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The Effect of Listing Price Strategy on Transaction Selling Prices

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Abstract While true underlying home values are expected to be randomly distributed, actual residential listing prices tend to be highly clustered. Particularly, more than 75 % of the homes in our sample are associated with a round or "just below" round asking price. This study provides a theoretical and empirical examination of how the thousands digit in a home's asking price is related to the final transaction price relative to its true underlying value. Our findings suggest that, on average, homes listed using a "just below" pricing strategy are associated with the greatest discount negotiated relative to the asking price. However, the higher initial degree of list overpricing reflected in "just below" pricing compared with other strategies more than offsets the greater discount. Therefore, "just below" is the most effective pricing strategy for the seller in terms of a greater dollar yield relative to value. These empirical findings have economic significance and are robust across both "buyer" and "seller" housing markets, new versus existing homes, and across multiple home price ranges.

Keywords List pricing strategies · Time on the market · Residential real estate

Introduction

Black and Diaz (1996) argue that due to limited human processing capacity, potential homebuyers often use the asking price on a home as a shortcut to estimate its value. Therefore, establishing a listing price that is expected to yield the highest settlement price without prolonging the property's time on the market is vitally important. While

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determining the value of a home involves many subjective factors, there is no reason to expect that the number of homes with a true underlying value of $180,000 would be different from the number of homes with a true value of $181,000 or $180,347. Nevertheless, asking prices tend to be highly clustered. For example, an examination of asking prices quickly reveals that many more houses are listed for $180,000 compared with $181,000 and that there are practically no houses that are listed for $180,347. Because homes in the U.S. often sell for six figure amounts, it is not surprising that most sellers will choose not to bother with an asking price that is too precise (such as $180,347) in most cases. However, even when the thousands digit is considered, many more sellers select an asking price that is associated with the figures 0 and 9 compared with 3 or 7, for instance.

In this study, we investigate how the thousands digit of the asking price is related to: (1) the discount buyers negotiate on homes relative to the listing price, and (2) the degree to which sellers overprice their home. Particularly, we associate the thousands digit with three different pricing strategies and compare them to determine which is the most likely to yield the highest settlement price after controlling for the true underlying value of the home. The three pricing strategies defined are round pricing (thousands digit is 0 or 5), "just below" round pricing (thousands digit is 9 or 4) and precise pricing (thousands digit is 1, 2, 3, 6, 7 or 8).

When examining the first effect, we observe that sellers who employ the "just below" pricing strategy allow for a greater discount relative to their asking price compared with sellers who use a round or precise strategy. On the other hand, when examining the second effect, we observe that sellers who employ the "just below" pricing strategy overprice their home by more than sellers who use a round or precise strategy. The difference in the degree of overpricing is both statistically and economically significant. Combining the two, the net effect is that the "just below" pricing strategy yields the seller the highest price relative to the true underlying home value. Alternatively stated, the higher initial asking price relative to the true underlying value of the property more than offsets the greater discount relative to the asking price associated with the "just below" pricing strategy. Therefore, our results are consistent with studies from other fields that advocate "just below" as the superior pricing strategy.

Allen and Dare (2004) and Palmon et al. (2004) examine the effect of pricing strategies on final transaction prices in a residential real estate setting and find conflicting results. The current investigation seeks to build on these two studies and contribute to the existing literature on optimal list pricing in five important ways. First, we explore the effect of three (not just two) theoretically based pricing strategies and their impact on final transaction selling price. Second, we do not focus on the hundreds' digit which is less powerful in its ability to meaningfully manipulate the transaction price, but instead identify pricing strategies based on the thousands digit in their price.[1] Third, the nearly 20-year period spanned by the data we employ allows us to examine the effect of pricing strategies in both buyer and seller markets; this dataset includes materially more observations than previously employed in studies

[1] As a robustness test, we also examine the effect of the ten-thousands and hundreds digits on discount and the degree of overpricing. We find no evidence that these digits are related to the negotiated price discount or settlement price relative to the underlying value of the house. For brevity, these results are omitted from this version of the paper.

that explore pricing strategies. Finally, our analysis distinguishes between new homes marketed by developers and existing homes sold by individuals. These two types of sellers are motivated by different forces and are likely to exhibit heterogeneous negotiation skills. Therefore, the same pricing strategy employed by each type of seller may not have the same effect. In sum, our more inclusive examination allows us to reconcile the mixed results found in past studies.

Literature Review

Pricing strategies have been empirically investigated since at least the 1950s. Rudolph (1954) and Friedman (1967) note that the majority of consumer good prices in the U.S. end with an odd number, particularly 9 or 5. Gilmour (1985) argues that retailers perceive the "just below" strategy as a tactic that positively affects their sales revenue. As a result, most retail food items, for example, are priced using this strategy (Hogl 1988; Schindler and Wiman 1989). Gas stations in the U.S. take the "just below" pricing strategy to the extreme when they offer their gasoline at a price that ends in 9/10 of a cent regardless of the fact that no actual currency this small in denomination exists.[2] The extensive usage of "just below" pricing is not unique to only a handful of countries or to a particular region of the world. Holdershaw et al. (1997) documented that 60 % of all prices end in a "9," while only 7 % end with a "0".[3] A series of studies from the 1990s supports the notion that "just below" pricing results in greater sales volume than rounded priced goods (Stiving and Winer 1997; Gendall et al. 1997; and Schindler and Kibarian 1996).

The effect of "just below" pricing on financial assets was recently examined in the finance literature. Bhattacharya et al. (2012) found that professional stock traders also form cognitive reference points when stocks cross a price threshold of an even dollar amount. In their examination of over 100 million equity trades, the authors found excessive buying at all price points one cent below round numbers and excessive selling at one penny above. For example, a change in stock price from $9.00 to $8.99 triggered significantly more buys than a change in price from $9.07 to $9.06. This pricing-volume relation is mostly a result of automatic "buy" and "sell" orders that are triggered when stocks trade below some round behavioral threshold.

