Auction Competitive Dynamics and Guide
(List) Prices in a Bubble Market

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Abstract

The auction literature finds competition drives price outcomes and has both rational and psychological components. In bubble markets psychological factors are likely to be heightened impacting on the dynamics of competitive behavior (Shiller, 2014).

We find, in a real estate bubble, guide prices have no influence in generating greater auction competition. In addition, our findings are supportive of the strength of the guide price in acting as an anchor on price outcomes. Thus we find no evidence that auction fever (e.g. Adam et al, 2015) occludes any assimilative role for the guide as an anchor.

Interestingly, however, we find evidence consistent with real estate agents systematically setting low guide prices relative to fundamentals, in an apparent belief in the reversal-of-the-anchoring effect (Ku et al, 2006), suggesting their actions in setting guide prices may have, in fact, paradoxically, dampened the effect of the bubble rather than amplifying it.

JEL Classification: D10, D44, D91, G41, R31

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1. Introduction

During the period from January 1994 to early 2007 Irish residential real estate prices nationally rose in excess of 500% and then in April 2007 they started to collapse, with a sustained decline continuing for almost six years eventually stabilising in March 2013. In the region of the capital city, Dublin and its hinterland the comparable rate of price increase was in excess of 510%. From peak to trough this fall (both nationally and in the Greater Dublin region) was in excess of 50% and in modern times is second only to Japan in terms of magnitude. The first warning that the Irish residential property market was significantly overvalued came in April 2003 (IMF, 2003) with further warnings made in quick succession (IMF, 2004; Economist, 2005). Our sample consists of residential real estate auctions in the Dublin market over the 18-month period from September 2004 to February 2006.

Bubble markets provide a rich context to explore the potential impact of behavioral biases and emotions in investors’ decision making processes (e.g. Shiller, 2000, 2008, 2014; Aliber and Kindleberger, 2015). Anchoring is one of the purest forms of behavioral phenomena and is amongst the most robust observations in the psychology literature. There is a substantive extant literature on anchoring in the decision making literature since the pioneering work of Tversky and Kahneman (1974). The anchoring and inadequate adjustment phenomenon is a cognitive bias arises arising from individuals’ cognitive limitations in making decisions.

1 When the property bubble finally burst it had disastrous consequences not only for the housing market, but also for the banking system and critically the entire Irish economy eventually triggering a €64bn bailout from the IMF, European Commission and European Central Bank in November 2010.
Research on anchoring and insufficient adjustment has repeatedly demonstrated that there is insufficient adjustment up or down from a starting position and exposure to even irrelevant numbers makes individuals’ subsequent quantitative judgments assimilate to the anchor. Auction guide prices may act as an anchor on competitive bidding behavior in an auction setting.

A competing theory to anchoring is that promulgated by Ku et al (2006), which they refer to as the reversal of the anchoring effect. The argument they make is that in the social setting of an auction lower starting (guide) price may result in higher selling prices. In their model setting a lower guide price attracts more competitors and the psychological processes that occur in the social context of an auction setting trigger a herding effect (Banerjee, 1992) causing a higher sales price to be achieved. The role of the guide price in their model is a mechanism to induce more intensive auction competition. Though they motivate their study using the housing market as an anecdotal illustration (page 975), their sample of auctioned items consists of low value items such as rugs, cameras and shirts. They find evidence items that start with a low guide price end up generating more competition resulting in a higher ultimate selling price consistent with what they term the reversal-of-the-anchoring effect.

For home purchasers, on the other hand, house values can be several times the households net worth (Flavin and Yamashita, 2002) and, in the case of such auctions, there may, we argue, be incentives for prospective purchasers to engage in more substantive search activity prior to the auction (Holt and Laury, 2002) and not be fooled by an artificially low price. Thus it is an open question whether the empirical findings of Ku et al (2006) in an auction setting are replicable in the context of high stakes transactions. Ku et al (2006) frame their argument for competitive behavior and herding in terms of escalation of commitment arising
from sunk costs and consequent value inference from the bidding behavior of other bidders. Escalation of commitment has both cognitive and emotional dimensions (Wong et al, 2006).

Interestingly, over the time period of our study there was widespread newspaper speculation that auctioneers setting low guide prices generated artificially high prices at residential property auctions. Such reporting is consistent with a belief in the reversal-of-the-anchoring effect.

Another stream of the auction literature frames auction competition from an emotional perspective. In the social setting of an auction, competitive bidding may be emotionally driven, enhanced by such factors as time pressure, hype, social facilitation and a desire to win, a process sometimes collectively referred to as auction fever, which impairs bidders decision making pushing them to bid beyond their limits (e.g. Adam et al, 2011, 2015; van de Bos et al, 2008).

As far as we are aware no prior research investigates the impact of guide prices on final auction outcomes in bubble markets. In bubble markets investors susceptibility to emotional factors in their decision making may be heightened (e.g. Shiller, 2014; Aliber and Kindleberger 2015; Tuckett and Taffler, 2008). Shiller (2014) offers the following definition of a bubble, which he frames using emotional terminology:

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2 They argue that the “complex social interactions” (p. 977) arising these factors will negate the assimilative role of the guide as an anchor.
3 Are advised minimum prices any better than guide prices, Irish Times, 9 March, 2006; Auction guide prices still don’t add up, Irish Independent, 28 August, 2006
4 Social facilitation is where the physical presence of a live audience may increase emotional arousal (Zajonc, 1965)
5 Aliber and Kindleberger (2015) in characterizing bubbles give examples of the various emotional terms used to describe the euphoric state that arises in a speculative bubble: “Manias...insane land speculation...blind passion...financial orgies...frenzies...feverish speculation...epidemic desire to become rich quick... wishful thinking... intoxicated investors... turning a blind eye... people without ears to hear or eyes to see...” (p.41)
A situation in which news of price increases spurs investor enthusiasm which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increases and bringing in a larger and larger class of investors, who, despite doubts about the real value of an investment, are drawn to it partly through envy of others’ successes and partly through a gambler’s excitement. (page 1487)

Studying auction bidding behavior in a bubble market context, and in the context of high stakes decisions (in contrast with Ku et al, 2006) provides a rich context to explore whether there is an assimilative effect of guide price anchors present in such a setting or whether the reversal - of - the - anchoring effect is manifest. It is an open question whether the impact of potentially heightened emotions on competitive bidding behavior, as predicted by the auction fever literature, may occlude any assimilative role for the guide as an anchor (cognitive bias) on price outcomes in such a setting.

