Can Superstitious Beliefs Affect Market Equilibrium?
Personal Beliefs and Beliefs about Others

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Abstract

We investigate whether superstitious beliefs held directly by only a fraction of the population affect market equilibrium. Using data from multiracial Singapore, we find that apartments whose unit numbers end with 8, an auspicious number for Chinese, are sold at 0.9% premium, whereas those that end with 4, an inauspicious number for Chinese, are sold at 1.5% discount. The discount for inauspicious number is insensitive to the immediate prospect of finding a superstitious buyer. It also applies to uncompleted units that were most likely bought for investment and subsequently sold without occupancy. This suggests that beliefs about others are important.

Keywords: Belief-based equilibrium, superstition, direct beliefs, indirect beliefs, housing prices

JEL classification: D1, R2, Z1

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Did he [Lee Kuan Yew, the first prime minister of Singapore] believe in fengshui and astrology? “A lot of Singaporeans suspect that you do,” my teammate Ignatius said.

Lee was genuinely shocked. “Utter rubbish! Utter rubbish! I’m a pragmatic, practical fellow. I do not believe in horoscopes. I do not believe in fengshui. And I’m not superstitious about numbers. But if you have a house which other people think has disadvantaged fengshui and numbers, when you buy it, you must consider that when you resell. So again it’s a practical consideration. Not that I’m interested in it. But if I buy that, I must get a low price because when I sell it I will get a low price. You believe I go for fengshui and horoscopes?” he asked, laughing with incredulity.


1 Introduction

When asked whether he believes in “feng shui” (geomancy) and astrology, Mr Lee’s answer illustrates how superstitious beliefs can affect market prices: equilibrium prices may reflect not the marginal buyer’s own willingness to pay or his own belief, but his beliefs about others, such as his beliefs about other people’s willingness to pay, which in turn depends on other people’s beliefs about others, and so on. This belief-based equilibrium is similar to the one described by Sandroni and Smorodinsky (2004). Nevertheless, when the beliefs are clearly superstitious and not shared by everyone in the economy, it is unclear whether they can sustain an equilibrium. On the one hand, non-superstitious buyers who are neutral to these beliefs may arbitrage against the superstitious buyers. On the other hand, the presence of superstitious buyers may change the price dynamics, making arbitrage risky. Instead of arbitraging against them, profit-maximizing non-superstitious buyers may have an incentive to mimic their behavior. A priori, it is unclear which effect will dominate.

Using field data, we empirically investigate whether superstitious beliefs held directly by only a fraction of the population can have persistent effect on market equilibrium and how this equilibrium may be sustained, whether directly through personal beliefs or indirectly through beliefs about others.
Specifically, we use a housing data set from Singapore, a multiracial society, to address two questions. First, whether a superficial feature of a product – in our case, the last digit of a property’s unit number – can affect market prices when there clearly exists a significant fraction of the population who is neutral to it. Second, whether the price effect is driven directly by personal preferences or indirectly by people’s beliefs about others through their expectation of resale prospect in the future. Culturally, the Chinese favor some words or numbers because they are homophones for auspicious words such as “prosperity”, and avoid others because they sound similar to inauspicious words such as “death”. In particular, number “4” sounds like the word for “death” and number “8” the word for “prosperity”. But clearly the non-Chinese do not share these beliefs; according to the census of population, about 25% of the resident population in Singapore are non-Chinese and at least 28.9% of the resident population aged 15 years and above are not literate in Chinese.\footnote{The data on ethnicity composition come from Table 1 of the \textit{Census of Population 2010}, downloadable at http://www.singstat.gov.sg/pubn/popn/c2010sr1/t1-11.pdf.} Moreover, many Chinese in a modern society do not seriously believe that these numbers really bring good or bad lucks. Nevertheless, Fehr and Tyran (2001) pointed out that beliefs about others could affect the equilibrium. In particular, they show that money illusion could affect prices and equilibrium in lab experiments through indirect effects, where people do not have money illusion themselves, but believe that others do. Our evidence suggests that their results may apply more generally to other forms of beliefs in the field.

A few studies have analyzed the impact of Chinese fondness for number 8 or aversion to number 4 on market prices. Nevertheless, to the best of our knowledge, none of them has tried to examine whether the impact is the result of direct beliefs or indirect beliefs. Bourassa and Peng (1999) document that houses with an auspicious street number are sold at a 1% premium in a few neighborhoods with a large population share of ethnic Chinese in Auckland, New Zealand. Chau et al. (2001) show that units located on the 8th, 18th, and 28th floors of apartment buildings in Hong Kong are sold at higher prices than those located on other floors during property booms. Nevertheless, the sample sizes in these two studies are small, covering only a few thousand transactions. Fortin et al. (2011) address
the small sample issue. Using 117,000 transactions in Vancouver, Canada, they find that houses whose addresses end with number 4 are sold at a 2.2% discount whereas those that end with number 8 are sold at a 2.5% premium in areas with at least 18% Chinese residents. Outside the housing market, Woo et al. (2008) and Ng et al. (2010) find that auspicious car plate numbers are auctioned at higher prices in Hong Kong, whereas Simmons and Schindler (2003) find that advertised prices in Chinese newspapers are more likely to end with 8 and less likely to end with 4.

Using data for all private condominium transactions in Singapore between January 1995 and April 2011, we analyze the impact of an apartment’s unit number on its transaction price. The variations in housing prices across unit numbers will be referred to as the unit-number price differentials or simply the price differentials henceforth. One advantage of using data from Singapore is that unlike some other countries, the numbering of apartments is tightly controlled in Singapore. Specifically, the Singapore government specifies that apartment units must be numbered sequentially in a clock-wise direction starting from number one, prohibiting the omission of any unit number or the manipulation of supply of units with auspicious or inauspicious numbers. Moreover, the large sample size and long sample period allow us to examine several issues that cannot be analyzed in the previous studies. First, the large sample size allows us to examine the price differentials using only transactions between property developers and individual buyers of newly developed properties. The finding of price differentials in new sales rules out transaction cost as an explanation because the same transaction cost is incurred for all units sold. It also rules out seller’s inexperience or incomplete information about housing market because the sellers are professionals who specialize in property development and sales. Moreover, by focusing on newly built apartments, there is less omitted variable bias as depreciation, maintenance, and renovation have not yet occurred. Second, the existence of a large number of buyers who bought an uncompleted unit but sold it before completion helps us to understand whether the price differentials reflect people’s own beliefs or their beliefs about others because these buyers never occupied the units they bought and they most likely bought for the sole purpose of investment or speculation with the intention of
resale. Thus, their own preferences for specific numbers are largely irrelevant. Instead, their beliefs about the preferences of other buyers are key. Furthermore, the finding of similar rates of return on apartments with different unit numbers for property investors or speculators also rules out any arbitrage opportunities given the price differentials.

