spirit encouraged within the programme.

Ethical aspects of the simulation were considered due to the use of human subjects with limited experience. The risk of severe penalty for poor performance was identified as a possible issue, especially as it contributed to final subject grades in an undergraduate subject. Subjects were permitted two options in participating in the exercise. One option was to be eligible for the bonuses and penalties that could result in marks between minus 2 and plus nine out of a nominal 5 mark allocation. The second option was risk adverse, and involved being graded in a conventional manner out of five, with no rewards and penalties. Subjects taking the second option were not permitted to bid for property and on average earned about 3/5. Since students had the choice to take risks or not, and even the risk-takers did not have to bid for property, it was considered that the simulation met ethical requirements. The high regard held by students for the simulation is an additional support for its claim to be ethical in its treatment of subjects.

RESULTS

The prices paid for the parcels sold in each simulation are shown in Exhibit 2:

	Simulation number	1	2	3	4	5	6	7	8
	Sale type	**Auction**	**Auction**	**Tender**	**Tender**	**Tender**	**Tender**	**Tender**	**Tender**
	Market sentiment			*Optimistic*					
	Student year	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**
Grade	Rational	**1997**	**1998**	**1998**	**1999**	**1999**	**2000**	**2000**	**2001**
1	*1880*	1950	1920	2800	1880	1880	1800	1880	1880
2	*1680*	1815	1790		1680	1680	1590	1680	1710
3	*1480*	1700	1720	2080	1480	1480			1480
4	*1280*	1626	1655			1280	1140	1280	1280
5	*1080*			1900			1200	1120	1060
6	*880*	1420	1586		880	880	780	880	1080
7	*680*	1323	1215	1080		680	500		880
8	*480*	1040	855			460	420	480	480
9	*280*	610	510	780	280	220	120	240	300
10	*80*	290	370		80	60	800	40	87
Average premium:		339	322	648	0	-11	3	-5	44

Exhibit 2: Parcel Sale Prices

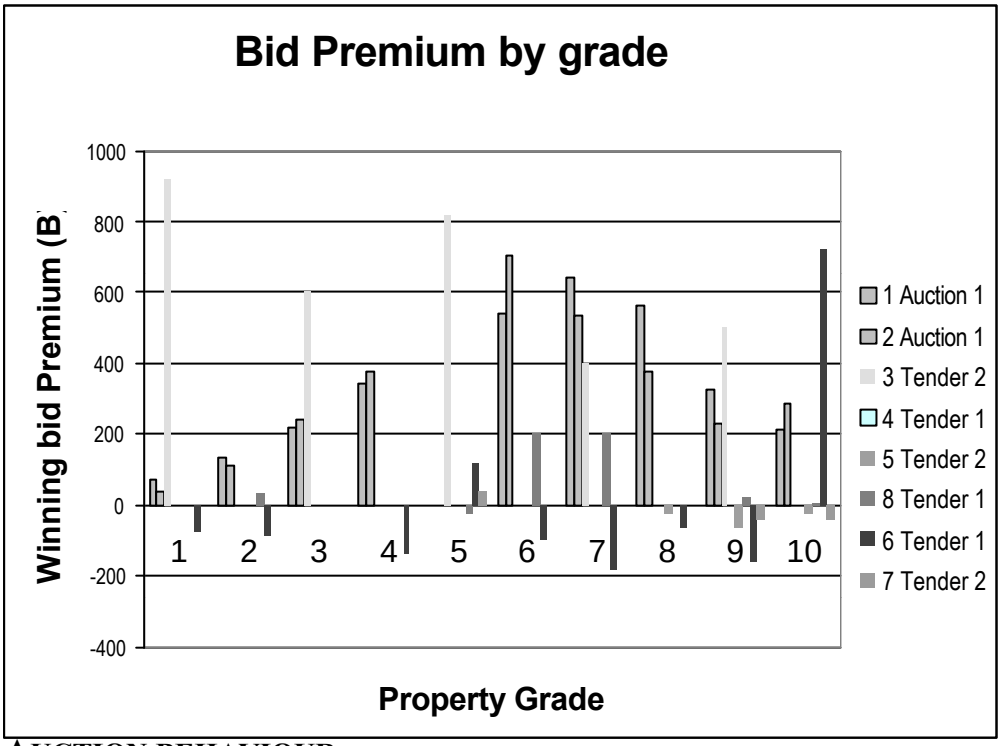
DISCUSSION

For the purposes of comparison, in this experiment there are four bases for price formation. The first is the rational determination, the second is the result from auction simulations, the third is the result from tender simulations and the fourth is the result from tenders in an unduly optimistic market.