Bucchianeri and Minson (2013) is the only extant research exploring the predictions of Ku et al (2006) in a high- stakes decision making context, though not in bubble market conditions. Specifically, they investigate the role of residential real estate list prices in driving final sales prices in the US market in the period 2005-2009. They find evidence consistent with the assimilative effect of the anchor and their results are not supportive of either the reversal of the anchor effect or of guide prices having no impact on transaction price outcomes. However, their data set straddles many different markets conditions and is not explicitly centred on a bubble market. They conduct their study in the context of negotiated sales transactions rather than auctions where the sales process extends over a protracted time period. In addition bidders are not located in an auction room and hence competitors are unable to directly observe each others bidding strategies. As such the authors are unable to
test the potential impact of auction fever arising from the social facilitation process, competitive rivalry and time pressure and its impact on the pricing dynamics and whether auction competition subsumes the role of the guide price as an anchor.

In contrast in our study we investigate the impact of price anchors in a bubble market during which prices were on a sustained upward trajectory for ten years prior to our data period. Our study is conducted in an English style open outcry auction market with all bidders physically present in the auction room. In addition, in contrast to Bucchianeri and Minson (2013) our empirical analysis incorporates an explicit measure of auction competition for each auction and are thus able to directly test whether lower guide prices (relative to fundamentals) generate more competition than higher guide prices. We are also able to test, whether final auction prices anchor on the guide price after controlling for auction competition.

Our research findings are interesting from a number of perspectives. We find, consistent with auction theory, greater auction competition generates a higher auction price. However, we report no relationship between the intensity of auction competition and the level of the guide price set by the auctioneer. In other words, a lower guide price relative to fundamentals does not induce a greater number of competing bidders to enter the auction process as predicted by Ku et al 2006. Furthermore, we find the assimilative role of the auction guide price plays a significant role in determining auction outcomes, independently of auction competition consistent with anchoring and insufficient adjustment. Accordingly, those properties that have a lower guide price relative to fundamentals generate lower sales prices than those properties that have a higher guide price relative to fundamentals. Thus any potential emotional impact of auction competition in a bubble market setting does not drown out the power of the guide price as an anchor in such a context. Our results are consistent with anchoring been a robust phenomenon in bubbles markets and contrast with the reversal of the anchoring effect of Ku et al (2006).
Interestingly, we find auctioneers in setting guide prices consistently set the guide price low relative to fundamentals and in many cases substantially lower than fundamentals despite our findings that such a strategy does not work. This appears, to be consistent with the belief that setting a lower guide price may be a better strategy for maximising sales revenue and an implicit belief in the authenticity of the assumptions underlying the reversal- of- the-anchoring effect. We find that such pitching of the guide price is potentially consistent with experts in bubble markets being equally as subject to making mistakes and biases in decision making as their less experienced counterparts (e.g. Cheng, Raina and Xiong, 2014).

In aggregate our results are consistent with auction bidders anchoring on the auction guide price in formulating their bidding strategies and that the assimilative effects associated with price anchors may be more reflective of bidders’ behavior, even in bubble market conditions, than the arguments associated with the reversal of the anchoring effect as proposed by Ku et al. 2006. In addition, the actions of auctioneers in setting low guide prices relative to fundamentals may have in fact dampened the effect of the bubble rather than amplifying it.

The rest of this paper proceeds as follows. In the next section we explore the literature on anchoring and insufficient adjustment. In the following section we set out the mechanics of the residential auction process in the Dublin auction rooms. In the next section we describe our sample characteristics. In the following section we explain how we determine the fundamental values of our sample of auctioned properties. We present our initial results on the relationship between auction guide prices and the level of auction competition, in the next section to explore whether the intensity of auction competition is related to the auctioneer’s setting of the guide price. In the following section we present our results on the relationship between auction guide prices and the prices achieved for auctioned properties. In the final section we conclude.
2. Prior Research

Anchoring is one of the purest forms of behavioral phenomena and is amongst the most robust observations in the psychology literature (Kahneman, Ritov, and Schkade, 1999). It is a cognitive bias arising from limitations in individuals’ decision making abilities in a variety of contexts. Research on anchoring and insufficient adjustment (Tversky and Kahneman, 1974) has repeatedly demonstrated that there is insufficient adjustment up or down from a starting position and exposure to even irrelevant numbers makes individuals’ subsequent quantitative judgments assimilate to the anchor. In such a setting individual’s tend to be drawn in by the characteristics of the object that are consistent with the high or low anchor and downplay or ignore other characteristics. Mussweiler and Strack (1999) refer to this as a selective accessibility model. They find that when individuals are given a high anchor for the price of a car they place emphasis on the characteristics of the car that are associated with high value e.g. luxury features and give less weight to other characteristics such as gas mileage.

Anchoring has been shown to have had a considerable effect on buyer-seller negotiations in an experimental setting where final outcomes are highly correlated with first offers (Galinsky and Mussweiler 2001) and is present in a wide range of literatures, including economic transactions (Galinsky and Mussweiler, 2001; Northcraft and Neale, 1987); public policy assessment (Plous, 1989) and judicial verdicts (Englich and Mussweiler, 2001).

The anchoring argument is in direct contrast to hedonic asset pricing models (HAPM) in the economics literature that in the case of house prices considers these to be set rationally and ultimately determined by attributes, such as location and amenities and other HAPM
characteristics (Sirmans, Macpherson and Zietz 2005; Anderson and Settle, 1996; Sheppard 1999). From this perspective market forces are expected to correct any mispricing behaviors.

Another branch of research (Ku et al. 2006) offers an alternative perspective arguing that a lower guide price will result in a higher sales price. They find, using data from eBay auctions, auctions that open with low asking prices generate a greater number of bids and ultimately finish with higher selling prices. They explain this pattern as being driven by a herding effect whereby bids by earlier aspiring buyers signal that a particular item is competitively priced (Simonsohn and Ariely, 2008) and leads others to enter the bidding. It is interesting to note that though Ku et al (2006) conduct their study using eBay auction data on low value consumer goods products they motivate their arguments in the opening paragraphs of their study by reference to the anecdotal reporting in the press that lower residential real estate asking prices generate higher sales prices (p. 975). Ku et al (2006) argue three forces contribute to the effect. Lower starting prices reduce barriers to entry which increases traffic and generates higher prices. Second, lower starting prices entice bidders to invest time, energy and financial outlay (creating sunk costs) and consequently escalate their commitment to the bidding process. Third, the traffic generated by lower starting prices can lead bidders to infer value in the item due to the bidding behavior of others. In sum, such bidding behavior will generate a hot market in the auctioned item whereby bidding by one bidder will stimulate other bidders to bid. Their argument is based on the assumption that “low starting prices can attract more bidders, which should induce a high final price” (p. 975)” and that the lower the guide price the more intensive and heated will be the bidding process and the higher the ultimate price.