Unlike most consumer goods and liquid financial assets where the buyer pays the spot price or walks away, the asking price for residential real estate is often viewed as a starting point for negotiation. Additionally, prices and purchase involvement in residential real estate are much higher compared with other retail purchases. Therefore, it is possible that the same pricing strategies that benefit the seller of soap or a loaf of bread do not directly translate to home sellers. While many papers in real estate examine residential listing prices from a valuation perspective (Miller and Sklarz 1987; Northcraft and Neale 1987; Haurin 1988; Horowitz 1992; Knight et al. 1994; Yavas and Yang 1995; Arnold 1999; Anglin et al. 2003; Haurin et al. 2010, and Deng et al. 2013, among others), only two papers to date explore how asking

[2] In Australia, coins smaller than 5 cents have not been used since 1992, yet still today, prices continue to be listed in fractions (such as $3.98) for which proper change cannot be given.
[3] Only 3 % of prices end in a "1, 2, 3, 4, 6, 7, or 8."

prices from a design and pricing strategy perspective may relate to residential real estate transaction prices. Allen and Dare (2004) examined prices in the south Florida market and found that what they call "charm pricing" leads to higher final sale prices. The opposite result was found in Palmon et al. (2004) who examined Texas residential real estate prices. Given the mixed findings and the age of both studies,[4] we argue in favor of the need to examine this issue in much greater detail.

Pricing Strategies and their Competing Hypotheses

When homeowners choose to sell their home, they first need to determine the asking price for their property. Even if performed sub-consciously, the process of setting an asking price for a home commonly involves three separate steps. In the first step, the homeowner tries to determine the fair market value of their home. Because the housing market is illiquid and two properties are never identical, determining the market value of a home is not an easy task and often includes many subjective elements.[5] In the second step, the seller sets a mental reservation price for the home. For many rational and unconstrained[6] sellers, the reservation price is likely to be a round number[7] that is not too far from the fair market value previously determined. Most sellers are aware that under typical market conditions potential homebuyers are not price takers, but will instead try to negotiate a lower price than that listed by the seller. Therefore, the third and final step in the process is to set the asking price for the home somewhat above the reservation price in order to allow room for negotiation. The asking price selected by the seller can be categorized as a "round" price, a "just below" round price or a "precise" price.

In this study, we focus on the thousands digit to help define each of these three pricing strategies. When purchasing a home, potential homebuyers often negotiate the price they are willing to pay. Subsequent offers and counter-offers made during the negotiation process are often an order of magnitude in the thousands of dollars, and therefore, the thousands digit provides an important starting point for negotiation from a valuation standpoint.

Round Pricing

Proponents of the round asking price strategy argue that sellers who set a round price for their home are likely to benefit from a stronger demand for their property. The demand hypothesis is based on the assumption that buyers, just like sellers, are likely to have a round reservation price that guides their search for a home. Therefore, a

[4] Datasets in both studies ended before both the dramatic run up and precipitous decline in the most recent real estate markets.

[5] If the seller employs a real estate agent to market and sell their home, the real estate agent will often provide their own opinion to the seller about the home's fair market value.

[6] Constrained sellers, such as underwater sellers, may be forced to price at a certain level and only accept an offer that is above this threshold, regardless of the value of their home.

[7] The reservation price for a home is often a mental threshold (Seiler et al. 2008) and therefore sellers are more likely to set a round reservation price. As a result, a reservation price such as $190,000 is more likely than $188,000, which is more likely than a reservation price of $188,392, for example.

house that is priced at $200,000, for example, will appear on the search list for buyers that search for homes in the $200,000~$250,000 price range as well as for buyers who search for homes in the $150,000~$200,000 price range. Additionally, depending on the type of sorting used by the buyer, a $200,000 house may appear at the very top of the buyer list, which is demonstrated to garner more of the buyer's attention (Seiler et al. 2012). Finally, buyers with a $200,000~$250,000 price range are less likely to be aggressive when negotiating on a house listed for $200,000 because it is at the bottom of their price range, which is another factor that can possibly benefit the seller who employs the round pricing strategy.

"Just Below" Round Pricing

Literature in related fields provides a vast amount of evidence to support the advocacy of the "just below" pricing strategy. One explanation for why this strategy is so effective is that while people have the mental capacity to round up prices from $199,900 to $200,000, for example, a house that is priced at $199,900 still appears less expensive, and is therefore more attractive to potential homebuyers. The human brain works so fast that it stores the left-most digit even before we are finish reading (or hearing) the full price. This behavior is often referred to as the truncation effect and is also partially due to the limited recall ability of our brain. Because the digits on the right carry less economic weight compared with digits on the left, our brain puts more emphasis on the 199 and will sub-consciously register the $199,900 house as being less expensive. Holdershaw et al. (1997) documented that in the retail space, 60 % of all prices end in a "9," while only 7 % end with a "0". Schindler and Kirby (1997) refer to the perceived-gain effect associated with "just below" pricing strategies, which makes consumers think they are getting a good deal. Based on the evidence that products priced with the "just below" strategy appear to be less expensive, it is likely that the "just below" pricing strategy allows home sellers to price their home at a premium without initially driving away potential buyers.

On the other hand, the "just below" pricing strategy presents a disadvantage to the seller from a demand perspective. While a house priced at $199,900 will appear on the list of buyers who search for a house in the $150,000~$200,000 price range, it will not appear on the list of buyers searching for a house in the $200,000~$250,000 price range. Therefore, houses that are priced using the "just below" pricing strategy are likely to be visible to fewer buyers.

