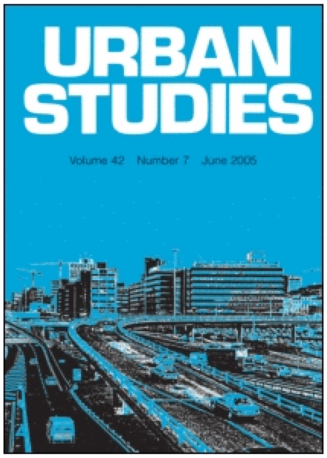

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A Statistical Explanation for Extreme Bids in the House Market

Eric J. Levin and Gwilym B. J. Pryce

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Summary. This paper proposes a simple statistical explanation for the phenomenon of extreme bids. During a boom, the housing market regime switches from a single bidder to a multiple bidder environment. The sale price in a multiple bidder auction is the maximum bid and the distribution of maximum bids contains a much higher proportion of extreme bids compared with the distribution of single bidder valuations. While this theory does not preclude behavioural explanations of extreme bids, it does demonstrate that a world free from strategic and idiosyncratic behaviour would not be a world free from extreme bids during boom periods. Therefore, when gauging the impact of strategic or idiosyncratic behaviour (either hypothetically or empirically) one has to measure the effect against a baseline regime where extreme bids are inevitable, not against a world that is free from extreme bids.

1. Introduction

Extreme bids become commonplace during house market booms and various explanations of this phenomenon have been proposed in the context of particular housing market upswings. In the popular press, for example, the extreme bids offered in some housing auctions have been characterised as the consequence of buyer desperation:

> In Edinburgh city centre, where demand easily outstrips supply and many properties are attracting more than a dozen notes of interest, the [difference between asking and selling price] exceeds 30 per cent. Similar high bids have been experienced in parts of Glasgow such as Merchant City, and in nearby Bearsden. The same is being seen in increasingly desirable pockets of east Fife and Aberdeenshire . . . Last month, a flat in the High Street, Edinburgh, which was advertised at offers over £53 000, sold for £108 500—105 per cent over the asking price. A second-floor flat in the Merchiston area, on the market at offers over £49 000, sold for £101 000—106 per cent over . . . Simon Fairclough, of the Edinburgh Solicitors Property Centre, said: "You can understand buyers who have missed out a couple of times and who are offering 30–40 per cent over to make sure they are successful the next time round (O'Donnell and Darroch, 2003).

Others explain house price instability as the outcome of market-making operations by intermediaries such as estate agents, surveyors and solicitors (Smith *et al.*, 2006), or have

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emphasised the persistence of local housing market conventions in bidding behaviour (Pryce, 2004). The argument put forward in this paper is that there is an additional explanation that rests entirely on the laws of probability. We should not be surprised either at the occurrence of extreme bids in a booming market or at the divergence of selling prices from surveyor valuations. These phenomena may be an inevitable consequence of the interplay of three distributions: the distribution of potential bids, the distribution of mean actual bids and the distribution of successful (maximum) actual bids.

To set the scene for our hypothesis and consider its status among the existing list of alternative explanations, consider Unwin's (2003) 'shopping mall vignette' as a possible metaphor of the debate (see Box 1).

The genuine surprise expressed by Chad at the mall guide arises from an epistemological fallacy. The 'You Are Here' arrow had not followed them around the shopping mall, nor was it evidence that they were predestined to be there at that moment in time. It was always there on the same noticeboard offering the same mundane message to each passer-by. In truth, the arrow was identifying the position of the noticeboard—the location of the reader was coincidental. No mystery. No conspiracy. No need for an additional cause. The preferred logical interpretation was the simplest one—the one that required the fewest assumptions, an example of Occam's Razor.

Similarly, we argue here that, as the market booms, there tend to be more bids per house auction (for prices to rise, demand must exceed supply—which is another way of saying that the number of properties for sale is less than the number of buyers chasing them) and this alone is sufficient to induce the phenomenon of extreme bids. This is because, when the number of bids per auction rises, the distribution of successful

Box 1. The shopping mall vignette. *Source*: Unwin (2003, pp. 24–25).

Scene:	*A shopping mall.*
Characters:	*Two teenage boys—Anaxagoras (The Axe) and Chad.*
The Axe:	We're lost.
Chad:	I know. I think society has let us down by failing to instil in us a sense of those values that . . .
The Axe:	No, you idiot. I mean it literally. I've no idea where the Body-Part Piercing Parlor is.
Chad:	Oh. There's a mall guide over there.

[*Chad walks over to the mall guide, which is a wall map showing the locations of the mall stores. he inspects it for a while*.]

Chad:	Oh, my god. [*Chad is unnerved*.] This is totally incredible. I just don't believe it.
The Axe:	What is it? Speak to me, Chad.
Chad:	Come and look. You won't believe this.

[*The Axe joins Chad and looks at the mall guide*.]

The Axe:	Well?
Chad:	Don't you see it? It took me a while to notice it too.
The Axe:	Notice what?
Chad:	We *are* exactly where the arrow says we are. How could they have known that??

[*The Axe ponders the situation*.]

Chad:	I knew that these shopping mall people were clever, but this is miraculous. [*Chad looks up suspiciously for cameras.*] [*Whispering.*] How do they do that? How did they know where we are? Axe, I'm scared.

(i.e. maximum) bids shifts to the right and alters in shape. Even if the distribution of *potential* bids remains unchanged, the metamorphosis of the distribution of *maximum* bids makes the increased likelihood of extreme bids not only possible, but inevitable.

This does not, however, preclude other explanations. First, the distributions of potential valuations of buyers and the reservation prices of sellers are likely to be shifted by bubble and panic psychology during market booms and busts. Secondly, the sale price lies somewhere between the floor price (the minimum price at which the seller is willing to relinquish property rights) and the ceiling price (the maximum price that the buyer is willing to pay to acquire these rights). In the absence of many buyers and sellers, the distribution of the surplus value between these two valuations will be determined by bilateral bargaining between buyers and sellers with market intermediaries. These raise issues of market power, principal–agent problems and complexity for estate agents, surveyors and solicitors, the relative power of each of these market participants being influenced by the institutional arrangements within which the final sale price is determined Buyer, seller and intermediary behaviour and the institutional arrangements in which they operate will clearly be important determinants of both the shapes and positions on the valuation distributions. However, the analysis in this paper focuses on a simple scenario of sealed bids with exogenous distributions of potential buyer valuations and seller reservation prices in order to highlight the impact of statistical distributions on extreme bids.