Our results show that new apartments whose unit numbers end with 4 (referred to as the U4 units or unfavorable units henceforth) were sold at a 1.5% discount whereas those that end with 8 (referred to as the U8 units or favorable units henceforth) were sold at a 0.9% premium. We also find that the price differentials tend to persist in the resale market, though the magnitude tends to diminish as the apartments age.

Because neutral buyers outnumber the supply of U4 units, the finding of a significant price discount suggests that there must be search frictions and the equilibrium is not characterized by perfect sorting, where the U4 units are sold only to neutral buyers. To investigate whether the price differential is due to direct beliefs or indirect beliefs, we check the sensitivity of the price differential with respect to the immediate prospect of finding a superstitious buyer. Suppose the price differential reflects buyers’ own preferences instead of indirect beliefs, then the immediate prospect of finding a superstitious buyer should affect the estimated price differential. This is because based on their own preferences, only superstitious buyers would require a discount for U4 units. On the other hand, if this price differential reflects buyers’ beliefs about others in the future resale market, then the immediate prospect of finding a superstitious buyer would make little difference because both superstitious and non-superstitious buyers would require similar discount for U4 units in this case.

To investigate this, we group the sample using various proxies for the immediate prospect of finding a superstitious buyer across space and time, such as by the local share of ethnic Chinese, the age composition of local residents, the time and volume of transaction. Generally the results show that the estimated price discount for U4 units is always significant and completely insensitive to the immediate prospect of finding a superstitious buyer. There is, however, some evidence that the price premium for U8 units increases in magnitude with the immediate prospect of finding a superstitious buyer.
Specifically, the premium is higher in areas with more ethnic Chinese, in areas where the population share of the older generation is higher, in the earlier half of our sample period, and in thicker markets with greater volume of transaction although the differences are not always statistically significant. These results suggest that indirect beliefs or beliefs about others may account for the stable price discount for U4 units, which measures buyers’ willingness to accept an auspicious number, whereas direct beliefs may be a more important determinant for the more volatile price premium for U8 units, which measures buyers’ willingness to pay for an auspicious number.

Finally, for uncompleted units that were bought and sold before the units were ready for occupancy, we also find significant price discount for U4 units but insignificant price premium for U8 units. Because these buyers bought and sold the apartments while they were still in construction, they never occupied the apartments they bought. Many of these buyers are likely to be property investors or speculators who had resale rather than personal use in mind when they bought. Thus, their willingness to pay or accept must largely reflect their beliefs about others rather than their own preferences. Because the estimate suggests that they demand a comparable discount for U4 units rather than bidding competitively to eliminate the discount, this evidence again suggests that indirect beliefs are likely to be important determinant of the price discount for inauspicious number. This evidence and the finding that the price differentials tend to be very persistent suggest that there is little evidence for arbitrage on U4 units.

2 Data and methodology

The residential housing market in Singapore consists of three types of properties: apartment buildings developed by the Housing & Development Board (HDB), private condominiums, and landed properties. HDB is Singapore’s public housing authority and its new apartments are sold only to Singaporeans at subsidized prices. Private condominiums are apartment buildings developed by private companies. They can be sold to both Singaporeans and foreigners. Landed properties refer to detached, semi-detached houses, or townhouses. These properties are developed by private companies and sold mostly to
Singaporeans. Permissions from the Singapore Land Authority are needed if foreigners want to purchase landed properties. According to the 2010 census, 82.4% of Singapore households lived in HDB flats, 9.7% lived in private condominiums and 6.6% lived in landed properties. Geographically, the city state is divided into 55 urban planning areas, and organized into five regions — Central, East, North East, North, and West. As of the first quarter of 2011, there were 260,108 units of private condominiums in Singapore, more than half of them were located in the Central region, 18% in the East, 14% in the North East, 13% in the West, and only less than 3% in the North.

The Singapore government provides clear guidelines on how units in multi-story buildings should be numbered. Hence, property developers have no room to manipulate the supply of U4 and U8 units. The Inland Revenue Authority of Singapore (2012) clearly states that “4, 13, 14, etc which can be perceived as undesirable or inauspicious will not be omitted” for house number or unit number, and “units are generally numbered sequentially in a clock-wise direction starting from ‘01’. A unit number will be provided for each distinct unit shown on the floor plan. Omission and reservation of any numbers is not allowed for a residential development.”

This study uses housing transaction data extracted from the Urban Redevelopment Authority’s Real Estate Information System (REALIS), which contains information on all private residential property transactions in Singapore since 1995. Specifically, the data set contains information on transaction date, transaction price, unit number, floor area, floor level, project name, street address, and property type. We focus on the transaction price of private condominiums to control for quality variation across housing units. There is little within-condominium quality variation, particularly for new condominium units, while the quality differences across condominium projects can be easily controlled for by condominium fixed-effects. Our data include all transactions conducted between January 1995 and April 2011. In total, our data set covers 171,889 transactions on 119,593 units, which account for 46% of all existing condominium units in Singapore. Among these transactions, 82,202 are new sales, 70,131 are resales, and 19,556 are sub-sales.\(^2\)

\(^2\)A transaction is considered as a new sale if a buyer (the original purchaser) purchased a property from the developer. A transaction is considered as a sub-sale if a buyer purchased a property from the
Figure 1 plots the average transaction price and annual transaction volume for these three types of transactions. Both price and volume varied considerably over time for all types of transactions. For example, the average transaction price of new sales plunged from S$1,003,964 in 1997 to S$643,668 in 1998, and climbed to S$1,015,513 in 2000. We control for these year-to-year variations in transaction price by including transaction year dummies in the regression.