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6 The physical presence of other competing bidders in an auction setting has been found to directly impact on bidders’ susceptibility to behavioral biases e.g. the winner’s curse (van de Bos et al (2008)
A parallel literature on auctions and competition finds that the physical presence of other bidders in an auction room stimulates an emotional response by other bidders, a phenomenon referred to in the literature as auction fever. (e.g. Adam et al, 2015). Emotions can restrict attentional capacity (Mano, 1993), lead to increased risk taking (Mano, 1994) and less robust information processing (Lewinsohn and Mano, 1993). Auction fever is enhanced by the excitement associated with the social interactions arising from the physical presence of other bidders at an auction (van DeBos et al, 2008) and where there is increased time pressure (Maule et al, 2000). The impact of time pressure is more manifest in English type ascending bid auctions that in their descending bid counterparts (Cheema, Chakravarti and Sinha, 2012). In addition, in the latter stages of an auction, where fewer bidders remain, this fuels a desire to win and beat remaining competitors (Adam et al, 2015). Such susceptibility to auction fever and emotional arousal is likely to be heightened in bubble market conditions, where individual decision making is likely to be influenced by emotions (Shiller, 2014; Tuckett and Taffler, 2008). The literature on auction fever has not specifically addressed the impact of guide prices in driving auction outcomes.

Bucchianeri and Minson (2013) is the only extant research exploring the predictions of Ku et al (2006) in a high-stakes decision making context, though not in bubble market conditions. They investigate the impact of list prices on sales prices of residential homes in Delaware, New Jersey and Pennsylvania over the period January 2005 to April 2009 and find that after controlling for fundamentals those properties with a higher list price generate a higher sales price, which is consistent with purchasers anchoring on property list prices in buying a property. They also seek to test whether in “hot” markets the relationship between list prices and sales prices would be different whereby setting a lower list price in order to generate more competitive bidding generates a higher sales price consistent with the arguments of Ku
et al (2006). They, however, report no difference in their results, conditional on the hotness of the market.

In their paper they characterize a “hot” market as zip code transaction volume up 30% over the equivalent month in the previous year. However, this measure is not a measure of price activity per se for a number of reasons. First, in the real estate literature there is an ambiguous relationship between trading volume activity and price changes (e.g. Stein, 1995, Genesove and Mayer, 2001, Berkovec and Goodman, 1996, and Clayton, Miller and Peng, 2010). In fact, Clayton et al (2010) find no correlation between property price increases and trading volume activity.

Second, Bucchianeri and Minson (2013) use zip code transaction volume as a proxy for the number of competitive bidders and hence a measure of the degree of herding behavior in property transactions. However, there is no necessary connection between the number of real estate transactions in a zip code and the number of bidders properties. For instance, lower zip code transaction volume could be associated with more bidders on each individual property transaction if the available properties in an individual zip code are scarce during that period due to an excess of demand over available supply. Thus transaction volume activity in a zip code may only be an imperfect proxy for competitive bidding behavior on individual properties within that zip code.

Third, as they conduct their study using negotiated sales transaction data rather than auctions the social context of observable competitive bidders is absent, which is a key ingredient in the Ku et al (2006) model as well as in studies on auction fever. Indeed, Bucchianeri and Minson (2013) specifically acknowledge this potential problem in discussing their findings:
“Herding requires a thick market with multiple buyers acting concurrently. It may be the case that this is simply not possible in the case of residential real estate where buyers are too few and too dispersed to influence each other.” (p.88).

Fourth, two thirds of the time period of their study (January 2005 to April 2009) coincided with a period of sustained price declines (August 2006 to April 2009) and the dynamics of the price/transaction volume relationship can differ between these two market conditions (e.g. Clayton, Miller and Penn, 2010).

Our study in contrast specifically investigates the impact of anchoring in the ultimate of “hot” markets, a bubble market where prices have been on a sustained upward trajectory during the entire time period of our study. In addition, we provide a direct measure of the intensity of competition for each of our sample properties rather than relying on zip code transaction volume as a proxy as is done in Bucchianeri and Minson (2013). Also, we address the rationalization by Bucchianeri and Minson (2013) their findings that a lower list price does not result in a higher sales price in a hot market as potentially being attributable to the difficulty for prospective purchasers to herd if they are unaware of each others bidding strategies. We can do this as our research is conducted in the context of public open outcry residential auctions where the number of competitive bidders can be directly observed as they are all in a central location (the auction room), and their bidding behavior is apparent to all present at the auction. Such factors have been shown to be drivers of auction fever. (e.g. Adam et al, 2015).


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Irish residential real estate auctions are conducted via the English open outcry (ascending bid) auction mechanism.

The auctions are held in a public auction room and the results are published in national newspapers. In English style auctions the auctioneer opens the auction typically by inviting offers for the property at the auction guide price and if there are no bids he/she then reduces the bidding until a starting bid is received. At that stage the auctioneer suggests a level for the second bid and bidding would proceed with the auctioneer announcing the next price level.\(^7\)

At a certain stage in the auction the auctioneer typically makes an announcement that the property is “on the market” which indicates that the vendor’s reserve price had been reached and thus the property would be sold to the highest bidder above that price. When the bidders complete bidding the auctioneer looks around the room to all previous bidders to encourage further participation. If no further bids are forthcoming the auctioneer announces “going, going twice, sold” or alternatively the auctioneer indicates that the vendor’s reserve price has not being reached and that the property is withdrawn. In such circumstances the auctioneer indicates the highest unsuccessful bidder at that stage would for a certain time period (typically a day or so), have exclusive rights to negotiate with the vendor following the auction. There is no requirement to publicly disclose the reserve price. This is in contrast with property auctions in other countries such as Australia where the reserve price is made public (Lusht 1996).

In the event of a successful auction the highest bidder is immediately invited to meet the vendor and sign a contract and pay a non-refundable deposit of 10% of the sales price and sign contracts normally within six weeks of the auction date. As Dublin real estate auctions require the successful bidder to pay the deposit for the property immediately after the auction

\(^7\) In some cases bidders would pre-empt the auctioneer and announce a bid in excess of the previous pattern of increment increases.
a potential bidder is likely to have spent funds on a property survey and a title search prior to the auction. In comparison, in negotiated private treaty sales the deposit is refundable up to the date contracts are signed, normally four-to-six weeks after the price is agreed.

In Ireland the law requires that three weeks prior to the actual auction a guide price is set for a property. The guide price acts as an initial signal of the property’s value and it performs an important market function from the perspective of both the buyer and the seller. For prospective buyers the guide price is invariably a key parameter for selecting properties to include in a search and may influence the price the buyer is willing to pay at the auction. It is therefore important to understand the relationship of the guide price to the selling price.

Legally the auction guide price is not a binding commitment for either the seller or the buyer as to the final sales price. In particular it should be noted that the guide price and the auction reserve price are not the same thing and that the guide may not necessarily influence the reserve. The guide price is rather the publically available estimate of the property valuation as prepared by the estate agent. The guide price may serve different roles. It may provide an indicator of value. It may also be directly linked with the marketing of the property whereby a guide price may be set lower than the true valuation in order to potentially attract more competition to the auction. (Ku et al, 2006).