Our main contribution is not to refute strategic behaviour in the housing market, but to demonstrate that a world *without* strategic behaviour would not be a world free from extreme bids during boom periods. On the contrary, we argue that it is inevitable that extreme bids will be more common during such phases because of the shifts in the sampling distribution of the maximum as the number of bids rises. So when gauging the impact of strategic behaviour (either hypothetically or empirically), one has to measure it against a baseline regime where extreme bids are inevitable, not against a world that is free from extreme bids. Our theory shifts the baseline against which the outcome of strategic interventions by estate agents must be compared.

The remainder of the paper is structured as follows. In section 2, we offer a brief review of the literature. Then we present our theory of extreme bids (section 3) and discuss the main assumptions (section 4). In section 5, we attempt to test the validity of our hypothesis using a simulated dataset before discussing the implications of our findings for the meaning of surveyor valuations (section 6) and the divergence between asking and selling prices (section 7). Section 8 offers a brief summary.

Before proceeding, we should also note that our analysis is based on the Scottish sealed-bid system, although we believe it to be extendable to other selling structures. We do not provide a detailed description of the Scottish system here because there are two recent papers that do this in full (Smith *et al.*, 2006; Pryce and Gibb, 2006).

2. Literature Review

There is widespread agreement on the sequence of events associated with the sale of a house. The seller chooses a list price with the help of an estate agent, prospective buyers use this information to decide whether or not to inspect the house and eventually one or more potential buyers makes a bid. There is, however, less agreement about the microstructure of housing markets and the nature of the relationship between valuation, the 'usual' list price, the actual list price, time on the market and the final selling price.

The housing market literature identifies a number of different ways in which the seller's choice of the list price influences the actual sale price of a house. For example, Anglin *et al.* (2003) emphasise the importance of the seller's choice of list price on the time taken to sell the house and also the likely selling price received. Allen and Dare (2004) discuss the psychological effects of using 'charm prices' that set the list price just below round-number price points. Miller and Sklarz (1987) and Northcraft and Neale (1987) consider how the list price affects the perceived valuation as well as conveying information to potential buyers. Haurin (1988) shows how greater variance in the distribution of buyer valuations of an atypical house lengthens time on the market because it is profitable to wait for more offers. Horowitz (1992) and Knight *et al.* (1994) suggest that a lower list price attracts more bids but also lowers the perceived valuation. Yavas and Yang (1995) examine the disincentive effect of overpricing on the estate agent acting on behalf of the seller. Arnold (1999) models the optimal list price strategy that trades off extra bids against a lower ceiling price, taking account of the cost associated with time on the market. Merlo and Ortalo-Magne (2004) incorporate strategic interactions between buyer and seller when the seller can revise the list price as time goes by.

More generally, Smith *et al.* (2006) suggest that the institutional procedures adopted by market-making intermediaries contribute to house price instability. The authors interviewed solicitors, surveyors, valuers, estate agents, property developers and property managers in order to understand how the house market-making process might have contributed to the extraordinary Edinburgh house price boom between 1996 and 2003. These interviews appear to support the authors' view that the operation of the house market exacerbates house price instability. During periods of relative price stability, buyers paid 5–10 per cent above the *offers over* price; the *offers over* price was set at a constant margin below the anticipated sale price; and all those involved understood roughly what the outcome would be. However, during the boom, one in three buyers in the Edinburgh study paid at least 10 per cent and sometimes 25 per cent over valuation.

Smith *et al.* explain the increase in the sale price to valuation ratio in terms of the institutional nature of the market process. For example, they maintain that professional valuers should provide a powerful anchor for price negotiations, but 'hadn't a clue' what potential buyers should offer when prices were rising fast. Estate agents started dropping 'offers over' list prices when the market started to take off in order to attract buyers. This created a disjunction between 'professional' pricing and pragmatic 'offers over' selling prices. This in turn encouraged the buyers' agent to advise buyers to 'offer as much as you can afford'. The authors maintain that their interviews support the hypothesis that the political and legal framework of market-making contributes to price instability.

We agree that the evidence provided by the interviews does not contradict the conjecture that institutional features of the house market contribute to house price instability and, in particular, to an unwarranted Edinburgh house price boom. However, Occam's Razor suggests serious consideration of the simplest explanation and we contend that there is a straightforward, more general, explanation for the apparently extraordinary bidding behaviour that has characterised the house price booms in Edinburgh, Glasgow and elsewhere.

3. Three Distributions

Consider now an explanation of extreme bids in terms of the interplay of probability distributions. This explanation, it should be said, is not a general theory of market cycles. We do not attempt to explain why the market booms, only that there are certain inevitable consequences when it does. Our goal is to explain the increased propensity of extreme bids during booms—bids that appear to be a long way from the average value potential bidders would place on the property. We present our explanation as the story of how three distributions change and interact during boom conditions and cause the final selling price to diverge from the mean valuation. This process is not contingent on bargaining behaviour, psychological effects, agency incentive distortions, or information 'conventions'. We suggest that the laws of probability lead to a fundamental relationship between the number of bidders and the final sale price. While our theory does not preclude the existence of strategic behaviour and market idiosyncrasies, it does demonstrate that a world without strategic behaviour would not be a world free from extreme bids during boom periods. Therefore, our theory shifts the baseline against which the outcome of strategic interventions by estate agents must be compared.

Our hypothesis can be summarised as follows. In an auction system of house sales, the distribution of final sales prices is defined by the distribution of the *maximum* bid in each auction, not the distribution of the *mean* bid. This is important because the distribution of the mean bid responds differently to increases in the number of bids than the distribution of the maximum bid. The distribution of the mean bid will tend towards the bell-curve (normal distribution) as the number of bidders increases (a widely celebrated result known as the Central Limit Theorem that underpins much of modern statistics). *Not so for the distribution of the maximum bid*. The distribution of the maximum bid systematically *deviates* from normality as the number of bids in each auction rises (see Wolinsky, 1988). This gives rise to the observed phenomenon of extreme bids. An increased proportion of successful bids (i.e. final sales prices) is drawn from the extreme upper tail of the underlying distribution of potential bids. This occurs without any change to the distribution of potential bids. This, we argue, is an inevitable statistical process. The story of extreme prices during booms is, in fact, the tale of three distributions.

Our hypothesis is illustrated in the stylised distributions of Figures 1 and 2. In Figure 1, panel A represents the distribution of all potential bids for property of type k. The shape of this distribution will be determined by the values that buyers put on a property which in turn will be determined by the pattern of consumer preferences and budget constraints at a given point in time. The shaded area in the right tail represents the proportion of buyers that would offer at least x. It is important to note that the actual shape of this distribution of all potential bids is not important because the analysis is independent of this issue. The reason is that, whatever the shape of the distribution of potential bidders, the Central Limit Theorem (arguably the most important theorem of statistics) ensures that distribution of the mean bid shown in Panel B tends towards the bell-curve (normal distribution) as the number of bidders increases.