Fortin et al. (2011) pointed out that the impact of unit numbers on housing prices may depend on the racial profile of local residents because the liking for 8 and the aversion to 4 originated from their Chinese pronunciations. Furthermore, if rising education and modernization in Singapore have weakened the influence of traditional beliefs on the younger generation, then the price differentials should also depend on the age profile of local residents. Thus, we also extract information on ethnic and age composition at the planning-area level from the 2010 Singapore census. The reason for using the most recent census rather than an earlier one is that we are interested in the ethnic and age profiles of those who bought apartments in these areas rather than those who lived there before they bought.

Table 1 reports some sample statistics. The average transaction price is about S$1.2 million. The average apartment has a floor area of 130 m². Most apartments are located in high rise buildings with an average floor level of about 9 stories. U4 units account for 12% of the total transactions while U8 units account for 8%. The apartments in our sample are located in 36 planning areas. The share of ethnic Chinese in these areas ranges from

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3. We focus on the last digit of the unit number because there is little variation in the first digit. About 75% of the apartments in our sample have a unit number between 1 and 19; less than 3% have a unit number between 40 and 49. There is also evidence that apartments located on the 4th, 14th, 24th, ... floors are sold at a discount while those located on the 8th, 18th, 28th, ... floors are sold at a premium. Nevertheless, for the sake of brevity, this paper focuses on unit number price differentials.
61% to 86% with a mean of 75%, which implies that the proportion of non-superstitious buyers outnumbers the proportion of U4 units at least two to one even if all ethnic Chinese are superstitious. The share of residents aged 50 and over varies from 20% to 40% with a mean of 31%.

These statistics suggest that if there are no market frictions, it is possible to have a perfect sorting equilibrium that is based on buyers’ direct beliefs only, where all U4 units are sold to neutral buyers at zero discount. This is because there are more neutral buyers than U4 units; not all Chinese are averse to number 4 but all non-Chinese should be neutral to number 4. Similarly, as long as there are more superstitious buyers than U8 units, in the absence of market frictions, all U8 units could be sold to superstitious buyers at a premium. In this perfect sorting equilibrium without market frictions, the price of a U4 unit will be unaffected by the superstitious buyers’ willingness to accept but a U8 unit will be sold at a premium that reflects the superstitious buyers’ willingness to pay. Thus, if we find a statistically significant price discount for U4 units, then we can reject a perfect sorting equilibrium that is based on buyers’ direct beliefs.

To estimate the price differentials, we estimate the following regression:

\[ p_{ijt} = \alpha_0 + \alpha_1 U4_{ijt} + \alpha_2 U8_{ijt} + \gamma' D_{Yt} + \beta' X_{ijt} + \mu_j + \epsilon_{ijt}, \]  

where \( p_{ijt} \) is the log price of apartment \( i \) of condominium \( j \) sold in year \( t \), \( U4 \) equals 1 if the apartment’s unit number ends with 4 and 0 otherwise, \( U8 \) equals 1 if the apartment’s unit number ends with 8 and 0 otherwise, \( D_{Yt} \) is a column vector of transaction year dummies that capture the impact of aggregate market condition on housing price, \( X \) is a column vector of apartment characteristics including floor area, floor level, and their third order polynomials, \( \mu_j \) captures condominium fixed-effects, and \( \epsilon_{ijt} \) is the random error term. Implicitly, apartments whose unit number does not end with either 4 or 8 (referred to as the Uo units hereafter) are used as the benchmark. As a result, \( \alpha_1 \) and \( \alpha_2 \) should be interpreted as the price differentials between U4 and Uo, and between U8 and Uo units.

\footnote{We have also tried to include a vector of transaction quarter dummies to control for price seasonality. The coefficients on U4 and U8 are basically unaffected by the additional controls.}
respectively.

To investigate whether the price differentials are due to buyers’ own preferences with imperfect sorting or beliefs about others, we check the stability of the price differentials and their sensitivity with respect to the immediate prospect of finding a superstitious buyer. To see why, suppose superstitious and non-superstitious buyers pay different prices for U4 and U8 units, then the price distribution of U4 units will be a mixture of the distribution of prices paid by superstitious buyers and non-superstitious buyers. In other words, the observed price of U4 units is

$$P_{U4} = \pi P_{U4}^N + (1 - \pi) P_{U4}^S,$$

where $\pi$ is the proportion of U4 units bought by neutral buyers, $P_{U4}^N$ and $P_{U4}^S$ are the prices paid by non-superstitious and superstitious buyers for U4 units, respectively. The superscript $N$ and $S$ denote non-superstitious and superstitious buyers, respectively, while the subscript denotes the $U_j$ units, where $j = 0, 4,$ or $8$. Let $P_{U_o}$ denote the observed price of Uo units. Suppose these prices have the following distributions:

$$P_{U4}^N \sim (\mu_{U4}^N, \sigma_{U4}^N), \quad P_{U4}^S \sim (\mu_{U4}^S, \sigma_{U4}^S), \quad P_{U_o} \sim (\mu_{U_o}, \sigma_{U_o}),$$

where $\mu$ is mean and $\sigma$ is standard deviation. If prices reflect buyers’ own beliefs, then the price of U4 units paid by non-superstitious buyers and the price of Uo units should be identically distributed, i.e., $\mu_{U4}^N = \mu_{U_o}, \sigma_{U4}^N = \sigma_{U_o}$. On the other hand, the price of U4 units paid by superstitious buyers should have a lower mean and a larger standard deviation than the price of Uo units, i.e., $\mu_{U4}^S < \mu_{U_o}, \sigma_{U4}^S > \sigma_{U_o}$. The former is due to superstitious buyers’ distaste for U4 units while the latter is due to potential heterogeneity in individual’s distaste for U4 units. Thus, the observed price of U4 units should have a lower mean and a larger standard deviation than that of the Uo units:

$$\mu_{U4} < \mu_{U_o} \quad \text{and} \quad \sigma_{U4} > \sigma_{U_o}$$

If prices reflect buyers’ own preferences, the price differentials between U4 and Uo
units should also vary over the price distribution because of variations in buyers’ own preferences. Furthermore, the magnitude of the observed price differentials is expected to vary inversely with the share of neutral buyers $\pi$. From equation 2, $\mu_{U_4} - \mu_{U_o} = \pi(\mu_{U_4}^N - \mu_{U_o}) + (1 - \pi)(\mu_{U_4}^S - \mu_{U_o})$. Because $\mu_{U_4}^N = \mu_{U_o}$ under the assumption that prices reflect buyers’ own preferences,

$\mu_{U_4} - \mu_{U_o} = (1 - \pi)(\mu_{U_4}^S - \mu_{U_o})$ (4)

In contrast, if prices reflect indirect beliefs rather than own preferences, then the prices of U4 units paid by superstitious and non-superstitious buyers would be very similar because of shared indirect beliefs, i.e., $\mu_{U_4}^S \approx \mu_{U_4}^N < \mu_{U_o}$. As a result, the observed price differentials are expected to be insensitive to the variation in the share of neutral buyers $\pi$. If prices reflect indirect beliefs, the price differentials should also exhibit greater stability over the price distribution. Beliefs about others are the expectation of individuals’ beliefs; expected value should be less volatile than the underlying beliefs. Similar arguments apply to the price distribution of U8 units.