Precise Pricing

Concerning the precise pricing strategy, we hypothesize that sellers who set an asking price, such as $197,xxx or $192,xxx, send a strong signal about the accuracy of the price attached to their house and their (un)willingness to engage in an aggressive price negotiation. This hypothesis is consistent with the "firmness" assumption made by Allen and Dare (2006) with regard to "charm pricing". Because buyers often use the asking price as a shortcut to establish an opinion of home value (Black and Diaz 1996), buyers who face a precise asking price are more likely to assume it is better and more accurately reflects the true value of the property. Therefore, if interested in that particular property, we hypothesize the final settlement price associated with a

precise pricing strategy will be closer to the asking price compared with the same property listed at a round or "just below" round price.

Because each of the three pricing strategies presented above are associated with different strengths and weaknesses, it is difficult to predict the net effect of each pricing strategy without further examination. To disentangle and compare the different attributes benefiting each strategy, we conduct an empirical analysis of the different pricing strategies using a rich transaction dataset. Our detailed analysis allows us to determine which is the most effective pricing strategy overall. We define the most effective pricing strategy as the one that results in the shortest time on the market and that captures the highest transaction price after controlling for the true underlying value of the home. Using a more comprehensive dataset and a different empirical approach, we attempt to reconcile the conflicting results presented by Allen and Dare (2004) and Palmon et al. (2004).

Housing Transaction Data

The empirical dataset employed in this study was provided by Real Estate Information Network (REIN) in Hampton Roads, Virginia. The original dataset includes a total of 385,175 unique residential real estate transactions in the Hampton Roads, Virginia, Metropolitan Statistical Area (MSA) that span the January 1993 through September 2011 time period. Each of those observations include transaction related information such as listing price, sale price, listing date, closing date and whether the property is a new construction. We exclude from the sample all transactions associated with a sale price that is 20 % higher or lower compared with the asking price and transactions for which the reported TOM is less than 1 day. These restrictions target non-arm's length transactions or possibly data entry errors. Additionally, we exclude all observations that do not include the full set of housing physical characteristics for which we control in our model. These exclusions reduce our sample size to 372,074 observations.

Panel A of Table 1 provides descriptive statistics for the dataset employed in this study. For the full sample, the average (median) sale price is $184,350 ($150,000) and the average (median) time on the market (TOM) is 62.26 (34) days. Newly constructed homes represent 17.69 % of the transactions. We calculate the price discount as the percentage difference between the asking price at the time the offer was made and the sale price so that a positive discount implies the selling price is below the asking price. The average discount for the full period is 1.19 %, while the median discount is 0.00 %.

Columns (2), (3) and (4) each include a sub-period of the data. Column (2) is designed to capture the modest up-trending housing market that preceded the housing boom period included in column (3). Column (4) reports the results during the recent housing bust. As one might expect, the average discount negotiated on a home during the boom period is the lowest, while the greatest discounts are observed during the bust period. Similarly, the average (median) TOM during the 99–06 time period is nearly half (third) compared with the 07–11 time period.

Table 1 Descriptive Statistics. This table reports descriptive statistics for each of the independent variables used in the study for the full sample as well as for three distinct market sub-periods and for new versus existing homes

	(1) Full period	(2) 1993~1998	(3) 1999~2006	(4) 2007~2011
Panel A: New construction and existing homes				
Observations	372,074	94,662	195,584	81,819
Average sale price	$184,350	$117,600	$187,532	$253,984
Median sale price	$150,000	$102,809	$154,900	$220,900
Average TOM (days)	62.26	70.68	46.90	89.24
Median TOM (days)	34	45	20	61
% new construction	17.69 %	23.54 %	17.52 %	11.31 %
Average discount	1.19 %	1.43 %	0.58 %	2.35 %
Median discount	0.00 %	0.00 %	0.00 %	1.38 %
Discount SD	3.84 %	3.44 %	3.72 %	4.26 %
Panel B: Only new construction				
Observations	65,807	22,287	34,267	9,253
Average sale price	$224,754	$135,382	$250,914	$343,135
Median sale price	$182,000	$126,750	$209,565	$299,000
Average TOM (days)	66.20	55.38	53.64	138.74
Median TOM (days)	9	1	5	87
Average discount	−0.65 %	−0.33 %	−1.31 %	1.02 %
Median discount	0.00 %	0.00 %	0.00 %	0.00 %
Discount SD	3.51 %	2.73 %	3.65 %	3.94 %

Panel B describes the transaction data for newly constructed residential real estate. Newly constructed housing is considerably more expensive than existing homes and experiences a shorter TOM. In particular, during the 93–98 and 99–06 time periods the median TOM is 1 and 5 days, respectively, before jumping to 87 days during the 07–11 bust period. The short TOM during the earlier period is consistent with the notion that during normal and favorable times, developers are able to market their product more effectively during the construction phase and sell it upon completion. When buyers were scarce during the bust period, however, the median TOM for new construction was even longer than for existing homes. Concerning listing price discounts, new construction sold, on average, for a *premium* of 0.65 % compared to the asking price. It is possible that the price premium commanded by new construction developers is a result of the fact that developers are more experienced in the negotiation process compared with individual sellers and/or that developers offer other incentives instead of a price reduction. Moreover, in a new development, one property that is sold for a discount may force the developer to sell all subsequent properties in the development at a similar discount. As a result, developers have a stronger incentive, compared with individuals, to avoid discounting their properties.

Methodology

Examination of Pricing Strategies and Price Discounts

We begin our analysis by observing the frequency associated with each pricing strategy within the data. If sellers ignore the different pricing strategies, we should expect to observe that the thousands digit of the asking price is uniformly distributed between 0 and 9 and thus each number captures 10 % of the observations.

It is possible that existing homes sold by individuals are priced differently than newly constructed homes that are sold by developers. To observe the pricing strategies preferred by each group, we also segment our listings into new and existing homes and report the thousands digit distribution for each.