Not all potential buyers bid in a particular auction. In fact, in this initial diagram (panels B and C of Figure 1), we assume in each auction that only one person puts in a bid. This one bidder is randomly drawn from the distribution of potential bids depicted in panel A. Panel B shows the average value of the bid in each auction if there were many auctions of this type (i.e. with only one bidder). Panel C plots the distribution of the maximum bid in each auction. Because there is only one bidder, distributions B and C are identical because the maximum bid will inevitably equal the minimum bid. In both cases, the area to the right of x is very small indeed—the chances of either the mean bid or the maximum bid in an auction being greater or equal to x is negligible.

Figure 2 tells a very different story. Here we have the same exercise, but with multiple bids in each auction. Although the bids are drawn from the same distribution of potential bids, the distribution of the maximum bid now has a different shape (fatter right-hand tail) and position (further to the right) compared with the distribution of the mean bid. So, the area to the right of x in panel C is now considerably greater than in either panel A or panel B, or indeed of any of the panels in the diagrams representing single-bid auctions (Figure 1). The spectacular increase in the probability of the successful bid (i.e. maximum bid) representing an extremely large value (greater than x) arises entirely from the increase in number of bids per auction for property type k. As the number of bids increases, the distribution of the *mean* bid tends towards the normal distribution (whatever the underlying distribution of potential bids) but the distribution of the *maximum* bid tends towards an

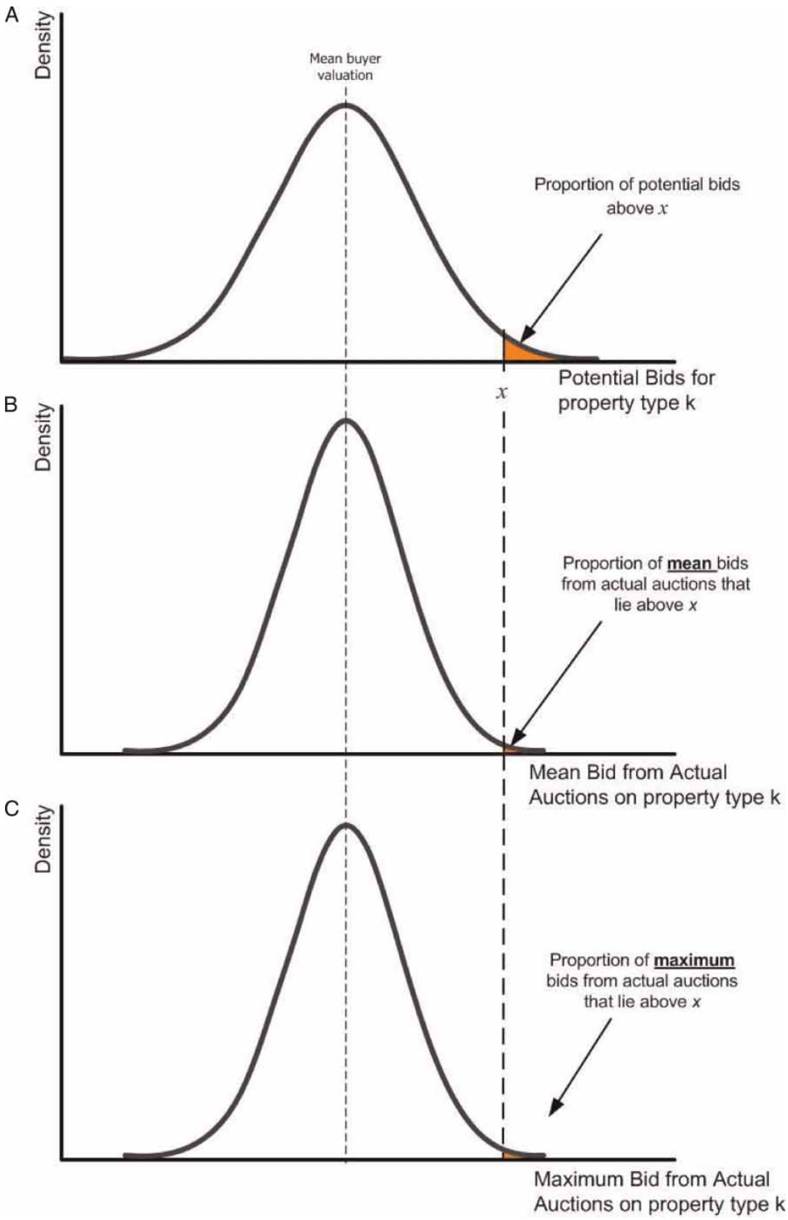


Figure 1. Three distributions: single-bid auctions.

extreme value distribution (such as the Poisson distribution or Gumbel distribution). We have assumed that the distribution of the population of potential bids is normal, but our basic hypothesis would also hold for a range of distributions for the population because of the laws governing sampling probabilities.

4. Assumptions and Diversions

We have assumed that the number of bids per auction rises during a boom because rising prices in an area reflect the fact that there are more buyers than sellers (demand is greater than supply). Indeed, it is likely that the steeper the rate of price increase, the