To keep our results clean, we first focus on the transaction prices of new sales. By focusing on new units bought directly from property developers, we control for unobserved quality differences due to depreciation, maintenance, interior decoration or renovation. Moreover, because property developers should be fully aware of the unit-number price differentials if they indeed exist, focusing on new sales also rules out incomplete information or inexperience on the part of sellers. We then investigate resale, including the condominium’s age and its squared as additional controls.

3 Empirical results

Column (1) of Table 2 reports our baseline estimates of the coefficients on U4 and U8 in equation (1). The results show that U4 units are about 1.5% cheaper than Uo units while U8 units are about 0.9% more expensive. Evaluated at the average condominium price of S$1,475,530 and the average exchange rate of US$1 to S$1.36 in 2010, our results
suggest that U4 units are sold at a discount of S$22,133 or US$16,274, whereas U8 units are sold at a premium of S$13,280 or US$9,765. The discount is equivalent to about 5.2 times the average monthly earnings of Singapore households in 2010. Could unobserved housing characteristics explain these price differentials? It is possible that knowing that U4 units are undesirable and U8 units are desirable to potential buyers, property developers deliberately assign number 4 to less desirable units and number 8 to more desirable units. For example, they can assign number 4 to the units facing a major highway or afternoon sun and number 8 to units with a better view. If so, then the observed price differentials may be attributable to unobserved differences in apartment characteristics rather than unit number.\footnote{It should be noted that developers might assign number 4 to more desirable units to make them more attractive to buyers.}

To test for omitted variable bias, we use a regression discontinuity design. Because apartment units are to be “numbered serially in a clock-wise direction” under government regulation, U4 units should be adjacent to either U3 or U5 units. Therefore, U3 or U5 units should share similar locational characteristics with U4 units. Similarly, U7 or U9 units should share similar locational characteristics with U8 units. For example, if a U4 unit faces a major highway, then its neighboring U3 unit or U5 unit has to, at least partially, face the same highway. Therefore, if the price differentials documented in column (1) are mostly driven by unobserved characteristics, then U3 and U5 units should also be sold at a discount whereas U7 and U9 units should also be sold at a premium. Column (2) reports the estimation results where U1 units are used as the benchmark. The results show that after controlling for apartment-specific characteristics such as floor area, U4 units are still significantly cheaper than both U3 and U5 units at the 1% level, and U8 units are still significantly more expensive than U7 and U9 units at the 2.2% level and 5.3% level, respectively. Moreover, while the coefficients on U4 and U8 are statistically significant at the 1% level, none of the coefficients on U3, U5, U7, and U9 is significant even at the 10% level.
Nevertheless, the above design comes with a caveat: we still need to control for apartment-specific characteristics that even adjacent apartments need not share, such as floor area. This is because while the numbering rule ensures that units with contiguous unit numbers are located next to each other, thus sharing similar locational characteristics, the rule does not, for example, prevent the developers from building smaller apartments for U4 units, vice versa for U8 units. In fact, we find that property developers do tend to allocate smaller floor area to U4 units, which our regressions control for. The average floor area is 116.11m² for U4 units, 123.79m² for other apartments, 123.99m² for U3 and U5 units. The differences between U4 and all the other units, as well as between U4 and U3 and U5 units are statistically significant at the 1% level. Figure 2 shows box plot of floor area against the last digit of unit number. It turns out that U4 units have smaller floor areas at the 25th, 50th and 75th percentiles, suggesting that the difference in floor area is not driven by a few outliers. Interestingly, the average floor area of U8 units is 123.94m², which is not significantly different from the other units. Nevertheless, its area is larger compared to the U7 and U9 units, which have an average floor area of 122.38m². The difference is statistically significant at the 2% level. To check whether our results are driven by potential nonlinearity that cannot be controlled for by the third-order polynomial function of floor area, we also tried the fifth-order polynomial function. The coefficients on U4 and U8 are unaffected by the choice of polynomial function.

[Insert Figure 2 here]

Next, we compare the price distributions of U4, U8, and Uo units to investigate whether the differences in means are driven primarily by differences among a small number of units or by similar differences across the entire distribution. To make a meaningful comparison, we need to control for quality differences across units. To do this, we first re-run regression (1) with the same control variables but without the U4 and U8 dummies. We then subtract the predicted contributions of observable characteristics and condominium fixed-effects from the transaction price. We call this residual price the quality-adjusted price.

[Insert Figure 3 here]
Figure 3 plots the cumulative distribution of quality-adjusted price. Table 3 reports the standard deviation of quality-adjusted price and the price at selected percentiles. Interestingly, the price discounts for U4 units are almost the same across the entire distribution. Using Uo units as the benchmark, the discount is 1.5% at the 25th percentile, 1.4% at the median and 1.3% at the 75th percentile. The interquartile range of the price of U4 units is only slightly larger than that for Uo units (0.0932 vs. 0.0913). The standard deviation of the price of U4 units is actually slightly smaller than that of Uo units (0.087 vs. 0.0879). None of these differences are statistically significant. This evidence suggests that the price discount is very stable. In other words, different buyers enjoy very similar discounts for U4 units. An individual’s preferences should have greater variations than his beliefs about others because the latter is basically an expectation of the former. So if prices reflect buyers’ own beliefs, then we expect greater variations in the distribution of price discount for U4 units, which is not what we observe. Instead, the stable price discount points to indirect beliefs: everybody including neutral buyers will only buy a U4 unit if it is sold at a discount because they expect others to demand a discount in the future. Thus, neutral buyers mimic the behavior of superstitious buyers rather than arbitrage against them.