To better examine the discount associated with each pricing strategy, we employ an OLS regression as well as a two-stage least squares (2SLS) regression where we control for possible simultaneity between the time-on-market variable and the discount. We define the following three different regression specifications:

$$Disc_i = \alpha + \beta^{*}precise_i + \mu^{*}TOM_i + \omega^{*}bust_i + \rho^{*}boom_i + \varepsilon_i \quad (1)$$

$$Disc_i = \alpha + \lambda^{*}round_i + \mu^{*}TOM_i + \omega{*}bust_i + \rho^{*}boom_i + \varepsilon_i \quad (2)$$

$$Disc_i = \alpha + \delta^{*}justbelow_i + \mu^{*}TOM_i + \omega^{*}bust_i + \rho^{*}boom_i + \varepsilon_i \quad (3)$$

where the dependent variable (*Disc*) is defined as the percentage difference between the asking price and the final transaction price. A positive (negative) *Disc* value corresponds with a settlement price that is lower (higher) than the asking price. The variables *precise*, *round* and *justbelow* are three dummy variables that indicate the pricing strategy employed in each transaction *i*. The *precise* dummy variable is set to 1 if the asking price thousands digit is 1, 2, 3, 6, 7 or 8, and is set to 0 otherwise. Similarly, the *round* and *justbelow* dummy variables are set to 1 when the asking price thousands digit is 0 or 5 and 9 or 4, respectively, and set to 0 otherwise.[8] The TOM variable controls for the time on the market and is defined as the number of months, with a day-level precision,[9] between the time the property is listed for sale and the closing date. Finally, the *boom* and *bust* dummy variables are set to 1 if the sale transaction occurred during the 1999–2006 and 2007–2011 time periods, respectively, and to 0 otherwise.

The regression specifications presented in Eqs. (1), (2) and (3) allow us to observe the effect of each pricing strategy in isolation while also controlling for key factors that may affect the discount negotiated relative to the asking price. In addition to these

[8] For robustness, we repeat this analysis for the ten-thousands and hundreds digit. We find no evidence on the relation between these two order digits and discount that can be supported with statistical significance. For brevity we exclude these results from this version of the paper.

[9] For example, if a particular house was on the market for 78 days before it was sold, TOM will be assigned a value of 2.56 (78/365*12).

equations, we also examine the effect of the three pricing strategies in one regression using the following equation:

$$Disc_i = \alpha + \beta^{*}precise_i + \lambda^{*}round_i + \mu^{*}TOM_i + \omega^{*}bust_i + \rho^{*}boom_i + \varepsilon_i \quad (4)$$

All the variables included in Eq. (4) are as previously defined. Note that *justbelow* is the omitted pricing strategy dummy variable. We use each of the regressions specified above to analyze the observations associated with new construction and existing homes separately. In order to address the possible simultaneity between *Disc* and *TOM*, in our 2SLS analysis, we instrumented *TOM* as the following[10]:

$$\widehat{TOM}_i = \alpha_0 + \alpha_1{}^{*}\ln(sqft) + \alpha_2{}^{*}\ln(age) + \alpha_3{}^{*}bedroom + \alpha_4{}^{*}bath + \alpha_5{}^{*}halfbath + \beta_i{}^{*}\sum_{i=1994}^{2011} dumyear\_i + \varepsilon \quad (5)$$

The right-hand variables are the physical characteristics of the residential property as well as time dummy variables. We provide definitions to these variables in the Appendix. To further test the robustness of the above regression results, we also apply the regression specification from Eqs. (4) and (5) to segments of the data defined by price quintiles. This robustness test allows us to observe whether the pricing strategy effects are more or less pronounced for particular price ranges.

Examination of Pricing Strategies and Degree of Overpricing

Determining how different pricing strategies are related to the discount negotiated relative to the property's asking price is an interesting and important issue. Still, if a particular pricing strategy yields a lower discount relative to the asking price compared with other strategies, it does not necessarily guarantee an overall higher settlement price relative to the true underlying value of the home. This is because it is possible that a higher degree of list overpricing is associated with a particular pricing strategy. Alternatively stated, if different pricing strategies are associated with different degrees of list overpricing, then the results from the discount analysis can be amplified, alleviated or overturned. Therefore, it is important to determine the average degree of overpricing associated with each list pricing strategy. To estimate the degree of list overpricing, we first employ a hedonic pricing model per the following equation:

$$\ln(price) = \alpha_0 + \alpha_1{}^{*}\ln(sqft) + \alpha_2{}^{*}\ln(age) + \alpha_3{}^{*}bedroom + \alpha_4{}^{*}bath + \alpha_5 * halfbath + \alpha_6{}^{*}TOM + \beta_i{}^{*}\sum_{i=1994}^{2011} dumyear\_i + \varepsilon \quad (6)$$

The dependent variable (*price*) is the settlement price of each transaction and, similar to Eq. (5), the right-hand variables are the physical characteristics of the residential property as well as time dummy variables.[11] The hedonic model presented

[10] We also used other specifications instead of Eq. (5), and the overall results were largely unaffected. For brevity, we exclude all other specification from this version of the paper.

[11] As a robustness check, alternative hedonic model specifications were tested and generally yielded similar results.

in Eq. (6) is estimated using 50 % of the transaction data chosen at random and estimated separately for new construction and existing homes. After the coefficients from the hedonic model are estimated, the degree of list overpricing (*overprice*) is calculated for each property from the remaining 50 % of the observations. The degree of overpricing is defined as the ratio of the asking price (*asking*) of each property to the estimated fundamental value of that property (*value*) generated by the coefficients estimated by the hedonic model.

$$overprice_i = \frac{asking_i}{value_i} - 1 \tag{7}$$

To determine whether the degree of overpricing differs among the three pricing strategies, the results from Eq. (7) are averaged across all the observations associated with each pricing strategy.