The rational prices are based on zero vacancy and rents that normalise returns to tenants. The simulations were all run to ensure a slight under-supply of rental property that caused some tenants to be forced onto the commons. The commons were necessary in order to provide an alternative to the property market and provide the equivalent of public welfare into the game. The commons provided a floor to wage expectations and a mechanism for allowing uniform under-supply. For these reasons the assumption in the financial valuation would appear reasonable, at least in setting a hard upper limit to value. Shrewd bidders were expected to apply a discount to this value to cater for rents that may be struck under the optimum, though such discount bids were relatively rare in the winning bids. The financial values and have been used as the reference and premiums above rational values have been charted for each of the simulations, as shown in Exhibit 3.

The auction simulations have a net average premium of ฿331, whereas the five tender simulations have an average premium only ฿7.8. Given that the standard deviation of the sample mean for the tender simulations is ฿20.3, the tender prices are not significantly different to the rational values. Using the 42 observations that compose the normal tender simulations, the standard deviation for a single price within the sample is ฿131.6 Using them as an estimate of the population of rational market pricings, returns an estimated population standard deviation of ฿133.2. The small difference between these two statistics suggests that ฿133.2 may be

confidently adopted as a conservative estimate of the population standard deviation for further analysis. This facilitates the analysis of the auction and optimistic tender simulations using the simpler Z test rather than the more common T test. Since T testing uses particular sample means to estimate population parameters, it has the weakness of being forced to rely on small sample sizes to estimate parameters that are consequently more likely to be less reliable.



AUCTION BEHAVIOUR

Exhibit 3: Premiums

On this basis, the standard deviation of the sample mean of the combined auction results is **B**31.4, which produces an observed Z score of 4.42 for the auction mean compared to the tender mean. For a 0.01 two tailed test, the critical Z score is 2.57, which means that the results support the hypothesis that the auction results do not come from the same population as the tenders. That means that the auction prices are statistically different to the tender prices, in this case exceeding them. Similar analysis of the optimistic tender simulation reveals that it has an observed Z score of 10.8, again indicating the optimistic tender simulation is statistically different to the normal tender simulations.

The preliminary conclusion from these results is that in a sober, well-informed market, tenders appear to return rational prices, whereas auctions under the same conditions tend to be more

bullish. The simulation that contained expectations of unspecified future growth appeared to be the least restrained by rational computations. Each of these three situations will be further considered in detail.

AUCTION BEHAVIOUR

Inspection of Exhibit 3 reveals that auction premiums grew through the first half of each auction, them subsided. The parcels were sold in order of diminishing value, so the growth in premiums may have been related in some way to the values of the properties. This would appear to have been contradicted by the fall off in premiums towards the end of each auction, however, it may have been the case that bidders were also wary of attaching high relative premiums to low value properties. This would explain the later restraint.