The evidence on the price premium for U8 units is less clear. Using Uo units as the benchmark, the premium is 0.5% at the 25th percentile, 0.9% at the median and 1.0% at the 75th percentile. Moreover, compared to Uo units, the price of U8 units has a larger interquartile range (0.0967 vs. 0.0913) and a larger standard deviation (0.0908 vs. 0.0879). The greater variation in price premium for U8 units is consistent with the hypothesis that prices reflect buyers’ own preferences. Nevertheless, none of the differences is statistically significant. Thus, the evidence here is not strong enough to really conclude that different buyers pay different premiums for U8 units.

To further examine whether the price differentials reflect buyers’ own preferences or their beliefs about others, we compare the price differentials across various sub-samples. For example, a proxy for the immediate prospect of finding a superstitious buyer may be the share of ethnic Chinese in that area, especially if buyers prefer neighbors from their
own ethnic group. As shown in equation (4), if buyers pay for their own beliefs, then the price differentials should be sensitive to the immediate prospect of finding a superstitious buyer. Specifically, for any given level of willingness to accept, the smaller the proportion of non-superstitious buyers (π) or the larger the proportion of superstitious buyers (1−π), the larger the observed price differentials should be.

To check this, we create a dummy variable \( HC = 1 \) if the proportion of ethnic Chinese in the planning area is larger than the median value of 75%, and 0 otherwise. We then include its interaction with U4 and U8 as additional controls in the regression. Column (1) of Table 4 reports the results. The coefficient on U4 is -0.013, which is very close to our baseline estimate of -0.015 reported in column (1) of Table 2. On the other hand, the coefficient on the interaction between U4 and \( HC \) is small and statistically insignificant, suggesting that the proportion of ethnic Chinese in the planning area has no significant impact on the price discount for U4 units. The stable and significant price discount for U4 units across areas with different ethnic profiles indicates that indirect beliefs may be important for the price discount. In contrast, the coefficient on the interaction between U8 and \( HC \) is relatively large and statistically significant at the 10% level, suggesting that the premium for U8 units is indeed larger in areas with a higher concentration of ethnic Chinese. In fact the coefficient on U8 itself is small and statistically insignificant, which indicates that there is no price premium for U8 units in areas where the proportion of ethnic Chinese is lower than median. The positive correlation between the price premium for U8 units and the proportion of ethnic Chinese in the area indicates that buyers’ own preferences may be driving the price premium.

Another proxy for the immediate prospect of finding neutral or superstitious buyers is the thickness of market. Presumably it is easier to find buyers who are neutral to U4 units or strongly favor U8 units when there are many buyers in the market; sellers do not have to wait around for too long for such buyers to come along when the market is hot and transaction volume is high. Thus, if the price differentials reflect buyers’ own preferences,

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6Exploiting variation generated by a public housing policy called “ethnic housing quotas”, Wong (2012) investigates ethnic preferences using public housing data from Singapore. Nevertheless, it is unclear whether the results also apply to the private condominium market.
then the estimated price differentials should be sensitive to the volume of transaction. On the other hand, if the price differentials reflect people’s beliefs about others in the future resale market, then the price differentials should be more stable across different market conditions that prevailed at the time of transaction. The big swing in transaction volume over time allows us to test this hypothesis. For example, in the second half of 2009 when Singapore’s housing market recovered quickly from the short slump in the preceding year, many buyers have to put thousands of dollars of deposit just to secure a right to view the show flats as most property projects were sold out in the first few days of the project’s launch. With such a hot property market, it should be easy for property developers to find neutral buyers who are willing to buy U4 units at no discount and superstitious buyers who are willing to buy U8 units at high premium.

We create a dummy variable $HV = 1$ if the annual transaction volume exceeds 8000 and 0 otherwise. Column (2) of Table 4 reports the results where the interaction terms between U4 and $HV$, and U8 and $HV$ are included as additional controls. The coefficient on U4 is -0.012, which is again almost the same as our baseline estimate. The coefficient on the interaction term between U4 and $HV$ is small and statistically insignificant, which suggests that market conditions that prevailed at the time of transaction do not affect the price discount. The stable and significant price discount for U4 units across the thick and thin markets supports the hypothesis of indirect beliefs. The estimated price premium for U8 units when transaction volume is low is 0.6%, but it is not statistically significant even at the 10% level. The coefficient on the interaction term between U8 and $HV$ is 0.5%, suggesting that the estimated price premium is 1.1% when transaction volume is high. Although the coefficient on the interaction term is statistically insignificant, the null hypothesis that U8 and its interaction with $HV$ are jointly insignificant can be rejected at the 0.5% level. This means that the price premium is only significantly positive when the immediate prospect of finding a superstitious buyer is high in a thick market.

[Insert Table 4 here]

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7The annual transaction volume is lower than 8,000 in 8 years of our sample and higher than 8,000 in the other 8 years. The average transaction volume is 5,965 in the thin market and 14,775 in the thick market. We have also tried to use other cutoff values, and our results were unaffected.
The prospect of finding neutral buyers may also be higher among the younger generation because they tend to be better educated and less likely to believe in superstitions. To test this hypothesis, we exploit the time and cross-sectional variations in the share of younger generation. First, we create a dummy variable $EL = 1$ for the earlier years 1995-2002, and 0 for the later years 2003-2011. By definition, more buyers belong to the younger generation in the later period. Column (3) of Table 4 reports the estimation results. The price discount for U4 units is again very similar over time: 1.3% in the earlier period vs. 1.6% in the later period. The coefficient on the interaction term between U4 and $EL$ is again small and statistically insignificant. The stable and significant price discount for U4 units over time again indicates that indirect beliefs may be important. There is some evidence that the magnitude of the price premium for U8 units declines over time as the proportion of younger generation who is expected to be less superstitious rises: the premium was 1.2% in the earlier period and 0.7% in the later period. The difference is relatively large but statistically insignificant.