Finally, we examine the relation between each pricing strategy's ultimate transaction price and the estimated fundamental value of the property. We do this while also controlling for the property's time on the market. For the 2SLS regression analysis, we estimate TOM as per Eq. (5).[12] Specifically, we employ the following regression specifications:

$$\ln(price)_i = \alpha + \alpha_1 * \ln(value) + \beta * precise_i + \mu * TOM_i + \varepsilon_i \tag{8}$$

$$\ln(price)_i = \alpha + \alpha_1 * \ln(value) + \lambda * round_i + \mu * TOM_i + \varepsilon_i \tag{9}$$

$$\ln(price)_i = \alpha + \alpha_1 * \ln(value) + \delta * justbelow_i + \mu * TOM_i + \varepsilon_i \tag{10}$$

where all the variables are as previously defined. Another specification that includes both the *precise* and *justbelow* dummy variables is also examined where the *round* dummy variable is omitted:

$$\ln(price)_i = \alpha + \alpha_1 * \ln(value) + \beta * precise_i + \delta * justbelow_i + \mu * TOM_i + \varepsilon \tag{11}$$

Results

Thousands Digit Frequency

In Table 2, we report the frequency of the thousands digit for all the listings in our sample. Column (1), which includes the full time period examined in this study, reveals that the numerical distribution of the thousands digit is far from being uniformly distributed, where 10 % frequency for each number would be expected. Together, the numbers 0, 4, 5 and 9 appear as the thousands digit of the asking price

[12] Once again, for robustness, we repeat this analysis for the ten-thousands and hundreds digits. We find no evidence on the relation between these two order digits and the degree of overpricing that can be supported with statistical significance. For brevity, we exclude these results from this version of the paper.

Table 2 Frequency of Thousands Digit Asking Price. This table reports the frequency with which the thousands digit in the asking price is associated with a certain number from 0 to 9. Chi-square tests compare the percentages to 10 %, the expected value from a uniform distribution

Thousands digit	(1) Full period	(2) 1993~1998	(3) 1999~2006	(4) 2007~2011
0	14.29 %	13.27 %	15.86 %	11.71 %
1	2.65 %	3.21 %	2.84 %	1.52 %
2	4.95 %	5.06 %	5.47 %	3.59 %
3	3.49 %	3.80 %	3.72 %	2.57 %
4	9.67 %	8.32 %	9.36 %	11.96 %
5	16.30 %	15.30 %	16.94 %	15.90 %
6	3.50 %	4.01 %	3.73 %	2.35 %
7	4.87 %	4.99 %	5.07 %	4.28 %
8	4.93 %	5.19 %	4.98 %	4.51 %
9	35.36 %	36.86 %	32.03 %	41.60 %
Chi-square p-value	0.000***	0.000***	0.000***	0.000***

in roughly 75 % of the listings, while the number 9 by itself represents over 35 % of the distribution. Each of the remaining six numbers represents less than 5 % of the distribution, where the number 1 is the least represented with only 2.65 % of the homes. This non-uniform thousands digit asking price distribution suggests that sellers most often employ "just below" pricing strategies (45.03 %), followed by round prices (30.51 %) and finally precise pricing (24.38 %). Columns (2), (3) and (4) indicate that similar pricing practices take place in all three sub-periods. It is worth noting that during the bust period (07–11) "just below" pricing is more prevalent than it is during the boom period (99–06). This may suggest that during a "seller's" market, sellers are less concerned with making their home appear less expensive than they are during a "buyer's" market.

Figure 1 illustrates the distribution of the asking price thousands digit for new construction versus existing homes. A cursory glance at the figure reveals that while new construction developers also most commonly use the number 9 as the asking price thousands digit, the overall number distribution for new construction is materially less dispersed.[13] For existing homes, the frequency distribution ranges from 1.75 % (for the number 1) to 37.94 % (for the number 9). In comparison, the least common thousands digit for new construction (1) still appears in 6.80 % of the cases, while the most common thousands digit (9) composes only 23.35 % of the distribution. The reason behind the more evenly distributed thousands digit pricing for new construction is unclear. Possibly, it is a result of developers' greater ability to precisely value their product. Another possible explanation for this phenomenon is that developers attempt to send a signal that their asking prices more closely reflect

[13] The standard deviation of the thousands digit number frequency for new construction is 4.95 % compared with 11.24 % for existing homes.

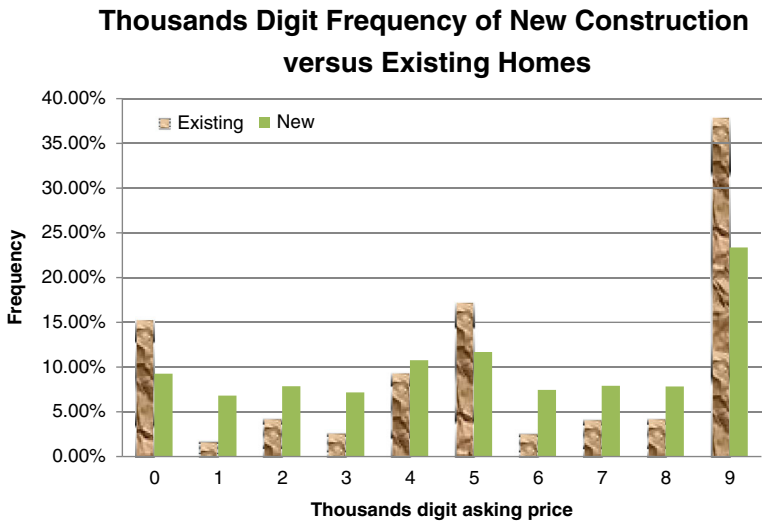

Fig. 1 Thousands Digit Frequency of New Construction versus Existing Homes. This figure shows the percentage frequency for each of the integers associated with the thousands digit of the listing price for both new and existing homes

the true value of the property and/or that they are not as willing to negotiate the price.