4. Sample Characteristics

Our sample period consists of the 18-month period from September 2004 to February 2006 (Table I). This period ended fourteen months prior to the start of the unravelling of the bubble in April, 2007. Prior to our sample period the Irish residential real estate market had been on an upward trajectory since January 1994, with no quarter during that entire period
exhibiting a price drop. Prices in September 2004, the start date of our sample period, were up in excess of 375% since January, 1994 (Figure 1).

**Figure 1 about here**

During our sample period there were a total of 1565 auctions of which 666 (44% of the total) resulted in a successful sale on the day of the auction. The authors attended 210 of these auctions. These 210 auctions were chosen randomly from a selection of residential real estate auctions in the Dublin area.\(^8\) The auctions were held mid-week usually on Tuesday, Wednesday and Thursday afternoons in the auction rooms of the real estate agents with a number of auctions taking place in sequence. The auctions generally occurred at concurrent times in the different auction houses; therefore it was only possible to attend 8 to 10 auctions per week on average.

Auctions from both the large and smaller real estate agencies were attended so as to minimize any potential bias from concentration on the bigger estate agents. Of the 210 auctions 106 of these resulted in a successful auction on the day of the auction, with the remainder selling within approximately one month following the auction via the negotiated sales mechanism. Ultimately we restricted our sample from 106 to 87 as we needed to be able to compare the prices achieved at our sample auctions with a portfolio of similar properties. (See below).

**Table I about here**

5. **Bid Price Relatives for Comparison Purposes**

\(^8\) The city and its region account for almost 1/3 of the population and generate close to 40% of GDP.
In order to test the role of auction guide prices in determining price outcomes we require robust estimates of an auctioned property’s fundamental value to act as a reference point. We adopt a dual approach, discussed below. The first is a (fundamental) reference price based on the average of similar properties, which we will style as *self-similar* properties, to the property being auctioned, using experienced professional real estate agents to identify these comparable properties. The second, employed as a robustness test, is a reference price derived from a hedonic asset pricing model (HAPM).

We regress the winning bid price relative to these reference prices (the mean price of self-similar properties –measure 1, the HAPM determined price –measure 2). Deviation of the winning bid from the reference price in the t-th auction, $B_t$ is determined as:

$$B_t = \ln \left[ \frac{p_t}{p_{m,t}} \right]$$ (1)

where $p_t$ is the value of the winning bid for the t-th property and $p_{m,t}$ is the reference price ‘m’ for the t-th property. “M” can take on one of two values, the average price of the similar properties or the HAPM predicted price. The advantage of this approach is the regression coefficients can be interpreted in percentage terms. (Tse et al, 2011)

5.1. Average Price of Self- similar Properties

To calculate the average value of the self- similar properties we proceed as follows:

We commence with the 106 successfully auctioned properties that were attended by the authors. We construct a self-similar portfolio of real estate prices for each of our auctions in the following way:
1. All 666 successful auctions from Table I are arranged according to the criteria: Time period of the auction, Location, House type, square feet, number of bedrooms, and condition of the property. The identification of these criteria, and their ordering in terms of importance were provided and agreed by two experienced auctioneers (one a current director and one a former director of a major real estate agency). They considered these variables and their ordering to be the key variables in identifying self-similar properties in the first instance.  

9 (see 3 below)

2. Self-similar properties are selected in respect to each of our sample of 106 successful auctioned properties. They are identified in respect to the above criteria and in the order specified above. By time period of the auction” we mean that in order to be a potential candidate as a self-similar property the property must have been successfully auctioned no longer than one month prior to that of our sample auctioned property.  

10 In terms of “location” the property must be located in the same postal district as our sample of auctioned properties. (These criteria are more restrictive conditions than adopted in the HAPM below where we amalgamate postal districts into discrete areas for the location variable and we use quarterly dummies for time).

3. Once the authors had completed the matching process recommended by the auctioneers the matched portfolios of self-similar properties were checked by each of the auctioneers independently for consistency and to spot any anomalies. At this stage some of our sample properties were excluded if, in the opinion of our

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9 The criteria selected by the two independent auctioneers all proved to be significant factors determining price in the HAPM discussed below, which provides a robustness test on the matching process.

10 Employing a longer window, such as two months would have increased the number of comparable self-similar properties. However, adopting a longer window also potentially increases the likelihood that prices may be potentially stale.
auctioneers, there are distinguishing features (unique characteristics) in relation to those comparable properties, or indeed our sample properties, which may have made a comparison inappropriate e.g. corner site, house sold with planning permission for extension already obtained, south facing garden, exceptional decor etc.

4. The mean of the auction price of self-similar properties is calculated: ( \( \bar{x} \) )

As a result of the matching process our sample of successful auctions was reduced from 106 to 87 in order to have a reasonable sample of at least three self-similar properties to make a price comparison to our sample properties.

5.2. Hedonic Asset Pricing Model (HAPM)

The model is estimated in log form (Sirmans, Macpherson and Zietz 2005).

The following regression is run:

\[
\ln (SP) = \alpha + \sum \beta_i X_i + \varepsilon
\]  

(2)

where selling price (SP) is expressed in log form, \( \alpha \) is a constant term, \( \beta_i \) is the regression co-efficient for the \( i \)-th housing characteristic, \( X_i \) and \( \varepsilon \) is the residual error term.

The characteristics evaluated in the model are broken down into their physical features (property size, bedrooms, bathrooms, garden, type of property, property condition), and, in addition we explore the properties’ locations, the size of the real estate agent marketing the property, and the time period in which the property is auctioned. Property size is measured by
the log of the square feet of the property. In relation to garden we adopt a dummy variable approach taking on a value of 1 if the garden size is under 50 feet in length, and zero otherwise. The property’s condition is also evaluated using a dummy variable approach. Condition takes on a value of 1 if the property is in excellent or good physical condition and zero otherwise. The data for the condition variable is extracted from the estate agents brochures for the auctioned properties and, where these are not available, from the agent websites or from the property descriptions in the national newspapers. In relation to property type these are decomposed into four categories (apartment, semi-detached, detached, Period property). The property type dummy excluded is the period property. A dummy variable approach is adopted in relation to the size of the real estate agency marketing the property. The top six real estate agencies account for over 70% of auctions and a dummy variable is set equal to 1 if the auctioned property is sold through one of these agents and zero otherwise.

In relation to location the Greater Dublin area is divided down into Dublin Central, North Dublin, South Dublin and South County Dublin. These areas are identified by postal codes (zip codes) and are grouped accordingly. The location variable excluded is North Dublin. Time dummies are also included to capture changes in price activity over the period. These time periods are September to December 2004, January to April 2005, May to August 2005 and September 2005 to February 2006. The time dummy excluded is September 2005 to February 2006.

The results of the hedonic asset pricing model, Equation 2, are reported in Table II.

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11 Location is dominated by two key submarkets namely South Dublin and South County Dublin. These are the two most highly priced areas in Greater Dublin.