Second, we divide the sample by the population share of the older generation (defined as those older than 50) in the planning areas; we create a dummy variable $ED = 1$ if the population share of older generation is higher than the median value of 31.8% and 0 otherwise. We then include its interaction with U4 and U8 as additional controls in the regression. Column (4) of Table 4 reports the estimation results. The price discount for U4 units in areas with a smaller proportion of the older generation is 1.5%, which is the same as our baseline estimate. The coefficient on the interaction term between U4 and $ED$ is very small and statistically insignificant, suggesting that the share of the older generation makes no difference to the price discount for U4 units in the area. The coefficient on U8 is positive and statistically significant at the 10%, while the coefficient on the interaction between U8 and $ED$ is insignificant.

Overall, Table 4 suggests that while the price discount for U4 units is robust, always statistically significant and unaffected by various proxies for the prospect of finding a neutral buyer, there is some mixed evidence that the magnitude of the price premium for

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8We have tried to use other cutoff values instead of the median, and our regression results were unaffected.
U8 units may be somewhat sensitive. The former suggests that indirect beliefs are likely to be the major driving force for the price discount, i.e., the presence of superstitious buyers changes the behavior of the neutral buyers through their beliefs about other buyers. They may have changed the price dynamics as well, making it difficult to arbitrage on the price differentials. This is the issue we turn to next: are there arbitrage opportunities given the price discount for U4 units?

In particular, could arbitrageurs buy U4 units at a discount, sell them to neutral buyers at a higher price and arbitrage away any price differentials? This would, however, imply a higher rate of return on U4 units for investors. To check this, we focus on buyers who purchased uncompleted units from property developers and sold them before construction was completed. We call this group of buyers investors because many of these buyers most likely bought the apartments for investment or speculation rather than personal use given that they sold the apartments even before the units were ready for occupancy. Because these buyers never occupied the units themselves and probably never intended to, their personal preferences seem irrelevant in their decisions. To the extent that they pay a premium for U8 units or demand a discount for U4 units, it should largely reflect their expectations about others’ willingness to pay or accept.

Table 5 reports the results for investors. Column (1) investigates whether different price differentials apply to purchases by investors. We find that investors bought at a lower price on average; the coefficient on the investor dummy is negative and statistically significant at the conventional levels. They also seemed to enjoy larger discount for U4 units and pay lower premium for U8 units but the differences are not statistically significant. Nevertheless, a joint test on the coefficients on the U8 dummy and its interaction with the investor dummy shows that they are not jointly significantly different from 0, which means that investors do not pay a significant premium for the U8 units. This evidence suggests that investors do not expect others to have a strong willingness to pay for an auspicious number. On the other hand, investors still demand a significant discount for U4 units. That investors demand a similar discount for U4 units as the other buyers

---

9Admittedly, some of these buyers may have sold the units because of unexpected shocks. But the following arguments apply as long as a significant fraction of these buyers are investors.
suggests that beliefs about others may be the key determinant of the discount on U4 units or the willingness to accept an inauspicious number.

[Insert Table 5 here]

We then regress the rate of return of their investment on the duration of the holding period and dummies for the year they sold their apartments. Column (2) of Table 5 reports the results. The coefficient on U4 is 0.002 while the coefficient on U8 is -0.001, implying that compared to the other units, the investors enjoy 0.2% more return on U4 units and 0.1% less return on U8 units. But both coefficients are economically small and statistically insignificant at the 10% level. To check whether investment in U4 or U8 units could yield a higher return at the tails of the return distribution, we report the 25th and 75th quantile regression results in columns (3) and (4), respectively. None of the coefficients from the quantile regressions are statistically significant at the 10% level.

In summary, the evidence suggests that investors did not earn abnormal returns from the unit-number price differentials. In other words, although investors enjoyed a significant discount on U4 units when they bought, they did not end up earning higher return on these units because the same discount was demanded by future buyers. This is evidence that indirect beliefs work through the consideration of future resale prospect. Investors also did not have a stronger tendency to buy U4 or U8 units than non-investors. Our calculation shows that while U4 and U8 units account for 10.9% and 8.3% of all new transactions, respectively, they account for 10.3% and 6.1% of the transactions between investors and property developers.

How persistent are these price differentials? Column (5) of Table 5 reports the price differentials for existing apartments in the resale market. To control for depreciation, we include an apartment’s age and its squared in the regression. The coefficients on both U4 and U8 are statistically significant at the 5% level, suggesting that both discount and premium still exist in the resale market. Nevertheless, the price differentials for resales are smaller in magnitude than new sales. One potential problem for including older resale units is that there may be greater unobserved quality variation due to renovation and maintenance. Hence, column (6) re-estimates the regression using only apartments that
have been resold within 3 years of completion. While the price differentials are larger for these relatively new apartments compared to the older apartments in the resale market, they are still slightly smaller than those for brand new apartments. The persistence of unit-number price differentials in the resale market may explain why neutral buyers may not arbitrage against superstitious buyers.

The evidence thus far suggests that, on the demand side, buyers’ own preferences may have little direct effect on the discount for U4 units. Rather, it may be people’s beliefs in persistent price differentials in the resale market that cause all buyers to demand a discount. On the other hand, buyers’ own preferences and their heterogeneity may have contributed to the greater variation in price premium for U8 units.

On the supply side, the Singapore government has provided clear guidelines on how property developers should number their properties. Hence, property developers have little room to manipulate the supply of U4 and U8 units. The Inland Revenue Authority of Singapore (2012) clearly states that “4, 13, 14, etc which can be perceived as undesirable or inauspicious will not be omitted”. This regulation makes it impossible for property developers to strategically reduce the supply of U4 units or increase the supply of U8 units. The regulation also stipulates that “units are generally numbered serially in a clockwise direction starting from ‘01’”, which makes it impossible for property developers to strategically manipulate the locational characteristics of U4 and U8 units without affecting U3 or U5 units, and U7 or U9 units, respectively.

Compared to the results reported by Fortin et al. (2011), the price discount for U4 units and price premium for U8 units documented in this study are smaller although the proportion of ethnic Chinese in our sample is much larger. The larger price differentials in Fortin et al. (2011) may be attributable to the difference in sample composition. In their sample, the share of ethnic Chinese in a Census Tract varies from 0 to 64.9%. Presumably, these who chose to live in communities with a high concentration of Chinese residents might be more traditional than others. As a result, they would pay a larger premium for U8 units and demand a larger discount for U4 units. This effect could be particularly strong in the resale market. For example, if a neighborhood suddenly becomes popular for Chinese, the
influx of Chinese residents can bid up the price of U8 units and drive down the price of U4 units. All these factors would cause the price differentials to be larger than otherwise.