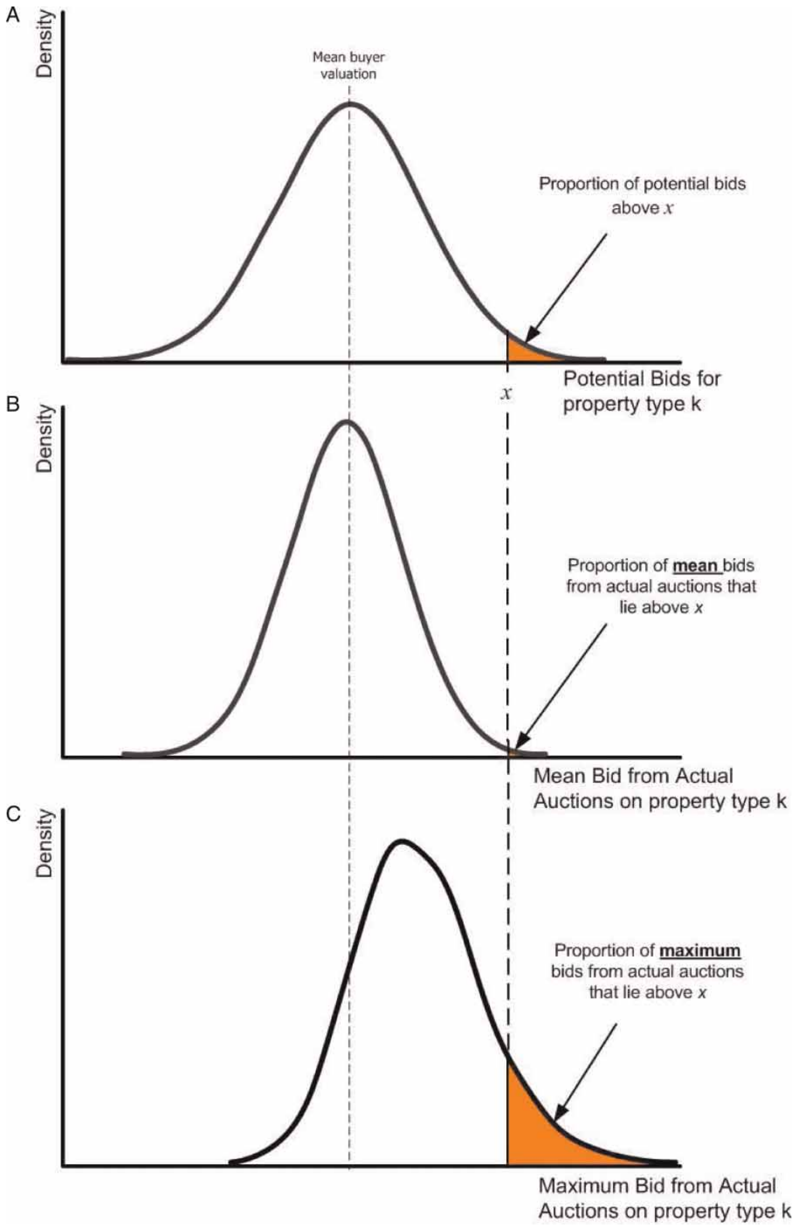


Figure 2. Three distributions: multiple-bid auctions.

greater the number of buyers for every house offered for sale. We have, however, also assumed that the distribution of the population of potential bids (panel A in Figures 1 and 2) also remains constant. This, of course, is unrealistic and we have imposed it only to simplify the statement of our hypothesis without loss of generality by isolating the effect of increasing the number of bids from other forces at play. In reality, the distribution of potential bids will shift in dynamic perpetuity as people constantly adjust their preferences and expectations. All this means in terms of our hypothesis is that, for every new distribution of potential bids, there will be separate sibling distributions for the mean bid in each auction and the maximum bid in each auction. So we can state more generally that, for any given distribution of potential bids, the chances of an extreme bid occurring in any one auction will tend to rise with the number of bids.

A second point to clarify here is our stance on the role of 'market-makers'. Gibb (1992) has argued that house purchase is primarily a process wherein market-makers have a pivotal role. However, we make a distinction between market-makers and market intermediaries that addresses the central issue that there are no market-makers in the housing market in terms of the conventional definition of a market-maker. Market-makers in financial markets guarantee to stand ready to act as counter-party principals for anyone wishing to buy or sell named stocks at any time during trading hours. That is, market-makers provide immediacy to stockholders and therefore liquidity to the stock market by sacrificing discretion over when and what quantity to buy or sell in return for the bid–ask spread. Competition between market-makers for each quoted share narrows the bid–ask spread, ensuring that market-makers make a normal profit in return for providing this service.

Market-makers carry inventories of stocks for which they act in the capacity of market-makers. Market-makers interpret unexpected inventory movements for a given stock as 'excess demand'—i.e. a signal that the demand and/or supply curve has shifted and that the market is not clearing at the current price. They adjust their buying and selling prices accordingly in response to unanticipated movements in their inventories. If the inventory of stock x falls and the inventory of stock y rises, the market-maker will raise both bid and ask prices for stock x and lower both bid and ask prices for stock y until the desired inventory levels are re-established at the new market-clearing equilibrium prices.

In financial markets, market-makers exist as intermediaries to provide immediacy for buyers and sellers, and they adjust bid and ask prices in response to changes in excess demand observed as unexpected movements in inventory. It is important to note that these market-makers acting as principals have no influence on the market buying and selling prices. Their price adjustments only reflect changes in supply or demand at prevailing prices. It is true that market-makers occasionally take a position on their own account, but this is not relevant. When they do this, they are acting as investors/speculators and not in their capacity as market-makers.

The mechanism of the housing market is very different. There are no market-makers in the house market because, unlike the shares of a given company, every house differs with respect to characteristics and location. It would be virtually impossible for a market-maker to translate inventory movements into excess demand and thereby identify bid and ask prices that would clear the market because each unit is unique and has a different value. That is, there is no mechanism by which market-clearing house prices can be established. In this house market environment, the seller posts a list price and waits for a potential buyer to make a bid for the house. The professional valuer is able to identify the likely selling price from past experience during periods of relative price stability. The professional valuer's valuation at the mean buyer's valuation enables building societies to lend, confident that it is possible to recoup the loan by a fast resale in the event of default. This same valuation also provides a guide to buyers in a single-bidder market concerning the likely sale price. The sale price may be above the mean valuation because there is a distribution of buyers' valuations. That is, a single bidder may offer a 5–10 per cent premium over the mean potential buyer valuation in order to secure the sale.

Buoyant house markets are very different. Multiple-bid sealed auctions occur far more frequently in a buoyant house market. The seller sets a closing date at which the sealed-bids submitted by potential buyers are opened and the house is sold at the highest bidder's price. The house market resembles the stock market insofar as non-zero excess demand is likely to precede change in the distribution of buyer and seller valuations, and perception of this excess demand raises the distribution of buyer valuations. However, the mechanism by which the initial increase in demand alters the price differs in the house market because there are no market-makers.

The problem is that rising demand in the house market creates two separate effects that are difficult to disentangle. First, holding the distribution of buyer valuations constant, the sale price rises with the number of bidders. The more bidders there are, the higher is the expected winning bid for any given distribution of buyer valuations and the larger is the gap between the mean buyer valuation and the sale price. Secondly, a rise in the number of bidders heralds a shift in the distribution of buyer valuations and a corresponding rise in the mean buyer valuation, as well as a growing gap between the current mean valuations and mean sale prices. Consequently the professional valuer becomes uncertain about the correct mean buyer valuation when a rising number of bidders signals excess demand. The estate agent is therefore correct to advise potential buyers to bid far in excess of the valuer's valuation in order to secure a purchase. The reason is that both the potential buyers' mean valuation and the gap between the sale price and the potential buyers' mean valuation (the valuer's valuation) are likely to rise above historical levels in a multiple-bid sealed price auction.