12 We also reran our HAPM regression using monthly rather than quarterly dummies with no impact on our reported results.
Table II about here

We would expect with the exception of the garden variable (expectation of negative and significant) that the coefficients on the physical property characteristics such as property size, bedrooms, bathrooms etc. would be positive and significant. The reported coefficients are in line with expectations with many of the variables significant at the 1% level. The property types are all significant with the exception of the apartment category. In relation to the location dummy variables they are all significant with the exception of Dublin Central. The south County Dublin area is highly significant. The real estate agent dummy variable is not significant. The time dummy variables are all negative and significant with the exception of the May to August 2005 period which though negative falls slightly short of significance at the 10% level. The negative coefficients on the time dummies are reflective of a rising property market over the period. It is noteworthy that the $R^2$ associated with the model is 64.3% indicating a good fit and are broadly comparable to the magnitudes reported in the HAPM literature (e.g. McMillan, 2004; Sieg, Smith, Banzhaf and Walsh, 2002).

6. Guide Prices and Auction Competition

In this section we test the relationship between the level of the guide price relative to fundamentals and the intensity of auction competition. If a lower guide relative to fundamentals stimulates more auction competition then this would be supportive of the reversal of the anchoring effect hypothesis. We address two questions: (1) Do auctioneers set guide prices low relative to fundamentals? , and (2) do guide prices influence the intensity of auction competition in the way suggested by the reversal of the anchoring effect hypothesis.

In Table 3 we present summary statistics on the relationship of guide prices relative to our two measures of fundamental value: the mean of self- similar properties and the HAPM
derived price. Table 4 then explores the relationship between the auction guide price and the
degree of auction competition.

Table 3 presents the frequency distribution of reported guide prices relative to both the mean
price of self- similar properties (G_t) and also to the HAPM equivalent, where:

\[ G_t = \ln \left( \frac{Q_t}{P_{m,t}} \right) \]  

(3)

and Q_t is the guide price for property t and P_{m,t} is the reference price for the t-th property.
“M” can take on one of two values, the mean price of the self- similar properties or the
HAPM predicted prices that were determined in the previous section.

**Table III about here**

Table III shows the average guide price as a percentage of the mean price of self- similar
properties is -24.1%, the minimum is -69.9% and the maximum is 14.4%. The t-value of the
average discount to the mean price of self- similar properties is significant at the 1% level.
Interestingly in 94.3% of cases the guide price is set at less than the mean price of self-
similar properties. Measuring the guide price relative to the HAPM price the average discount
is -32.8% again significant at the 1% level. The minimum is -40.1% and the maximum is
-25.1% and in all cases the advertised guide price is less than the HAPM. In aggregate across
both reference prices these results reflect a systematic understating of the value of the
property by the estate agents in setting their guide prices and are suggestive that the guide
price is not a good estimator of property value. Rather it may be a tool to attract bidder
interest and stimulate the intensity of auction competition consistent with the predictions of
the reversal of the anchoring effect.
We test whether a low guide price stimulates greater competition at the auction by performing the following regression:

\[
C_t = \gamma_0 + \gamma_1 G_t + \varepsilon_t \quad (4)
\]

where \( G_t \), the dependent variable, is defined as in equation (3) above. We employ two measures of competition \( (C_t) \) for robustness purposes: the first proxy is the number of bidders in auction \( t \), the second proxy is the average number of bids per bidder that an auction takes to reach its conclusion from the initial bid (Tse et al, 2011).\(^{13}\) The average number of bids per bidder is thus the total number of bids in the auction divided by the number of bidders at the auction. \( \varepsilon_t \) is the residual term.

The results are reported in Table IV. If a lower guide price relative to either the HAPM or mean price of similar properties stimulates more competition in the auction we would expect a negative and significant relationship between \( G_t \) and both competition proxies.

**Table IV about here**

We find the relationship, though in the expected direction in three of the four regression equations, is not even close to being significant.\(^{14}\) In addition, we report that none of the \( R^2 \)'s associated with the four regression equations has an explanatory power in excess of 1.5% suggesting that the guide price is not an important determinant of the intensity of competition

---

\(^{13}\) There are an average of 3.2 bidders at each auction with an average 6.7 bids per bidder. The maximum number of bidders bidding at an auction is 6 (average number of bids per bidder 21.5) and the minimum number of bidders is two (average number of bids per bidder was 2.3).

\(^{14}\) As an additional robustness test we perform two additional regressions using data from the portfolio of self-similar properties. Specifically, we run the regressions using (1) the maximum value and (2) the minimum value from these portfolios for each of the properties as the independent variable, rather than the mean price of similar properties. Our results in both cases are similar to those reported using the mean (average) value of self-similar properties.
at the auction. Thus it is interesting to note that though the real estate agents appear to set the

guide price below the reference price this does not translate into increased competition for

those properties. Auctioneers may have an incentive to set a low guide price to enhance the

probability of a sale at the auction as opposed to maximising the price at an auction. Real

estate markets are prone to standard agency problems as real estate agents receive only a

small percentage (typically 1½% to 2½%) of the sales proceeds as commission (e.g. Anglin

and Arnott, 1991; Levitt and Syverson; Rutherford and Yavas, 2012) and hence their share of

the sales proceeds is relatively low. We test whether this occurred by performing a
difference in means test for the $G_t$ variable between those properties sold at auction and those
withdrawn and subsequently sold through the negotiated sales mechanism and find no

significant differences in means indicating that the level of the guide price was not a factor

leading to an unsuccessful auction. Thus it appears that the level of the guide price relative
to fundamentals did not have an impact in terms of driving the likelihood of sale in an auction
setting rather than the property being withdrawn and sold later by means of a negotiated sales
transactions.

Our findings, whilst not in line with potential agency considerations are potentially
consistent with the literature finding that in bubble markets experts are subject to mistakes
and biases in decision making in the same way as their less experienced counterparts (e.g.
Cheng, Raina and Xiong, 2014; Hussam, Porter and Smith, 2008). Thus it may be our real
estate agents believed in the reversal- of –the- anchoring effect hypothesis even though it
does not appear to have any validity.

15 In fact the incentive effect to be less concerned about the sales proceeds and be more concerned with setting a
price to maximise the likelihood of a quicker sale is potentially greater in an Irish context than in a US context
where standard commissions are of the order of 6%.
16 To perform this test we adopted the same methodology to calculate the mean prices of self-similar prices as
that adopted for the portfolio of successful auctions.
17 For example, Cheng, Raina and Xiong, (2014) find professional banker lenders in the middle of the US
property bubble were exposed to biased behavior in forming their own property portfolios in the same way as
less experienced individuals were.
Is it the case auction prices are determined rationally based on housing characteristics adopting a hedonic asset pricing model approach (e.g. Sirmans, Macpherson and Zietz, 2005) and the setting of artificially low guide prices may have no demonstrable impact on auction prices? Given the value of auctioned real estate relative to an individual’s wealth (Flavin and Yamashita, 2002) there may be more incentives for information search prior to engaging in the auction and therefore less reason for bidders to use the advertised guide price as a valuation signal (Holt and Laury, 2002).