Finally, consistent with our results on the importance of indirect beliefs, in a survey that we ran at the National University of Singapore with 88 undergraduate economics students, we find that while only 24% of them indicated that they would personally require a price discount to buy U4 units or pay a price premium for U8 units, 86% of them believe that there are at least some other buyers who would require a price discount or pay a price premium for the respective units.\textsuperscript{10} In other words, while a relative minority care about the unit numbers personally, an overwhelming majority in the same population believe that others do.

Fehr and Tyran (2001) find that while the direct effect of money illusion may be insignificant, money illusion can still affect the equilibrium through indirect effect or beliefs about others if there is strategic complementarity. In their model, strategic complementarity means that an individual firm’s profit maximizing price is positively related to the aggregate price level. This gives rational firms an incentive to partly imitate the behavior of the non-rational firms which gives the latter a disproportionately large impact on the aggregate price level. This makes indirect effect important. Similar condition seems applicable to the U4 units: if non-superstitious buyers believe that some superstitious buyers would demand compensation for accepting an inauspicious number, it is profit-maximizing for them to also demand compensation for accepting an inauspicious number because of the future prospect of resale. On the other hand, the opposite seems to be true for U8 units: just because some superstitious buyers would pay to acquire an auspicious number does not give profit-maximizing non-superstitious buyers an incentive to also pay a premium. Our evidence is consistent with this interpretation. The implication is that through strategic complementarity and indirect beliefs, superstition and other form of illusions can sometimes have a surprisingly large and persistent effect on market equilibrium, even though only a fraction of the population is directly afflicted.

\textsuperscript{10}The survey did not make a distinction between willingness to pay for an auspicious number and willingness to accept an inauspicious number.
There is some evidence that the willingness to accept an inauspicious number is greater in magnitude than the willingness to pay for an auspicious number. This may be related to loss aversion (Kahneman and Tversky, 1979), where losses are valued more than commensurate gains. A natural reference in this case may be the price of comparable apartments that have neither auspicious nor inauspicious unit number, i.e., the price of Uo units. Relative to this reference, buyers demand compensation for accepting an inauspicious number, which represents a loss to them, while they pay to acquire an auspicious one, which represents a gain to them. Sellers, being professional property developers, are experienced traders. There is evidence that experience in trading tends to eliminate traders’ prospect theory preferences (List, 2003, 2011). As a result, buyers’ prospect theory preferences would prevail, especially in new sales by property developers. This also suggests that beliefs associated with misfortune or potential losses may be more powerful in sustaining an equilibrium than beliefs associated with good luck or potential gains, especially when some market participants will remain inexperienced given the infrequent nature of these transactions.

4 Conclusion

Using a data set that includes all private condominium transactions in Singapore from January 1995 to April 2011, we find that a 1.5% discount is needed to induce buyers to accept apartments with unit number ending with 4, a number that sounds inauspicious (like “dying”) in Chinese, even after controlling for the apartment’s and condominium’s characteristics. On the other hand, we find that buyers are willing to pay a 0.9% premium for apartments with unit number ending with 8, a number that sounds auspicious (like “prospering”) in Chinese. In 2010, these estimates imply a discount of about US$16,274, and a premium of about US$9,765. The price differentials are persistent. Furthermore, there is some evidence that the discount needed to induce willingness to accept an inauspicious number is larger in magnitude and more stable than the premium that people are willing to pay to acquire an auspicious number – a phenomenon that may be related to loss aversion.
Given the fact that Singapore is a multiracial society with non-Chinese accounting for more than 25% of the resident population, the finding of a persistent price discount for U4 units is especially surprising. Moreover, the estimated price discount for U4 units does not seem to depend on the immediate prospect of finding a superstitious buyer; the price discount remains very stable when we split the sample using different proxy indicators of this prospect. The stability of the price discount suggests that neutral or non-superstitious buyers enjoyed very similar discount as superstitious buyers, which is consistent with the hypothesis that the equilibrium price reflects buyers’ beliefs about others rather than their own preferences. Most importantly, buyers who purchased an uncompleted unit but sold it before completion also demanded a significant discount for U4 units, though they did not pay a significant premium for U8 units. Because they never occupied the apartments and they sold the apartments even before construction was completed, they most likely bought the apartments for the purpose of investment rather than personal occupancy. Thus, the prices they were willing to pay must reflect not personal preferences but their beliefs about others in the resale market. Furthermore, they did not earn abnormal return even though they bought U4 units at a discount because other buyers demanded similar discount when they sold these units later.

Neutral buyers may not bid up the prices for U4 units if given their beliefs about others, they expect future buyers to demand a discount for these units, whatever their own beliefs or preferences may be. In this case, neutral buyers may have an incentive to mimic the behavior of superstitious buyers rather than to arbitrage against them. Consistent with this interpretation, the resale data show that the rate of return to property investment does not depend on the unit number. Furthermore, if buyers base their property purchase decisions on their own preferences, then given the recent low mortgage rate of about 2%, selling U4 units at a 1.5% price discount only makes economic sense if it takes more than 9 months for the sellers to find a neutral buyer, which seems implausibly long given the extremely high volume of transactions in the property market at this time. Overall, the evidence suggests that the price discount exists because of the buyers’ beliefs about others and their expectation of persistent price differentials, an expectation that is generally
supported by evidence in the resale market. The result may be a belief-based equilibrium that is supported by direct beliefs by some and indirect beliefs by many.
References


Figure 1: Transaction price and volume over time
Figure 2: The relationship between floor area and the last digit of unit number
Figure 3: The cumulative distribution of quality adjusted price
<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction price (S$)</td>
<td>1,160.373</td>
<td>107,000</td>
<td>33,411,650</td>
</tr>
<tr>
<td>Floor area ($m^2$)</td>
<td>130.31</td>
<td>26</td>
<td>1,186</td>
</tr>
<tr>
<td>Floor level</td>
<td>8.66</td>
<td>1</td>
<td>56</td>
</tr>
<tr>
<td>U4</td>
<td>0.12</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>U8</td>
<td>0.08</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Proportion of Chinese in the planning area</td>
<td>0.75</td>
<td>0.61</td>
<td>0.86</td>
</tr>
<tr>
<td>Proportion of older residents (&gt;50 years old)</td>
<td>0.31</td>
<td>0.20</td>
<td>0.42</td>
</tr>
</tbody>
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Notes: U4 is a dummy variable that equals 1 for apartments whose unit number ends with digit 4. U8 is a dummy variable that equals 1 for apartments whose unit number ends with digit 8.
Table 2: The impact of the last digit of unit number on housing price (new sales only)