Exhibit 4: Relative Premiums

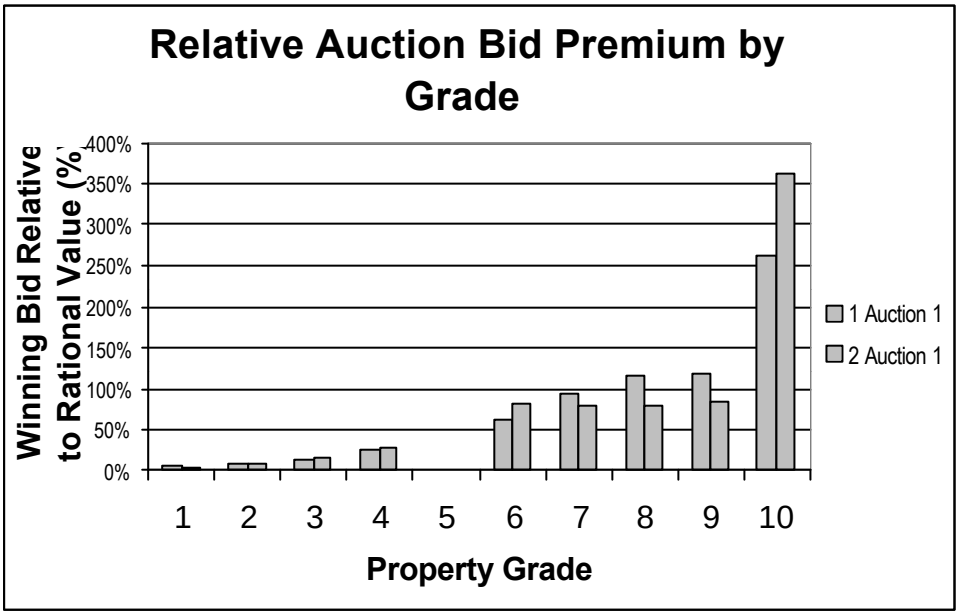


Exhibit 4 charts the auction premiums as percentages of the rational prices. It is apparent from this chart that the premiums did grow relatively throughout the auction in what appears to approximate an exponential trend. A behavioural explanation for this may be that the early premiums may have come from bullish bidders who were keen to become landlords at any cost. The successive prices may have resulted from the effect of a psychological reassurance provided by each previous sale. This is illustrated in Exhibit 5 that compares the average auction premium by property grade against a notional initial 6% premium grown at 55%.

The tendency for premiums to diminish from the mid-grades to the least productive grade (grade 10) may also have been influenced by growing realisation that the poorer parcels could not support the higher repayments from rentals sufficient for successful purchase over four years. In this case the cause of the latter restraint does not have to be tied to some subtle mathematical analysis on the part of the bidders. This is more satisfying because simulation three

suggests that subjects are not capable of analysis of this sort. The bulge towards the middle of the auction may either be explained simply by optimism feeding on the encouragement of the prior behaviour of others, or by some subtle evaluation linked to property value. Future simulations may use different orders of property value to explore this further. It is clear that prices were well in excess of the rational bids, reflecting an over-optimism that resulted in the majority of landlords going into receivership in those simulations.

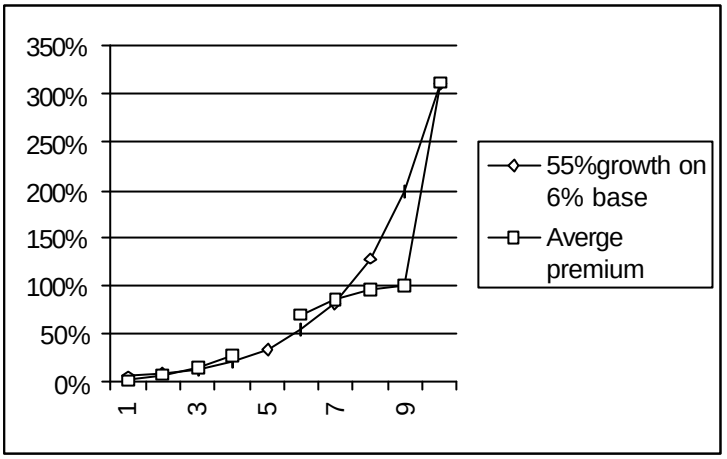


Exhibit 5

TENDER BEHAVIOUR.

Simulations 4-8 returned very conservative bids that relate well to rational expectations. The average premium across the five simulations was negligible at about ฿7.8. Also apparent were several sales at discounts to the rational prices. These were probably prudent considering the riskiness of achieving optimum rents through the whole of the simulation. On the whole, it would appear that tendering returns prices that are closer to rational valuations. This would appear to contradict the conventional wisdom that auction prices are the superior indicator of true value.

For the vendor, this would appear to be a shortcoming of tendering, though other factors should also be taken into account before choosing to use auction. Experienced property brokers do appear to believe that auctions will return the better sale result in particular cases. The results here confirm this popular belief, contrary to the findings of the studies cited earlier that suggest auctions always return discounts.

TENDER BEHAVIOUR UNDER UNCERTAINTY

Simulation 3 was executed using tender, but subjects were told that there would be *a productivity increase sometime after year one*. The prices bid reflect an inability to price this risky prospect of future benefit. There is no evidence of the hump favouring the middle grades, which further suggests that the latter was an artefact of the auction situation.

The simulation involved landowners having to cover their purchases using their first four years of rent or face severe penalties. Diaz *et al.* (1999) considered the importance of rewards in this type of experiment and the design of this experiment is in good accord with their recommendations. The penalties were very real to the subjects as the simulation carried a nominal 5% weight towards their final assessment and bankrupt landlords faced grades between minus two and zero. The game is constructed so that the long-term winner is more likely to be a property owner than a tenant, which is in conformity with common experience. The typical tenant scored between three and four marks out of five.