In the next section we test the relationship between guide prices and auction sales prices. If it turns out that our subsequent results are consistent with auction winners anchoring on the guide price then it would be the case that paradoxically the actions of auctioneers through setting low guide prices relative to fundamentals may have in fact potentially dampened the impact of the Irish residential property bubble rather than amplifying it.

7. Guide Prices and Final Auction Prices

7.1. Model

As outlined above our proxy to reflect the impact of the various factors on bidding behavior and auction outcomes is based on the deviation of the winning auction bid from a reference price ($B_t$). (See Equation 1).

In what follows we examine the relation between $B_t$ and the auction guide price and the level of auction competition.

We estimate the following equation:
\[ B_t = \gamma_0 + \gamma_1 C_t + \gamma_1 G_t + \varepsilon_t \]  

(5)

\[ B_t = \ln \left( \frac{p_t}{p_{m,t}} \right) \]

where \( p_t \) is the value of winning bid for the \( t \)-th property and \( p_{m,t} \) is the reference price ‘m’ for the \( t \)-th property. “M” can take on one of two values, the average price of the similar properties or the HAPM predicted price.

The subscript \( t \) denotes the \( t \)-th auction. The \( \gamma \)'s are regression parameters to be estimated.

Guide “G” for property ‘t’ is calculated in a similar manner to \( B_t \) and is the same as set out in equation 3 above and we employ the same two measures of competition (\( C_t \)) in auction ‘t’ that we employed in the previous section.

Prior auction research has consistently demonstrated higher competition leads to higher auction prices. Bazerman and Samuelson (1983) interpret competition in terms of its impact on auction participants bidding to their own reservation price. In their model, as the number of bidders’ increases the bidder will bid closer to her own reservation price and the expected sales revenue increases. In the absence of competition there are fewer incentives for bidders to bid up to their own valuation prices and it would be less likely that there will be a successful sale. Thus in their model bidders rationally respond to the number of bidders at the auction. Other models of competition argue that there competitive process itself may generate its own momentum triggered by behavioral and emotional factors causing prices to detach from fundamentals. (e.g. Ku et al, 2006; Adam et al (2015)

\section*{7.2. Guide Prices and Auction Outcomes}
In Tables V and VI we report on the effects of the guide price and competition on realized auction prices. Table V presents the results with the level of auction competition proxied by the number of bidders at the auction and Table VI presents the results with competition proxied by the average number of bids per bidder. These tables are based on the results arising from Equation 5.

**Tables V and VI about here**

We find in Table V consistent with auction theory the greater the level of competition, as proxied by the number of active bidders at the auction, the higher the ultimate auction price. Using the mean (average) price of self-similar properties the addition of one bidder increases the final auction price by 6%. The comparable impact of one additional bidder using the HAPM as the reference price is also 6%. Both of these co-efficients are significant at the 1% level.

In Table V we find a higher guide price relative to either the mean price of self-similar properties or HAPM is positive and significant at the 1% level indicating that higher guide prices relative to fundamentals lead to higher auction prices and lower auction guide prices lead to lower auction prices.\(^\text{18}\)

Our results are consistent with auction winners using the guide price as a price anchor in their bidding behavior. As a robustness test Table VI presents the comparable results to Table V but using the average number of bids as the competition proxy. The reported results in Table VI are identical to those reported in Table V. Thus in aggregate our results are invariant to the competition proxy employed.

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\(^{18}\) For robustness purposes we reran our regressions, firstly by dropping the competition variable, and secondly using the residual from equation 4 rather than the actual competition variable with no change to our reported results.
The $R^2$ using the mean price of self-similar properties as the reference price in Table V (Table VI) is 70% (65%) versus 30% (17%) for the HAPM. This is not surprising as the methodology employed in calculating the mean price of self-similar properties used real estate experts to determine the comparable properties and explicitly took into account any unique characteristics of either our sample of successful auctions or the comparable properties which may have rendered a comparison potentially inappropriate. Our results in this regard are also interesting in light of the distribution of guide prices relative to both the mean price of self-similar properties and the HAPM as reported in Table III where the distribution of guide price relative to fundamental values is much tighter using the portfolio of self-similar properties as the benchmark. 19

Our finding of a significant assimilative impact of the auction guide price on prices contrasts with the findings of Ku et al (2006). In addition, our results are interesting in light of the findings presented in Tables III and IV where guide prices are set consistently at a discount to the mean price of self-similar properties and HAPM prices and that there is no relationship between auction competition and auction guide prices.

The Ku et al (2006) model is predicated on a low guide price being a stimulator of auction competition by reducing barriers to entry, increasing sunk costs and escalating commitment. Thus any assimilative effect of the anchor in auctions is, in their model, more than counterweighed by the impact of auction competition once the auction commences. Such a view of auction competition is also consistent with auction fever where the emotions associated with the presence of other people in an auction setting generate excitement (Lee et al, 2009) and a strong desire to win (Malhotra et al, 2008), overriding any potential anchoring impact of the guide price.

---
19 In a small number of cases using the HAPM as the benchmark price we report in Table 3 that the guide price is above fundamentals. This may be potentially driven by some unique characteristics in our sample auctions that were not reflected in the HAPM specification.
Our findings, in contrast, are supportive of both competition and the assimilative effect of the guide price as an anchor being significant determinants of price outcomes across our auction data set. Our results are interesting in light of the persistent behavior of the auctioneer across our sample period to set the guide price at a discount to fundamental values. (Table III).

Our findings in a bubble market are consistent with anchoring playing a significant role in establishing prices achieved in property transactions. They are not consistent with the reversal of the anchoring effect hypothesis promulgated by Ku et al (2006). Thus those properties that were advertised with a high price relative to fundamentals achieved a higher price than those advertised with low prices relative to fundamentals. In other words residential real estate property buyers anchored on the list (guide) price. Our finding is that in a bubble market, where emotions are likely to play a significant role (e.g Shiller, 2014) auction bidders anchor on the guide price and the competitive process at the auction does not subsume the role of the guide price as an anchor. In addition, setting a low guide price does not stimulate more auction competition as predicted by Ku et al (2006). We can conjecture their finding may be attributable to the nature of the items been auctioned. Their auctioned items were all low monetary value items such as cameras, rugs, and shirts. In such circumstances bidders may have been potentially drawn into the auction by the price. In contrast in the case of our study given the value of auctioned real estate relative to an individual’s wealth (Flavin and Yamashita, 2002), there are more incentives for information search prior to engaging in the auction and therefore less reason for bidders to infer value from the guide price.
8. Conclusion

The auction literature finds the intensity of competition drives price outcomes and has both rational and psychological components. Our paper is the first study to test the impact of auction guide (list) prices on both competition and auction price outcomes in a bubble market. Bubble markets provide a rich context to explore the potential impact of behavioral biases and emotions in investors’ decision making processes (e.g. Shiller, 2014; Aliber, and Kindleberger, 2015; Tuckett and Taffler, 2008).