Thousands Digit Relation to Discount and TOM

Table 3 reports the discount associated with each number included in the asking price as the thousands digit. Column (1) indicates that the discount associated with round and "just below" round asking prices is materially larger compared to the discount associated with precise pricing. On average, round pricing (thousands digit is 0 or 5) and "just below" pricing (thousands digit is a 4 or 9) both yield a discount of 1.32 % compared to the asking price. Precise pricing (thousands digit is 1, 2, 3, 6, 7 or 8), on the other hand, yields an average discount of 0.42 %. Interestingly, the thousands digit most commonly used by the seller (9) yields the highest discount (1.61 %), while the thousands digit used the least (1) yields the lowest discount (0.03 %). The observation that round and "just below" round pricing strategies yield higher discounts compared to precise pricing is persistent throughout the three sub-periods presented in columns (2), (3) and (4).

Figure 2 displays the discount associated with each thousands digit number for new construction and existing homes. While it is clear that existing homes sell for a discount and new construction homes sell for a premium when compared to the asking price, the volatility in the percentage discount or premium is similar. The standard deviation of the discount across the different thousands digit numbers for existing homes is 0.31 %, while for new construction it is 0.30 %. In both cases, the highest and second highest discounts (or lowest and second lowest premiums) are associated with the numbers 9 and 5 as the thousands digit, respectively. The findings presented in Figure 2 suggest that regardless of whether or not developers of new construction are pricing their homes more accurately than individuals, they are also

Table 3 Discount Associated with each Thousands Digit Asking Price. This table reports the percentage discount associated with homes listed with each thousands digit integer between 0 and 9 for the full period and three sub-periods

Thousands digit	(1) Full period	(2) 1993~1998	(3) 1999~2006	(4) 2007~2011
0	1.26 %	1.65 %	0.68 %	2.67 %
1	0.03 %	0.33 %	−0.47 %	1.49 %
2	0.45 %	0.92 %	−0.08 %	1.60 %
3	0.37 %	0.82 %	−0.24 %	1.72 %
4	1.02 %	1.29 %	0.38 %	2.00 %
5	1.38 %	1.68 %	0.79 %	2.53 %
6	0.28 %	0.69 %	−0.30 %	1.69 %
7	0.59 %	0.98 %	−0.01 %	1.75 %
8	0.78 %	1.03 %	0.15 %	2.12 %
9	1.61 %	1.71 %	1.04 %	2.55 %

more prone to negotiate a lower selling price when the asking price is round or "just below" round.

To more closely examine the discount associated with each thousands digit, panel A of Table 4 presents the regression results in accordance with the different specifications of Eqs. (1), (2), (3) and (4). The first three specifications confirm the results from Table 3 and indicate that the precise asking price strategy is associated with a lower discount (specification 1). Also confirming the results from Table 3, specifications (2) and (3) show that for existing homes, the round and "just below" asking price strategies are associated with greater discounts. In economic terms, houses listed using a precise pricing strategy are discounted by 0.40 % less compared with other housing while a "just below" pricing strategy yields a discount that is 0.26 % higher. Specifications (5) through (8) repeat the analysis performed in specifications

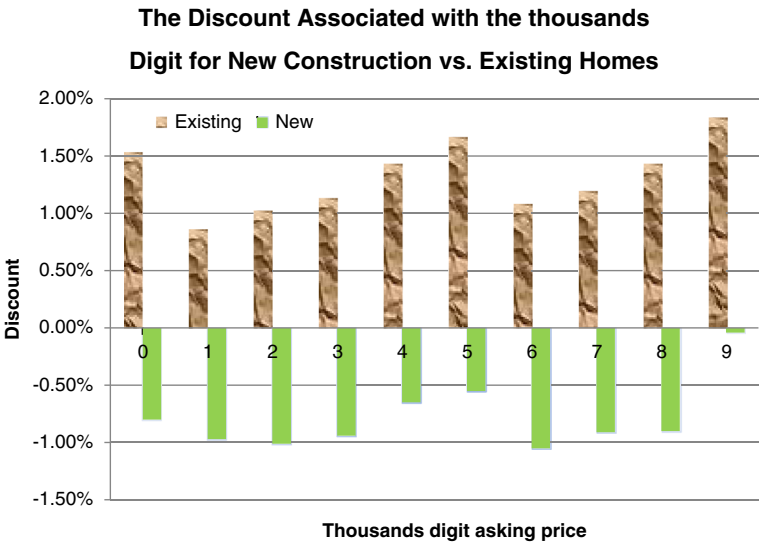

Fig. 2 Discount Associated with the Thousands Digit for New Construction versus Existing Homes. This figure shows the percentage discounts for all integers associated with the thousands digit of the listing price for new versus existing homes

Table 4 Factors Affecting Housing Price Discount – Regression Results. Panel A of this table reports the regression results from the specifications defined in Eqs. (1) though (4) and employs an OLS style regression. Panel B of this table reports the regression results using a 2SLS style regression. For the 2SLS analysis, TOM is estimated using Eq. (5). Precise price is a dummy variable equal to 1 when the thousands digit equals 1, 2, 3, 6, 7 or 8, and 0 otherwise. Round price is a dummy variable equal to 1 when the thousands digit equals 0 or 5, and 0 otherwise. "Just below" is a dummy variable equal to 1 when the thousands digit equals 9 or 4, and 0 otherwise. TOM is time on the market in months. 07~11 period and 99~06 period are dummy variables equal to 1 when the closing date occurred during the 2007~2011 and 1999~2006 time periods, respectively. All coefficients are statistically significant at the 1 % level