<table>
<thead>
<tr>
<th></th>
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<th>(2)</th>
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</thead>
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<tr>
<td>U0</td>
<td>0.006</td>
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<tr>
<td></td>
<td>(.003)**</td>
<td></td>
</tr>
<tr>
<td>U2</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.002)</td>
<td></td>
</tr>
<tr>
<td>U3</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.003)</td>
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</tr>
<tr>
<td>U4</td>
<td>-0.015</td>
<td>-0.012</td>
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<tr>
<td></td>
<td>(.003)**</td>
<td>(.003)**</td>
</tr>
<tr>
<td>U5</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.003)</td>
<td></td>
</tr>
<tr>
<td>U6</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.003)**</td>
<td></td>
</tr>
<tr>
<td>U7</td>
<td>0.004</td>
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</tr>
<tr>
<td></td>
<td>(.003)</td>
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<tr>
<td>U8</td>
<td>0.009</td>
<td>0.012</td>
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<tr>
<td></td>
<td>(.003)**</td>
<td>(.003)**</td>
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<tr>
<td>U9</td>
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<tr>
<td></td>
<td>(.003)</td>
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</table>

Number of observations: 81,154 (both columns)
Number of Condominium Projects: 463 (both columns)

Notes: Numbers in parentheses are standard errors.

*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Uj=1 if an apartment’s unit number ends with digit j (j = 0 · · · 9) and 0 otherwise.

All regressions control for floor area, floor level, their third-order polynomials, year of transaction, and condominium fixed-effects. The estimation results are insensitive to the inclusion of dummies for transaction quarters.

Table 3: Selected statistics of quality adjusted price (new sales only)

<table>
<thead>
<tr>
<th></th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>U4 Units</td>
<td>-0.115</td>
<td>-0.0577</td>
<td>-0.0111</td>
<td>0.0355</td>
<td>0.0837</td>
<td>-0.0133</td>
<td>0.087</td>
</tr>
<tr>
<td>Uo units</td>
<td>-0.0983</td>
<td>-0.0432</td>
<td>0.0029</td>
<td>0.0481</td>
<td>0.0944</td>
<td>0.001</td>
<td>0.0879</td>
</tr>
<tr>
<td>U8 units</td>
<td>-0.0873</td>
<td>-0.0383</td>
<td>0.0115</td>
<td>0.0584</td>
<td>0.107</td>
<td>0.0097</td>
<td>0.0908</td>
</tr>
</tbody>
</table>

Notes: The quality adjusted price is the residual price after controlling for apartment characteristics, year of transaction, and condominium fixed-effects.

Uj (j = 4, 8) units refer to apartments whose unit number ends with digit j.
Uo units refer to apartments whose unit number ends with neither digit 4 nor digit 8.
Table 4: The unit-number price differential across various sub-samples

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
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<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U4</td>
<td>-.013</td>
<td>-.012</td>
<td>-.016</td>
<td>-.015</td>
</tr>
<tr>
<td>U4 × HC</td>
<td>-.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U4 × HV</td>
<td></td>
<td>-.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U4 × EL</td>
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<td>.003</td>
<td></td>
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<tr>
<td>U4 × ED</td>
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<td></td>
<td></td>
<td>.0004</td>
</tr>
<tr>
<td>U8</td>
<td></td>
<td>.004</td>
<td>.006</td>
<td>.007</td>
</tr>
<tr>
<td>U8 × HC</td>
<td></td>
<td>.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U8 × HV</td>
<td></td>
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<td>.005</td>
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<tr>
<td>U8 × EL</td>
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<tr>
<td>U8 × ED</td>
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**Number of Observations**: 81,154 81,154 81,154 81,154

**Number of Condominium Projects**: 463 463 463 463

Notes: Numbers in parentheses are standard errors.

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*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

**HC** = 1 if the population share of ethnic Chinese in the planning area is higher than the median value of 75%.

**HV** = 1 if the annual transaction volume is higher than 8,000, and 0 otherwise.

**EL** = 1 for transactions made in the earlier period from 1995 to 2002, and 0 otherwise.

**ED** = 1 if the population share of the older generation (more than 50-year old) is higher than the median value of 31.8% in 2010.

All regressions control for floor area, floor level, their third-order polynomials, year of transaction, and condominium fixed-effects.
Table 5: Investment motive and unit-number price differential

<table>
<thead>
<tr>
<th></th>
<th>New Sales Rate of Return on subsale</th>
<th>Resale Market</th>
<th>All</th>
<th>Recently built</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS (1)</td>
<td>25th (2)</td>
<td>75th (3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Investor</td>
<td>-.018</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(.002)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U4</td>
<td>-.014</td>
<td>.002</td>
<td>-.006</td>
<td>.011</td>
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<tr>
<td></td>
<td>(.002)***</td>
<td>(.006)</td>
<td>(.006)</td>
<td>(.008)</td>
</tr>
<tr>
<td>U4 × Investor</td>
<td>-.005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.006)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U8</td>
<td>.010</td>
<td>-.001</td>
<td>.001</td>
<td>-.010</td>
</tr>
<tr>
<td></td>
<td>(.003)***</td>
<td>(.006)</td>
<td>(.007)</td>
<td>(.009)</td>
</tr>
<tr>
<td>U8 × Investor</td>
<td>-.006</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.006)</td>
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<tr>
<td>N</td>
<td>81,154</td>
<td>7,665</td>
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</tbody>
</table>

Notes: Numbers in parentheses are standard errors.

*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Investors are buyers who purchased the apartments from property developers and sold their units before the units were ready to move in.

Recently built refers to resales that happened within 3 years of completion.

Column (2) reports the OLS estimation results; Columns (3) and (4) report the 25th and 75th quantile regression results.

All regressions control for floor area, floor level, their third-order polynomials, year of transaction, and condominium fixed-effects. Column (2) also controls for the number of years between the initial purchase and the subsequent sale, as well as the dummies for year of sale. Columns (5) and (6) also control for the age of the apartments.