5. Simulated Effect of Increased Numbers of Bidders

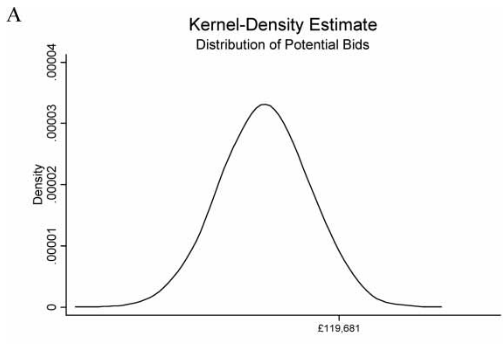
We now present the results of our simulation model based on a hypothetical database of 30 000 house valuations with a mean of £100 000 (sd = £11 962) which represents the population of potential bids for a particular type of house, k. This distribution of potential bids reflects the range of preferences and budgets over all possible bidders. In reality, this distribution is also likely to reflect the distribution of income in the wider population due to the effect of budget constraints on actual bids. The amount people are willing to offer on a particular house is governed not only by tastes—which we might reasonably assume to be approximately bell-shaped—but also by the ability to pay which may not be normally distributed. For the sake of simplicity, we assume in the results reported here that the distribution of potential bids is normal. We also ran our simulations on a variety of alternative population distributions and found that the results remain essentially the same. (Because the distribution of income in the wider population is positively skewed, for example, one might argue that the distribution of potential bids should be of a similar shape—such as a log-normal distribution.)

We then randomly draw each sample representing a particular auction from this population distribution of potential bids samples of size n. We draw many samples (20 000), representing many auctions of size n for the sale of property type k in order to see how the effect of varying n pans out in the long run.

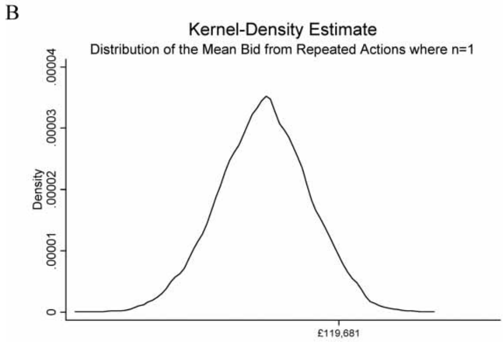
The next step is to define what we mean by an extreme bid

> *Definition*: An extreme bid is one that is drawn from the section of the upper tail of the distribution of potential bids that lies above the 95th centile—that is, one that is in the top 5 per cent of bids that the *population* of potential buyers would offer for a given property.

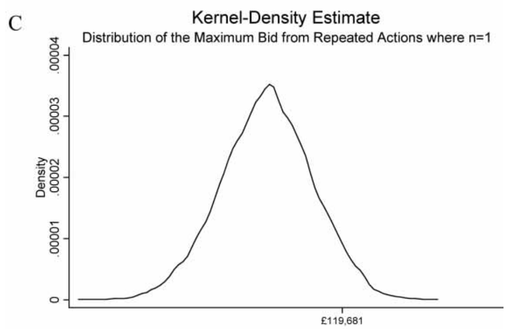
The relationship between the number of bidders and the selling price in a sealed-bid auction for a given distribution of buyer valuations can be demonstrated by observing what happens to the maximum bid price as the number of bidders rises. Figure 3 depicts our attempt to replicate the three stylised panels of Figure 1 using the simulation methods described earlier, assuming $n = 1$. Figure 4 depicts our attempt to replicate the three panels of Figure 2 using the simulation methods described earlier, assuming $n = 4$. Just from looking at the graphs, it can be seen that our hypothesis appears to be confirmed: the chances of the successful bid exceeding £119 681 in an auction increases from 5 per cent to 18 per cent when the number of bids rises from 1 to 4. However, this is not true of the mean bid: the chances



% potential bids > £119,681 = 5.00%

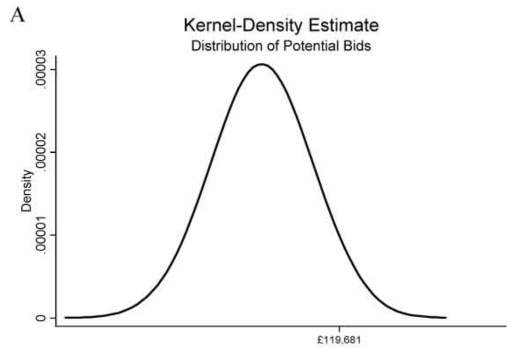


% mean bids > £119,681 = 5.01%

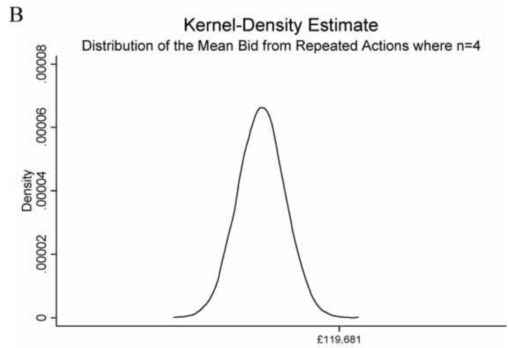


% max bids > £119,681 = 5.01%

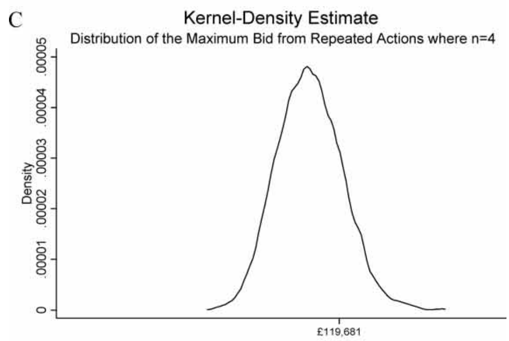
Figure 3. Simulated distributions: single-bid auctions.



% potential bids > £119,681 = 5.00%



% mean bids > £119,681 = 0.045%



% mean bids > £119,681 = 18.13%

Figure 4. Simulated distributions: four-bid auctions.

of the mean bid in an auction exceeding £119 681 actually falls to less than 0.5 per cent as the number of bids per auction rises from 1 to 4.