We explore the potential impact of guide prices on price outcomes in residential real estate auctions in the Dublin market over the period September 2004 to February 2006. We address two specific research questions in relation to bubble markets. First, do auctioneers set artificially low guide prices relative to fundamental values and does such a strategy stimulate the intensity of auction competition as found by Ku et al, (2006)? Second, does the guide price act as an anchor in determining prices or is any prospective assimilative effect of the guide occluded by any potential psychological factors arising in the auction room and from broader market conditions driving the intensity of auction competition?

We find consistent with the auction literature more intense auction competition is associated with a higher auction price. In addition, we find final auction outcomes are influenced by the auction guide price. Specifically, we find those properties with higher guide prices relative to fundamentals result in higher auction prices and those properties with lower auction guide prices lead to lower auction prices. Thus competitive intensity in English style open outcry, ascending bid auctions in a bubble market environment does not occlude the importance of the guide price as an anchor on the determination of winning bid
prices in such a setting. Thus independently of the impact of any emotional factors arising from auction fever there is a strong assimilative effect of the guide price as an anchor.

We find auctioneers consistently set guide prices low relative to fundamentals, sometimes substantially lower than fundamentals. However, we report no relationship between the setting of the guide price and the intensity of competition at the auction. Thus it appears that real estate agents were acting as if they believe in the reversal- of- the- anchoring effect.

It is noteworthy the proportion of total properties offered for sale by real estate agents through the auction mechanism increased dramatically as the bubble period progressed, increasing by 36% between 2003 and 2004, coinciding with the first warning by the IMF in early 2003 that the market was exhibiting bubble- like characteristics, and by c.15% a year in each of 2005 and 2006. It was only in 2007 as the bubble peaked and started to burst that the proportion of properties auctioned started to decrease.\textsuperscript{20} We speculate that our results in this regard are consistent with an implicit belief by auctioneers in auction fever. Such results are also consistent with other recent findings in the economics literature whereby, in bubble markets experts may be subject to biases and errors in their decision- making processes in the same way as their less experienced counterparts.

Interestingly, from a public policy perspective there was a belief as the bubble reached its peak that artificially low guide prices were making auction prices more frothy and consequently this lead to the enactment of the Property Services Regulation Act (2011). This Act provided, inter alia, that auctioneers instead of guide prices disclose an advised market value (AMV), which has a statutory definition in terms of being a price reflecting the expectation of the amount that would be achieved in an arm’s length transaction where the

\textsuperscript{20} This data was extracted based on a manual counting of newspaper advertisements of houses offered for sale via auctions and negotiated sales transactions as no publicly available searchable database existed during the period.
buyer acts “knowledgeably” and “prudently”. There are significant penalties for non-compliance, including disbarment from the real estate business. Our research is suggestive that were the AMV to have been in place during our study period it may paradoxically have exacerbated prices.

In aggregate our results are consistent with auction bidders anchoring on the auction guide price in formulating their bidding strategies, even in bubble markets, and that the actions of auctioneers in setting auction guide prices low relative to fundamentals may have, in fact, dampened the effect of the bubble rather than amplifying it.

References


Figure 1. Graph of Irish Residential Real Estate Prices 1994-2013
Table I. Auction results for September 2004- February 2006

<table>
<thead>
<tr>
<th>Period</th>
<th>Total auctioned</th>
<th>Total sold at auction</th>
<th>Sold prior to auction</th>
<th>Sold directly after auction</th>
<th>Withdrawn and sold within six weeks of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
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<td>2013</td>
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</tbody>
</table>

Source: OECD
This table presents background statistics on the total population of auctions taking place in the Dublin residential real estate market over the period September 2004 to February 2006.

### Table II. Hedonic asset pricing model regression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-statistic</th>
<th>Coefficient</th>
<th>T-statistic</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
This table shows the results of the hedonic asset pricing model regression (HAPM), Equation 2. The model is estimated in log form (Sirmans, Macpherson and Zietz 2005). The characteristics evaluated in the model are broken down into their physical characteristics (property size, bedrooms, bathrooms, garden, type of property, property condition) and, in addition, we explore the properties location, the size of the real estate agent marketing the property and the time period in which the property is auctioned. Property size is measured by the log of the square feet of the property. In relation to garden we adopt a dummy variable approach taking on a value of 1 if the garden size is under 50 feet in length and zero otherwise. The property’s condition is also evaluated using a dummy variable approach. Condition takes on a value of 1 if the property is in excellent or good physical condition and zero otherwise. In relation to property type these are broken down into four categories, (apartment, semi-detached, detached, Period property). A dummy variable approach is adopted in relation to the size of the real estate agency marketing the property. The top six real estate agencies account for over 70% of auctions and a dummy variable was set equal to 1 if the auctioned property is sold through one of these agents and zero otherwise. In relation to location the Greater Dublin area is divided down into Dublin Central, North Dublin, South Dublin and South County Dublin. These areas are identified by postal code (zip codes) and are grouped accordingly. The location variable excluded is North Dublin. Time dummies are also included to capture changes in price activity over the period. These time periods are September to December 2004, January to April 2005, May to August 2005 and September 2005 to February 2006. The time dummy excluded is September 2005 to February 2006. Dummy variables are denoted by †. The level of significance is denoted by *** \(p \leq 0.01\), ** \(p \leq 0.05\)*, * \(p \leq 0.10\). We use Newey-West standard errors.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>9.75</td>
<td>26.71***</td>
</tr>
<tr>
<td>Square feet†</td>
<td>0.54</td>
<td>9.90***</td>
</tr>
<tr>
<td>Bedrooms</td>
<td>0.07</td>
<td>3.31***</td>
</tr>
<tr>
<td>Excellent condition†</td>
<td>0.09</td>
<td>2.84***</td>
</tr>
<tr>
<td>Small garden†</td>
<td>-0.23</td>
<td>-6.67***</td>
</tr>
<tr>
<td>Apartment†</td>
<td>0.19</td>
<td>1.53</td>
</tr>
<tr>
<td>Semi-detached†</td>
<td>-0.19</td>
<td>-4.88***</td>
</tr>
<tr>
<td>Detached†</td>
<td>0.079</td>
<td>1.92*</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>0.048</td>
<td>2.77***</td>
</tr>
<tr>
<td>Dublin Central†</td>
<td>0.011</td>
<td>0.14</td>
</tr>
<tr>
<td>South Dublin†</td>
<td>-0.44</td>
<td>-2.95***</td>
</tr>
<tr>
<td>South County Dublin†</td>
<td>0.23</td>
<td>5.05***</td>
</tr>
<tr>
<td>Big agent†</td>
<td>-0.05</td>
<td>-1.11</td>
</tr>
<tr>
<td>Sept-to-Dec04†</td>
<td>-0.22</td>
<td>-4.91***</td>
</tr>
<tr>
<td>Feb-to-April05†</td>
<td>-0.12</td>
<td>-2.87***</td>
</tr>
<tr>
<td>May-to-July05†</td>
<td>-0.06</td>
<td>-1.51</td>
</tr>
<tr>
<td>(R^2) Adjusted</td>
<td></td>
<td>64.3%</td>
</tr>
</tbody>
</table>