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Existing homes				New construction			
Panel A: OLS								
Constant	1.21	1.01	0.93	1.23	−0.11	−0.41	−0.57	0.05
Precise price	−0.40			−0.43	−0.54			−0.70
Round price		0.08		−0.08		−0.04		−0.42
"Just below"			0.26				0.61	
TOM	0.15	0.16	0.15	0.15	0.11	0.11	0.11	0.10
07–11 period	0.68	0.79	0.76	0.68	−0.46	−0.36	−0.44	−0.47
99–06 period	−0.18	−0.11	−0.13	−0.17	−0.66	−0.64	−0.65	−0.66
Adjusted R^2	3.61 %	3.37 %	3.50 %	3.62 %	2.72 %	2.24 %	2.82 %	2.89 %
F-statistic	2,422	2,254	2,340	1,942	262.89	214.11	271.99	223.40
Panel B: 2SLS								
Constant	−1.71	−1.97	−1.99	−1.79	−1.84	−1.97	−2.11	−2.00
Precise price	−0.56			−0.53	−0.64			−0.49
Round price		0.18		0.11		0.13		0.11
"Just below"			0.39				0.31	
TOM	1.61	1.70	1.77	1.74	0.77	0.81	0.91	0.88
07–11 period	0.60	0.56	0.63	0.58	0.07	0.10	0.17	0.16
99–06 period	−0.56	−0.58	−0.66	−0.61	−0.62	−0.62	−0.61	−0.61
R^2	2.36 %	2.24 %	2.07 %	2.16 %	1.96 %	1.94 %	1.89 %	1.91 %
Chi-square	3,354	3,207	2,986	3,095	418.19	401.88	356.24	369.18

(1) through (4) for newly constructed homes. The overall results for new construction are similar to the results generated from existing homes, but with a slightly higher magnitude. For new construction the discount associated with precise pricing is 0.54 % lower compared with other housing and "just below" is associated with a discount that is 0.61 % higher. In Panel B we report the results from our analysis using a 2SLS regression (using Eqs. (1) though (5)). Our results remain robust when we define TOM as an endogenous variable and estimate it separately. Our main variables of interest retain their sign under this analysis with an even slightly higher magnitude when existing homes are considered.

As a robustness check, we also examine the relations among each of the three pricing strategies and the level of discount across different home prices. In Table 5, we repeat specifications (4) and (8) from Table 4 using a 2SLS style regression for each of the five quintiles of the sample in terms of price. We again conduct the analysis separately for existing homes (Panel A) and for new construction (Panel B).

Table 5 Factors Affecting Housing Price Discount by Quintile. This table reports the results from the 2SLS regression specified in Eqs. (4) and (5) to identify the factors that affect price discounts by home price quintile. Panel A reports the results for existing homes and Panel B for new construction. Precise price is a dummy variable equal to 1 when the thousands digit equals 1, 2, 3, 6, 7 or 8, and 0 otherwise. Round price is a dummy variable equal to 1 when the thousands digit equals 0 or 5, and 0 otherwise. TOM is time on the market in months and is estimated according to Eq. (5). 07~11 period and 99~06 period are dummy variables equal to 1 when the closing date occurred during the 2007~2011 and 1999~2006 time periods, respectively. * indicates statistical significance at 5 %. All other coefficients are statistically significant at the 1 % level. 1st quintile is the bottom 20 % of observations in terms of price

	Quintile				
	1st	2nd	3rd	4th	5th
Panel A: Existing homes					
Constant	−2.23	−1.98	−1.76	−1.32	−1.11
Precise	−0.38	−0.32	−0.54	−0.65	−0.59
Round price	0.10	0.07*	0.13	0.11	0.15
TOM	1.43	1.50	1.70	1.81	1.79
07–11 period	1.13	0.31	−0.11	−0.34	−0.55
99–06 period	−0.37	−0.54	−0.81	−1.05	−1.41
R^2	2.18 %	2.38 %	2.26 %	2.15 %	2.07 %
Panel B: New constructions					
Constant	−2.33	−2.20	−2.05	−1.55	−1.31
Precise	−0.41	−0.38	−0.45	−0.51	−0.57
Round price	0.10	0.05*	0.13	0.14	0.16
TOM	0.62	0.59	0.76	1.01	0.99
07–11 period	0.76	0.28	0.14	−0.12	−0.18
99–06 period	−0.40	−0.44	−0.59	−0.96	−1.04
R^2	1.83 %	1.88 %	1.90 %	1.87 %	1.81 %

This segmentation of the data reveals that the negative effect of the precise pricing strategy on discount is consistent across all price ranges.

Thousands Digit and Degree of Overpricing

Figure 3 illustrates the average degree of list overpricing associated with round, precise and "just below" pricing strategies. The difference between the average degree of list overpricing between round (3.01 %) and precise (3.14 %) pricing strategies is not statistically significant, whereas the "just below" pricing strategy (5.35 %) is significantly higher than both the round and precise pricing strategies. This difference is not only statistically significant, but is material from an economic perspective as well.