More detailed information on our simulations is presented in Table 1. As the number of bids per auction rises, the average value of the mean bid stays fairly constant at around £100 000, in contrast to the average value of the maximum bid which rises steadily to over £117 000. The movement of the average maximum bid away from the average mean bid is plotted in Figure 5 as a declining ratio. The proportion of bids over £119 681 rises with the number of bids per auction to nearly 34 per cent for the distribution of the maximum with 8 bidders (Figure 6). The proportion of mean bids over £119 681 falls with the number of bidders per auction, declining quickly to zero. Note, though, that in both

Table 1. Descriptive statistics on the distributions of the mean bid and the maximum bid

n	Mean £	Median £	Standard deviation £	95c (£)	99c (£)	Percentage of mean bids > £119 681	Percentage of maximum bids > £119 681	Average mean bid as percentage of average maximum bid
Distribution of the mean bid[a]								
1	99 936	100 093	12 002	119 697	126 643	5.010		
2	99 987	99 956	8 382	113 826	119 345	0.900		
3	99 880	99 943	6 867	111 173	116 001	0.220		
4	99 967	99 976	5 955	109 831	113 714	0.045		
5	100 006	99 982	5 383	109 002	112 617	0.005		
6	100 040	100 085	4 900	108 078	111 455	0.000		
7	99 977	100 014	4 537	107 345	110 389	0.000		
8	100 041	100 064	4 248	106 958	109 964	0.000		
Distribution of the maximum bid[a]								
1	99 936	100 093	12 002	119 697	126 643		5.010	100.0
2	106 732	106 433	9 750	122 955	130 132		9.685	93.7
3	110 015	109 821	8 783	124 634	131 583		13.800	90.8
4	112 215	111 947	8 266	125 921	133 135		18.130	89.1
5	113 935	113 723	7 867	127 107	134 624		22.680	87.8
6	115 145	114 926	7 579	127 870	135 109		26.800	86.9
7	116 075	115 803	7 282	128 226	135 150		30.160	86.1
8	117 014	116 753	7 113	129 083	136 355		33.990	85.5

[a]from 20 000 auctions with *n* bids of properties of type *k*.

distributions the standard deviation declines (as does the coefficient of variation) but less so for the distribution of the mean. Essentially, as the number of bids rises, the mean bid in each auction will give an increasingly reliable estimate of the mean value placed on the property in the population as a whole, whereas the maximum bid in each auction

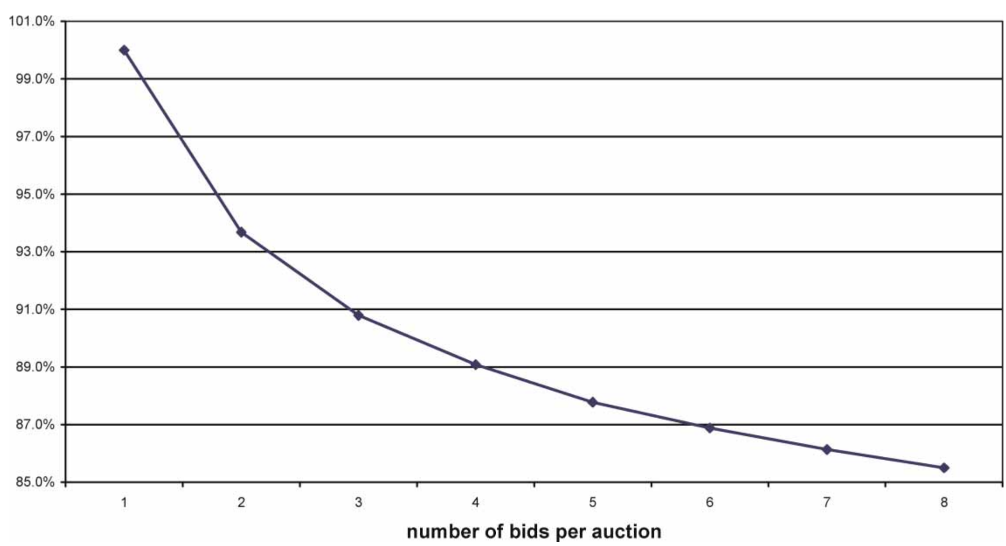


Figure 5. Average mean bid as a percentage of average maximum bid.

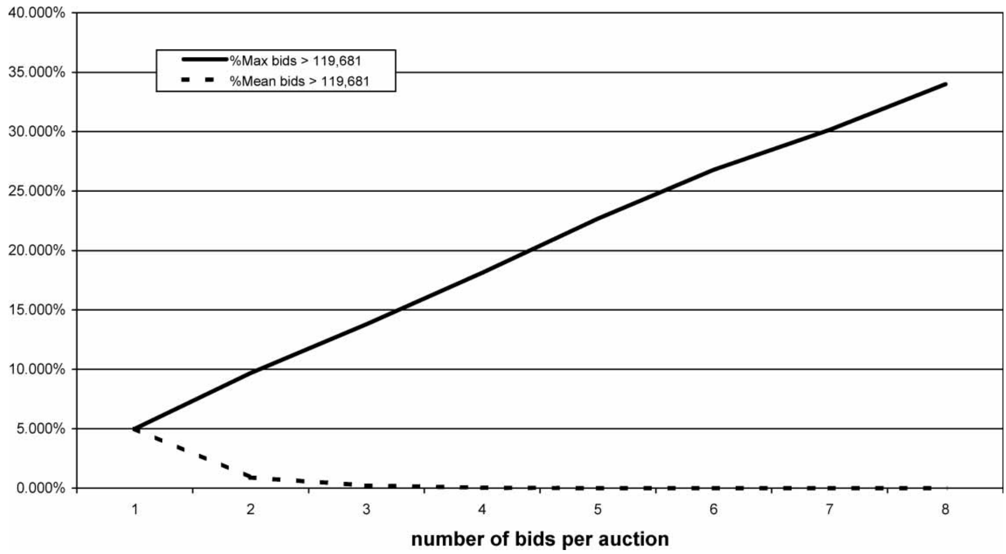


Figure 6. Proportion of bids greater than £119 681.

will converge towards the value placed on the property by the potential buyer who values it most highly in the population as a whole.[1]

6. The Meaning of Surveyor Valuations

Our simulations suggest that the difference between the distributions of the mean and maximum bids will increase as the number of bids per auction increases. This raises some important questions about the goal and meaning of survey valuations. Is the surveyor attempting to estimate the *final sale price*, or is he/she attempting to gauge the *average value* that all potential buyers would put on the property (or indeed some confused combination of the two) at a particular point in time. There is a case for suggesting that the definition of valuation for a valuer is the appropriate price on which lenders should base their mortgage allocation decisions.

Note that the nature of the housing market differs between periods of relative price stability and periods of boom. Multiple bids drive the actual selling price farther along a given distribution of buyer valuations. It is reasonable for the valuer, however, to base his estimate of the long-term value of the house on the *average* value potential bidders would place on the property—rather than the fortuitous outcome of a single auction. Because the Central Limit Theorem dictates that the mean of all sample means will equal the population mean when the sampling process is random, the valuer will attempt to ascertain the distribution of the *mean* bid, not the distribution of the *maximum* bid because it is the former, not the latter, that will be the best guide to the true average value that the market places on the property for the purpose of collateral value to a mortgage lender. This distinction between the definition of valuation for mortgage purposes and the value of a property achieved in a particular auction, provides the simplest explanation for the widening gap between valuer valuations and the selling price during a boom—the divergence occurs because the maximum bid diverges from the mean bid as the number of bids per auction increases.