Subjects therefore had to balance the attraction of the bonus marks against the risk of a substantial real penalty. To bid high meant to be in the running to win a property, but also to raise the likelihood of bankruptcy. All subjects in simulation three were bankrupted, as were most in the auction simulations.

It may be argued that the subjects in simulation three were too naïve to bid responsibly. To answer this criticism, their behaviour may be compared to simulation run 5. Both simulations were second year classes that had also done the exercise in their first years, as simulations 1 & 2 respectively. The experience of over-optimistic landlords in the early simulations should have warned subjects against bullish bidding. Simulation 5 returned the most conservative prices in the entire experiment, while simulation three was at the other extreme.

The pattern of premiums is hard to validate financially. Premiums ranged from 50% to over 100% above the certain rational values. Given that the increases may have occurred anywhere in the five years of the simulation, any risk-adjusted valuation of them would infer an expectation of productivity increases several times that level. It would appear that little attempt was made to systematically quantify this, with bidders focused only on winning the properties.

In actual markets, knowledge is seldom as complete as in these simulations. If it is the case that optimism can so bias bidding behaviour as to take it well out of the realms of what could be considered rationally defensible on financial grounds, it may be a major factor in price formation.

IMPLICATIONS FOR PROPERTY CYCLES

There have been many attempts to explain property cycles, and there appear to be several possible explanations for them. However, the behavioural tendencies suggested by this experiment may also be applied to general market behaviour in a way that results in a mechanism that is capable of producing regular market fluctuations.

The two behavioural tendencies found in the simulations appear to be consistent with wider market behaviour. If bidders do take signals from recent sales, then the effect may extend outside the auction room to other instances of sequential sales to suggest behavioural mechanisms in the real estate market generally. The trend in recent sales may therefore be a major factor in bidder expectations of the likely winning bid in a coming sale. This is common experience; in a rising market, all participants tend to expect the trend to continue.

Likewise, if the irrational pricing of optimism is a widespread reality, then it may have an inordinate influence on any market that adopts unduly optimistic expectations. A market that somehow develops optimism that property worth will increase in the future may therefore inordinately value this expectation.

These two mechanisms could combine under optimistic conditions to explain the boom phase of the property cycle. If pessimism causes comparably inordinate undervaluing of assets with the market taking cues from previous sales, then the negative correction phase of the cycle is also explained

Small and Oluwoye (2000) suggested a conceptual model for the real estate cycle based on these two mechanisms with turning points related to financing and yield triggers. Such a model has the advantage that it results in simple mathematical relations that describe the oscillations of the market and has the capacity to accommodate both deterministic and chaotic fluctuation patterns. This research provides an important support for that conceptual approach. The key variable then becomes the actual quantification of optimism and the key research issue for understanding market fluctuations is the mechanism by which markets switch from pessimism, through neutrality to optimism.

DATA ISSUES

The data may be slightly misleading due to the fact that only winning bids were recorded and parcels were sold beginning with Grade 1. Lusht has suggested in describing the *Bidder's Curse* that the bidder who errs most optimistically will win the property, but faces ruin (Lusht 1994). In these simulations, the winner of any particular grade may have been over optimistic compared to the rest of the group. Hence, the group's behaviour is not completed observed. Likewise, the simulation procedure allowed any subject one property only, so any inordinate bids by that person for lesser grades dropped from sight.

This could partly explain the occurrence of discount prices towards the end of simulation 5 and the reining in of premiums towards the ends of each simulation. The explanation would be on the basis that the earlier sales had flushed out the most bullish purchasers, leaving the more conservative ones to win the latter properties.

On one hand a more complete analysis of bidder behaviour may be available from a more detailed analysis of all bids, or some modification of the simulation rules to allow multiple purchase. On the other, it may not be desirable to explore this issue too far, because it risks focusing too much on individual behaviour, rather than the more important social process of the market's behaviour as a whole. Auction prices are only those that come from the highest bidders, and in general, purchasers do drop out of the market once their needs for property ownership are sated. The object of property economics is to understand property market behaviour, and while this may be informed by an understanding of individual participant behaviour, the latter is not its primary focus.