Table III. Frequency distribution of guide prices relative to mean price of self-similar properties and to HAPM
<table>
<thead>
<tr>
<th>% Range of guide prices relative to reference benchmark</th>
<th>Guide price relative to Mean price of self-similar properties %</th>
<th>Cumulative % (descending)</th>
<th>Guide price relative to HAPM %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 20</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 &lt; x ≤ 20</td>
<td>3</td>
<td>3.4</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>5 &lt; x ≤ 10</td>
<td>0</td>
<td>0.0</td>
<td>96.6%</td>
<td></td>
</tr>
<tr>
<td>0 &lt; x ≤ 5</td>
<td>2</td>
<td>2.3</td>
<td>96.6%</td>
<td></td>
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<tr>
<td>-5 &lt; x ≤ 0</td>
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<td>2.3</td>
<td>94.3%</td>
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</tr>
<tr>
<td>-10 &lt; x ≤ -5</td>
<td>6</td>
<td>6.9</td>
<td>92.0%</td>
<td></td>
</tr>
<tr>
<td>-20 &lt; x ≤ -10</td>
<td>21</td>
<td>24.1</td>
<td>85.1%</td>
<td></td>
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<tr>
<td>-30 &lt; x ≤ -20</td>
<td>25</td>
<td>28.7</td>
<td>61.0%</td>
<td></td>
</tr>
<tr>
<td>-40 &lt; x ≤ -30</td>
<td>18</td>
<td>20.7</td>
<td>32.3%</td>
<td></td>
</tr>
<tr>
<td>-50 &lt; x ≤ -40</td>
<td>7</td>
<td>8.1</td>
<td>11.6%</td>
<td></td>
</tr>
<tr>
<td>-60 &lt; x ≤ -50</td>
<td>2</td>
<td>2.3</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>-70 &lt; x ≤ -60</td>
<td>1</td>
<td>1.2</td>
<td>1.2%</td>
<td></td>
</tr>
<tr>
<td>Less than -70</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>-24.1%</td>
<td></td>
<td>-32.8%</td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>16.0%</td>
<td></td>
<td>10.0%</td>
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<tr>
<td>t-statistic</td>
<td>14.0</td>
<td></td>
<td>91.4</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>-22.9%</td>
<td></td>
<td>-32.2%</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>-69.9%</td>
<td></td>
<td>-40.1%</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>14.4%</td>
<td></td>
<td>-25.1%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td></td>
<td>87</td>
<td></td>
</tr>
</tbody>
</table>

**Table IV.** Regression of competition proxies on guide reference price relatives
This table presents the results of our two regressions from equation 4. The independent variable in both instances is the deviation of the guide price from a reference price. In the HAPM regression the reference price is the price generated from the HAPM regression reported in Table 2. In the case of the "Mean price of self-similar properties regression, the reference price is the mean price of similar properties that were successfully auctioned in the same time period as our sample of 87 auctions using a number of the characteristics from the HAPM model (table 2), specifically: time period of the auction, location, house type, square feet and number of bedrooms and the condition of the property. In both cases the actual winning bid is divided by the reference price and the natural log calculated. The competition variable is the number of bidders at the auction (Panel A) or the average number of bids per bidder (panel B). The level of significance is denoted by *** p≤ 0.01, ** p≤ 0.05**, * p≤ 0.10. We use Newey-West standard errors.

### Table V. Winning bid price relative regression using number of bidders as the competition proxy

<table>
<thead>
<tr>
<th>Variable</th>
<th>HAPM</th>
<th>Mean price of self-similar properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.129</td>
<td>0.74</td>
</tr>
</tbody>
</table>
This table presents the results of our two regressions from equation 5. The dependent variable in both instances is the deviation of the winning bid from a reference price. In the HAPM regression the reference price is the price generated from the HAPM regression reported in Table 2. In the case of the “Mean price of self-similar properties regression, the reference price is the mean price of similar properties that were successfully auctioned in the same time period as our sample of 87 auctions using a number of the characteristics from the HAPM model (table 2), specifically: time period of the auction, location, house type, square feet and number of bedrooms and the condition of the property. In both cases the actual winning bid is divided by the reference price and the natural log calculated. The competition variable is the number of bidders at the auction The level of significance is denoted by *** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.10$. We use Newey-West standard errors.

<table>
<thead>
<tr>
<th>Variable</th>
<th>(Estimate)</th>
<th>(t-Statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>(0.94)</td>
<td>(5.38)***</td>
</tr>
<tr>
<td></td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(1.76)*</td>
<td>(54.47)***</td>
</tr>
<tr>
<td>Guide</td>
<td>1.03</td>
<td>(3.11)***</td>
</tr>
<tr>
<td></td>
<td>0.89</td>
<td>(13.13)***</td>
</tr>
<tr>
<td>$R^2$</td>
<td>29.66%</td>
<td>70.01%</td>
</tr>
</tbody>
</table>

**Table VI.** Winning bid price relative regression using average number of bids per bidder as the competition proxy
<table>
<thead>
<tr>
<th>Variable</th>
<th>HAPM</th>
<th>Mean price of self-similar properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.29 (2.43)</td>
<td>0.21 (6.53)***</td>
</tr>
<tr>
<td>Competition</td>
<td>0.01 (3.44)***</td>
<td>0.01 (3.22)***</td>
</tr>
<tr>
<td>Guide</td>
<td>1.22 (3.66)***</td>
<td>0.93 (12.34)***</td>
</tr>
<tr>
<td>$R^2$</td>
<td>17.05%</td>
<td>64.71%</td>
</tr>
</tbody>
</table>

This table presents the results of our two regressions from equation 5. The dependent variable in both instances is the deviation of the winning bid from a reference price. In the HAPM regression the reference price is the price generated from the HAPM regression reported in Table 2. In the case of the “Mean price of self-similar properties regression, the reference price is the mean price of similar properties that were successfully auctioned in the same time period as our sample of 87 auctions using a number of the characteristics from the HAPM model (Table 2), specifically: time period of the auction, location, house type, square feet and number of bedrooms and the condition of the property. In both cases the actual winning bid is divided by the reference price and the natural log calculated. The competition variable is the average number of bids per bidder at the auction The level of significance is denoted by *** $p \leq 0.01$, ** $p \leq 0.05$**, * $p \leq 0.10$. We use Newey-West standard errors.