7. The Divergence of Asking and Sale Prices

We have so far focused our attention on why sale prices—the maximum bids in each auction—deviate from surveys commissioned by the buyer. Can our tale of three distributions offer any insight into the question of why selling prices appear to diverge from upset prices (i.e. 'list' prices or 'asking' prices) during a boom? Estate agents are quick to deny allegations of market-fixing, as the following quote demonstrates:

> It would be worrying if undervaluing a property was a tactic that was increasingly being used. Certainly the ESPC would not support that. The notion that the upset price should be a minimum that the seller should wish to realise is a good one. However, there may very well have been incidences where prices have been underestimated—it is not a science, it's an art (Simon Fairclough, Edinburgh Solicitors Property Centre; quoted in O'Donnell and Darroch, 2003).[2]

The final sentence of this quote is revealing. It suggests that it may be uncertainty rather than conspiracy that is the primary cause. Clearly, this is the explanation that estate agents would prefer us to adopt, but is it consistent with our theory?

This explanation would be perfectly plausible if it were not for the fact that the valuation provided for the seller is not typically for mortgage purposes—it is purely an aid to identifying the upset price. The mortgage valuation is usually based on a separate, more thorough inspection, which under the present system in Scotland is commissioned by the buyer (although this would change if the Single Seller Survey and Home Information Packs were introduced). An interesting question, then, is whether estate agents' valuations for sellers diverge from either (or both) upset prices or final selling prices during a boom. Unfortunately, this is not something we have empirical information on at present and so we can only speculate. It is possible that the upset price, like the mortgage valuation, may be based on a surveyor estimate that is to some extent trying to gauge the average price that buyers would offer for the property, rather than the maximum that could be achieved in a given auction. In other words, the explanation offered in the previous section may well still hold—as these two distinct statistical entities diverge during a boom, so does the difference between asking and selling prices.

An additional implication of our finding, however, is that estate agents and sellers may have an incentive to increase the number of bidders *per se* because the chances of an extreme bid rise rapidly with every extra bidder that participates in an auction. If this can be achieved by artificially suppressing the asking price, then estate agents and sellers have an incentive to set a lower asking price. However, this tactic should only succeed for a limited period. Buyers would simply adjust their interpretation of the asking price accordingly and not bother to bid unless they believe they have a reasonable chance of success. Nevertheless, under bounded rationality buyers may be naïve, perhaps because they are not in the game long enough to learn what is going on. This becomes an empirical issue.

There remains the question of why the incentive to lower the asking price should be greater during a boom. Are not the incentives equally great (if not greater) to undervalue the upset price during a slump? There are possible explanations for why estate agents do not lower the asking price in order to attract more bids during a less buoyant market. For example, one could argue that the price-setting process switches from being an auction-based system to a bi-lateral bargaining-based system as the market slows. Once the seller is in a bi-lateral bargaining situation, it is counter-productive to set an artificially low asking price that may be interpreted as a signal that the seller is willing to accept a low price.

This regime-switching story is by no means implausible but it does suggest qualitative breaks in dynamics of the transactions process that should reveal themselves in the data. For example, one might expect sudden falls in the average proportionate difference between asking and selling price when the market slows as sellers switch from an anticipated auction system to an anticipated bargaining scenario—sellers raise the asking price (*ceteris paribus*) because of the risk of finding themselves in a bilateral bargaining situation. However, the opposite appears to be true, at least for Glasgow. In Figure 7, the percentage over the asking price rises at almost exactly the same rate as the change in constant quality prices *CQP* (see the Appendix, Table A1, for the underlying hedonic regressions) but appears to decline at a slower rate after the boom has peaked.

The regime-switching argument is only consistent with the evidence if one combines it with additional assumptions, such as the belief that this particular market scenario is unique and that sellers and agents are only learning incrementally the benefits of suppressing the asking price as the market booms. Since many buyers are also sellers, one has to assume that buyers quickly become aware of the tactic.

So where does this leave us? It is clear that our tale of three distributions does not preclude strategic behaviour on the part of sellers and estate agents (although it does shift the baseline against which the outcome of strategic interventions by market agents must be compared). Lowering the asking price to attract more sellers may be a rational response at the individual level, but this strategy would not determine the pace or direction of the market as whole. If one seller lowers the asking price he/she may attract more bidders. If, however, every seller lowers the asking price, there is no net increase in the number of bidders relative to sellers and the impact is neutral. We do not address this fallacy of composition. Secondly, during a boom, the distribution of potential bids is likely to be shifted by anxiety to avoid further transaction costs after many failed bids while the distribution of seller reservation prices during a slump is shifted downwards by a protracted time on the market without any bidders. That is, market conditions feed back to alter the distribution of valuations and this is ignored in our simplified model based on statistical distributions. Ultimately, primal market forces will prevail. Average prices in an area rise when there are more buyers than sellers of properties in that area. And when there are many bidders per house auction, there will be a greater chance of an extreme bid, due (at least in part) to the laws of probability that govern the relationship between the distribution of the maximum bid and the number of bidders.

If there are no further shifts in demand or supply (which is a big ‘if’ given the potential for constant changes to income, labour markets, population flows, new construction

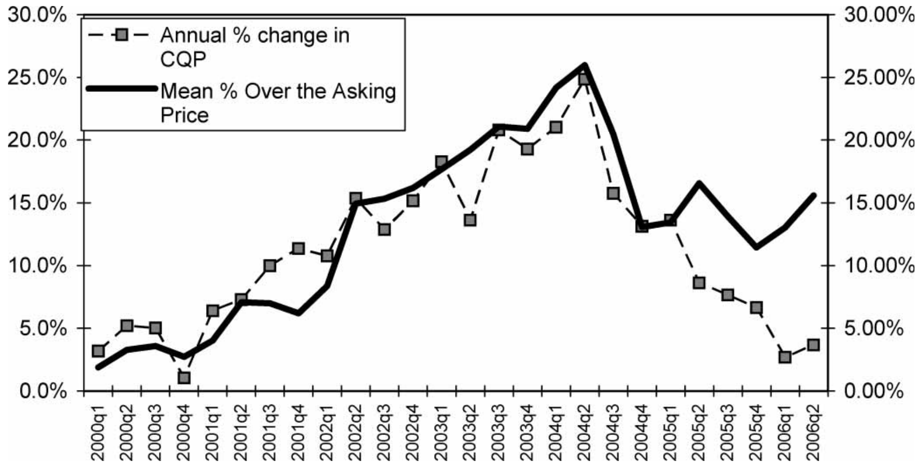


Figure 7. Percentage over the asking price and house price change. *Source*: GSPC data on Strathclyde.

and planning policy), prices will rise to a point where the number of buyers will roughly equate to the number of dwellings for sale. At that new equilibrium, there will be fewer bids per auction (particularly when there is a significant cost to bidding) and less chance of extreme bids occurring.