CONSISTENCY AND VALIDITY

Experiments are only useful for research if they produce consistent results when repeated and have a valid relationship to the actual situation that they model. In this experiment simulations 1 & 2 and also 4-8 may be used to check for consistency for auctions and tenders respectively. In both cases, the results indicate consistency.

Validity is more difficult to identify. The simulations are simplifications of conditions in actual markets. For example, few market participants have the level of certain knowledge that was available in the simulations. Conversely, brokers are aware that certain market conditions do favour auctions over other methods of sale, and these insights appear to have been validated by the experiment, contrary to the previous studies on actual auctions. Likewise the phenomenon of market feedback, where early sales appear to be used to set bidder attitudes later in the market, appears to be consistent with actual market behaviour.

The most important issue in assessing validity is assessing the degree to which the experimental situation models the actual situation. Two aspects of this are especially important, one is the degree to which the behavioural mechanisms in the experiment parallel those of the real world and the other in the relative balance of incentives and deterrents between the artificial laboratory situation and the real world.

The experiment appears to utilise the same mechanisms as the real world, albeit simplified. Purchasers have to evaluate the prospective properties in terms of their rental potential within their financial constraints. Purchase is only profitable if subsequent rentals are sufficient to cover financial obligations and the cost of failure is high. Although the financial, operating and leasing mechanisms are simple, they are essentially similar to real world situations.

The appropriateness of the rewards and punishments is more difficult to defend. Resource constraints have limited the running of the simulations, so fine tuning of the parameters is difficult. Moreover, it may be dangerous to adjust the reward structure too much for fear of merely setting it so as to obtain expected results. As it stands, the author would like to use the severity of rewards and punishments as an independent variable in future trials in the hope of containing the apparent over-optimism of auction markets. There may be ethical constraints to taking this too far considering that the rewards and penalties relate to grades in university subjects. It may be that more severe penalties for bankruptcy may reduce both tender and auction prices. This is clearly an aspect for further research. What can be concluded however, is that the experiment does appear to display reasonable consistency and defensible validity.

CONCLUSION

This experimental approach appears to offer insights into the behaviour of property purchasers. In a well-informed market, the tender process appears to return prices close to rational financial evaluation. By contrast, auctions appear to encourage prices at a premium to the underlying

rational value. Uncertain prospects of future benefit appear to be priced with irrational premiums.

At first sight, the positive internal auction price effect appears to only correspond with some of the literature, and is not substantiated by the majority of real-world studies. This may be because of other behavioural issues. Likewise, the auction premium effect is counter to most of the literature; Lusht (1994), Mayer (1998) Allen and Swisher (2000), and Brennan (1971) all found that auction prices were at discounts to expected values. However, the instances examined may have carried other implicit expectations of lower prices. For example, Allen and Swisher (2000) studied properties sold at an auction devoted to mortgage defaults. Buyers could be expected to be cautious about the valuations and also they would expect that the vendors would not be as discriminating in setting reserve prices. Similarly, Lusht (1994) studied the sale of bank branches in Australia as they were released in bulk onto the market. Buyers could likewise have expected discounts and could also have been suspicious of the long-term prospects signalled by the bank's choice to liquidate its property. Brennan (1971) examined early auctions in Canberra (Australia) finding them to return heavy discounts as evidenced by later private re-sales. In that case, there was considerable uncertainty regarding the viability of the Australian Capital Territory. All of these instances were blighted by either undue pessimism or the self-fulfilled expectation that the sales would be at a discount.

One advantage of the experimental approach is that it can be designed to control for these extraneous variables. Indeed, it would appear possible to design experiments to explore their actual operation in a way that cannot be done by post-hoc study of actual auctions. The simulation/game that forms the basis of this study would appear suitable for this purpose.

The inordinate pricing of uncertainty is a finding that deserves closer study. If optimism can produce unduly bullish markets, then its absence may explain the discount pricing found in previous studies. Auctions do appear to be well regarded as an effective marketing method, which would not be the case if they always returned discount prices. This author noticed the trend towards auctions during the strongly rising market 1988 in Sydney that appeared to return premium prices, though a systematic study of this relative popularity would be necessary before drawing firm conclusions.

The behaviours revealed in this experiment are sufficient to explain market behaviour in boom conditions and perhaps in the pessimistic phase of the property cycle as well. This would appear to provide sufficient behavioural mechanisms to construct a behavioural theory of property cycles.

The experiment appears to produce consistent results and is arguably a valid tools for understanding actual property market behaviour.

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