The evidence that houses priced using the "just below" strategy are more overpriced compared to other housing is consistent with the extant literature that advocates this pricing strategy. Table 6 further examines the home's transaction price across the three pricing strategies, while also considering the estimated house value and time on the market. Panels A and B employ OLS and 2SLS style regressions,

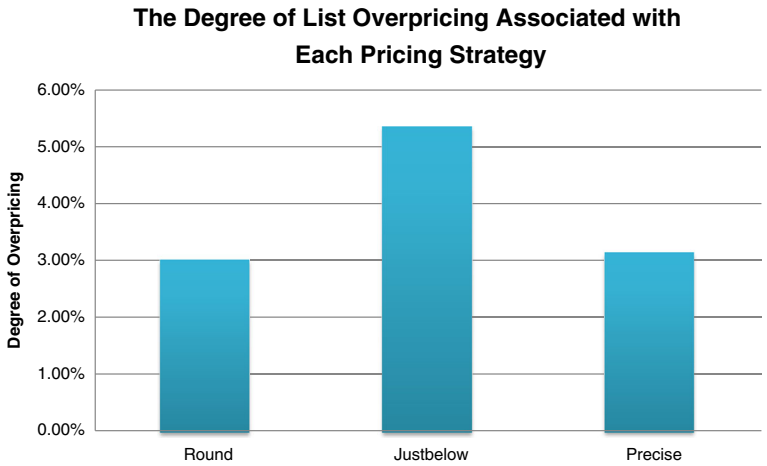

Fig. 3 Pricing Strategies and Degree of Overpricing. This figure shows the percentage of list overpricing associated with each of the three list pricing strategies. The degree of list overpricing for each pricing strategy is calculated by first employing the hedonic model presented in Eq. (6) on half of the sample. Then, the generated regression coefficients are applied to the remaining half of the sample in order to estimate the value of each observation. Finally, Eq. (7) is employed to calculate the degree of overpricing. Precise price is defined as a pricing strategy where the thousands digit equals 1, 2, 3, 6, 7 or 8. Round price is defined as a pricing strategy where the thousands digit equals 0 or 5. "Just below" is defined as a pricing strategy where the thousands digit equals 9 or 4

respectively. The results represented in both panels are consistent and generally confirm the combined results from Figs. 2 and 3. Columns (4) and (8) suggest that "just below" and precise pricing strategies are superior to round pricing in terms of the final price yield. According to Panel B, "just below" and precise pricing yield a price premium of 1.96 % and 1.28 %, respectively, compared with round pricing for existing homes. This price premium is significant in statistical and economic terms. For new construction, round pricing is still the inferior strategy. In this category, the premium associated with the other strategies is slightly lower (1.18 % for "just below" and 0.63 % for precise pricing), but still carries statistical significance and economic importance.

Taken together, we conclude that sellers set a higher list price compared to the true underlying home value when using the "just below" pricing strategy. Buyers then negotiate more heavily from this list price. In net terms, the final settlement or transaction price is still higher than what would result from either a round or precise listing price strategy. As such, we conclude that the "just below" pricing strategy yields the highest amount of money for the home seller even after consideration of marketing time, and as such, represents the best pricing strategy for sellers to employ.

Conclusions

Establishing a listing price for a home that yields the highest final transaction price without prolonging the time on the market is an important issue for all home sellers.

Table 6 Price Strategies and Final Transaction Price. Panel A of this table reports the regression results from the specifications defined in Eqs. (8) though (11) and employs an OLS style regression. Panel B of this table reports the regression results using a 2SLS style regression. For the 2SLS analysis, TOM is estimated using Eq. (5). Precise price is a dummy variable equal to 1 when the thousands digit equals 1, 2, 3, 6, 7 or 8, and 0 otherwise. Round price is a dummy variable equal to 1 when the thousands digit equals 0 or 5, and 0 otherwise. "Just below" is a dummy variable equal to 1 when the thousands digit equals 9 or 4, and 0 otherwise. TOM is time on the market in months. All coefficients are statistically significant at the 1 % level

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Existing homes				New construction			
Panel A: OLS								
Constant	−0.38	−0.41	−0.48	−0.52	−0.51	−0.58	−0.49	−0.50
True value	101.81	101.59	101.93	101.13	102.90	102.35	102.85	102.61
Precise price	0.58			2.23	0.12			0.52
Round price		−2.20				−1.13		
"Just below"			1.81	2.86			0.61	1.03
TOM	−0.09	−0.10	−0.09	−0.09	−0.12	−0.14	−0.14	−0.13
Adjusted R^2	85.51 %	85.57 %	85.70 %	85.85 %	88.74 %	88.70 %	88.56 %	88.79 %
Panel B: 2SLS								
Constant	0.48	0.46	0.34	0.60	−0.35	−1.11	−0.93	−0.40
True value	100.02	100.32	99.94	98.89	100.10	100.45	100.13	99.99
Precise price	0.85			1.28	0.26			0.63
Round price		−1.61				−0.87		
"Just below"			1.34	1.96			0.75	1.18
TOM	0.17	0.18	0.18	0.16	−0.28	−0.27	−0.28	−0.30
Chi-Square p-value	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %

From a valuation standpoint, it is clear that the asking price should reflect the value of the home. However, the pricing strategy the seller chooses to employ is also important. In this study, we examined the effect of three different pricing strategies, defined by the thousands digit of the asking price, on the discount and settlement price negotiated on residential real estate transactions.

The results of our empirical analysis suggest that sellers who employ the "just below" pricing strategy are able to set a higher list price for their home compared with other pricing strategies. However, while homebuyers are more drawn to "just below" priced properties, they also tend to negotiate down the price further. Still, the net effect yields a final transaction price that is higher than when employing the two alternative pricing strategies – precise pricing and round pricing. These findings combine to clearly demonstrate that the "just below" pricing strategy is most effective in a real estate setting, as has been found to be the case in a myriad of other retail settings, typically where price and purchase involvement are much lower and where the buyer is merely a price-taker. Robustness checks confirm that the empirical results we present are statistically and economically significant and hold across both buyer's and

seller's markets, new construction and existing homes, across different home price ranges and also when examined using different econometric approaches.

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Appendix: Definition of Variables

sqft	Living area of the house measured in square feet
age	Age of the house measured in years
bedroom	Number of bedrooms in the house
bath	Number of bathrooms in the house
halfbath	Number of half bathrooms in the house
dumyear_i	Dummy variable indicating the year during which the transaction took place. i can take an integer value between 1994 and 2011.

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