Perhaps the most profound complication raised by our hypothesis is its implication for the meaning of 'value' in the context of a house auction system. If the distribution of the mean bid was fundamentally the same as that of the maximum bid, there would be less of a problem. But it is not so and we are left with the question of what buyers, sellers, estate agents and indeed surveyors mean when they talk of the value of a house. Are they referring to the average mean bid or the mean maximum bid? We take the view that the valuer is attempting to establish a sustainable long-term value factoring out short-term volatility. Given that no-one knows how long a market will bubble, it makes sense for the lenders to go with the long-term, that is, the average mean bid.

8. Conclusion

This paper proposes a simple statistical explanation for the phenomenon of extreme bids observed during house market booms. The origin of this phenomenon is the absence of any market-making mechanism to identify bid and ask prices that would instantly clear the market, because each house is unique with respect to characteristics and location. In this environment, the seller posts a list price and waits for a potential buyer to make a bid for the house. During periods of price stability, the professional valuer identifies the likely selling price from past experience. The professional valuer's valuation at the mean buyer's valuation enables building societies to lend, confident that it is possible to recoup the loan by a fast resale in the event of default. This same valuation also guides buyers in a single-bidder market concerning the likely sale price.

During a boom period, however, the market regime switches from a single-bidder to a multiple-bidder environment. The sale price in a multiple-bidder auction is the maximum bid and the distribution of maximum bids contains a much higher proportion of extreme bids compared with the distribution of single-bidder valuations. The inevitability and simplicity of this statistical explanation of extreme bids in a rising house market justifies its claim to be a central explanation under the principle of Occam's Razor. This explanation is consistent with professional valuer confusion about the correct valuation during the boom. It becomes impossible to distinguish gaps between the sale price and the mean potential buyer valuation caused by multiple bids, and the shifting distribution of potential buyer valuations associated the excess demand of a booming house market. This in turn provides an innocent explanation for estate agents' exhortations to buyers to 'just offer as much as you can afford'.

The statistical explanation for extreme bids is also consistent with the asymmetrical behaviour of estate agents in boom compared with quiet house markets. During the house market boom, they lower the 'offers over' price in order to increase the number of bidders. However, they do not lower the 'offers over' price during quiet house markets when there is still likely to be only one bidder and the main effect would be to signal a low seller reservation price. Our analysis does not preclude attempts by market intermediaries to rig the market, but the phenomena that have been used as evidence that the political and legal framework of market-making contributes to price instability are consistent with perfectly innocent behaviour together with the statistical explanation for extreme bids.

The main contribution of this paper, therefore, is to demonstrate that a world without strategic and idiosyncratic behaviour would *not* be a world free from extreme bids during boom periods. On the contrary, it is inevitable that extreme bids will be more common during such phases because of the shifts in the sampling distribution of the maximum as the number of bids rises. So when gauging the impact of strategic behaviour (either hypothetically or empirically) one has to measure it against a baseline regime where extreme bids are inevitable, not against a world that is free from extreme bids. Therefore, our theory shifts the baseline against which the outcome of strategic and idiosyncratic interventions by estate agents must be compared.

Notes

1. If we increased n to its largest possible value so that all 30 000 of our potential bidders submitted a bid in an auction ($n = 30\,000$), then the maximum bid in that auction would exactly equal the maximum value placed on the property in the population as a whole.
2. Simon Fairclough, of the Edinburgh Solicitors Property Centre, was speaking in the context of rising proportionate differences between the asking price and selling price in Edinburgh.

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Appendix

Table A1. Hedonic regression results used to create the constant quality price index ($N = 35\ 566$)

Variable	Coefficient	t	Quarter dummies	Coefficient	t
Acre	73 316.8	22.3	y1999q2	1 325.1	1.0
Alarm	−236.5	−0.4	y1999q3	1 860.8	1.5
Bay	15 320.9	35.1	y1999q4	3 756.8	2.7
Bedrooms	16 816.4	73.7	y2000q1	1 925.0	1.4
Detached bungalow	51 180.7	49.0	y2000q2	4 557.6	3.2
Semi bungalow	26 703.4	22.3	y2000q3	5 002.3	3.3
Terrace bungalow	6 543.9	2.1	y2000q4	4 433.6	2.7
Distance to Glasgow	−1.3	−39.6	y2001q1	5 936.9	3.9
Conservatory	6 259.7	6.0	y2001q2	9 309.1	6.2
Conversion	54 519.1	39.6	y2001q3	11 564.4	7.8
Deprivation score	−667.7	−8.5	y2001q4	11 829.4	7.7
Driveway	−566.4	−0.9	y2002q1	13 112.3	9.9
Ensuite	15 579.8	19.3	y2002q2	20 071.0	14.9
Flat 1st floor	−947.0	−1.8	y2002q3	20 856.2	16.1
Flat 2nd floor	549.2	0.9	y2002q4	22 819.2	17.3
Flat 3rd floor	3 434.4	2.0	y2003q1	26 608.2	20.4
Lower flat	−4 690.0	−5.4	y2003q2	31 074.5	24.0
Main door flat	9 709.9	6.7	y2003q3	37 815.0	29.3
Upper flat	−5 292.7	−7.0	y2003q4	38 925.5	28.6
Garage	10 880.3	24.0	y2004q1	44 967.4	32.9
Garden	−2 229.9	−5.2	y2004q2	53 866.0	40.9
Gas central heating	5 284.4	15.7	y2004q3	53 334.5	39.9
House	4 603.3	7.1	y2004q4	51 996.3	37.8
Luxury	19 799.8	20.5	y2005q1	59 364.7	44.2
Mature	−745.1	−0.7	y2005q2	63 742.7	48.1
No. of bathrms	23 994.8	7.7	y2005q3	62 070.9	47.2
Needs upgrading	−10 406.0	−5.8	y2005q4	59 483.5	43.6
Cottage	14 660.1	9.0	y2006q1	62 596.4	47.7
Parking	8 330.9	17.2	y2006q2	68 319.9	50.5
Public rooms	23 995.1	65.7			
Spacious	673.6	1.8			
Stone	4 247.1	8.5	constant	−41 613.1	−12.5
Traditional	6 555.5	14.0			
Victorian	18 743.6	8.1			
Views	6 919.1	9.9			
Detached villa	29 618.7	33.2			
Semi villa	4 953.8	7.9			

Note: Adjusted $R^2 = 0.71$.